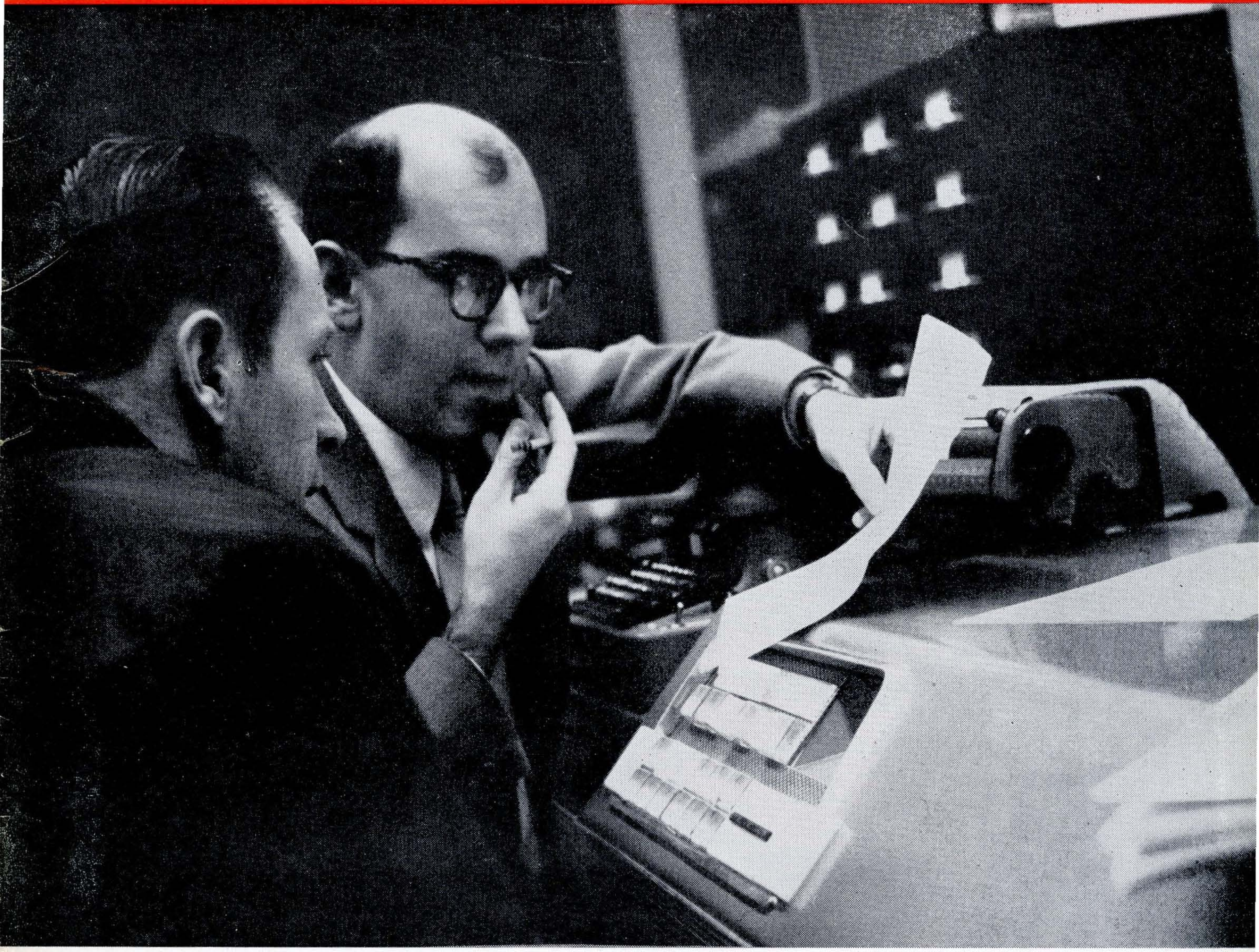
COMPUTERS
and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS



Electronic Computers for Teaching Undergraduates

Survey of Basic Computer Components

FEBRUARY
1959
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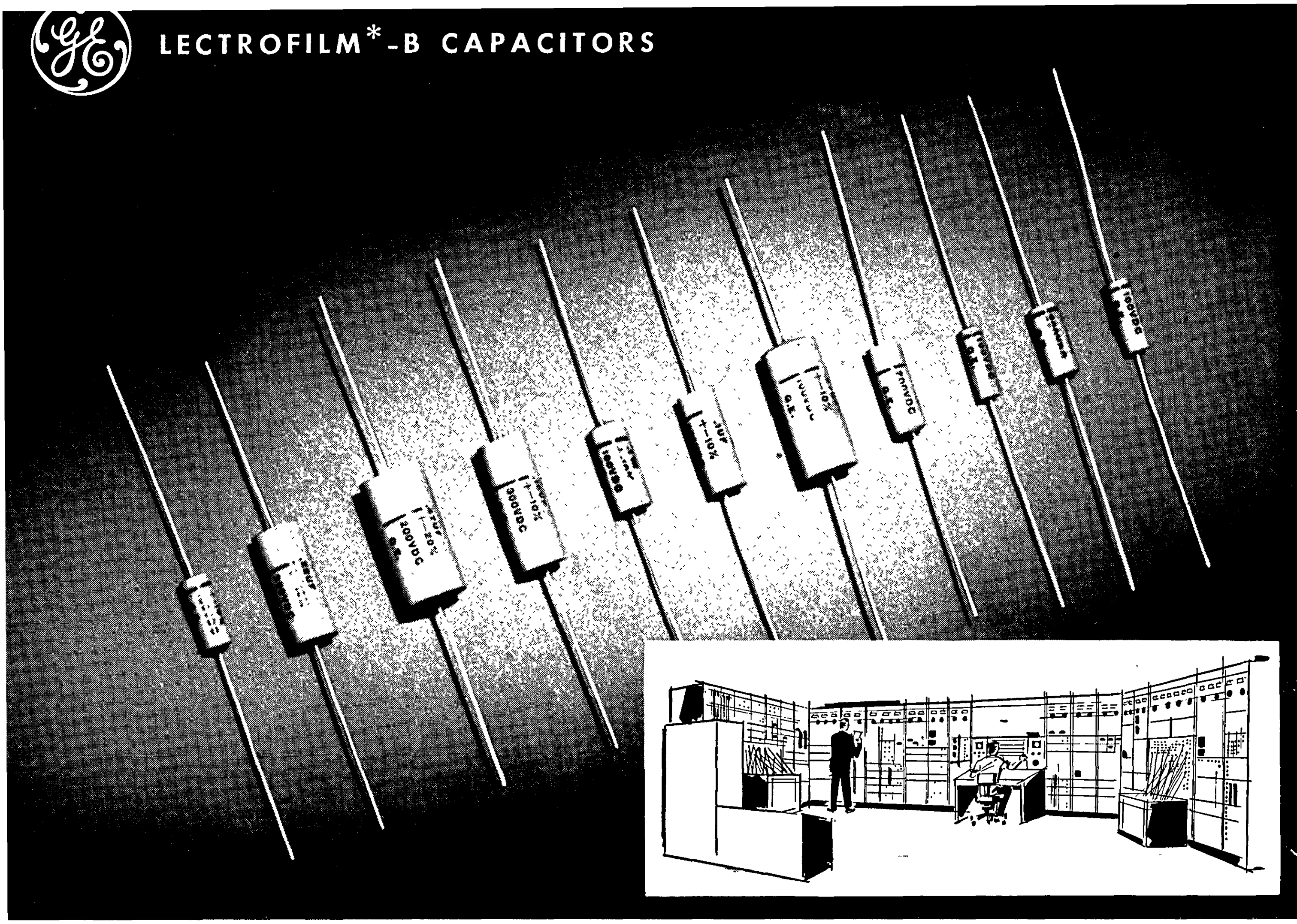
VOL. 8 - NO. 2



For Computer Applications, General Electric Announces . . .

New Lectrofilm*-B Capacitors With a Design Life of 44,000 Hrs.

Over 3,000,000 unit-hours of life test data in accordance with G-E Specification MTC-3 indicate a probability of survival in excess of 0.99 for 44,000 hour life, under rated voltage at 85 C. At 125 C, indicated probability of survival is in excess of 0.98 . . . and low unit cost means the highest order of reliability per dollar invested.

LOW FAILURE RATE AND LONG LIFE of these inexpensive G-E capacitors result from using only the highest quality materials and the closest of process controls . . . units are precision wound with high-purity aluminum foil and capacitor-grade Mylar† film dielectric. No solder is used, and introduction of contaminants through impregnation is eliminated.

SMALL, LIGHTWEIGHT ENCLOSURE consists of tape wrapped around the compact roll and sealed with epoxy resin, forming a rugged case which resists humidity, vibration and shock.

TO MEET YOUR APPLICATION REQUIREMENTS, 14 case sizes are available in five ratings—100-, 200-, 300-, 400-, and 600-volt. Capacitance range within each rating is: 0.015 to 0.68 uf in 100 volts; 0.010 to 0.47 uf in 200 volts; 0.0047 to 0.22 uf in 300 volts; 0.0033 to 0.15 uf in 400 volts; and 0.0010 to 0.10 uf in 600 volts.

GET A QUOTATION TODAY ON NEW LECTROFILM-B CAPACITORS by contacting your General Electric representative. Ask for your copy of life-test data and G-E Specification MTC-3. Or, write to Section 447-5, General Electric Co., Schenectady, N. Y.

** Trade-mark of General Electric Co.*
† Registered trade-mark of DuPont Co.

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*transac** S-2000 by PHILCO

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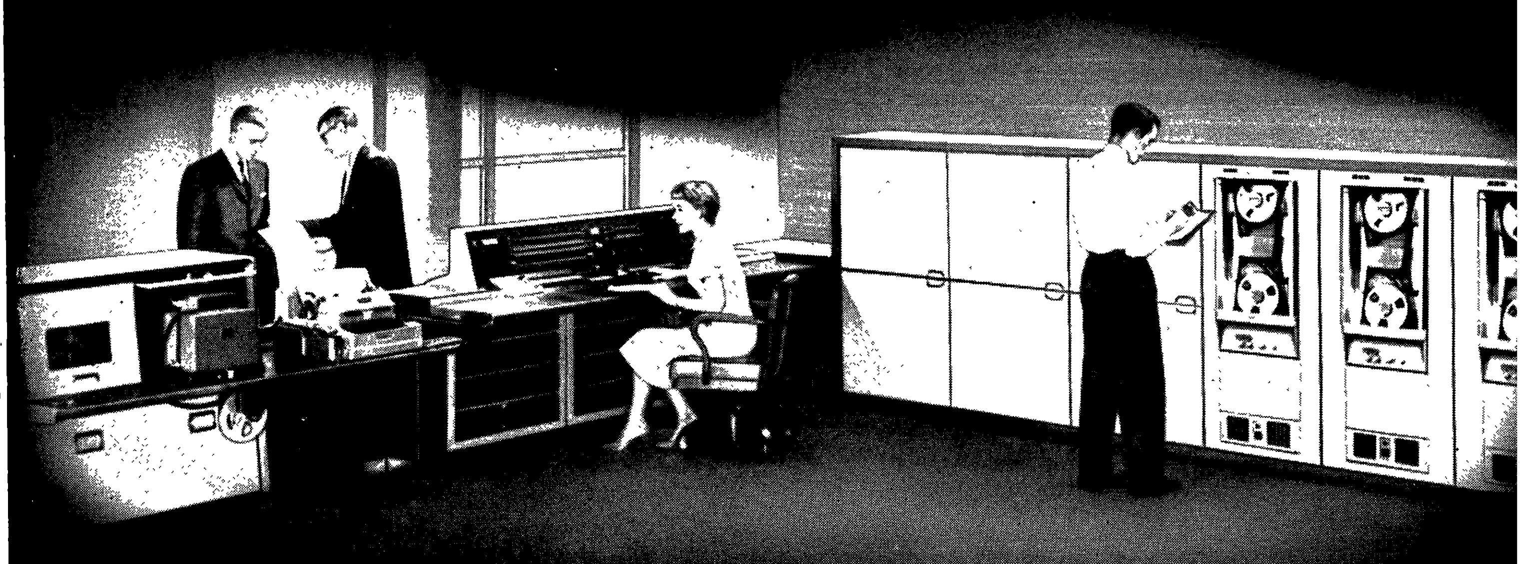

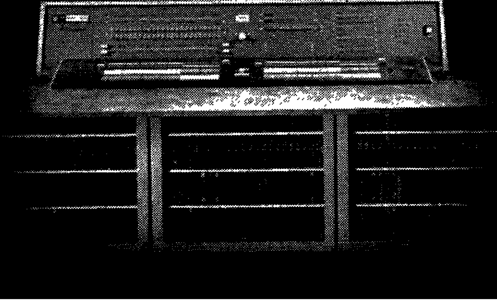

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COMPUTERS *and* AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS

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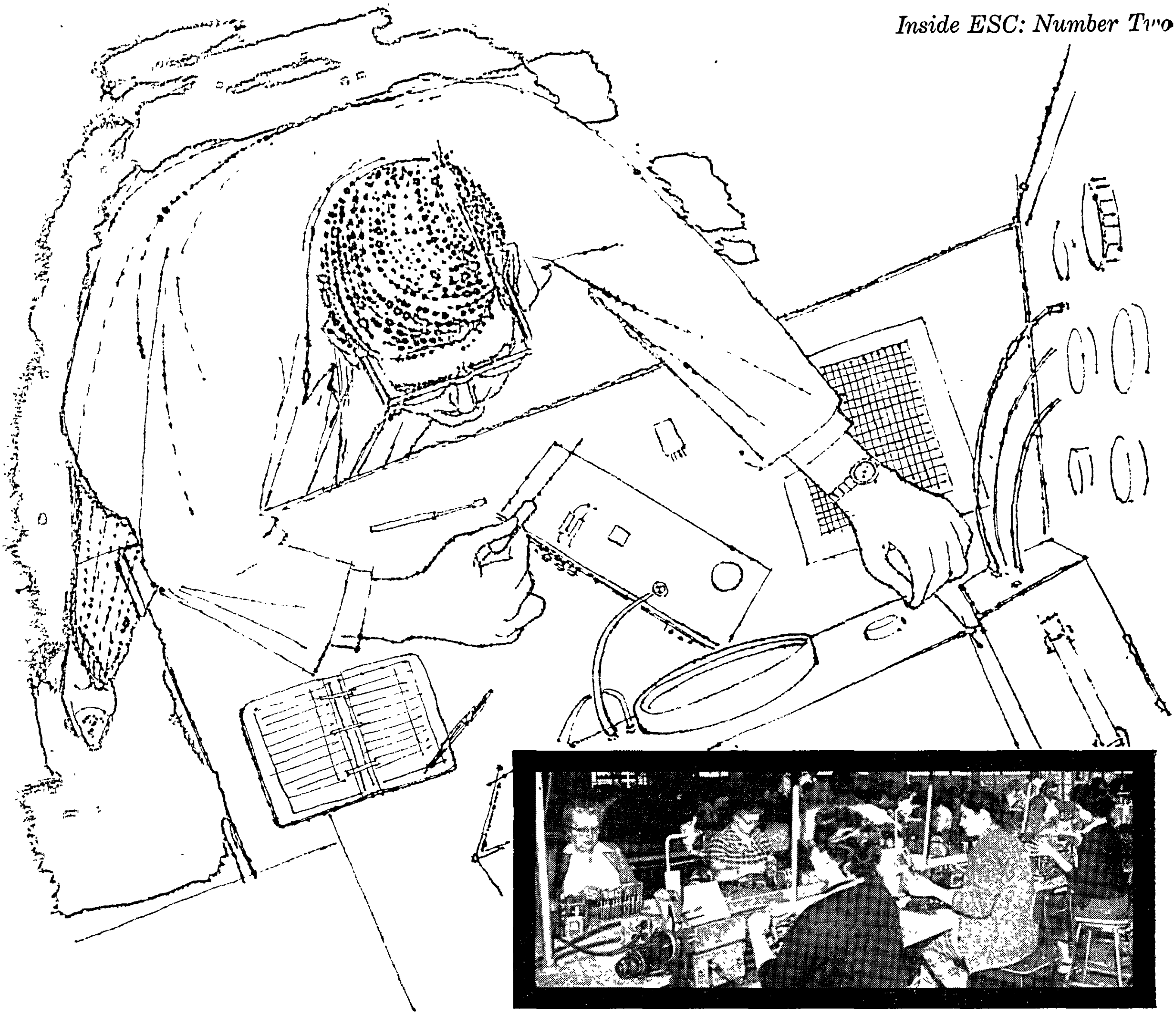

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Readers' and Editor's Forum

THE SOCIAL RESPONSIBILITIES OF COMPUTER PEOPLE — ACM COMMITTEE REPORT

Committee on Social Responsibility of Computer People, Association for Computing Machinery

(*Editorial Note:* The following report by the Committee on Social Responsibility of Computer People was presented to the Council of the Association for Computing Machinery at its meeting on December 4, 1958. The Council received the report and tabled it for later consideration since there had been no opportunity for members of the Council to read it before the Council meeting. The report of the Committee, of course, in no way commits or binds the Council or the Association. The report was released for publication January 7, 1959.)

ON JUNE 11, 1958, at the meeting of the Council of the Association at Urbana, Ill., the President was authorized to appoint a committee to consider "the social responsibilities of computer people to advance socially desirable applications of computers and to help prevent socially undesirable applications." A committee of four (the undersigned) was appointed, has held three meetings during the autumn of 1958, and hereby respectfully presents this report.

The committee considered the meaning and scope of its assignment. The committee arrived at a tentative statement and findings on the social responsibilities of computer people, which are given in Sections 1 and 2 below. The committee agreed that its assignment did not include defining or recommending an official position to be taken by the Association for Computing Machinery. The committee did agree, however, on recommending to the Council further action, which recommendation is stated in Section 3 below.

Section 1 — Introduction

One most basic fact concerning modern man is that he has his being in human society. In earlier times he was less dependent on others, and in turn the fortunes of the larger group were not so directly based on the contributions of the individual. But as man fashioned his social organization into ever higher and more complex forms, the relationship between the individual and society became closer and more interdependent. The individual no longer provides for any appreciable part of his own needs; he performs a small fraction of the total work required in the production of goods and services. Through division of labor his role has become increasingly specialized. At the same time society has become dependent on the individual to perform his indispensable part in the highly organized system of partial contributions of many people.

Along with the growth of mutual dependence, man's power has increased a thousand-fold. Compare the ancient man with his bow and arrow to today's pilot carrying atom bombs. Thus the individual has acquired power to affect drastic changes in the conditions of life of many people.

There is a universal cause and effect relationship between man and society. All of us accept responsibilities for ourselves, and hence by the same principle we must assume social responsibilities — for in a profound sense the two cannot be separated.

While every human being has social responsibilities, their nature and degree vary from individual to individual. A highly trained scientist in an influential position, for example, has responsibilities different from those of a fur trapper in the north woods.

We must look at ourselves (computer people) as being in control of a tremendously powerful tool. It is necessary to understand the vital role that computers play in the affairs of men. We must comprehend something of their place in technological progress, in science and management, in automatic control and prediction. Computers are becoming an essential part of the social organism itself, particularly its communication and control system. Since computers are inextricably tied to economy and culture, we must never lose sight of their importance to the welfare of our country and mankind. When one reflects upon the great forces that we computer people are associated with, it is no longer difficult to grasp, and perhaps to accept, our heavier-than-average share of responsibility.

What might one do to discharge his computer-connected social responsibilities? One positive thing would be to help develop socially desirable applications, such as those mentioned in Section 2 of this report. The solution of scientific problems relating to man's welfare and happiness is a wide area for the application of computers.

Section 2 — Findings

1. *Basic Social Responsibilities.* Each human being shares equally in a basic social responsibility — a duty towards society. This duty is in part enforced legally and in part assumed ethically.

2. *Special Social Responsibilities depending upon the Individual's Role and Functions in Society.* In addition, a human being has a number of special social responsibilities determined by his various roles and functions in society — his spheres of influence, knowledge, occupations, activities, etc. Each of these carries with it a value system whether esthetic or ethical, and the variety of these value systems may engender conflicts within the individual. Each individual must face and resolve these conflicts for himself.

3. *The Social Responsibilities of Computer People.* Therefore, the individual involved in computer activities has, in addition to all his other social responsibilities, those placed upon him by his computer activities — responsibili-

ties towards society and the parts of it: his profession, his employer, his country, mankind as a whole, etc.

a. He cannot rightly ignore these responsibilities. He should think about them.
Example: It is wrong to give no thought to the subject of his responsibilities as a computer person.

b. He cannot rightly delegate his responsibilities. Therefore, he should not accept without thinking standards of values and behavior suggested to him.
Example: It is wrong to accept orders of an employer without considering their morality. If he disagrees, he must either argue the point or resign or both.

c. He cannot rightly neglect to think about how his special role as a computer person can benefit or harm society. Therefore, he should think about how his special capacities can help to advance socially desirable applications of computers and help to prevent socially undesirable applications.
Example: It would be wrong for him to share in the application of automatic computers to the extermination of millions of people.

d. He cannot rightly avoid deciding between conflicting responsibilities. Therefore, he must think how to choose.
Example: In a conflict between the value system "the advancement of pure knowledge" and the value system "science in the service of humanity," it would be wrong for him to avoid making a decision.

4. *Socially Desirable and Socially Undesirable Applications.*

a. There are many applications of computers which are obviously socially desirable.
Examples (all of these are currently being investigated on computers):
analysis of causes and processes contributing to cancer; analysis of mental and emotional illness; solution of metropolitan traffic problems; mechanical translation of languages to aid in scientific understanding.

b. There are also some applications of computers which are obviously socially undesirable.
Example (one cited by Dr. W. J. Pickering, Head, Jet Propulsion Laboratory, Calif. Institute of Technology):
"This is the prospect we face: the decision to destroy an enemy nation — and by inference our own — will be made by a radar set, a telephone circuit, an electronic computer. It will be arrived at without the aid of human intelligence. If a human observer cries 'Stop, let me check the calculations,' he is already too late, his launching site is destroyed, and the war is lost."

c. There are some, perhaps many, applications of computers which cannot be readily classified as socially desirable or socially undesirable.

Section 3 — Recommendations

In view of the above statement, the Committee recommends that the Council of the Association for Computing Machinery take the following course of action:

a. that the Council, if it sees fit, approve releasing and publishing of this report as the report of the Committee without binding or committing the Association;

b. that the Council encourage the study and discussion in various publication media of topics related to the social responsibilities of computer people;

c. that the Council approve the establishment of forums on this subject at meetings of the Association for Computing Machinery;

d. that the Council continue this committee on a stand-by basis.

Saul Gorn, Chairman
Melvin A. Shader
Arvid W. Jacobson
Edmund C. Berkeley

DYNAMIC PRODUCTION SCHEDULING PAYS OFF

David I. McGinnis
Aircraft Gas Turbine Div.
General Electric Co.
Cincinnati, Ohio

TWO MONTHS AGO General Electric's Jet Engine Department at Cincinnati invested $17,000. Within a year that investment will save an estimated $30,000!

The investment was for a new dynamic production scheduling system to handle the extremely complicated task of scheduling the average load of 9000 backlogged jobs in the 50 machine tool areas of the Department's parts manufacturing operation.

At the end of two months operation, the new system had increased the efficiency of the manufacturing shops by 4 percent. In money, this means a projected savings of $30,000 the first year, even considering the development expense and the costs of running the program on an IBM 704 computer.

But even more important than the tangible dollar savings is the shops' increased ability to accept new orders and dispatch them to the proper work areas almost immediately. The tremendous backlog of orders can be reduced greatly, yet idle time can be minimized and crash programs can be absorbed easily into the workflow.

Developed after ten months work by J. A. Steffen of Parts Manufacturing and Lee N. Caplan of Computations, the scheduling program can, in 30 minutes of computer time:

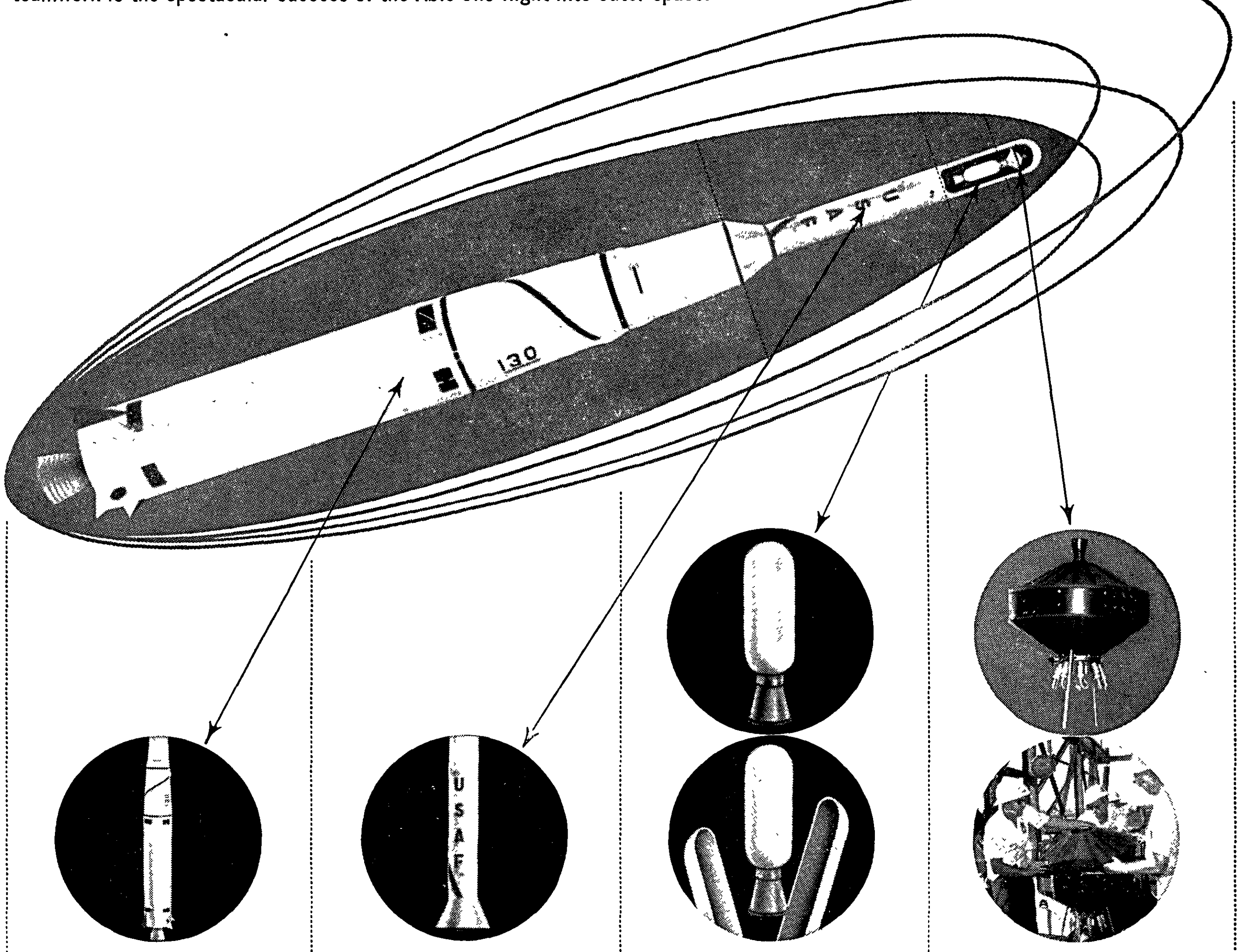
- Produce a complete work load schedule for the machine shops each week
- Provide the expected workload for the next 365 days
- Automatically produce dispatch work cards for the machine tool areas for each job

Each week an average of 9000 cards containing job information are sent from Production Control to Computations. There, the cards are read into the IBM 704 computer. The computer, operating on the Dynamic Production Scheduling program, checks the information for errors, and eliminates impossible dates, such as February 29 in a non-leap year or 31 days in a 30-day month. The system then arranges all jobs by order of priority and by necessary sequential machining operations and assembly steps.

Out from the machine come printed work cards for

Able-One... a new apogee in scientific teamwork!

Preparation and execution of an undertaking such as the United States' IGY space probe demanded the participation and exceptional efforts of 52 scientific and industrial firms and the Armed Forces. The Advanced Research Projects Agency and the AFBMD assigned Space Technology Laboratories the responsibility for the project which was carried out under the overall direction of the National Aeronautics and Space Agency. One measure of this teamwork is the spectacular success of the Able-One flight into outer space.



1st stage: Vehicle, Douglas Aircraft **Thor** IRBM; propulsion, Rocketdyne; airframe, control, electrical and instrumentation, Douglas Aircraft; assembly, integration, and checkout, Douglas Aircraft.

2nd stage: Propulsion system and tanks, Aerojet-General; control, electrical, instrumentation, accelerometer shutoff, and spin rocket systems, STL; assembly integration, and checkout, STL.

3rd stage: Rocket motor, U. S. Navy Bureau of Ordnance and Allegheny Ballistic Laboratory; structure and electrical, STL; assembly, integration, and checkout, STL; ground testing, USAF's Arnold Engineering Development Center.

Payload: Design and production of **Pioneer,** the payload of the Able-One vehicle, was conducted by STL in addition to its overall technical direction and systems engineering responsibility of the Air Force Ballistic Missile Division project. This highly sophisticated package included a NOTS TV camera and transmitter and Thiokol rocket motor.

Inquiries concerning openings on our staff will be welcomed by

Space Technology Laboratories, Inc.

5730 Arbor Vitae Street, Los Angeles 45, California.

each machine tool area, and workload schedules for the next 42 days. These schedules, delivered to Production Control, show when each job will be started and completed, and to what capacity each machine will be operating.

Including computer machine time and preparation of the input data, the entire scheduling job requires only 2½ hours. Before the dynamic production scheduling system was placed in operation, an experimental task force attempted to do the scheduling job by hand. After four days of working around the clock, they gave up the task as "impossible."

The outstanding advantages of the system are:

- Realistic up-to-date production schedules prepared on time
- Efficient work loading that results in minimum idle time for men and machines
- Automatic assignment of work to machine tool areas
- Accurate prediction of the effects of "crash" programs on delivery dates and schedules
- Better evaluation of each shop's efficiency

Because of the many advantages and demonstrated success of the new system in scheduling job shop operations, General Electric's Computations personnel are already investigating the application of the system to many other areas of work at the Aircraft Gas Turbine Division's Cincinnati plant.

COMPUTER TALKS

AT THE ANNUAL meeting of the American Association for the Advancement of Science, in Washington, in December, a program sponsored by the Association for Computing Machinery took place Tuesday afternoon, Dec. 30, 1958. It was entitled "Adventures with Electronic Digital Computers." The talks were:

1. French to English by Computing Machine / A. F. R. Brown, Research Associate, Machine Translation Project, Georgetown University, Washington, D.C.
2. Musical Compositions by a Digital Computer / Lejaran Hiller, Assistant Professor of Music, Department of Music, University of Illinois, Urbana, Ill.
3. Computers and the Dead Sea Scrolls / Paul Tasman, Manager of Data Processing, IBM World Trade Corporation, New York, N.Y.
4. Capital Airlines Reservation System / R. C. Douglas, Manager of Electronic Sales and Development, Capital Airlines, Washington, D.C.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION TO GET NEW HIGH-SPEED COMPUTER MEMORY

Richard A. Terry
Telemeter Magnetics
Los Angeles, Calif.

A NEW HIGH-SPEED computer memory is being manufactured for the National Aeronautics and Space Administration. The memory, which will cost nearly $100,000, will permit large scale computations of space problems at unprecedented speeds. Equipment incorporating the new memory is to be part of the computation facilities of the Lewis Research Center in Cleveland, Ohio, a laboratory of the NASA which studies chemical, nuclear, and nuclear electric rockets for missiles and space craft, and other power plants.

The memory has a data storage capacity of more than 160,000 "bits." With this system, the computing equipment can transfer information between its storage registers at the rate of more than 80,000 thirty-six "bit" computer words per second, which is more than double previous performance. Corresponding speed increases will be achieved in all of the simple arithmetic operations.

ONE MILLION MAGAZINE ADDRESS LABELS A DAY

AN ELECTRONIC PRINTER for magazine address labels is to be delivered to the Curtis Publishing Company of Philadelphia for use in printing address labels for their magazines. Stromberg-Carlson, San Diego, Calif., is the manufacturer.

The machine will be capable of printing over one million address labels per eight-hour day for the *Saturday Evening Post, Holiday,* and *Ladies Home Journal.* The equipment will be an S-C 5500 high speed electronic label printer combined with an M-60 auxiliary editing buffer. The system will print labels up to ten times faster than existing electro-mechanical printers.

All Curtis Publishing Company subscription information is being processed through an electronic computer and placed on magnetic tape. The Stromberg-Carlson printout system will further expedite magazine mailing.

The S-C 5500 high speed electronic label printer utilizes a Charactron shaped beam tube and a XeroX Copyflo printer for rapid electronic printing. The M-60 editing buffer will handle up to four magnetic tape inputs, while the S-C 5500 will print simultaneously on four separate rolls of paper.

The S-C 5500 electronically registers address information and perforates continuous rolls of paper to label size so that addresses are prepared for Cheshire mailing equipment. The XeroX Copyflo printer employs a dry printing technique using inexpensive, untreated paper.

CALENDAR OF COMING EVENTS

February 10-13: High-Speed Computer Conference, Louisiana State University, Baton Rouge, La.

March 2-4: American Management Association 5th Annual Electronics Conference and Exhibit, Statler-Hilton Hotel, New York, N.Y.

March 3-5: Western Joint Computer Conference, Fairmont Hotel, San Francisco, Calif.

April 2-4: Joint Meeting — Institute of Mathematical Statistics (Central Region) and Association for Computing Machinery, Case Institute of Technology, Cleveland, Ohio.

May 14-15: Operations Research Society of America National Meeting, Shoreham Hotel, Washington, D.C.

June 15-20: International Conference on Information Processing, Paris, France.

June 22-25: British Computer Society 1st Annual Conference, Cambridge, England.

Sept. 1-3: Association for Computing Machinery Annual Meeting, Mass. Inst. of Technology, Cambridge, Mass.

check RCA for standard or special ferrite cores!

...for a wide range of computer applications!

Now—commercially available from RCA—a comprehensive line of fast-switching, low- and high-drive, memory cores and several new memory-plane designs to provide equipment designers with one of the broadest lines of memory core products in the industry.

MEMORY CORES • In addition to a line of standard ferrite cores developed for coincident-current memory applications (ranging in switching time from 0.2 μ sec. to 3 μ sec.), RCA now offers a new group of ferrite cores particularly suited for both high-speed, word-address memories, and slow-speed, low-drive coincident-current memories. These cores are available for an applied field (H) ranging from 0.2 to 1 oersted, and in sizes from 0.050" x 0.030" to 0.370" x 0.290". The smaller-size cores make possible the design of high-speed memory devices with driving currents suitable for either transistor or tube drivers. Typical characteristics are given in the table.

MEMORY FRAMES • A compact, rugged aluminum frame utilizing a new stack-wiring concept makes possible a "bit-packing factor" greater than ever before. 8,192 bits may be stored in a 7" x 7" x 0.3" frame. For more economical designs and even greater compactness, a laminated frame accommodating 8,192 bits in a 5½" x 5½" x ¼" space (including terminals) is also available.

FERRITE APERTURE PLATES • RCA's apertured-plate construction utilizing ferrite-core material having low-drive, medium-speed characteristics, can store 256 bits of information in a space less than 0.9" x 0.9" x 0.025", thus making possible the design of compact memories for transportable equipment in which minimum weight and space are vital considerations.

The aperture memory plates have a nominal full driving current requirement of 320 ma., a switching time of about 1.8 μ sec., and an undisturbed output (1) signal (uV1) of greater than 40 mv. making them especially suitable for use in transistorized circuits. In addition, the precision registration of the holes makes it possible to stack the aperture plates quickly and accurately.

Rigid production controls insure excellent uniformity of undisturbed output signal and peaking time...testing assures dependable performance of each storage element.

For ferrite cores having uniformity to meet your most exacting design requirements, and for dependable delivery schedules, contact your local RCA Sales Representative.

Typical Characteristics of Ferrite Cores for 2:1 Coincident-Current Applications

RCA Type▲	T_s μ sec.	T_p μ sec.	uV_1 mv.	dV_z mv.	Driving Current ma. (I_m/I_{pw})	T_r μ sec.
XF-3806	.27	.13	160	26	1100/660	.12
XF-4019	.67	.32	106	14	725/450	.12
XF-3018H	1.18	.53	55	9	460/275	.20
XF-4028	1.08	.60	72	4	380/190	.50
XF-3973	1.28	.71	48	5	350/215	.40
XF-3673	2.80	1 35	22	4	210/126	.50
XF-4003	2.60	1.45	24	3	190/95	.50
XF-4004	2 36	1.26	26	5	190/95	.50
XF-4005	4.10	2.35	10	5	125/63	.50
XF-4006	9.0	4 8	4 5	4 5	90/45	.50
XF-4007	7.5	4.3	4 5	5.0	70/35	.50
XF-4008	13.0	6 5	2 0	3 5	40/20	.50

Time is measured from 10% of current rise to 10% of voltage (uV_1) fall.
▲All type numbers are for .050" x .030" x .015" size.

Typical Characteristics of Ferrite Cores for Switching Applications
Switching Time (T_s) μ sec. vs. Applied Field (H) in oersteds

RCA Type▲	Switching Time (T_s)—μ sec.						
	H =.5	H =1.0	H =1.5	H =2.0	H =3	H =4	H =5
XF-3806						.22	.18
XF-4019					.41	24	.163
XF-3018H			1.12	.75	.36	.226	161
XF-3973			.73	.42	22	138	.105
XF-3673		1.16	.63	.40	.22	.15	
XF-4003		1 04	.60	39			
XF-4004	3.84	90	52	34	194	.129	
XF-4005	3 69	.81	.48	312	.174		
XF-4006	2.36	.71	.41	.260	.142		
XF-4007	1.38	48	28	.194			
XF-4008	1.53	.41	.242	165			

Time is measured from 10% rise to 10% fall of uV_1. Rise time of current pulse is approximately 35 millimicro-seconds To convert drive in oersteds to current in amperes For core size of 050 OD x 030 ID, multiply H x 0 25 For core size of .080 OD x 050 ID, multiply H x 0 41.
▲All type numbers are for 050" x .030" x .015" size

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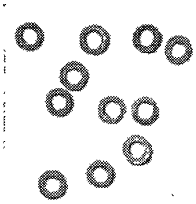
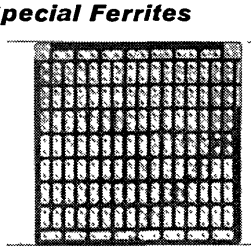
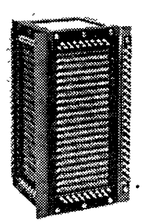


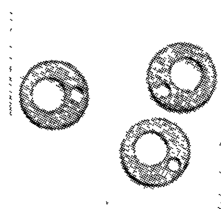
RCA MEMORY CORES



RCA FERRITE APERTURE PLATE



RCA MEMORY FRAME



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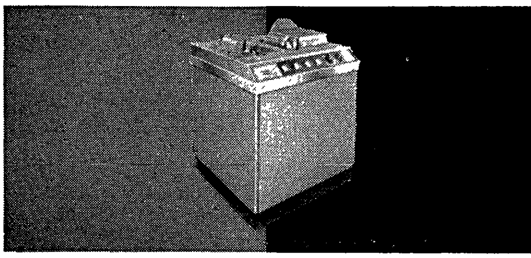
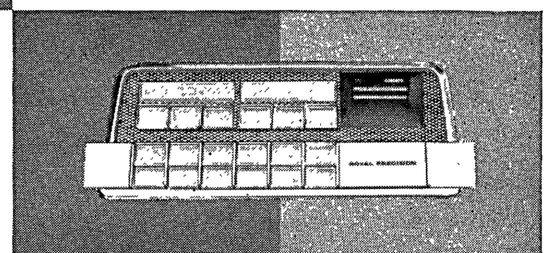
GIVES YOU THE SPEED, CAPACITY AND MEMORY YOU WANT AT LOWEST DOLLAR COST!

Desk-sized, mobile • Plugs into ordinary wall outlet • Self-cooled • Installed without charge • Lowest cost ever for a complete computer system • Subroutines and programs available • Customer training • Large staff of applications analysts • Sales and service facilities available coast-to-coast.

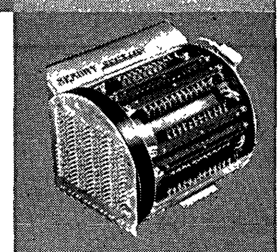


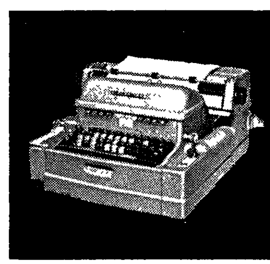
High-speed photoelectric reader—with or without mechanical punch—available for system expansion. Loads entire drum in approximately 5 minutes.

Remarkably simplified command structure and controls require only minimum computer experience. Front panel oscilloscope for concise display.



Full flexibility of stored-program operation with unusually large non-volatile memory of 4096 words.





Complete format control. Alpha-numeric input-output via keyboard or punched paper tape. No additional equipment needed to operate.

For further information and specifications, write Royal McBee Corporation, Data Processing Division, Port Chester, N. Y.

ROYAL McBEE

data processing division

Positions for High School Graduates in Data Processing

Enoch J. Haga
Vacaville, Calif.

(Based on a part of thesis for M.A. degree at Sacramento State College, Electronic Data Processing — Implications for Business Education in High School, May 1958)

WHAT ARE THE positions open to high school graduates in both public and private electronic data processing installations? When electronic data processing equipment is used for business purposes, the operators of such equipment are business machines operators; their training therefore falls naturally within the scope of vocational business education.

Individuals in the computer field were surveyed by mail for information relating to employment opportunities in computer installations. During January and February of 1958, 295 persons listed in the June, 1956 issue of "The Computer Directory"[1] were contacted. Their interests encompass business, construction, design, electronics, logic, mathematics, programming, and sales. The purpose was to find out:

Kinds of jobs available in an electronic data processing installation
Educational background required for these jobs
Special training required for these jobs
Length of special training required for these jobs
Who gives the special training required for these jobs?

The responses consisted of 103 replies, or 35 per cent of all the questionnaires mailed out.

Two lists of positions found in computing centers precede the report of the survey in order to show the scope of positions available in typical electronic data processing installations.

Positions Available in a Univac Installation[2]

Operations manager. Supervises Chief Operator, Administrative Control Chief, and Chief Tape Librarian in order to administer the established procedures of the Center.

Operations coordinator. Supplies assistance to facilitate the operational efficiency of the UNIVAC Center. Analyzes, reports, and makes recommendations for the improvement of procedures and production operations with standardization and cost reduction as the objective.

Chief operator. Supervises three Shift Chiefs and the Outside Installations Chief. Supplies operational and technical assistance as required to attain optimum use of the Central Computer and Peripheral Equipment.

Administrative control chief. Supervises the Chief Unitypist, Scheduler-Dispatcher, Materiel Control Clerk, Statistical Clerk and Clerical Staff. Administers appropriate controls to attain optimum use of UNIVAC Center facilities.

Chief tape librarian. Supervises supporting staff in order to obtain, review and distribute Library routines.

Shift chief. Supervises the performance of assigned Operator Personnel in order to facilitate production. Supplies operational advice and assistance from a detailed knowledge of problem and production requirements, supplements operator instructions.

Outside installations chief. Supervises the performance of assigned Operator Personnel in order to facilitate production. Supplies operational advice and assistance from a detailed knowledge of problem and production requirements, supplements operator instructions.

Computer operator. Operates the Central Computer, High Speed Printer, Card to Tape Converter, Tape to Card Converter, and other equipment as may be developed.

Electronic machines operator. Operates the High Speed Printer, Uniprinter, Card to Tape Converter, Tape to Card Converter, and other equipment as may be developed.

Chief unitypist. Supervises the personnel of the Unityping Section, and supplies administrative direction for all work performed by the Section.

Unitypist "A". Operates Unityper machines, transcribing all types of data forms from coded copy to magnetic tape for use on the Central Computer and High Speed Printer.

Unitypist "B". Operates Unityper machines, transcribing data from coded copy to magnetic tape for use on the Central Computer or High Speed Printer.

Scheduler-Dispatcher. Schedules and allocates time for all projects on the Central Computer and Peripheral Equipment. Maintains maximum utilization of all production time on all equipment.

Materiel control clerk. Receives, checks, counts, records, ships, and provides for storage of UNIVAC Center and customer property and materiel.

Statistical clerk. Summarizes, audits, adjusts, and processes equipment log data for billing, evaluation, and operational purposes.

Programming manager. Supervises Administrative Programmers and Scientific and Procedures Specialists in order to administer the established procedures of the Center in attaining optimum programming efficiency.

Administrative programmer (systems analyst). Supervises and directs more than one Senior Programmer. Supplies professional, technical, and administrative assistance to attain optimum programming efficiency.

Senior programmer. Supervises and directs one or more programming teams. Supplies professional, technical, and administrative assistance to attain optimum programming efficiency.

Programmer. Acts as Project Leader, unless project is exceptionally large and complex, then will share responsibility with Senior Programmer. Assists project team in analyzing, charting, coding and processing assigned problems.

Coder. Assists in the preparation of detailed flow charts by which the problem will be processed. Translates the details into a series of coded instructions for use on the Central Computer. Carries the coding through computer testing and production phases.

Trainee. Following successful completion of the Programming Courses, assists in the coding of new projects under the immediate supervision of his project leader.

Qualifications of Typical Electronic Data Processing Personnel[3]

Systems analyst. Uses much logical reasoning and some mathematics through high school algebra. A college education or equivalent is desirable but not essential. Studies most helpful are those in business and the logical sciences such as mathematics. Training in punch card equipment is desirable but not essential.

Programmer. Equivalent of four years of high school. Uses much logical reasoning and some mathematics through elementary algebra. Training in punch card equipment is desirable but not essential.

Standards planner. Same as for programmer.

Console operator. The ability to read and write, add, subtract, multiply and divide whole numbers, decimals and fractions; understand and follow written and verbal instructions. Knowledge of elementary algebra. Equivalent to four years high school. Knowledge of basic wiring principles of punch card equipment.

Auxiliary operator. The ability to read and write, add, subtract, multiply and divide whole numbers, decimals and fractions, understand and follow written and verbal instructions.

Librarian. Same as for auxiliary operator.

Programmers may be divided into three grades. The starting position is "Coder" or "Trainee programmer." The second level is simply called "Programmer;" and the third or top level position is called "Senior programmer" or "Blocker." It should be noted that formal education requirements do not bar anyone who has the aptitude, initiative, and ingenuity needed on the job.

Report of the Survey

BIZMAC and RCA Recorder Central (Medium Size Computer for Processing Sales). The two positions that require high school education are *keypunch operator* and *librarian;* keypunch operators "must be good typists with a small error factor per volume of data keypunched;" with previous typing experience, training of one to two months is required, usually under the direction of the senior keypuncher at the installation site. Librarians also require training of one to two months under the machine room supervisor; "previous evidence of careful meticulous work" is required to help avoid "loss of magnetic tapes."

Datatron 205. Three jobs are open to high school graduates on this equipment: *computer* (for check work), *IBM operator,* and *programmer* (*elementary*). Several weeks training is required for computers, and this training is usually acquired in high school; a "short course in desk calculation" plus "excellent grades in mathematics" are needed. Operators generally receive training of from one day to several months, given usually in IBM or high school business courses. Programmers (elementary) need several months training from the manufacturer, on-the-job, or in special schools; special training required includes a coding course.

ERMA. None of the projected ERMA installations is in operation yet, but according to officials of the Bank of America, there will be at least four jobs open to high school graduates. *Equipment operators* will receive "general orientation and special training in operation of component equipment" in the "bank's own programming course and on the job training." Duration of this special training will be six months. The training for *utility clerks* will be the same as for equipment operators excepting that the duration of training will be only four months. *Flexowriter operators* will require six months "typing and special training in Flexowriter operation" in high school, business college or on-the-job. *Mail clerks* will require training of one month, on-the-job, in "operations of special equipment" and in "form and document distribution."

IBM 650. Programmers should have three to five years on-the-job experience on IBM machines; training at the IBM 650 Advanced Programming school for two weeks is necessary; in addition from one to three months training in programming for the IBM 650 is needed, and this training is given usually by the manufacturer or on-the-job. "Punched card machine wiring training is helpful but not necessary." A *supervisor* needs special training in "machine operation" and "administrative techniques" of two weeks duration given on the job. Previous on-the-job training of two to four years is needed, including attendance at various IBM schools, and "experience and adaptability along with academic background must be considered here." An *IBM specialist* needs two to four years on-the-job training plus several IBM schools (Basic Wiring, 402, 403, Collator, and 407). An *IBM machine operator* needs six months to two years experience on IBM machines. Also, "punched card machine operation training is helpful" but "not necessary." Other special training mentioned for operators was "IBM sponsored Basic Wiring, 402, 403, and Collator Schools" which require four weeks in school and three to six months on-the-job training; another reply stated that machine operation could be learned in two weeks under the direction of the supervisor. *IBM 650 operators* require "experience and adaptability . . . with academic background." They should have some basic IBM courses behind them, and also should take the IBM Primary 650 Programming School which is of one or two weeks duration. Also needed on this installation are *IBM keypunch operators,* and they should have from six months to two years experience on IBM machines. Actual training in machine operation takes two weeks under the direction of the supervisor.

IBM 702. There are several jobs open to high school graduates on this installation. First are *component operators* who need six months of "general orientation to EDPM" and "operation of computer and components" in the company's "own programming course and on-the-job training." *Tabulating supervisors* need three to five years experience in operation of all types of tabulating equipment and "experience in personnel supervision;" this special training could be obtained from equipment manufacturers and on-the-job experience. The *tape librarians* require four months of "general orientation to EDPM component operation" in the company's "own program and on-the-job training." *Tabulating machine operators* need one to two years experience in the operation of all types of tabulating equipment, obtained from equipment manufacturers and on-the-job experience. *Keypunch operators* need one year of experience in the operation of the keypunch machine, obtained from the equipment manufacturers and on-the-job experience. Also needed on this kind of installation are *mail clerks* and *secretaries.* Mail clerks should have one month of on-the-job training in the "operation of special equipment and form distribution." Secretaries require the usual general secretarial training which may be obtained in six-months in a "secretarial college or equivalent."

IBM 705. It seems reasonable to assume that the jobs open to high school graduates on the IBM 705 should be about the same as those open on the IBM 702. One reply stated that the position of *programmer* was open to high school graduates with IBM and on-the-job special training — consisting of a "five week programming course" and "two months case studies." The same reply stated that special training from IBM in a "five week programming course" was sufficient to qualify a high school graduate for *EDP analyst.* Also, a *console operator* required IBM training of a "five week programming course" and "two months apprenticeship."

National Cash Register 304. There are several kinds of jobs open to high school graduates on this installation. *Magnetic tape handlers* require only one or two days experience. *Magnetic tape librarians* require only one or two weeks experience, but the "person must be careful, neat, and efficient." *Printer and paper tape handlers* require only one or two days of on-the-job experience. *Operators* need experience and three months training from the manufacturers. *Auxiliary operators* need the same special training as operators. *Keypunch operators* need about two months of business keypunch training. *Coders* need clerical training of three to six months.

RAMAC 305-A. High school or technical school will qualify machine operators who also need one year of special training from the "manufacturer of equipment and on-the-job." The special training needed is in punched card and computer operation.

UNIVAC. Several positions are open to high school graduates on this large scale installation. College men are preferred for *programmer,* but under some circumstances high school graduates can qualify. Mathematics, logic, and accounting seem to provide a useful background. The special training required for the programmer consists of a Remington Rand programming course of six weeks to three months duration. Additional on-the-job training of three months is probably desirable. A high school education "plus industrial experience" might qualify a *systems analyst.* "Punch card machine operation experience" and some manufacturer courses would qualify the *punched card methods analyst.* The *console operator* should have a background similar to that of the programmer — mathematics, logic, and accounting, and should have special training of two to twelve weeks in an operator class. The *senior IBM equipment operator* needs "some IBM school," but "mostly on-the-job" training on "various IBM machines and wiring principles, plus background as IBM operator." The *IBM equipment operator* needs two weeks training from the manufacturer in "basic machine operation and basic wiring principles." The *auxiliary equipment operator* requires about two weeks to one month of on-the-job training in auxiliary equipment operation. *Unitypers* need about one week of special typing instruction. For *Unitypers chief clerk* (operations), ten weeks of company or manufacturer training is needed. "Operational knowledge of all equipment" is also required. To qualify *control and distribution clerks,* about one week of on-the-job training in "operation of bursters, decollators, check signers, etc." is needed. It is conceivable that a high school graduate with a background of electronics, "such as navy radar school," could qualify for the position of *maintenance technician,* after about eighteen weeks of manufacturer training in a maintenance class.

Summary of the Results of the Survey

It is easily seen that most of the jobs available to high school graduates in electronic data processing installations are, for the most part, of the clerical and operator variety, often involving operation of peripheral or auxiliary equipment rather than the computer itself. Positions found to be available to qualified high school graduates were:

General

Electronic data processing analyst
Punched card methods analyst
Systems analyst
Programmer
Supervisor
IBM specialist
Maintenance technician

Operator

Auxiliary equipment operator
Equipment operator
IBM operator
Component operator
Console operator
IBM 650 operator
IBM keypunch operator
Magnetic tape handler
Printer and paper handler

Clerical

Chief clerk
Computer
Control and distribution clerk
Flexowriter operator
Librarian
Mail clerk
Secretary
Tape librarian
Utility clerk
Unityper

Because most of the above jobs listed were in the operator and clerical fields does not mean that higher level jobs (such as programmer, coder, systems analyst, coordinator, and the like) are closed to high school graduates. In fact, one reply to the survey stated:

> Educational requirements vary widely and really exist only when a man is being hired from the outside at a pretty high level or as a "college trainee." Most companies will train qualified methods people with punched card experience who have proven themselves on the job regardless of previous education. IBM has an EDPM aptitude test which indicates aptitude for programming and which is relied upon widely in industry. I have known programmers at all levels who have had varied educational levels — high school to MBA. I would recommend math in high school and math and accounting in college.

A letter from The National Cash Register Company[4] makes similar observations:

> Your questionnaire is enclosed. The brevity of our comments arises not from unwillingness to cooperate, but rather from a reluctance to suggest any boundaries on education of people who are interested in a field as new and dynamic as is electronic data processing. It is our experience that opportunity exists in this field for people of various educations ranging from high school degrees through graduate study at universities. We have also found people with limited education, but wide practical experience have

been employed successfully in electronic installations.

We believe it will be helpful . . . to consider that certain other factors are equally as important as specific education. Attitude, aptitude, persistence, willingness to work, curiosity, logicalness and interest all effect (sic) importantly the suitability of a person for this type of work. This is true whether he be involved at a junior level of programming of a small-scale computer or aspires to the highest level of systems analysis and administration of a large-scale data processing installation.

It is reasonable to conclude that operating, maintenance, and clerical jobs will be open to many high school graduates, and that certain of the better qualified and more experienced high school graduates may qualify for higher level jobs such as programmer and systems analyst. Ability, experience, and personal characteristics seem to be more important than educational background in the selection of electronic data processing personnel.[5]

Civil Service Positions

In addition to many kinds of tabulating equipment operator and related peripheral equipment jobs, there are some civil service positions in the area of electronic data processing which are open to high school graduates. Early in 1958 the Bureau of the Census announced an examination for "Electronic Computer Operator/Trainee." Applicants were required to have three years of experience, and the written test covered three aspects: "abstract reasoning, coding, and ability to act upon somewhat complicated oral instructions." Annual compensation for this position ranges from $3,670 to $4,480.[6]

The California State Personnel Board, on September 20, 1957, set up specifications for the position of "Programmer, Electronic Data Processing." Applicants are required to have four years experience in tabulating machines and a high school education. Five years of tabulating machine work and high school graduation is qualifying for the position of "Supervisor, Electronic Data Processing," set up also on September 20, 1957. In the Department of Employment, with sufficient experience, the high school graduate might advance to "Assistant Chief, Data Processing Section," and to "Chief, Data Processing Section." Both of these last two positions were established also on September 20, 1957. The monthly compensation for these positions is:

Programmer, Electronic Data Processing:	$530-$644
Supervisor, Electronic Data Processing:	$644-$782
Assistant Chief, Data Processing Section, Department of Employment:	$710-$862
Chief, Data Processing Section, Department of Employment:	$950-$1.050[7]

As may be seen, there is plenty of room for advancement, and undoubtedly, many new positions in the electronic data processing field will be created in future years.

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France Ratifies Convention Establishing The International Computation Centre

George Lewis
Fair Lawn, N.J.

FRANCE RECENTLY BECAME the sixth country to ratify the intergovernmental Convention establishing an International Computation Centre, when Mr. Jean Coulomb, director of the French National Centre for Scientific Research, deposited his Government's instrument of acceptance with the Director-General, Dr. Luther H. Evans. Other countries which have ratified the Convention are Belgium, Ceylon, Italy, Japan and Mexico.

The Centre's main function will be to ensure mutual assistance and international collaboration between institutions and specialists dealing with computation and information processing. It will promote exchange of information on scientific problems being studied in various countries, and will help countries which do not possess their own computation equipment. Assistance will also be given to Specialized Agencies of the United Nations and to international scientific organizations.

The Centre is at present operating in Rome on a provisional basis until such time as the Convention comes into force after ratification by ten countries. Under the terms of a contract drawn up between Unesco and the Italian Government, the Provisional Centre has since January 1958 made several studies for international organizations, and carried out preparatory work. It has established a network of corresponding institutions, made a census of computation bodies, published an information bulletin, and is compiling a multilingual dictionary on electronic computation. Its work includes the training of specialists, and organization of scientific meetings.

The Centre is at present financed by seven countries: Belgium, Ceylon, Ecuador, France, Italy, Japan and Mexico.

Electronic Computers for Teaching Undergraduates

Byron Martin
New York, N.Y.

AFTER A YEAR'S experimenting, a small but complete automatic electronic computer has taken its place in the undergraduate curriculum at Lehigh University, Bethlehem, Pa., as "just another" unit of teaching equipment. The front cover of this issue of **Computers and Automation** shows the computer (the LGP-30, marketed by Royal McBee, Port Chester, N.Y.) in use for instruction.

While not unique — Ohio University and perhaps other colleges also are using electronic computers in teaching of undergraduates —, the Lehigh application has unusual significance, because undergraduate students desiring to learn have the first claim to use of the machine.

Educational Role of Computer

Most computers installed in universities have been expensive (medium or large-scale). As a result, emphasis in their use has been placed on research contracts from outside sources, or on carrying out important research projects by faculty and graduate students. Naturally, undergraduates who received instruction in computer programming and operation have been of necessity restricted in their acquaintance with the computer to classroom descriptions and rather brief demonstrations and laboratory work. This has followed from the cost of the equipment; for, in any properly budgeted and well managed organization including a university, it is necessary to balance the high hourly cost of the computer against sponsored research.

At Lehigh, on the other hand, the educational role of the computer, and particularly its part in teaching undergraduates, is foremost. A conflict in request for time on the machine between sponsored research or use in a classroom is always settled in favor of the classroom.

Initial Equipment

The initial equipment in the Lehigh Computer Center, is the LGP-30, a general purpose, digital computer in the $50,000 class. It is a magnetic drum machine, with a storage of 4,096 words, each consisting of nine digits and sign. It requires no special electrical outlets or air-conditioning, and can be rolled easily on casters from one place to another.

Courses

At Lehigh, in alternate semesters, an introductory course in computers is offered to all qualified undergraduates. In the term "qualified," the university does not necessarily require that a student have a specific formal background in mathematics or engineering, but that a student must demonstrate "an ability to think in mathematical terms, a mathematical maturity." Students for this computer course have been accepted about equally from the engineering and the liberal arts schools.

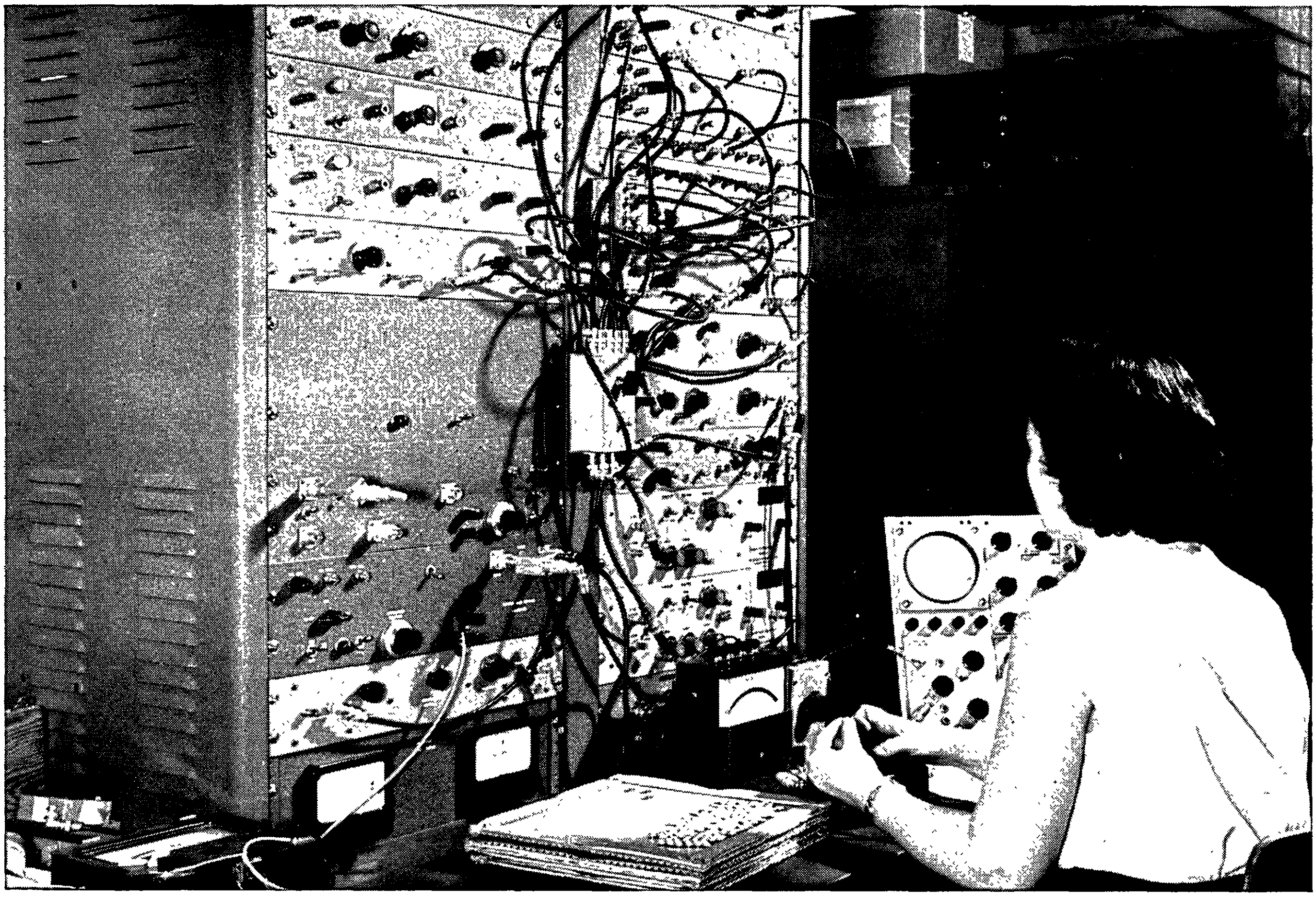
The introductory course (taught by Gerhard Rayna, who is shown in the front cover picture, wearing glasses) meets three times a week for lectures; on two afternoons a week the computer is reserved for four hours for undergraduates doing laboratory work. Each student is required to complete three problems during the semester, problems which he selects, develops, and programs himself. During one semester these ranged from solution of problems in matrices to calculating and updating bank accounts and indicating overdrafts.

The computer is also being used in the solution of actual classroom problems in other courses such as Production Control and Work Simplification, in the field of industrial engineering. In addition, the computer is in process of being applied in courses in psychology, economic statistics, and business management. Another course where the computer is used, in the industrial engineering department, is devoted simply to the role of computers in data processing.

Faculty Seminars

At the same time, William A. Smith, Jr., assistant professor of industrial engineering and director of the Computer Center, has been conducting seminars in computer programming and operation which are open to all members of the faculty. The aim of this is to acquaint the faculty with the capabilities of the equipment so that they can use it where appropriate in their own courses. Faculty members have taken advantage of this opportunity, including members of the departments of mechanical engineering, education, economics, accounting, and geology.

L. V. Bewley, Dean of Lehigh's College of Engineering, sums it up: "The more computer-minded we make the young men we turn out, the faster they will adjust to the advanced equipment of modern engineering and business and become productive members of the staff of any organization."



OPPOSITION TO NEW IDEAS

Neil Macdonald
Assistant Editor
Computers and Automation

1. New Ideas

About three months ago I lent a friend of mine a book by E. J. Ruppelt called "The Report on Unidentified Flying Objects."[1] A short while ago my friend returned the book to me, and I said, "What did you think of it?" He said he had not read it. I was surprised, and said, "Did you look at it?" He said, No, he hadn't. I was still more surprised and said to him, "Why not?" He mentioned two prominent astronomers who had said that flying saucers were nonsense, and said, "That's good enough for me. I don't want to spend time on them."

I looked at him and smiled, and said, "Well, that is a nice, comfortable way of settling something, isn't it? Accept the views of someone else without thinking about them yourself?"

He looked at me, quite uncomfortable. I suddenly realized I might be losing a friend; I said, "Forgive me for teasing you," and changed the subject.

But it struck me with great force how often a new idea is judged by "Who says so?" instead of on more logical evidence. I began to wonder seriously about OPPOSITION TO NEW IDEAS, both in the computer field and more generally. For automatic computers and their fantastic powers are one of the great new ideas of the twentieth century, and many aspects of computers have encountered opposition.

A new idea is disturbing, provoking, uncomfortable, sometimes frightening. It often requires the making of a decision, and that often requires mental work, utilization of psychic energy. As James M. Barrie, Scotch author and scholar, said once, "Work is not real work unless you would rather do something else." So human beings resort to a great variety of different methods to avoid doing adequate work upon new ideas.

2. "You Can't Make an Automatic Computer"

Charles Babbage was undoubtedly the first computer scientist who suffered opposition over a new computer idea. He probably first conceived the idea of making an automatic digital computer in 1812, when he was a professor of mathematics at Cambridge University in England. He set out to build a "Difference Engine," a machine which would construct mathematical and navigational functions by adding various orders of differences.

In his case, he met first with some success, including aid from the British Government for some twenty years; but little progress was achieved, and in 1833 government aid was withdrawn and the project dropped. Babbage, however, incurably optimistic and obstinate, at once laid plans for a much more ambitious machine which he called an "Analytical Engine." This was to consist of three parts: (1) the "store," where numbers were to be stored or remembered; (2) the "mill," where arithmetical operations were to be performed on numbers taken from the store; and (3) the "sequence mechanism," which would select the proper numbers from the store and instruct the mill to perform the proper operations.

As we can see from the viewpoint of more than a century later, his idea was perfect — both complete and accurate. We can also see that the failure of his plan at the time was due mainly to the lack of sufficiently advanced machine tools, and the lack of mechanical and electrical devices that finally became available around 1900-10. But the verdict about Babbage back in the 1830's and for many years afterwards was that his whole idea was absurd, nonsensical, laughable, as well as a waste of money. In fact, I remember hearing some echoes of that laughter when I was studying in school and college in the 1920's.

3. "You Can't Really Use an Automatic Computer Because it is too Unreliable"

Another of the arguments many people asserted against the new idea of a computer in the years 1946 to 1950 was that automatic computers could not be expected to operate both reliably and speedily, because the number of electronic parts in a computer was extraordinarily high. "Why, who ever heard of a machine with a million parts that was not breaking down every few minutes?"

This argument too has suffered greatly in the course of a few years. What would have seemed fantastic reliability has now been built into a great many automatic computers.

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[1] "The Report on Unidentified Flying Objects" by Edward J. Ruppelt, Doubleday and Co., New York, 1956, 243 pp. An interesting and scientifically objective book, reporting (among other data) that up to the end of 1953, there had been 429 sightings (out of 1593 thoroughly investigated sightings) of flying objects that could not reasonably be identified as balloons, aircraft, astronomical bodies, searchlights on clouds, birds, mirages, reflections, frauds, hoaxes, etc. A great many of these 429 sightings were combined radar-visual sightings; some included photographs; a few included movies. Ruppelt, a former Air Force Officer, was head for 2½ years of the Air Force project charged with investigating and analyzing UFO's, under the direction of the U.S. Air Force Technical Intelligence Center located at Wright Patterson Air Force Base, Ohio. Since the beginning of 1954, however, the U.S. Air Force has adopted a policy of suppressing all news about UFO's.

4. "Machines Don't Think"

Another thesis in the computer field, which is perennially opposed by many kinds of people, is that "a machine can think" or "it is appropriate to call automatic computers giant brains."

A recent astute comment on this thesis is provided by the present name of a project at the Research Laboratory for Electronics at Massachusetts Institute of Technology. This project is called the "Artificial Intelligence Project." It consists of a serious and sensible investigation of programs to handle various types of intellectual activity not yet performed by machines. Examples are programs by means of which an automatic computer: may learn from experience; or prove high school geometry theorems; or improve its method of playing a game, such as chess, on the basis of learning; or "take advice" in carrying out a simulated geographic trip from one location to another.

But what would have been the reactions of newspaper reporters and the public if the project had been called not "Artificial Intelligence" but "Machine Intelligence"? Yet certainly the problems mentioned require intelligence for their solution, and certainly machines (automatic computers) are being programmed to deal with these problems and solve them. The name "artificial" does not change the reality.

5. "It is Impossible to Plan Production for a Whole Society Using Computers"

Another thesis that relates to the computer field is expressed in one of the standard arguments against the variety of socialism that is defined as a planned economic society in which the means of production are in theory owned by all the people and operated in their interest, and distribution is in theory "from each according to his capacity, to each according to his work." The argument is that such a society cannot possibly operate properly, because the amount of detail and the number of decisions to be made are so great that the calculations cannot possibly be performed.

This same argument about quantity of calculation has also been used about weather forecasting. The argument is that the amount of data required, and the mathematical equations that need to be applied, are so voluminous and involved, that the forecast cannot possibly be computed in time to do anybody any good. For example, the opponents of the idea may say with quiet humor, "Yes, today's 8:00 a.m. forecast will come out of the computer at 7:00 a.m. tomorrow." And everyone laughs (or is supposed to).

But a number of computer scientists are seriously working on the problem of weather forecasting using automatic computers. And there exist at least half a dozen nations in the world today including at least 800 million people where a planned economic society called by some people socialism is operating with the benefit of at least some degree of computation.

6. Wisdom Before the Event

Now it is easy enough to be wise after circumstances have shown that a certain idea is false or bad — a broken reed, like the impossibility of reliable computers, or an evil principle, like McCarthyism. But how can one be wise before the event, the outcome, has been revealed?

For dealing with new ideas which are unpopular, disliked, or opposed, a scientific method does exist and can be followed. It is outlined below.

7. "Impossible"

"That is impossible!" "That is contrary to human nature." "No computer will ever do that."

Here the most useful response is "Why?", "How do you know?" People need a skeptical, inquiring attitude. A great many things that were impossible at one time have become possible at some later time. "Ever" in fact is an exceedingly long time, more than a thousand years, more than a million years. And the world is a more complicated place than many of our theories make it out to be. For example, the mechanics and relativity of Albert Einstein include the mechanics of Isaac Newton as a useful first approximation at small velocities.

There are two kinds of real impossibility. One kind is logical; the other kind is observational. Under the agreement that "2, 4, plus, equals" are to have their usual meanings, then it is really impossible that 2 plus 2 does not equal 4. Why? Because of definitions and logic. The other kind of real impossibility relates to observations of the physical world. Under properly described, ordinary conditions, it is really impossible that common table salt will not dissolve in common tap water. Why? Because of many experiments about solutions that have no exceptions, and a well established physical theory that explains solutions.

Between these kinds of real impossibility, and many kinds of impossibility asserted in ordinary discussion, there are many differences.

In the computer field, a great many statements of the form "no computer will ever have such and such a property" should be wondered about and questioned. And if the statement is questioned and wondered about long enough, and if the property is useful, it is perhaps even likely that one day a computer will have that property in substance, if not in literal detail. In the same way, man does not fly by flapping wings like a bird — but he does fly.

8. "Impractical"

"Well, it might be possible, but it certainly is impractical." "If you try it, it won't work" (or, "won't work adequately.") This is another favorite comment from many people.

But this comment does allow a good response: you can try it and it might work. And if you do try it sensibly and on a small scale, and it does work, and works fairly well, then in this day and age, you have usually put together a rather good case for proving that the idea is practical.

In the computer field, the channel of trying something resourcefully on a small scale, and eventually making the idea work, has been a big avenue for advance. This avenue has meant winning many arguments, that such and such a type of computer or component was practical.

But we should not forget that the avenue was open in the first place basically because of government funds for computer development. In the years 1940 to 1950, only a relatively small amount of business capital was devoted to computers. The denial of adequate funds and a sympathetic administration of them may be an almost insuperable barrier to proving that something is practical.

9. "I Don't Believe It"

Another argument that opposes new ideas is: "I don't believe it." "There must be an error in reporting."

A good example of this kind of opposition is an anecdote in "The Wright Brothers" by F. C. Kelly (Ballantine Books, New York, 1950), telling how a freelance reporter,

D. B. Salley, went to Kitty Hawk, N.C., where the Wrights were carrying out experiments with their flying machine. Salley inquired of a number of newspapers if they would be interested in buying his reporter's story about how one of the Wrights had flown 1000 feet in a flying machine, about 20 feet above the ground. One of the editors he inquired of, the telegraph editor of "The Cleveland (Ohio) Leader," was so indignant and insulted by the offer of the improbable story that he wired Salley collect "cut out the wild-cat stuff" and paid no further attention to Salley's response.

Even after Orville and Wilbur Wright had proved by their flights that flying in a machine heavier than air was both possible and practical, people generally simply would not believe that it had happened. The Wrights found that it took about four years to change the minds of people generally. In fact, the first large group of people to be convinced were Frenchmen and not Americans.

But "I don't believe it" is of course not a sound argument against a new idea.

10. "Contrary to Authority"

"So and so says such and such. Who am I to disagree with him?" "So and so says that . . . is nonsense, and that is good enough for me."

This is the argument from authority.

Part of the strength of this argument is the real fact that the world is very complex, and that an individual human being using his utmost efforts can have first hand knowledge of only a small part of it. As one wise man noted, we all really know nothing in most subjects. So we have to rely often on certain selected people for information and judgments — on "experts."

Nowadays, it seems as if the divine right of kings to rule has largely been replaced by the divine right of experts to establish and reveal the truth. It is in fact extraordinary in how many ways the degree to which a man may be listened to is dependent on his social and professional status, the nature and degree of his authority. If you or I say something, it usually counts for very little; but if Secretary of State John Foster Dulles or President Dwight D. Eisenhower says something, most newspapers in the country print it, and a lot of people accept it. They accept it for purposes of daily behavior, even if verbally they express some disagreement, as in desegregation or foreign policy. For example, Dulles says frequently that mainland China must not be "recognized." As a result, most people in the United States including most of Congress, in their everyday behavior, act as if mainland China does not properly exist.[2]

11. The Judgment of Experts by Non-Experts

The problem of authority raises the question of the judgment of experts by non-experts. Ordinary people, the great mass of people who are non-experts, must often judge the experts. There are several bases for judging experts which are thoroughly sound.

First, there is the test of "Why?" If you can, ask the expert "Why?" and listen to what he says; see if he makes sense. It is very hard work in a rapidly expanding field such as the computer field, and in many other fields besides, to stay an expert. Often, in fact, once a man becomes an expert, he is promoted out of the area in which he has to stay working if he is to remain an expert.

Second, there is the test of results. See what the expert produces as results. Often the results are poor, bad, or dreadful. Even if the expert has the finest degrees, preparation, and experience, if the results are bad, you may have to get another expert. In the American Civil War, the test of results was applied month after month to the commanding generals on the Federal side; and when they kept losing battles, they were replaced, until finally General Ulysses S. Grant defeated the Confederates.

Of course, when the experts can withhold knowledge of the objective results from the non-experts who are to judge these results, we are in a pretty kettle of fish. To obtain a knowledge of the objective results must then be a main effort of the non-experts in dealing with the experts.

This is true, for example, in the field of education, where there are no objective measures of education reported; and true in the field of a government's foreign policy, where there is no independent agency assessing the work of the State Department or Foreign Office, as the case may be; and true in the field of military affairs, where "security" and "classification" can cover up a great deal that is bad. It is probably fortunate that Sputnik I was launched by the Russians in October 1957. As a result, an objective test of results produced could be applied to the military and educational establishments of this country; and a "teachable moment" could and did result for both the non-experts and experts in the United States.

In the computer field, however, we are lucky: the non-experts can judge the experts by the actual work produced by the automatic computers which the experts create. In fact, in most consumer goods fields, the fine anti-trust laws of the United States often really prevent the disappearance of free competition between experts; this protects consumers and the public. These laws have been applied in the computer field, for example, by the U.S. Government in the case against International Business Machines Corporation; and they have widened the area of competition, particularly by making certain computer field patents open.

12. "Disloyal"

Another source of very strong opposition to new ideas is the feeling that it is disloyal, or may be thought to be disloyal, to give any attention to certain classes of ideas. This has been backed up in this country by the long period of military security classification 1941 to the present. In connection with clearing a person for classified work, inquiries are made about the person's friends, associations, and what he reads. There was a time when "he reads about Russia" or "he reads about Communism" was derogatory information.

The application of computers to solving certain social and economic problems, such as eliminating unemployment, planning all industrial production, obtaining a rich and abundant life for all people in the United States, minimizing waste and unnecessary scarcity, providing medical and hospital care to everybody — would be considered by many people in the United States to be disloyal and suspect.

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[2] Yet mainland China, a country of 600 million population, from 1957 to 1958 increased its total annual agricultural and in-industrial output by 70 percent (see *The New York Times* for Jan. 1, 1959), a somewhat unusual accomplishment for a country that does not properly exist, and especially for a country which supposedly is about to overthrow its present government and restore to rule a dictator who fled ten years ago.

In the computer field, the advent of Sputnik I in October 1957 caused a significant change. Interest in Russian computer accomplishments, interest in machine translation from Russian to English, has become widespread, perhaps even fashionable. Today we teach Russian in many schools, and over 10,000 Americans have purchased translations of scientific Russian texts. In fact, achievements in the computer field all over the world, both machines and applications, ought to be and are of interest to computer people everywhere.

The epithet "disloyal" is of course not a sound argument against a new idea.

13. "Outside of My Field"

Finally, one of the commonest forms of opposition to new ideas is the argument: "Well, that's outside my field," "I am too busy," "I have no time," "I am not interested," "What's that to me?", etc.

This is one of the biggest sources of opposition to new ideas. Here again, this is an entirely natural and inevitable result of the complexity of the world. In the computer field, already, a single scientist is no longer expected to be a master of all the facets of a computer. Components are one field, applications are another, programming is a third.

But no matter how much specialization inevitably proceeds, we must examine new ideas and keep in touch with them. The computer people who worked on cathode ray tube memory saw nearly all their work go out as junk, when magnetic core memory arrived. At the Eastern Joint Computer Conference in December there was much talk of the "next generation" of computers, with new solid-state devices.

No one can afford to stick consistently to the attitude "not my concern," "not my field." This is the primrose path to becoming extinct. Computer people, like all other people who desire to live and flourish, must give thought to new ideas, especially the new ideas with giant possibilities, such as the intercontinental ballistic missile with the nuclear warhead, which in the world we live in is the unpublicized, central underlying motive for pouring funds into space travel.

14. The Intelligent Treatment of New Ideas

From time to time **Computers and Automation** has put forward the idea that computer people are in reality information engineers, engineers in the information sciences. This thesis is being confirmed more and more, it seems, as the effect of handling information reasonably and in great quantities and at high speeds reaches out to more and more fields, such as translating from one language to another.

Idea: If it is possible to teach a human being something, then it ought to be possible to teach essentially the same thing to a machine.

Idea: If a human being can perform a certain intellectual process, then it ought to be possible to program a machine to perform that process — and the more difficult the process, the more appropriate for the machine.

Idea: It ought to be possible to program machines to handle ideas in discussion, simulating human beings.

Idea: It ought to be possible to educate machines to know what human beings know as the result of the education of human beings.

Idea: It ought to be possible for a human being to treat a new idea tentatively, inquiringly, appraising it to determine objectively its degree of merit — and to teach a machine to do as well or better.

• Computer people, as information engineers, as experts in the information sciences, should have a particularly sensible and scientific attitude towards new ideas.

Could a Machine Make Probability Judgments?

Part 2 — Concluding Part

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(Continued from the January, 1959, issue, vol. 8, no. 1, p. 16)

Chess is a game played between two players, called White and Black, on an 8 by 8 board, with 16 pieces of each colour, moved alternately. Sometimes a move involves a capture of an opposing piece. There are six types of piece: King, Queen, Rook, Bishop, Knight and Pawn. Each player has a single King and his opponent's aim is to capture it. This is called "winning the game."

In the von Neumann theory of games, chess is trivial since in principle it could be completely worked out. In practice this is impossible, since a complete catalogue of all possibilities would exhaust all the matter in the observable universe. The game is actually played by using a mixture of calculation and judgment, as in all serious games and efforts of the intellect. (Some "end-games" can be completely worked out. Precise subroutines for doing this could be appended to machine programs of the type to be described. Since the game of chess is only incidental to the discussion I shall say no more about end-games.)

Calculation in chess is usually called "tactics." It consists in working out so-called "forced variations." These can be defined as sequences of moves in each of which a piece is captured and its value is at least as great as that of the capturing piece, or when an unprotected piece is captured. Also when the choice of moves on one side is very restricted the variation is to some extent forced. I assume that the machine could be programmed to work out forced variations. The analysis of forced variations beginning at a certain position forms a "logical tree" whose end-points are quiescent positions. The size of the tree has a very skew distribution:[20] when the tree is very large the original position is said to be "complicated." When it is too complicated a modification of the definition of "forced" is required. Proper chess is played with a two-faced clock, and if the machine got into time-trouble it would automatically change its definition of a forced variation in order to speed up its current move. It might also move faster when its opponent was in time trouble, in order to give him less time to think.[21]

The evaluation of quiescent positions is done by means of "strategic" principles. The probability that a quiescent position is won, drawn or lost should then be estimated. These probabilities depend on the two players. If it is imagined that they are both perfect players, then the probabilities are all 0 or 1, but even in this case we can get probabilities between 0 and 1 by making use of axiom A4′ instead of A4. With real players it would also be desirable to estimate the probabilities that the opponent will make the various selections of moves in almost forced variations. This would be essential for a modified form of chess in which the opponent's moves were selected randomly. I shall consider only the problem of evaluating quiescent positions.

Presumably the probability of winning is a function of the positions of the pieces on all the 64 squares. But for practical play this is not very helpful. In practice a player can estimate his advantage in terms of what pieces are on the board, what squares are controlled (giving more weight to the central squares and to the squares near the Kings), whether there are doubled pawns, outpost Knights, open files, Bishop-pairs, passed pawns and so on. We may assume that the odds of winning rather than losing (the ratio of the probabilities) is some function of all these types of advantage. It is customary to assume that the "material" advantage can be expressed linearly in terms of the pieces (pawn $=1$, knight $=3$, queen $=9\frac{1}{2}$, etc.). It may be adequate to assume that the log-odds are linear in all the types of advantage that are worth listing, with certain coefficients, $\alpha, \beta, \gamma, \ldots$ (The probabilities of winning, drawing, or losing can perhaps be expressed in the form $(p^2, 2pq, q^2)$, and the above log-odds mean $\log(p^2/q^2)$. Judging by some statistics of E.T.O. Slater, p^2/q^2 is approximately 1.4 for the initial position in master chess. I believe that White's advantage is worth half a move or a fifth of a centre pawn, so a pawn is worth a factor of $1.4^5 = 5$, and a queen $5^{9\frac{1}{2}} = 5{,}000{,}000$.)

Now suppose that the machine selects the parameters for itself in some random manner. Then, for each quiescent position the instructor could tell the machine whether it had over- or under-estimated the log-odds of winning, preferably with an associated weight. The machine would thereby be given information from which it could, with the aid of some iterative algorithm, gradually improve its values of the parameters $\alpha, \beta, \gamma, \ldots$ I have not yet worked out the details of the algorithm, but its interest would not be primarily philosophical.

After a time the machine would perhaps arrive at a sensible set of values of the parameters $\alpha, \beta, \gamma, \ldots$ It would then be behaving as if it were making sensible probability judgments concerning the quiescent positions. If we did not know the numerical values of $\alpha, \beta, \gamma, \ldots$ as adopted by the machine, we would not know how the machine was making its judgments.

It is true that it would be possible to find out what these numerical values were by means of certain types of experiment, but it should also be possible by means of psychological experiments to find out how humans make judgments. For all we know even humans may make judgments by means of unconscious calculations. In the distinction, made previously, between calculations and judgments, the "calculations" were supposed to be conscious.

It may be thought that the determination of parameters by a machine is not a convincing example of judgment-making. It would be much more convincing if the machine were also capable of determining a functional form, instead of assuming linearity. Clearly this would also be possible to some extent by means of a suitable program, using the same method of instruction.

It would be still more impressive if the machine were capable of forming new abstractions, such as the idea of doubled pawns. The selection of functional forms is in fact a step in this direction. (For example, the abstraction known as "the advantage of two bishops" could easily be expressed by means of a non-linear function.) If the machine were at all good at forming abstractions it would be well on the way to becoming a first-class scientist. I think it would be wrong to insist on this facility in order to arrive at an affirmative answer to the main question of this talk. There are, after all, only a small proportion of *human* chess players who discover new strategic principles for themselves. It took men as a whole a few hundred years to discover the importance of getting the pieces out quickly during the opening.

This chess example is a little forced because it may well be adequate to evaluate quiescent positions in terms of some score which is not necessarily related to probability. Nevertheless it seems more satisfactory, if possible, to evaluate the position in terms of probabilities. In particular it would facilitate a further improvement of the machine's play, wherein it allowed for the probabilities of its opponent making various moves in a non-quiescent position.

Summary

I may summarise then by saying that general-purpose computers should quite soon be capable of making probability judgments in a reasonable but rather thin sense, i.e., by determining numerical values of parameters and using these for the evaluations of quiescent positions. (The references to chess are introduced in order to make the discussion more concrete, and other games could be invented for which the arguments would be more appropriate.)

More speculatively a P.R.N. machine, or, more likely, a hybrid, may within twenty years be making probability judgments in a very convincing sense, i.e., in a manner that we shall not be able to understand much better than we can understand how humans make probability judgments. (By a "hybrid" is meant here the special case of a P.R.N. machine that consists of a general-purpose computer with random networks appended.)

[1] Based on a talk given on 13th January, 1958 to the Philosophy of Science Group of the British Society for the History of Science and on 14th January to the Gaberbochus Common Room.

[2] Some of the literature may be found in or traced through the section "Behaviour and its mechanism" in *Information Theory* (Third London Symposium), edited by Colin Cherry (London, Butterworths, 1956). See also R. M. Friedberg, IBM Journ. Res. and Dev., 2 (1958), pp. 2-13, which appeared simultaneously with this talk.

[3] Or pseudo-random networks: compare a review of *Symposium on Monte Carlo Methods in Mathematical Tables and Other Aids to Computation,* 11 (1957), 44-46. Discussions of random networks are by now fairly familiar.

[4] Vol. 59 (1950), 433-460.

[5] "Philosophy of science: a personal report," *British Philosophy in the Mid-Century* (Allen and Unwin, 195-), 155-191, esp. pp. 170-1.

[6] "Can induction be mechanised?", *Information Theory (loc. cit.)*, 226-230 (with discussion by Moles, Good, Fairthorne, Bell, McCulloch, and Hutten).

[7] *Probability and the Weighing of Evidence* (London, Griffin; New York, Hafners, 1950).

[8] "Rational decisions," *J. Roy. Stat. Soc. ser. B,* 14 (1952), 107-114.

[9] "The appropriate mathematical tools for describing and analysing uncertainty," Chapter 3 of *Uncertainty and Business Decisions* (Liverpool, University Press, 1954; 2nd edn. 1957).

[10] *The Foundations of Mathematics* (London, Kegan Paul, 1931).

[11] *The Theory of Games and Economic Behaviour* (2nd edn., Princeton, University Press, 1947), Appendix.

[12] *The Foundations of Statistics* (New York, John Wiley; London, Chapman and Hall, 1954).

[13] "Probability," *Enc. Brit.* 11th edn. 22 (1910), 376-403.

[14] *Human Knowledge* (London, Allen and Unwin, 1948), esp. p. 359.

[15] *Theory of Probability* (Oxford, University Press, 1939).

[16] *Logical Foundations of Probability* (Chicago, University Press, 1950).

[17] "The propensity interpretation of the calculus of probability, and the quantum theory," *Proc. Ninth Symp. of the Colston Res. Soc.* (London, Butterworths, 1957).

[18] It is of course not essential that the effect should be achieved by chemical means, although this may be the method used in the brain.

[19] *Design for a Brain* (London, Chapman and Hall, 1952).

[20] See, for example, "The number of individuals in a cascade process," *Proc. Cam. Phil. Soc.* 45 (1949), 360-3.

[21] *Symposium on Information Theory* (Ministry of Supply, London, 1950; and *Trans. of the I.R.E.,* Feb. 1953), p. 199.

Soviet Union Announces Electronic Computing Centers For Over-all Economic Planning

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The Soviet Union announced recently that in the near future, high-speed computers will be used in the field of planning and statistical reporting of the national economy. Every economic area (the USSR recognizes 105) is to have its own computing center, from which reports will be forwarded to republic computing centers, and finally to an all-union computing center.

The methods of computing, the announcement said, have been worked out. Experimental tables of correlation between various branches of the national economy have been compiled. Questions such as more rational coordination between various economic regions of the USSR and the most efficient transportation of goods are to be solved.

By analyzing steadily increasing quantities of data and using elaborate computing techniques, Soviet economists expect to reach the point where they will be able to determine quickly the effect of individual phenomena on the economy of the country as a whole.

According to Y. Kusmin, Deputy Chairman of the Council of Ministers of the USSR and Chairman of the State Planning Committee, the output of computers in 1965 is to be six times as great as in 1958.

Kusmin also reported that experiments with computers are being carried out in the Soviet Union to make certain production processes fully automatic. He also stated that Soviet engineers had developed an "automatic dispatcher" for electric railroad trains, consisting of a computer and a "memory" with stored data concerning track conditions, time-table, etc.

Traditionally, the main centers for the development of electronic machines and instrumentation were those of the Moscow and Leningrad industrial areas, but since the policy of decentralization of Soviet research was launched in 1957, increasing numbers of problems are being delegated to outlying branches of the USSR Academy of Sciences and the Republican Academies of Sciences. Computing machines for the various research centers and for planning and industry are being developed with a priority. The first Soviet computer was developed by the Institute of Mathematics of the Ukrainian Academy of Sciences. It is one of the two computers installed at the Academy of Sciences in Moscow. Early models of Soviet computers were capable of doing 1,000 operations per second; at present the new types are said, on the authority of Academician Palladin, President of the Academy, to be capable of 10,000 operations per second.

A new universal computer, called the Kiev, is now being assembled at the Ukrainian Academy of Sciences. This machine, the work of Ukrainian scientists Academician Boris Gnedenko and Prof. Victor Glushkov, can be used for solving a wide range of mathematical problems, for controlling production processes at metallurgical works, chemical, oil and other industrial plants. It is reported to be capable of establishing in a matter of a few minutes the optimal method of operation of a blast furnace depending on the quality of the ore, coke, and sinter cake of the charge. By means of automatic devices the machine maintains the mode of operation it had set, and signals when the pig iron is ready for tapping. The Kiev machine is capable of performing 7,000 operations per second and possesses several unique features. All its units, including the arithmetic, storing, and other elements, operate independently, that is on different frequencies which facilitates adjustment. The Kiev computer requires floor space of only 40 square meters for its installation and maintenance. The standard parts of the machine can be used for the assembly of various special purpose computers. Another Kiev computer is being made for the Dubna Nuclear Research Institute.

Another electric machine for determining the optimal method of using water for the exploitation of oil-bearing strata has been developed by the Institute of Precision Mechanics and Computing Methods of the USSR Academy of Sciences, and has already been used in the Azerbaijan oil industry. The machine, called M-8, using samples from several wells, creates an electric model of the deposits and determines the location of an oil pool, the best sites for drilling wells and performs exact calculations on the filtration of liquids through layers, and determines the amount of water and the pressure necessary for the optimum output of each well. The stationary system of the machine uses more than 8,000 electronic tubes and occupies an area of 200 square meters. An "electronic brain center" to serve the oil, chemical, mining, and engineering industries in Azerbaijan is in the process of construction in Baku under the authority of the Azerbaijan Academy of Sciences. It will be equipped with electronic computing machines, continuous action mathematical machines, laboratories, and design offices.

A provincial computing center in Georgia, founded a year ago by the Georgian Academy of Sciences is staffed by specialists trained at Tiflis University and the Georgian Polytechnic who had completed post-graduate courses in Moscow. A special rapid electronic computer is now being assembled, to be housed in a four story building. The Central Asian industries are to have a computer center in Tashkent. The machine is of the "Ural" type and belongs to the Institute of Mathematics and Mechanics of the Uzbek Academy of Sciences and will serve the largest Uzbek industrial enterprises, research institutes, and design agencies.

SOVIET COMPUTING MACHINES AND CENTERS

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Academician Nesmeyanov, speaking at the sixth general session of the Council for Co-ordinating the Scientific Activities of the Republican Academies and the branches of the USSR Academy of Sciences, gave a list of the most important problems for Soviet scientists to solve. These were: problems bearing on the immediate needs of the national economy; problems connected with compounds of high molecular weight; nuclear physics; computing techniques; and semi-conductors. The development of computing machines seems to be receiving a particularly high priority in connection with the Soviet drive in nuclear technology, space exploration and automation.

BOOKS and OTHER PUBLICATIONS

(List published in COMPUTERS and AUTOMATION, Vol. 8, No. 2, February, 1959.)

WE PUBLISH HERE citations and brief reviews of books, articles, papers, and other publications which have a significant relation to computers, data processing, and automation, and which have come to our attention. We shall be glad to report other information in future lists if a review copy is sent to us. The plan of each entry is: author or editor / title / publisher or issuer / date, publication process, number of pages, price or its equivalent / comments. If you write to a publisher or issuer, we would appreciate your mentioning **Computers and Automation.**

Shamos, Morris S., and George M. Murphy, editors / Recent Advances in Science: Physics and Applied Mathematics / Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y. / 1956, printed, 384 pp., $7.50.

This volume is the outcome of the First Symposium on Recent Advances in Science, held at New York University in 1954. The text, composed of 12 chapters written by experts, including Richard Courant, I. I. Rabi, Hans A. Bethe, William Schockley, seeks to inform practising scientists, engineers, and laymen of recent important developments in the fields of physics and applied mathematics. Chapters on atomic and nuclear physics, techniques of operations research, transistors, ferromagnetism, cryogenics, applied mathematics, and implications for future trends in industrial development, are included; the index 24 pp. long is detailed and helpful.

Riordan, John / An Introduction to Combinatorial Analysis / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. / 1958, printed, 244 pp., $8.50.

The main emphasis of this fascinating book is "on finding the number of ways there are of doing some well-defined operation." In order to appreciate the text, the reader should be at home with algebra and series. The chapters are: Permutations and Combinations; Generating Functions; the Principle of Inclusion and Exclusion; the Cycles of Permutations; Distributions and Occupancy; Partitions, Compositions, Trees and Networks; Permutations with Restricted Position. The book includes important classic problems, many exercises, ample mathematical illustrations of points discussed, and extensive lists of references.

Davis, Martin / Computability and Unsolvability / McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y. / 1958, printed, 210 pp., $7.50.

The author, a professor of mathematics, introduces "the theory of computability and noncomputability, also referred to as the theory of recursive functions." His first seven chapters, out of a total of eleven, assume no special mathematical training on the reader's part. He discusses: decision problems, about methods for deciding the truth or falsity of a whole class of statements; computable functions; unsolvable decision problems; mathematical logic; recursive functions; Turning machines; and other topics. There are many illustrative mathematical examples.

Grabbe, Eugene M., Simon Ramo and Dean E. Wooldridge, Editors / Handbook of Automation, Computation, and Control; Volume 1, Control Fundaemntals / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. / 1958, printed, app. 1050 pp., $17.00.

This is the first of a three-volume set of sourcebooks for technical personnel working in the fields of systems engineering, automatic control, and computers. This first volume contains control fundamentals. Volumes 2 and 3 cover computers and data processing, systems and components. The general mathematics treated in Volume 1 include sets and relations, Boolean algebra, probability and statistics, as well as a number of branches of engineering mathematics. Compilations of numerical analysis methods, feedback control theory, operations research data, and information theory round out this volume of control fundamentals. Many references are given.

Higonnet, Rene A., and Rene A. Grea / Logical Design of Electrical Circuits / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N.Y. / 1958, printed, 220 pp., $10.00.

The text seeks to explain the principles of Boolean algebra so that engineers having no specialized training in switching circuits or advanced mathematics can utilize Boolean methods "for analyzing relay, diode, and vacuum tube circuits, particularly in the design of control circuits in telephone dialing systems, automation systems," and computers. Illustrations clarify the subject material; also, methods are included for simplifying circuits and for designing complex circuits.

Humphrey, Watts S., Jr. / Switching Circuits with Computing Applications / McGraw-Hill Book Co., Inc., 330 West 42 St., New York 36, N.Y. / 1958, printed, 264 pp., $8.50.

This book is intended both as a graduate engineering text and as an aid to the practising design engineer, and covers the most important single application of switching circuits — digital systems. The methods described simplify the design of modern high-speed digital computers and their hundreds of individual switching-circuit networks, and allows the designer to complete the detailed organization of very large systems without drawing a single circuit diagram. After a general introduction to the subject of computers, the main text starts with a treatment of Boolean algebra and then applies this algebra to the design of some relay networks. The subject of Boolean matrices, as well as their application to relay and magnetic core circuit design, plus a simple method for recognizing redundant elements in such a matrix, are also covered in detail. A bibliography and index are included.

Automation and Remote Control, in English Translation / Publication of the Academy of Sciences of the USSR, translated into English by the Consultants Bureau, Inc., 227 West 17 St., New York 11, N.Y. / photo-offset, annual subscription $185.00.

A sample issue of *Automation and Remote Control* in English translation (October, 1956) contained 10 articles dealing with topics such as: "The Computation and Analysis of the Dynamics of Restrictor Hydraulic Amplifiers," "Bit Feed Control in Drilling Wells with Cutting Motors," "The Approximate Solution of Partial Differential Equations Via Electrical Models," etc. The translation seems clear. The material is amply illustrated. A single article appearing in the publication may be purchased from the Consultants Bureau, Inc. for $12.50.

Salzer, Herbert E., and other authors / Table for the Solution of Cubic Equations / McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N.Y. / 1958, printed, 161 pp., $7.50.

This table, designed for 7 decimal or 7 significant figure accuracy, aids an engineer, physicist, or mathematician to obtain the numerical solution of cubic equations having real coefficients with the use of an ordinary desk calculator. An introduction explains the use of the table.

Kaplan, Wilfred / Ordinary Differential Equations / Addison-Wesley Publishing Co., Reading, Mass. (copies available in the U.S. and Canada only) / 1958, printed, 534 pp., $8.50.

This volume in the *Addison-Wesley Series in Systems Engineering* is intended to be a textbook for a first course in differential equations. However, illustrations of the mathematical theory utilize many of the new ideas of instrumentation engineering, an dthe text stresses practical understanding of the material, rather than merely a teaching of devices for special solutions. Thus the book is an introductory text "especially suited for use by those going on in the field of instrumentation and control." Twelve chapters include discussions of equations of first order and first degree, linear equations of arbitrary order, application of matrices to simultaneous linear differential equations, and solutions in terms of power series.

SURVEY
of
BASIC COMPUTER COMPONENTS

In November we inquired of over 100 organizations in the computer field who we believed manufactured basic computer components. The letter mailed out said that the February issue of **Computers and Automation** would contain a special section, "Survey of Basic Computer Components," and explained:

> Examples of "basic computer components" are ferrite cores for computer rapid memory, transistors, diodes, and electronic tubes for computer switching, magnetic drums for computer medium memory, etc. — components which are basic to or essential to the construction and operation of computers and data processors. The information we particularly want is shown on the enclosed reply form. Would you like to send us this information, and any other information that you think we should have, so that we may include you adequately in this survey?
>
> The reply form ("may be copied on any piece of paper") asked for the following information:

1. Name of component? ....
2. Brief description of component? ....
3. Purposes and uses of component? ....
4. Why is this component basic to or essential in the construction and/or operation of at least some kinds of computers and data processors? ....
5. Price range: between .... and ....
6. Any remarks? ....

We are grateful to those companies who replied to us, with information in the form we asked for it. Their replies are reported below.

We shall be glad to receive from anyone additional or revised entries in the above style. We plan to publish supplements in later issues, from time to time, reporting this kind of reference information for the computer field.

AMPLIFIERS: D.C. Operational Amplifiers / DESCR: Precision computing amplifiers; either self-contained package of 4 amplifiers, or as separate dual, triple, or quadruple packages requiring external power. Accuracy to .01%; bandwidth to 20 KC / USE: in integrating, summing, inverting, and generating special transfer functions via analog techniques / ESSENTIAL: as the basic building block of an analog computing system / PRICE RANGE: $100 to $1,200 / Electronic Associates, Inc., Long Branch, N.J.

AMPLIFIER: Transistor Computing Amplifier, Package Model 807 / DESCR: building-block packaged amplifier. Plug-in type. 400 cycles. Rigid; small; exceptionally long life / USES: for airborne and landborne computers utilizing 400 cycles / ESSENTIAL FOR: replacing more bulky amplifiers / PRICE RANGE: $150 to $225 / Instruments Div., The W. L. Maxson Corp., 475 Tenth Ave., New York 18, N.Y.

CAPACITOR: El-Menco Dur-Mica / DESCR: Fixed silvered mica capacitor having a dip coat of resin; precise; stable; long life; reliable / USES: in many circuits / ESSENTIAL FOR: many high reliability applications / PRICE RANGE: $30 to $1000 per thousand / The Electro-Motive Mfg. Co., Inc., Willimantic, Conn.

CORES: Tape-Wound Bobbin Cores / DESCR: Made from either Permalloy or Deltamax thin tape material in gauges from 1/8 to 1 mil. Produced under complete control of the raw material for processing, and of the fabrication of the finished product / USE: in shift registers and logic devices / ESSENTIAL: often, because of better reliability as compared with many other methods / PRICE RANGE: about $0.60 to $2.00 / The Arnold Engineering Co., P.O. Box G, Marengo, Ill.

CONNECTORS: Printed Circuit Varicon Connectors / DESCR: Forklike contacts; proved reliability. Permit maximum and complete flexibility for interconnections / USE: for interconnection of components, modules and equipments / ESSENTIAL FOR: reliable connections with infinitesimal possibility of failure / PRICE RANGE: — / Elco Corp., "M" St., Below Erie Ave., Philadelphia 24, Pa.

CONNECTORS: Printed Circuit Electrical Connectors / DESCR: Molded body of different compounds is equipped with single or double row contacts which can accommodate 1/16", 3/32", or 1/8" printed circuit boards. Pin and socket variety also available for right angle dip soldering, or taper pins provide positive, space-saving connection between printed circuitry and conventional wiring. Permit direct connection to printed circuit card, cable, or a "plug" mounted sub-assembly / USES: in many classified computers and missiles; in many industrial applications / ESSENTIAL FOR: many logical building block circuit applications where small space, weight, and cost requirements are necessary / PRICE RANGE: $0.50 to $10.00 / Continental Connector Corp., 34-63 56 St., Woodside 77, N.Y.

DELAY LINES: Electromagnetic Delay Lines / DESCR: delay lines that provide high ratio of delay time to rise time. Delay ranges from .25 microseconds to 10 milliseconds / USES: to provide storage of information / ESSENTIAL FOR: internal storage for arithmetical operations / PRICE RANGE: $6 to $600 / Digitronics Corp., Albertson Ave., Albertson, L.I., N.Y.

DELAY LINES: Magnetostriction Delay Lines / DESCR: an acoustic delay device; little affected by temperature (delay coefficient about 5 ppm at OoC; suitable for operation at digit rates up to one million per second; capacities, up to 3000 bits per element; many forms available; low cost per bit; rugged; device can be tailored to individual requirements for storage capacity and packaging / USES: as delay line or as recirculating storage in airborne computers, etc. / ESSENTIAL FOR: many applications, as memory in either main storage or computing storage (as in computer Pegasus) / PRICE RANGE: $125 to $350 / Ferranti Electric Inc., Electronics Div., 95 Madison Ave., Hempstead, N.Y.

DIODES: 1N625 Series Switching Diodes / DESCR: Subminiature glass encapsuled silicon junction diodes. Saturation voltage range, 35V to 200V / USE: Perform the functions of electronic switches, under specific operating conditions, in computer circuits. Rugged construction. Hermetic seal. Operating temperature, —80°C to +150°C. Power dissipation, 200 MW at 25°C. / ESSENTIAL FOR: High speed switching requirements of electronic computers / PRICE RANGE: $1.28 to $2.95 / Sperry Semiconductor Div. of Sperry Rand Corp., Wilson Ave., So. Norwalk, Conn.

DIODES: 1N690 Series Switching Diodes / DESCR: Subminiature glass encapsuled silicon junction diodes, working voltage 36V to 180V; switching current ½ ampere maximum / Rugged construction. Hermetic seal. Operating temperature, —65°C to +150°C. Power dissipation, 400 MW at 25°C. / USE: Perform the functions of electronic switches in computer circuits / ESSENTIAL FOR: High speed switching of high current pulses in electronic computers / PRICE RANGE: $4.45 to $7.95 / Sperry Semiconductor Div. of Sperry Rand Corp., Wilson Ave., So. Norwalk, Conn.

DIODES: Silicon Diodes and Rectifiers / DESCR: — USES: Power rectification, blocking, mixing signals, etc. / ESSENTIAL: when the line voltage is A.C., and the system needs D.C. / PRICE RANGE: about $2.50 to $100 / United States Dynamics Corp., 1250 Columbus Ave., Boston 20, Mass.

DIODES: Type S-180 Avalanche Switching Diode / DESCR: Subminiature glass encapsuled silicon junction diode. Operating voltage: 6.0V to 7.5V. Rugged construction. Hermetic seal. Maximum operating temperature, 150°C; power dissipation, 250 MW / USE: Semiconductor device designed to perform function of electronic switch. Operates in the avalanche breakdown region of the diode's inverse characteristic. Switching time, less than one millimicrosecond / ESSENTIAL FOR: Performing ultra fast switching, which is needed to increase the operating speed of electronic computers / PRICE RANGE: — / Sperry Semiconductor Div. of Sperry Rand Corp., Wilson Ave., So. Norwalk, Conn.

DIODES: Temperature limited diode (vacuum tube) / DESCR: Voltage sensing device of extremely high accuracy / USES: Many applications / ESSENTIAL FOR: for high accuracy voltage regulation / PRICE RANGE: $4.10 to $22.50 / Thermosen, Inc., 375 Fairfield Ave., Stamford, Conn.

GEARS: Gear Trains and Rotary Components / DESCR: Precision gear trains; rotary components; complete sub-systems; integrators; resolvers; servo motor gear heads; and other rotary components / USES: for missile computers and other applications / ESSENTIAL FOR: performing a function in a minimum space with minimum weight and power / PRICE RANGE: $100 to $1,000 / Thomas A. Edison Industries, Instr. Div., McGraw-Edison Co., Lakeside Ave., West Orange, N.J.

INPUT: Data-Integrator / DESCR: a peripheral data processing device that accepts constant information from prepunched master cards, etc., and variable data from a manual keyboard, etc., punches such data into 5, 6, 7 or 8 channel paper tape / USES: as a direct reporting unit in a production plant; in nearly every accounting function / ESSENTIAL FOR: many common language applications; preparing input directly for use with computers; also, via tape to card, for punch card systems / PRICE RANGE: $4,000 to $5,000 / Taller & Cooper, Div. American Electronics, Inc., 75 Front St., Brooklyn 1, N.Y.

INPUT: Low-Level Data Sampling Switch / DESCR: A commutator that operates by the depression of multiple reeds against a common ring under the influence of an insulating wheel. The large number of reeds (180 or 256) allows many wiring combinations. A noise figure of less than 15 pv is achieved since there is no movement of the reed on the common ring during the conduction period / USES: as a switch for multiplexing several transducers into a single information channel / ESSENTIAL FOR: many industrial data processors where low-level multiplexing is necessary because a large number of analog inputs are used / PRICE RANGE: $735 to $850 for basic units; driving means, wiring, and connectors are additional / Genisco, Inc., 2209 Barry Ave., Los Angeles 64, Calif.

LOGIC: Basic Logical Modules (Tube or Transistor) / DESCR: Custom designed for special applications / USES: in data processing systems / ESSENTIAL FOR: many computing systems / PRICE RANGE: about $10 to $150 / Avion Div., Alexandria ACF Industries, 800 N. Pitt St., Alexandria, Va.

MAGNETIC Memory Core Frame / DESCR: Nine inch square frame molded from Plascon Alkyd 446. 70 contacts on each of 4 sides, equally spaced on 0.100 centers. Maximum of 4900 cores, when wired. Each contact contains two-tine configuration for input and output connections / USES: to support wiring and cores for memory matrix / ESSENTIAL FOR: the mechanical structure which physically supports the individual magnetic memory cores / PRICE RANGE: $10 to $15 / Amphenol Electronics Corp., 1830 So. 54th Ave., Chicago 50, Ill.

MAGNETIC: Audiotape Type EP (Extra Precision) / DESCR: Magnetic recording tape on Mylar, acetate or paper base; variety of widths and thicknesses; extremely high accuracy. Available on variety of reels and hubs / USES: in recording and transmission of data; control of processing; input; output, etc. / ESSENTIAL: in many applications involving recording and transmission of data / PRICE RANGE: — / Audio Devices, Inc., 444 Madison Ave., New York 22, N.Y.

MAGNETIC: Ferrite cup cores, ferrite toroids / DESCR: Ferrite toroids of soft and permanent magnetic material; cores vary in diameters from .350 to 1.500 O.D. with and without center posts and center holes; toroids .200 to 6.000 diameter / USE: cups and soft magnetic toroids used as pulse transformer cores and permanent magnetic toroids used as a magnetic clutch device / ESSENTIAL FOR: higher frequency ranges, for molding into various desired shapes, such as cups, not readily available in iron, permanent magnets used for clutch mechanism / PRICE RANGE: dependent upon requirement and size, starting possibly at $0.10 per piece and up / Stackpole Carbon Company, Stackpole St., St. Marys, Pa.

MAGNETIC Tape Handlers, Types FR-200A, FR-300 and FR-400 / DESCR: Memory and storage devices for "writing" digital data on magnetic tape and "reading" data from the tape / USES: To store digital information and feed it to computers as required; to record and store output from computers / ESSENTIAL FOR: feeding information into computers at rates approximating the capacity of the computer / PRICE RANGE: $2,000 and up / Ampex Corp., Instrumentation Div., 934 Charter St., Redwood City, Calif.

MAGNETIC tape transport / DESCR: high precision, multi-speed reel and loop transport / USES: move magnetic tape past recording or reading heads / ESSENTIAL FOR: many storage or memory devices / PRICE RANGE: $2,500 to $5,000 / Minneapolis-Honeywell Regulator Co., Davies Labs., 10721 Hanna St., Beltsville, Md.

MAGNETIC: MPT-1 Magnistor / DESCR: a magnetic circuit element consisting of permanent and transient ferrite magnetic cores. Both encased in tough epoxy. Usually furnished in 6-bit plug-in modules. Each capable of storing and comparing 6 bits of digital data / USES: as a magnetic storage and computing element in data processing and computer equipment / ESSENTIAL: as a method of storing and comparing digital information / PRICE RANGE: about $11 to $15 / Potter Instrument Co., Inc., Sunnyside Blvd., Plainview, N.Y.

MAGNETIC: Magnetic Shift Register Bits and Assemblies / DESCR: Shift register bits, assembled in encapsulated and hermetically sealed packages. Also, complete wire board subsystems consisting of multiple bits and driver circuits. A magnetic shift register consists of a number of square loop magnetic cores connected so that digital information may be logically shifted / USE: as a memory for computers / ESSENTIAL IN: many computer applications / PRICE RANGE: $5 to $10, each bit / Sprague Electric Co., North Adams, Mass.

MAGNETIC DRUM: Monroe Magnetic Storage Drum Model 440 / DESCR:

Magnetic drum with storage up to 2,000,000 bits. Dimensions, 10" x 26". Drive, coupled to 3600 RPM. Shaft position, horizontal. Packing density, up to 169 bits to inch / USE: for a large capacity memory in computing and automation equipment / ESSENTIAL FOR: many computing and automation applications / PRICE: $8094, less heads / Monroe Calculating Machine Co., 555 Mitchell St., Orange, N.J.

MAGNETIC DRUM: Monroe Magnetic Storage Drum Model 320 / DESCR: Magnetic storage drum of medium high capacity; store as high as 1,000,000 bits depending on designer's circuits. Drive direct to 6000 RPM. Shaft position horizontal or vertical. 20" long by 6" or 8" diameter. Supplied with or without phonic disc and/or clock tracks. Excellent history of military use / USE: Magnetic drum storage for computers and automation equipment where moderately high storage is needed / ESSENTIAL FOR: many applications needing magnetic storage memory, delay lines / PRICE RANGE: $3450 to $4138, less heads / Monroe Calculating Machine Co., 555 Mitchell St., Orange, N.J.

MAGNETIC DRUM: Monroe Magnetic Storage Drum Model 96B / DESCR: Moderate capacity magnetic storage drum; bit capacity up to 275,000 bits. Drum size 3½" long by 8" or 10" diameters. Drive, direct coupled at 3600 RPM. Recommended shaft position vertical / USE: provide magnetic storage of digital information for computers, automation / ESSENTIAL FOR: many computer applications / PRICE RANGE: $2750 to $2935, less heads / Monroe Calculating Machine Co., 555 Mitchell St., Orange, N.J.

MAGNETIC DRUM: Monroe Modular Magnetic Storage Drum / DESCR: Low up to moderate storage capacity. Size, from 4" diam. x 1" long, to 10" diam. x 2" long. Bit capacities up to 150,000 bits. All drums have exactly the same drive, bearing assembly, mounting plate and heads; variable rim of drum. Long history of reliable operation / USE: in magnetic drum storage memory systems. Modular, to offer flexibility of storage capacity with optimum cost / ESSENTIAL FOR: many computer applications / PRICE RANGE: $989 to $1375, less heads / Monroe Calculating Machine Co., 555 Mitchell St., Orange, N.J.

MAGNETIC HEADS: Record-reproduce Heads / DESCR: Multi-track heads of various track width, spacing and mountings. Standard and custom design. Both digital and analog applications / USES: for translating electrical signals into impulses that can magnetize particles on magnetic tape, cards, or drum; also for producing electrical signals when recorded tape, cards or drum are moved past the heads / ESSENTIAL FOR: transferring data onto tape, cards or drum, and to read back stored data / PRICE RANGE: $25 to $1500 and more, depending on tracks, quantity, mounting, housing, precision, etc. / Minneapolis-Honeywell Regulator Co., Davies Labs, 10721 Hanna St., Beltsville, Md.

MAGNETIC HEAD: Monroe Magnetic Record-Playback Head / DESCR: Flat, permitting high density assembling of heads; roughly size of 25c piece. Ferrite core for low loss, with 1 mil air gap; up to 600 turns; 2 lead, 3 lead (Center tap) or 4 lead. Up to 100 millivolt playback at 1 mil head space and 940 inches per second of travel. Completely shielded. Designed to be mounted in multiple banks with maximum track density. Designed for good shielding, easy repair. Simple and flexible mounting for easy positive adjustment / USE: Recording and reading digital information on magnetic storage drums. Designed specifically for drums / ESSENTIAL FOR: many computer applications / PRICE RANGE: $15 to $23 / Monroe Calculating Machine Co., 555 Mitchell St., Orange, N.J.

MAGNETIC HEADS: Monroe General Storage Magnetic Heads / DESCR: Bank of 10 Monroe Record-Playback Heads built into mount. Heads in parallel array with double MU Metal Shield between adjacent heads. Bank of 10 heads is 1.125" long. May be interlaced, yielding track density of 16 tracks per inch. Mounting hardware may be supplied in multiples, thus enabling the designer to mount 1 to 7 banks in parallel array with easy access to wiring, and easy positive head adjustment. Easy to replace defective heads and readjust. / USE: as a method of mounting heads in banks for efficient use on magnetic storage drums / ESSENTIAL FOR: many computer applications / PRICE RANGE: $200 to $293 / Monroe Calculating Machine Co., 555 Mitchell St., Orange, N.J.

MAGNETIC HEADS: Monroe Adjustable Head Assembly / DESCR: Mounting and head assembly which permits angular adjustment of record-playback heads while drum is in motion. 2½° adjustment either way of designed center of pole piece. May be used in multiples with individual adjustment on each head and positive lock for each. Also, flexible in that if the designer needs to change the location substantially, the whole assembly can be lifted from the drum assembly and relocated with great ease and without requiring purchase or making of new hardware / USE: for low cost delay, precession, high speed access, recirculation register, phase shifting of information, etc. / ESSENTIAL FOR: many applications / PRICE RANGE: $60 to $80 / Monroe Calculating Machine Co., 555 Mitchell St., Orange, N.J.

MEMORY: Memory Cores, Memory Planes, Memory Systems / DESCR: Low speed and high speed ferrite memory cores. All types and sizes of memory planes. Special switch cores, laddics, and mads. Buffer memory systems, either sequential or random. Ferrite recording heads. Pot cores / USES: as internal memories for data processors, logical functions, systems for computer input-output equipment / ESSENTIAL: in nearly all large computers for high speed and proved reliability / PRICE RANGE: Cores from a few cents each; memories up to $100,000 / General Ceramics Corp., Keasbey, N.J.

NOISE: Electronic Noise Generator / DESCR: generates low frequency gaussian noise for analog computer studies / USES: simulates statistical quantities in analog computer studies / ESSENTIAL: as the only method used to simulate statistical quantities on an analog computer / PRICE RANGE: $1,400 to $1,500 / Elgenco Inc., P.O. Box 45344, Airport Station, Los Angeles 45, Calif.

OUTPUT: Cathode ray tube, 1DP1, 1DP7, 1DP11 and 1DP15 / DESCR: One inch miniature cathode ray tube; operates with 800 volts accelerating / USES: Readout device / ESSENTIAL FOR: a form of data readout / PRICE RANGE: $12 to $20 / National Union Electric Corp., Electronics Div., 1201 E. Bell St., Bloomington, Ill.

OUTPUT: Data Read-Outs / DESCR: Electro-mechanical, data display devices; operating on coincidence-seeking principle; providing binary to decimal translation / USES: non-volatile storage and display; electrical read-out for remote display, recording, or verification; visual display of digital data directly from binary codes. Data may be numeric or alpha-numeric / ESSENTIAL: in many applications, to provide the link from the machine to the man / PRICE RANGE: — / Union Switch & Signal Div., Westinghouse Air Brake Co., Pittsburgh 18, Pa.

OUTPUT: Nixie Numerical Indicator Tubes / DESCR: a gas-filled, cold-cathode, 10-digit (0 through 9), numerical indicator. Common anode and 10 cathodes (numbers). Application of potential between a selected number and common anodes causes it to light with characteristic neon glow / USE: to convert electromechanical or electronic signals to readable characters, as in a console readout / ESSENTIAL FOR: many applications requiring easily readable output signals / PRICE RANGE: $8 to $11 / Burroughs Corp., Electronic Tube Div., P.O. Box 1226, Plainfield, N.J.

OUTPUT: Numerical glow discharge tube / DESCR: A readout tube presenting numerals 1 thru 0 in a neon glow, one inch diameter, one inch seated height. Numerals .610 inches in height / USES: as a computer readout device / ESSENTIAL FOR: a form of data readout / PRICE RANGE: $8 to $15 / National Union Electric Corp., Electronics Div., 1201 E. Bell St., Bloomington, Ill.

OUTPUT: Comparison glow discharge tube / DESCR: A glow tube which displays a scale ordinate and abscissa with points available for recording data for photographing or visual display / USES: Readout of information on a graph type presentation / ESSENTIAL FOR: a form of data readout / PRICE RANGE: $15 to $30 / National Union

Electric Corp., Electronics Div., 1201 E. Bell St., Bloomington, Ill.

OUTPUT: Monoscope tube / DESCR: A miniature monoscope tube 1 inch diameter, 3½" long. Available with the alphabet, numerals and a few extra characters as used on a typewriter / USES: Character generation for readout from a cathode ray tube / ESSENTIAL FOR: visual readout or printing of data / PRICE RANGE: $25 to $35 / National Union Electric Corp., Electronics Div., 1201 E. Bell St., Bloomington, Ill.

OUTPUT: Dekatron Glow Tube / DESCR: a cold cathode glow tube, containing in one glass envelope up to 36 cold cathode diodes circularly arranged around one anode. Electrical impulses cause a glowing spot to move successively around the periphery, one move per impulse. A surrounding dial face indicates digits 0 through 9 or 12. Eliminates complex circuitry, saves space and components. Low current and cold cathode features reduce heating problem / USES: Since output can be taken from 12 cathodes, the Dekatron may be used for counting, electronic switching, frequency division, subtraction, and timing applications / ESSENTIAL FOR: many applications in counting, totalizing, sorting, switching, storing, programming, or controlling with readout included / PRICE RANGE: $10 to $15 / Baird-Atomic, Inc., 33 University Rd., Cambridge 38, Mass.

PLUGBOARD: Patch Panel Type 256 / DESCR: 6" by 6" by ⅛"; jacks and plugs with positive contacts; individual contacts have a minimum current capacity of one ampere; gold-plated pins; guaranteed performance; weight of entire assembly, less than 2¾ lbs. / USES: For control instruments; computer switching circuits / ESSENTIAL FOR: quick-change from one program to another; airborne equipment / PRICE RANGE: — / Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass.

POTENTIOMETER / DESCR: Precision miniature wire-wound potentiometer in many sizes / USES: to change mechanical motion into an electrical signal / ESSENTIAL: as the simplest and most reliable form of a mechanical-electrical transducer / PRICE RANGE: — / Ace Electronics Assoc., 99 Dover St., Somerville, Mass.

POTENTIOMETER, Precision wire-wound / DESCR: a transducer, — electro-mechanical device whose voltage output is some function of its shaft position. Motion usually, but not necessarily rotary. Precise mechanical tolerances / USES: To supply information in the form of a voltage to a computer / ESSENTIAL FOR: economy, versatility, accuracy / PRICE RANGE: $5 to $30 per section / The Gamewell Co., 1238 Chestnut St., Newton Upper Falls, Mass.

POTENTIOMETERS / DESCR: rotary and rectilinear actuated voltage dividers. Voltage is a function of rotary or translatory displacement. Infinite resolution; high speed (up to 1,000 rpm); long life, over 10 million cycles / USE: as a voltage divider where an output proportional to position is required. Voltage can be proportional to a specific mechanical position in a memory bank / ESSENTIAL FOR: conversion of mechanical positions to electrical signals / PRICE RANGE: $30 to $200 / Markite Corporation, 155 Waverly Place, New York 14, N.Y.

POTENTIOMETERS / DESCR: electromechanical transducers that consist of precision variable resistors which provide a voltage output that is a linear or non-linear function of the motion of a mechanical shaft / USES: in analog computers for providing information about initial conditions / ESSENTIAL: as an electro-mechanical transducer in missiles, fire control systems, radar, sonar, loran, and various computers / PRICE RANGE: $10 to $500 / Helipot Div. of Beckman Instruments, Inc., 2500 Fullerton Rd., Fullerton, Calif.

POTENTIOMETERS, Precision / DESCR: Rotary type wirewound potentiometers; from ½" to 3"; single turn, multi-turn. Trim type potentiometers. Commercial potentiometers, resistors, rheostats / USES: in analog computers / ESSENTIAL FOR: precise voltage control; position feedback of mechanical elements / PRICE RANGE: $5 to $500 / Clarostat Manufacturing Co., Dover, N.H.

POTENTIOMETERS, Precision Wirewound / DESCR: Variable resistors; ½ inch to 8 inches in diameter; single turn units with 360° transfiltration or less; may be ganged / USES: in voltage dividers, analog computers, variable resistors, trimmers / ESSENTIAL FOR: changing an electrical value to a mechanical motion or vice versa / PRICE RANGE: $10 to $1,000 / Maurey Instrument Corp., 7924 South Exchange Ave., Chicago 17, Ill.

POWER SUPPLIES: A.C. & D.C. Regulated / DESCR: Static magnetic regulator with no moving parts, to provide AC voltages directly and DC thru semiconductor rectifiers. Provides stable voltages to critical circuits regardless of line voltage fluctuations up to 15% of nominal / USES: many applications / ESSENTIAL FOR: many circuits that operate only on relatively stable voltages / PRICE RANGE: $12 to $1000 / Sola Electric Co., a Div. of Basic Products Corp., 4633 W. 16 St., Chicago 50, Ill.

PRINTED CIRCUIT BOARD ENCLOSURE: Elco Varipak / DESCR: enclosure for printed circuit boards / USES: For packaging printed circuit card modules and holding boards and printed-circuit connectors in alignment / ESSENTIAL FOR: alignment at maximum density / PRICE RANGE: $19 to $33 / Elco Corp., "M" Street below Erie Ave., Philadelphia 24, Pa.

RECTIFIERS, Silicon / DESCR: Silicon power rectifiers: from 0.5 to 70 amp. from 50 to 800 volts; several package types, including axial lead, printed circuit lead, and stud mounted / USES: For computer power supplies with output currents and working voltages as mentioned above, for operation at temperatures up to 150°C / ESSENTIAL FOR: Computers of all types with both transistor and vacuum tube circuits require high reliability DC power supplies for their operation / PRICE RANGE: — / ITT Components Division, P.O. Box 412, Clifton, N.J.

RECTIFIERS and Diodes (selenium and silicon) / DESCR: Axial-lead types, plug-in types, bracket-mounted types, depending on specific application / USES: For conversion of power supply from AC to DC; as blocking diodes to cut off signals in portions of circuits where signals are not wanted; to protect contacts by eliminating arcing across switches, relays / ESSENTIAL FOR: many computer applications / PRICE RANGE: $0.30 to $1.00 for diodes; $2 to $100 for rectifiers / International Rectifier Corp., El Segunda, Calif.

RELAY, Mercury - Wetted Contact / DESCR: Consists of magnetic switch (hermetically sealed in a high-pressure hydrogen atmosphere in a glass capsule) and a coil, enclosed in a steel vacuum-tube-type envelope with a standard medium sized octal plug base. Complete freedom from bounce. The contact surfaces of the switch are wet with mercury fed up a capillary path from a reservoir at the bottom end; provides extraordinary uniformity of reliable performance throughout a life of many billions of operations / USES: in all types of high-speed switching machines and devices demanding highest accuracy and dependability, high speed, high current, and high voltage handling / ESSENTIAL FOR: Many computer circuits / PRICE RANGE: $9.78 to $21.44 / C. P. Clare & Co., 3101 W. Pratt Blvd., Chicago 45, Ill.

RELAYS, Electrical Relays and Solenoids / DESCR: custom designed and built / USES: in automatic equipment, computers, missiles, aircraft / ESSENTIAL FOR: many applications / PRICE RANGE: $3 to $20 / Phillips Control Corp., 59 West Washington St., Joliet, Ill.

RELAYS: Class B, Class E, Series SQPC, Series OCS / DESCR: relays, telephone type, of proved reliability and long life / USES: electromagnetic switching / ESSENTIAL FOR: many computer applications / PRICE RANGE: $5 to $15 / Automatic Electric Co., Northlake, Ill.

RESISTOR: Weston Vamistor Metal Film Resistor / DESCR: a metal film precision resistor in which the resistance element, actually a glass-band, embedded, ribbon of metal, is thermally fused to the inside wall of a steatite tube. Plated brass terminal caps are attached to silvered ends of tube. Entire unit is molded in epoxy resin. The element is a new alloy of the nickel chromium family, providing high stability and low temperature coefficient / USES: Higher quality, smaller size, lower price replacement for precision wire wound resistors in computer and other circuits where highly precise, extremely stable resistors are required / ESSENTIAL FOR: many computer field applications because of performance, size, and price advantage over other types of resistors / PRICE RANGE: $0.75 to $1.50 / Weston Instruments, Div. of Daystrom, Inc., 614 Frelinghuysen Ave., Newark 12, N.J.

RESISTORS: Precision film Resistors, Fixed glass Capacitors / DESCR: Resistors: Tin oxide film fired on glass base. Capacitors: glass as dielectric / USES: in computer circuits / ESSENTIAL FOR: many applications requiring stable components / PRICE RANGE: varies widely depending on value and tolerance / Corning Glass Works, Electronic Components Dept., 550 High St., Bradford, Pa.

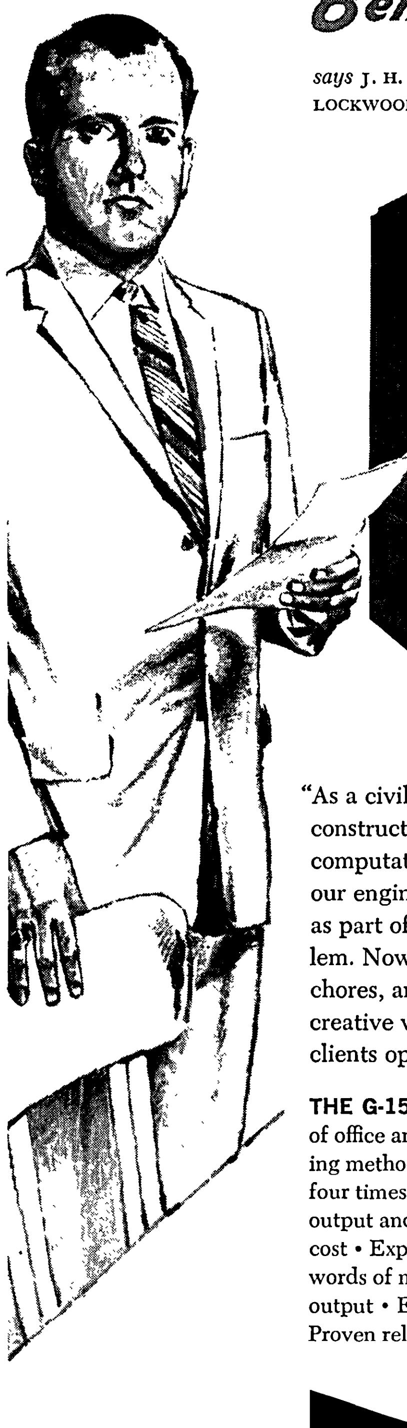
SOCKETS, Transistor and Relay / DESCR: multi-purpose sockets accommodate all pin configurations for standard transistors in one socket. Relay socket accommodates many standard sub-miniature relays. Materials meet military specs / USE: for mounting transistors and sub-miniature relays / ESSENTIAL FOR: many applications requiring easy mounting and replacement of components / PRICE RANGE: $0.10 to $0.15 / Elco Corp., "M" St. below Erie Ave., Philadelphia 24, Pa.

SWITCHING TRANSFORMER / DESCR: Encapsulated and hermetically sealed transformers wound on 4-79 molypermalloy bobbin cores / USE: used as current drivers to drive coincident current memories / ESSENTIAL: in many computer applications / PRICE RANGE: $3.50 to $7.50 / Sprague Electric Company, North Adams, Mass.

TRANSISTOR, 2N1028 Switching / DESCR: Silicon PNP alloy junction transistor with low input impedance, low saturation voltage, low leakage current. Maximum ratings, (1) V_{ce} or V_{eb}, —10 volts, (2) collector current, —100 ma. Rugged construction. Hermetic seal. Operating temperature, —65°C to 150°C. Power dissipation, 150 MW at 25°C / USE: Semiconductor devices designed to perform the functions of electronic switches in computer circuits / ESSENTIAL FOR: high speed switching requirement of electronic computers / PRICE RANGE: about $22.00 to $31.40 / Sperry Semiconductor Div. of Sperry Rand Corp., Wilson Ave., So. Norwalk, Conn.

TRANSISTOR, Germanium PNP Power, Type 2N553 / DESCR: Medium power germanium transistor; exceptionally low collector cut-off current / USES: For series regulation / ESSENTIAL FOR: many applications to series regulation / PRICE RANGE: $4 and up / Delco Radio Div., General Motors Corp., Kokomo, Ind.

TRANSISTORS, Diodes, and Rectifiers / DESCR: Germanium and silicon transistors; point contact gold-bonded germanium and bonded silicon diodes; diffused silicon rectifiers / USES: as switching elements; and in power supply equipment / ESSENTIAL FOR:



Many forthcoming computers rely completely upon transistors for switching functions. Earlier computers and current models use diodes extensively with vacuum tubes and switching circuits / PRICE RANGE: about $2.00 to $8.00 (transistors), $0.35 to $6.00 (diodes), $1.00 to $10.00 (rectifiers) / Raytheon Manufacturing Co., 215 First Ave., Needham Heights 94, Mass.

TRANSISTORS, Rectifiers, Diodes, Controlled Rectifiers, Unijunction Transistors / DESCR: active solid state components / USES: in amplifying, switching, controlling, sensing, and rectifying, in electrical and electronic equipment / ESSENTIAL FOR: many computers and data processors / PRICE RANGE: — / General Electric Company, Semiconductor Products Dept., Syracuse, N.Y.

TUBES: Beam Switching Tube / DESCR: a high vacuum electronic tube in which the electron beam can be directed to any one of ten discrete output positions. The beam can be switched sequentially, or at random, from position to position at megacycle rates, with constant current outputs available at each point. Due to its ten positions, the tube is a natural decade divider. In addition, any number of tubes can be directly cascaded to form an electronic distributor of more than 10 positions. A less-than-10 position switch can be obtained by simple circuitry changes around a single tube. The tubes can be preset to any position, and may be used to address core memories since they can convert a binary coded address to a discrete output / USE: in counting, timing, sampling, frequency dividing, gating, encoding, decoding, distributing / ESSENTIAL FOR: replacing 20 or more ordinary tubes or transistors and associated circuitry in applications cited above / PRICE RANGE: $20 to $40 / Burroughs Corp., Electronic Tube Div., P.O. Box 1226, Plainfield, N.J.

TUBES, Electronic / DESCR: Miniature, subminiature, and glass tubes of dual triode, dual diode, rectifier and thyratron type. Extreme reliability. Long life / USES: in arithmetic and storage units as counters, drivers, gates, clamps, and amplifiers / ESSENTIAL FOR: much electronic circuitry in both military and industrial computers / PRICE RANGE: $0.70 to $5.00 / General Electric Co., Receiving Tube Dept., Owensboro, Ky.

TUBES: Electron Tubes and Semiconductor Diodes / DESCR: twin triodes with separate cathodes; dual control heptodes; germanium diodes; etc. / USES: in large-signal applications; amplifier circuits; on-off control circuits; high current switching applications / ESSENTIAL FOR: many computer switching applications / PRICE RANGE: — / Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L.I., N.Y.

ADVERTISING INDEX

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