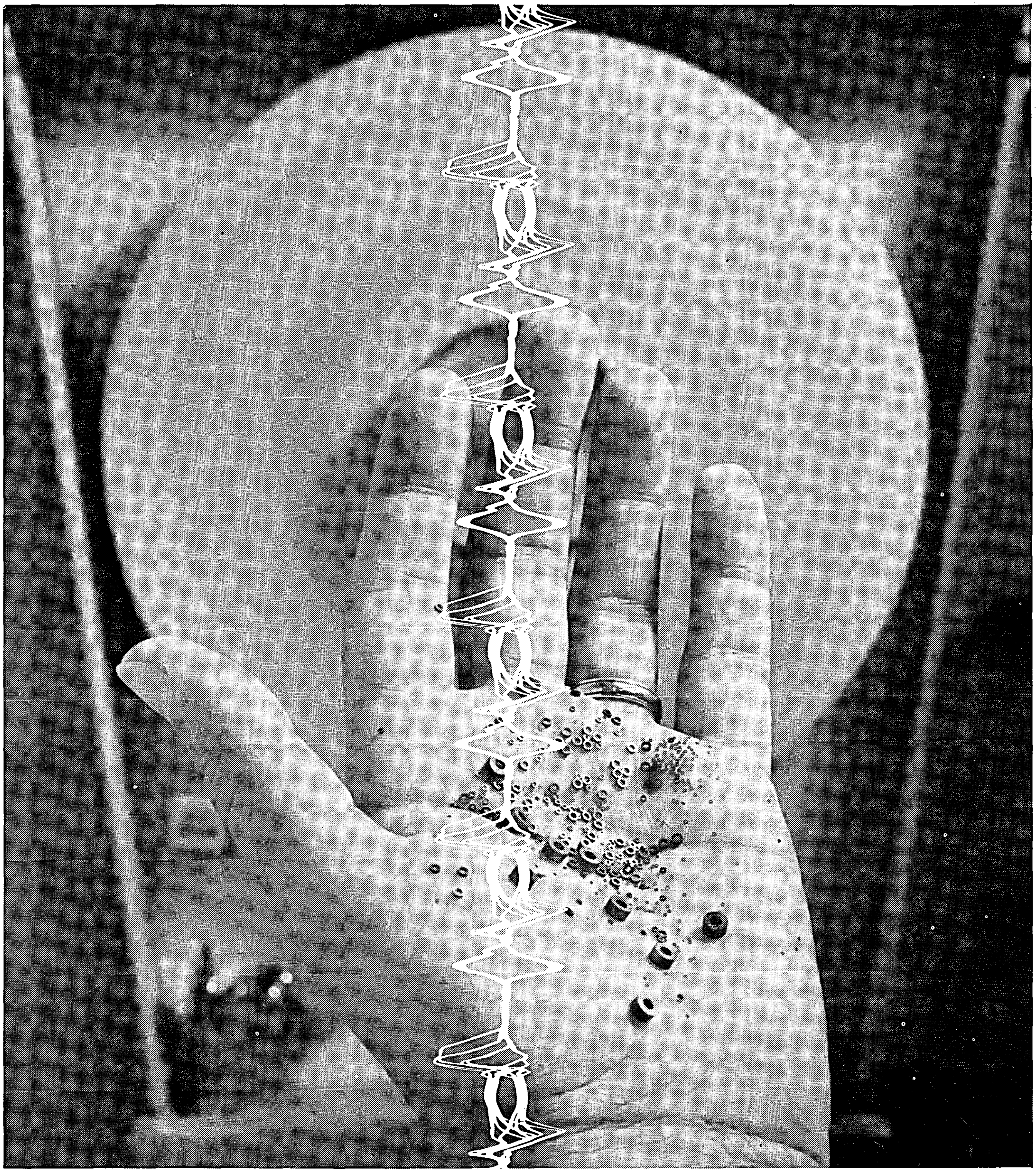
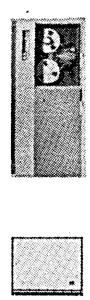
Richard Darnell, Sys Engr
IBM Corp
3424 Wilshire Blvd
Los Angeles Calif

13
3571
84

When in the course of  *choosing a site significant to a new age the history of which reflects a freedom to assemble, to propose anew and to influence favorably the climate of opinion, we held the selection to be self-evident . . . the City of Philadelphia having been so chosen, the Fall Joint Computer Conference will there convene on December 4, 5, 6, 1962.*

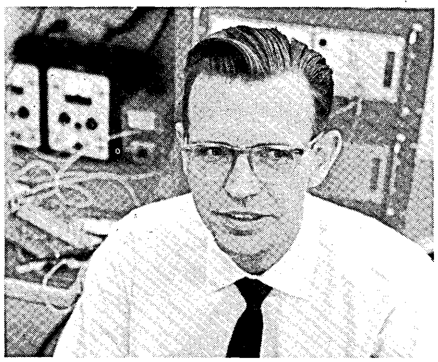




(Advertisement)

Mean Time to Failure: 2,000 Computer Hours

According to Robert M. Beck, V.P.—Engineering for Scientific Data Systems, Inc., "it is now logical to expect a full year of 40 to 50 operating hours per week from a digital computer, without failure." Beck's opinion, based on the reliability program for Scientific Data's 900 Series computers, represents "a balanced philosophy going far beyond a component count numbers game."



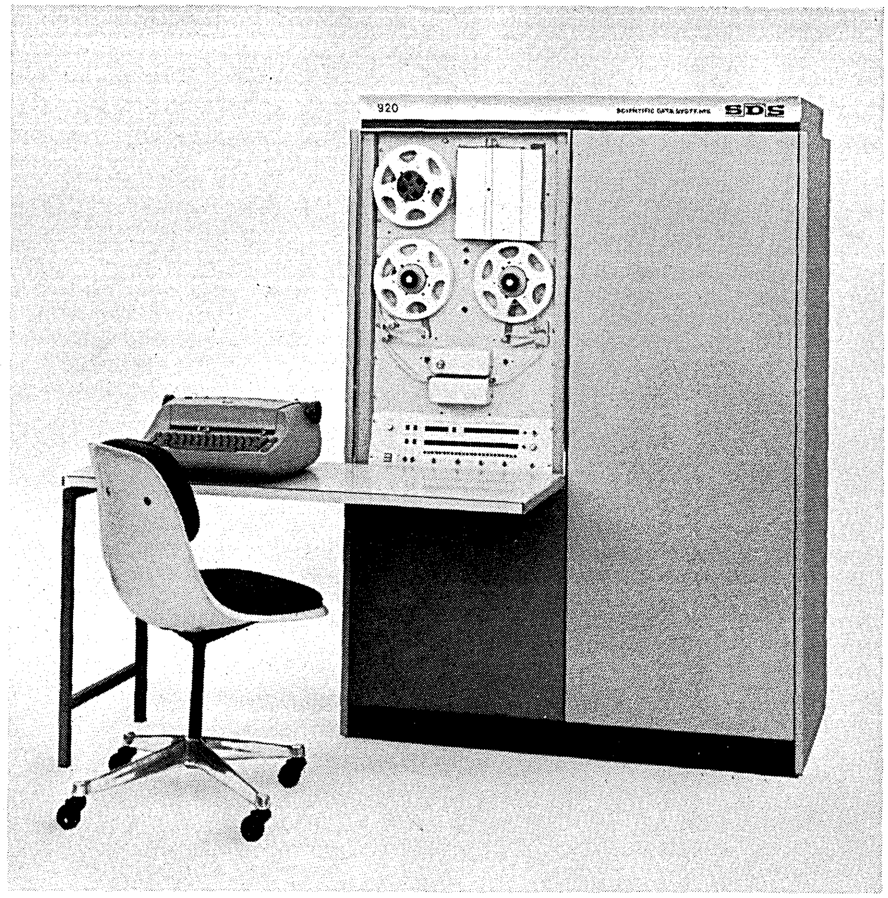
BECK

Circuit design is critical. According to Beck, "we consider circuit noise as the paramount design consideration with respect to computing reliability and therefore use noise rejection networks at both the input and output of all active circuit elements. Further, our circuits have wide built-in tolerances — for example, voltages may vary by as much as 36% without affecting computer operation. Silicon transistors allow for operation to 130°F. to eliminate the need for inherently unreliable air conditioners."

Reduced component count. Beck continued, "once it is established that circuits are reliable and tolerances are wide, reduction of component count becomes a major factor. At SDS, we use new techniques that reduce component count by a factor of from 3 to 5 with a corresponding increase in reliability."

Input/Output reliability. Beck further stated: "Digital I/O equipment is unreliable by its very nature (i.e. the failure ratio between a paper tape punch and a computer is 1,000,000 to 1). Therefore, the computer, with its great inherent reliability, is the best available entity for detecting and compensating for I/O error. Our 900 Series input/output schemes are designed so that the computer operates in closed loop synchronization with its I/O equipment, automatically monitoring every input signal, rejecting errors and initiating recycling of correct data. In addition, we have made design allowances for input signals with the worst possible noise, amplitude, chatter and timing."

"We are certain that our new 900 Series Computers place a new standard on predictable computing reliability."

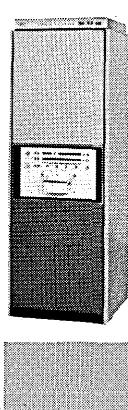


FORTRAN II...*FAST!*

The basic SDS 920 Computer compiles FORTRAN II statements at rates in excess of 200/minute. Not only is SDS FORTRAN II compatible with IBM 7090 FORTRAN II, but it also allows for greater statement flexibility.

The SDS 920 is a solid state digital computer with a 4096-word core memory. It has all the speed (16 μsec. add — 32 μsec. multiply) and operating features found only in much more expensive equipment, plus a comprehensive software package and a complete line of peripheral equipment.

How's that for $98,000?



The SDS 910, a smaller computer, costs only $48,000 (half the price of comparable machines) yet shares the principal features of the 920. The 910 is designed for on-line control and real time systems work, as well as general purpose computing.

SEE THE SDS 920 COMPUTER OPERATING at Booth #137-8, Fall Joint Computer Conference

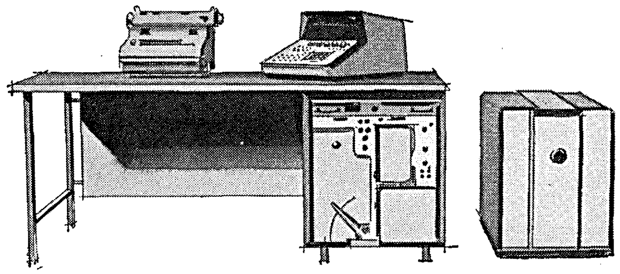
SCIENTIFIC DATA SYSTEMS

SDS

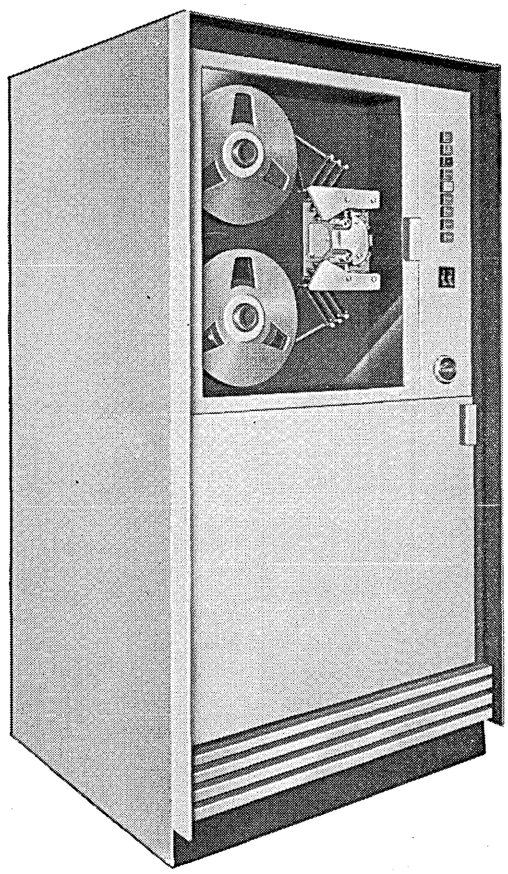
1542 FIFTEENTH STREET • SANTA MONICA, CALIFORNIA

CIRCLE 4 ON READER CARD

at AUTONETICS



they chose POTTER tape transports...



for the Recomp II MT computer system

This system offers the user a magnetic tape memory unit with a capacity of over 600,000 words—and four of these units can be coupled to permit a total memory capacity of over 2,500,000 words.

Key to this highly reliable memory system is the Potter Model 910 Digital Magnetic Tape Transport. In other configurations, the Potter Model 910 solid-state unit provides data transfer rates to 22,500 per second on ½-inch tape or 40,000 characters per second on 1-inch tape at tape speeds up to 75 inches per second. In Recomp II MT, the Model 910 is teamed with the transistorized Model 921A Read-Write Amplifier system, which provides flexibility to match virtually any digital tape application.

To learn more about Potter Digital Magnetic Tape Transports write today.

POTTER INSTRUMENT CO., INC.
Sunnyside Boulevard • Plainview, New York

T.M.

CIRCLE 6 ON READER CARD

DATAMATION 62

the automatic handling of information

volume 8, number 11

Feature Articles

Departments

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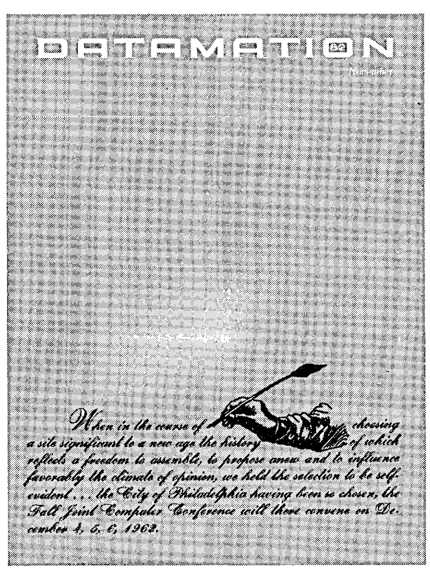

Cover

Renowned as the birthplace of the Constitution of the U.S., Philadelphia is the host city for the 1962 Fall Joint Computer Conference. Art Director Cleve Boutell has depicted the concepts of freedom of expression and the airing of new ideas in her cover design. Complete details for the December 4, 5 and 6 conference may be found in a special section beginning on page 47.

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Printed by Beslow Associates, Inc.

Messrs. Faulkner (left) and Jones examine Columbia SF-100 Mylar Ribbon in high speed chain printer at Spiegel, Inc. computing center.

SPIEGEL
1061 W. 35TH STREET

EXECUTIVE OFFICE **CHICAGO 9**

Mr. Les Banks
Vice President Sales Research
Columbia Ribbon & Carbon Co.
Glen Cove, N. Y.

Dear Mr. Banks:

Since the introduction of the Columbia's SF-100 Mylar Ribbon into the Computing Center at Spiegel, Inc., we have used it exclusively for the printing of turn-around documents that are read on our Optical Scanner. The figures printed using the SF-100 Mylar Ribbon have a far better print quality than those printed with a fabric ribbon. Thus, the Mylar Ribbon has contributed greatly to the reduction in the number of rejects that we formerly experienced on our Scanner. It is also much cleaner to handle.

We feel fully confident in endorsing this ribbon for applications of this type.

Respectfully yours,

C.E. Faulkner
COMPUTING CENTER
MANAGER

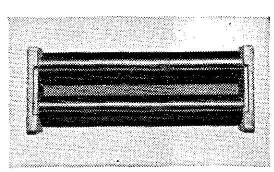
R.H. Jones
COMPUTING CENTER
SUPERINTENDENT

bg

SPIEGEL COMPUTING CENTER COUNTS ON COLUMBIA SF-100 MYLAR RIBBONS

Messrs. Faulkner (right) and Jones examine turn around documents produced with Columbia SF-100 Mylar Ribbon to be read on Spiegel's optical character reader.

FREE DEMONSTRATION. Spiegel, Inc.—one of the world's largest mail order firms—and other businesses, banks, insurance companies and public utilities are capitalizing on the superior results produced by the Columbia SF-100 Mylar Ribbon. For a free demonstration write: Columbia Ribbon and Carbon Mfg. Co., Inc., 303 Herbhill Road, Glen Cove, New York.



Columbia
SF-100 RIBBONS

CIRCLE 7 ON READER CARD

important DATES

• The 1962 Fall Joint Computer Conference will be held on Dec. 4, 5 and 6th at the Sheraton Hotel, Philadelphia, Pennsylvania.

• The Association of Data Processing Service Organizations will hold a Symposium in San Francisco on January 21. Location of the meeting to be announced.

• The AIEE Winter General Meeting, Jan. 27-Feb. 1, 1963, will feature special sessions on Artificial Intelligence. The meeting is scheduled for New York City.

• The AIEE/IRE International Conference on Nonlinear Magnetics will be held at the Shoreham Hotel, Washington, D.C., April 17-19, 1963.

• The 1963 Spring Joint Computer Conference will be held May 21, 22 and 23rd, 1963, at the Cobo Hall, Detroit, Michigan.

• The Fourth Joint Automatic Control Conference will be held at the University of Minnesota, Minneapolis, on June 19-21, 1963. Sponsors are the American Institute of Chemical Engineers, AIEE, IRE, and American Society of Mechanical Engineers.

• The 1963 ACM National Conference will be held Aug. 28, 29, and 30th in Denver, Colorado.

• The 1963 Fall Joint Computer Conference will be held in the Las Vegas, Nev., Convention Center, Nov. 12-14, 1963.

• The Fifth International Automation Congress & Exposition has been scheduled for November 19-21, 1963, at the Sheraton Hotel, Philadelphia.

• The 1964 Spring Joint Computer Conference will be held at the Washington Hilton Hotel, Washington, D. C., May 26-28, 1964.

• The 1964 ACM National Conference will be held in Philadelphia, Penna., Aug. 25-28, 1964.

• The IFIP Congress 65 is scheduled for New York City in May, 1965. It is the first International Congress scheduled for the United States.

letters

programmer analysis

Sir:

Bully for Mr. Joseph Morgan (letters, September DATAMATION). Any manager who needs such an elaborate statistical analysis as that described by Col. Jordan in order to appraise his programmers is hardly worthy of the name. Such statistics are needed only by those who know nothing about programming or programmers.

Although Mr. Morgan's statement that a competent manager knows intuitively which are his best programmers is probably true, it should also be pointed out that it is quite easy for a competent manager to accurately appraise his programmers without resorting to either statistics *or* intuition.

C. W. CROSSLEY
Burroughs Corp.

Sir:

There seems to be some discrepancy between the content of Col. Jordan's article and Mr. Morgan's description. Rereading the article, it appears that Col. Jordan meant #5, "Number of assemblies versus mean number of assemblies" to be a kind of "programmer efficiency" score as measured by how much work he does on the program between assemblies. It is a ratio of his "good" assembled programs to his total number of assembled programs, rather than a simple count, as it seems Mr. Morgan thought it to be.

PAUL R. COOLEY
Los Angeles, Calif.

an end to proliferation

Sir:

The article "The Language Proliferation" appears to contain an error in the FORTRAN sorting routine. Statement number 25 should read: (25 IF NUMBER (J)-NUMBER (j-1) 26,10,-10) instead of 25 IF (NUMBER (J)-NUMBER (J-1) 10,10,26).

It has mystified me for some time why so many redundant symbolic languages for computers continue to be written and how one programmer or coder may be expected to operate with all or even part of these without confusion. Possibly two approaches are derived from the Shaw article and from the consensus of the European ALGOL meetings attended by Daniel D. McCracken and reported in "A New Home For ALGOL" in the same issue.

1. Let the compiler experts spend considerable more effort on improving the ones we have. This is surely needed.

2. Let us see if we can formulate some underlying principles for compilers and attempt to bring together a congress of design engineers and compiler experts to see what can be developed to alleviate machine oriented languages using these principles as guide lines. Flexible but systematic standardization rather than proliferation should be the goal.

CARL R. BLACK
Instructor in Data Processing
Antioch College
and coordinator Computing Facility
Fels Research Institute
Yellow Springs, Ohio

more "bright" ideas

Sir:

In the September issue of DATAMATION, Fred Gruenberger listed 30 "bright" ideas in the computing field. Since he implied the list could be extended, I would like to add four items:

Relocatable subroutines
Trapping
Column binary
Error-tracing

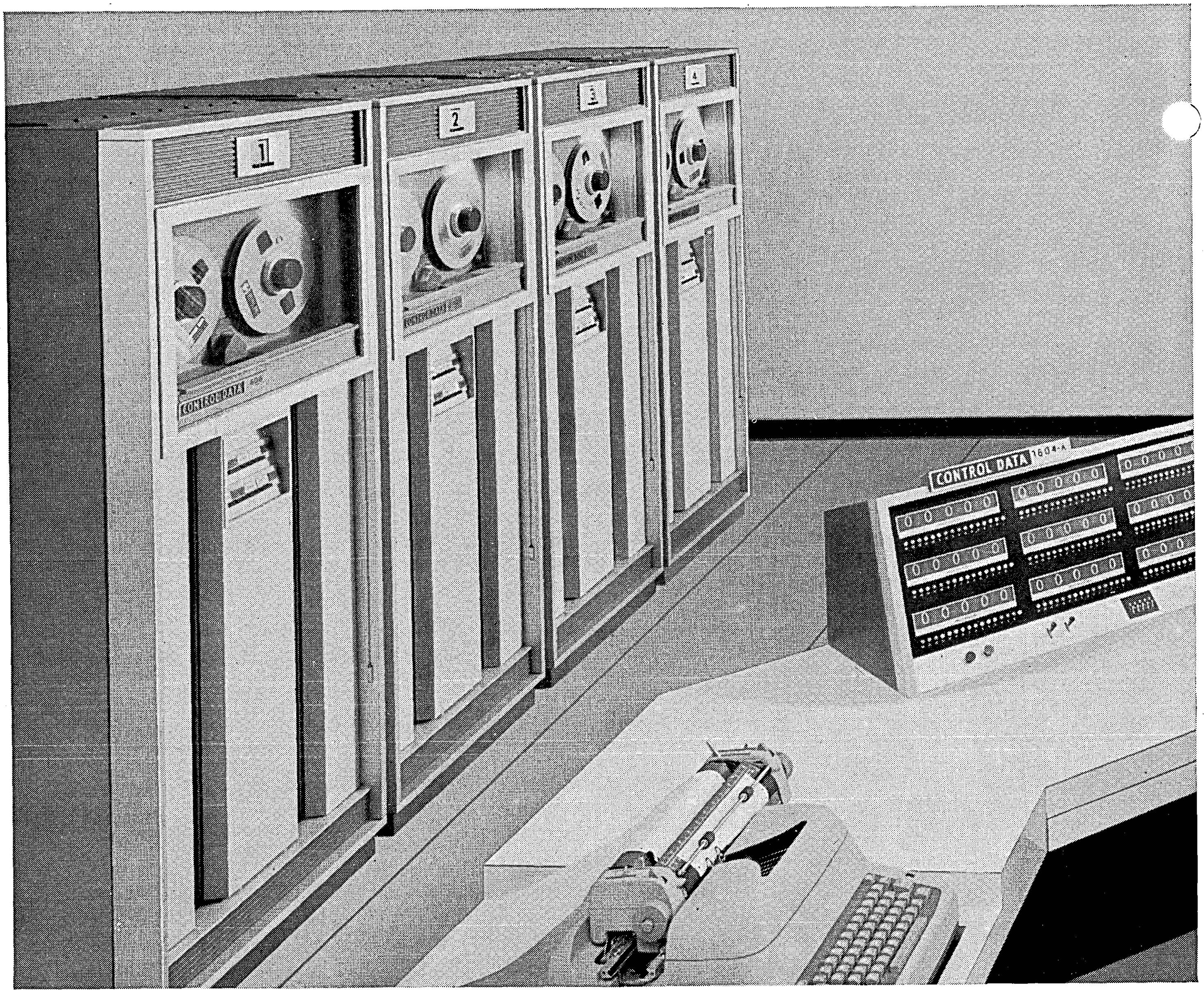
D. J. HAHN
General Electric Co.
Evendale, Ohio

another multi-computer

Sir:

Your article on multi-computers ("Why Multi-Computers," by W. F. Bauer, Sept., 1962) was read with interest by many people in this company. However, I would like to add The Teleregister Corp. to Dr. Bauer's list of companies producing multi-computers. Teleregister has four multi-computer systems in operation, including the world's largest commercial data-processing system, and has several more in the final stages of construction.

HANS VAN GELDER
The Teleregister Corp.
Stamford, Conn.



Why so many computer users prefer

...and five reasons why it will pay you to know!

The Control Data 1604/1604-A Computer, demonstrated a leader in a competitive and demanding field, continues to prove its ability to scientists and engineers as the computer to solve their problems, and to management as the computer to help maintain their profit. Here are the reasons why!

RELIABILITY: The 1604/1604-A continues to log an unusual history of "uptime." Why? The people from Control Data have been making computers for a long, long time. Their experience, their reputation are built into every Control Data computer. Your confidence has been their objective, your demands have been their guide. This is why the 1604/1604-A proven records set a high standard of performance.

SOFTWARE: With the Control Data 1604/1604-A Computer come proven programming systems that grow with your needs: These systems include PERT • COBOL* • CODAP • CO-OP MONITOR • LINEAR PROGRAMMING • ALGOL* • FORTRAN 62 • FORTRAN 63*.

These systems will also be compatible with the 3600 Computer. Additional, proven programming systems (including JOVIAL) are available through the Co-op users organization.

SERVICES: A wide range of proven services come with the 1604/1604-A. These include Programming Assistance • Programmer and Operator Training • Programming Systems Improvement • Installation Check-out • Post Installation Assistance • System Analysis • On-site Customer Engineering.

the Control Data 1604/1604-A

APPLICATIONS: The power, versatility and usefulness of the Control Data 1604/1604-A Computer are demonstrated by the many users who rely upon its proven problem-solving capabilities. Real-time, on-line data reduction/data acquisition, large-scale problem-solving, large-scale data processing, biomedical and institutional research, weather prediction, oceanography, petroleum reservoir analysis, and flight simulation to name a few. Names of these satisfied users are available to you through the Control Data office near you.

LOW-COST: The Control Data 1604/1604-A is available today at an amazingly low cost. With its proven performance, programming systems and services, the Control Data 1604/1604-A offers the most computer for the least dollars spent.

These are the main reasons why so many computer users prefer the Control Data 1604/1604-A. To learn more about how the 1604/1604-A can solve your computing problems now, contact the Control Data representative nearest you.

**Available in early 1963.*

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Minneapolis 20,
Minnesota

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CORPORATION

Why so many Programmers prefer the Control Data 1604/1604-A

The 1604/1604-A is not only a powerful, reliable, efficient computer, providing more computations per dollar expended, it is a computer that's "programmer designed" . . . one that together with its software will simply and quickly serve the needs of the programming personnel who use it. Consider these software packages.

FORTRAN 62 Fortran 62 for the 1604/1604-A has all the ease and efficiency of older Fortran systems, plus featuring rapid compile times. Most significant in this new Fortran system, however, are the input/output statements which allow the programmer to take advantage of the buffering capabilities of a modern computer. For example, the statement BUFFER IN (5,0) (A,B) initiates a transfer of information from peripheral equipment #5, recorded in even parity to a region of common memory, starting with variable A and ending with variable B. Meanwhile, computation can continue. At a later time, this statement may be executed IF (UNIT, 5) N1, N2, N3, N4, causing transfer of control to statement N1 if the information transfer is satisfactorily completed, to N2 if the transfer is not completed, to N3 if an end-of-file mark is encountered and to N4 if an error is apparent after the transfer is completed. Companion statements, ENCODE and DECODE, may be used in conjunction with the buffering statements to provide format control over conversion of variables.

FORTRAN 63 Control Data's Fortran 63 will be available early in 1963 and will include all Fortran 62 statements. It will provide even further extensions to the Fortran language. With Fortran 63 it will be possible to declare variables by type . . . integer, real, double precision, complex and logical. Conditional transfers will be effected on logical as well as arithmetic expressions. Memory allocation at run-time will be accomplished through array dimensions expressed as parameters of subprograms. Compile time will be just as fast. Extensive Do-loop examination during compiling will ensure optimum use of index registers. The result will be an object program comparable in efficiency to a hand-coded object program. Storage allocation and buffering capabilities of Fortran 63 make it applicable to a new class of programs previously restricted to machine language.

1604/1604-A COBOL Statements in Control Data's Common Business Oriented Language will closely resemble an English language statement, and will yield a program which serves as its own documentation. Control Data's Cobal will be ready in early 1963.

ALGOL Control Data will also have an Algol compiler early in 1963. Compiling speed will be fast and it will feature load-and-go operation. It will compile an efficient object code while retaining most of the features of Algol 60.

CODAP Control Data's assembler for the 1604/1604-A is CODAP. It provides a convenient symbolic machine language and enables automatic conversion of decimal and octal constants as they occur within a program.

CO-OP MONITOR CO-OP MONITOR is a master system which controls input/output, program interrupt and the use of a real-time clock without sacrificing flexibility. All Control Data compilers and assemblers operate within this system and object programs can be linked together by the loader in the CO-OP MONITOR system.

PERT Control Data's Program Evaluation and Review Technique provides management with an orderly and rapid planning and evaluation method, having print-out capabilities which keep the user easily in touch with the progress of his project.

CDM2 Control Data's linear programming system is written in Fortran and uses the Revised Simplex Method. It includes a master control system with maximum flexibility. Operating in single precision, it is considerably faster than competitive linear programming techniques. This is possible because of the 1604/1604-A 48-bit word length and the use of checking features which assure the preservation of significance.

UPWARDS COMPATIBILITY Software systems compatible with the above are being implemented on the Control Data 3600 Computer, so that programming done for the 1604/1604-A can be used on the 3600 Computer. Additional, proven programming systems (including JOVIAL) are available through the CO-OP users organization.

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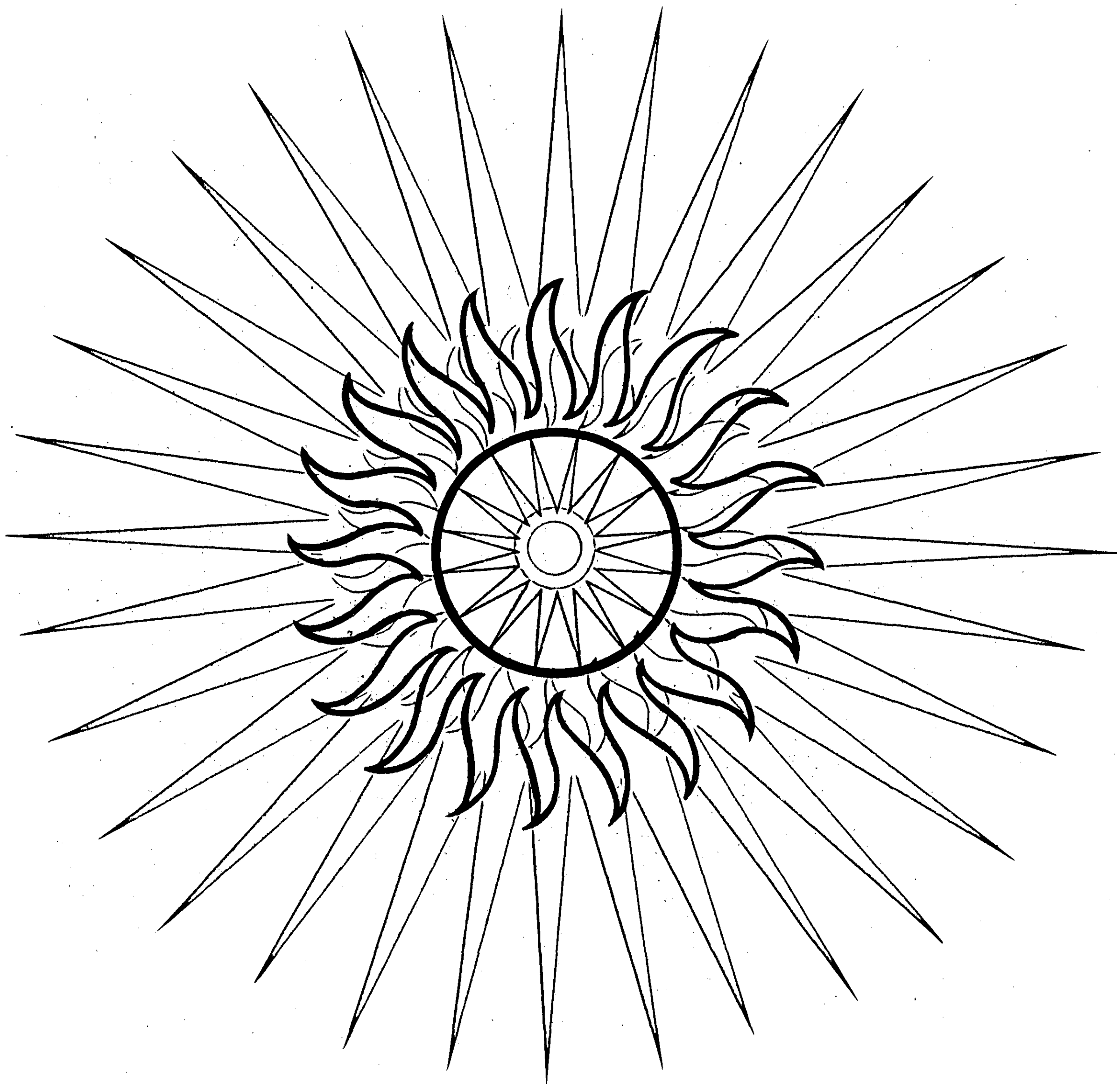
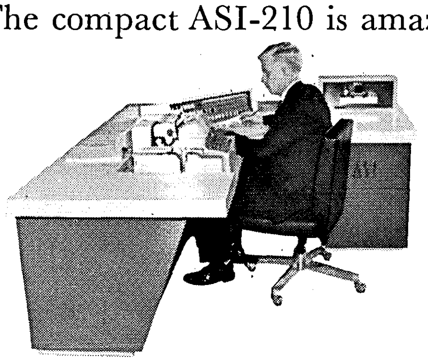


Capabilities unlimited

From analysis of the paths of atomic particles to the simulation or control of spacecraft flight — our versatile ASI-210 computer does a wide variety of exacting chores. The compact ASI-210 is amazingly fast, too, because it makes intelligent use of its basic



2-microsecond memory cycle. May we tell you more about this economical system? Advanced Scientific Instruments, Inc., 5249 Hanson Court, Minneapolis 29, Minnesota. KEllogg 3-2501.

ASI

MORE COMPUTATION PER DOLLAR

CIRCLE 15 ON READER CARD

DATAMATION BUSINESS & SCIENCE

A COMPACT COMPUTER FOR THE CORNER CONFECTIONER

With a nation-wide sales pitch paving the way, IBM brought into the computer arena its new 1440 data processing system, described by IBM last month as "one of the most important new products ever announced."

A clear cut below the 1401 in price, the 1440 occupies a space between the 1401 and UNIVAC's 1004. Announced price for a minimum 1440 configuration (console, CPU, and card read-punch) is $1,500; the 1004 goes from $1,150 to $1,500 monthly.

An interesting component of the new machine is the 1311 disc storage drive. This drive, also available for other IBM equipment, features a removable disc pack. A full system containing cards in and out, line printer, small processor, console and two disc drives rents for about $2,600 per month. The 1440 is thus aimed at the small, but affluent, businessman.

In an indirect dig at the 1004, which utilizes external programming, the 1440 sales film makes a strong point in favor of its internally-programmed feature, by prominently displaying a wired 407 plug board: "a thing of the past."

(For a description of the 1440, see page 76.)

UNIVAC 1107 ARRIVES AT COMPUTER SCIENCE

The much-heralded, long-delayed "thin-film" computer for non-military use, the UNIVAC 1107, has been delivered to Computer Science Corporation's new quarters in Los Angeles. CSC's 1107 boasts a 128-word thin-film control memory, 65K words of magnetic core memory, and six million words of magnetic drum memory. With the acquisition of the 1107, CSC will enter the service bureau field. Heading service bureau operations will be Dan Mason.

Software support runs from an assembly system, monitor system, UNIVAC's version of COBOL, to FORTRAN IV which CSC will write. Some 15 orders have been placed for the 1107, UNIVAC reports.

ANYTHING YOU CAN DO...

As latest entrants in the race for computer supremacy, two of the country's largest advertising agencies, Young & Rubicam, and Batten, Barton, Durstine & Osborn, announced the installation of new computers--an IBM 1620 at Y & R, and a Honeywell

HIGH SPEED RIBBONS

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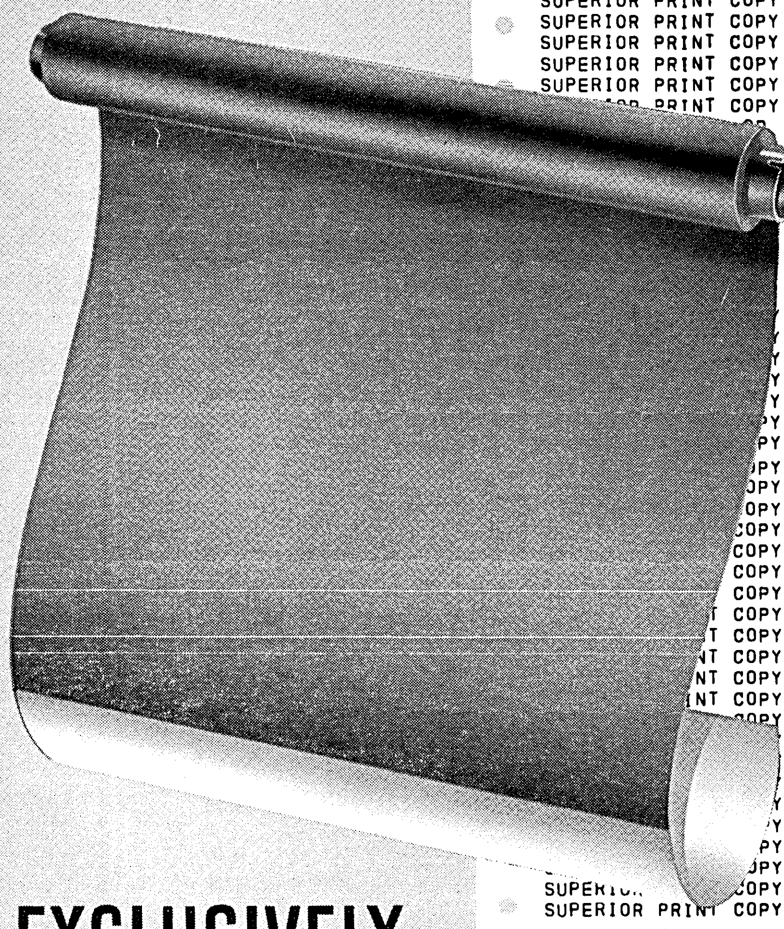

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Use the ribbons made for one printer only — the Anelex printer. They have been designed to meet the requirements of high speed, heavy duty printer operation where quality print-out, long wearing, low cost ribbons are essential for trouble-free production.

To realize the quality printing your printer was designed to deliver, install the ribbon proven best by laboratory test and on the job use in hundreds of data processing installations — Anelex.

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Do you feel that your EDP System could be improved in scope or efficiency by a device or attachment tailored to your specific requirements?

Situations of this sort are the full time concern of the qualified staff at Data Systems Corporation, where the exception is the rule.

Complete responsibility is assumed for all phases from problem definition to in-place operational hardware. You deal with one responsible source throughout.

Data in any form can be converted to the medium or format best suited to your system.

Standard output can be changed to the form dictated by its end use.

Communication between sites and system can be introduced wherever it contributes to efficiency.

Does our approach make sense to you?

Since it very well may, we suggest that you

Contact . . .

Data Systems Corp

For a rapid convergence to the solution of your unique requirements.

VALLEY FORGE INDUSTRIAL PARK
NORRISTOWN, PA.
Area Code 215—GL 2-5711

CIRCLE 59 ON READER CARD

400 at BBDO. The systems will be used for marketing and media tasks, and hopefully, "...to improve the entire image of advertising."

Young & Rubicam was first in line with its announcement, describing their 1620 as a "High Assay Media Model" (HAMM). Not to be outdone, BBDO waited 24 hours to declare that "Y & R's 1620 is a small machine. Our 400 can do anything in spades the 1620 can do, but the 1620 can't do everything the 400 can do." This, from Honeywell, which happens to be a BBDO client. Y & R's counter-claim was that it was two years ahead of competition.

On a more sober note, it was reported that cooler heads in agencies employing data processing equipment were working toward computer system uniformity.

THE TAB CARD MARKET

Business Supplies Corp. of America, Princeton, N. J., has filed a 150 megabuck damage suit against IBM. The firm wants the courts to bar IBM from the tabulating card business in order to "free" the tab card industry "from all restraint of trade and all future violations of the anti-trust laws."

IBM's reply was to the effect that under the terms of the 1956 consent decree, it has helped the Princeton firm substantially, and further, exceeded the decree's requirements. Its support consisted of the sale of presses to Business Supplies. They also made available copies of manuals, blueprints, drawings and other material relating to tab cards and machines. Business Supplies personnel were allowed to visit IBM plants for a first-hand view of manufacturing techniques.

DP EQUIPMENT FROM PLAIN PIPE RACKS

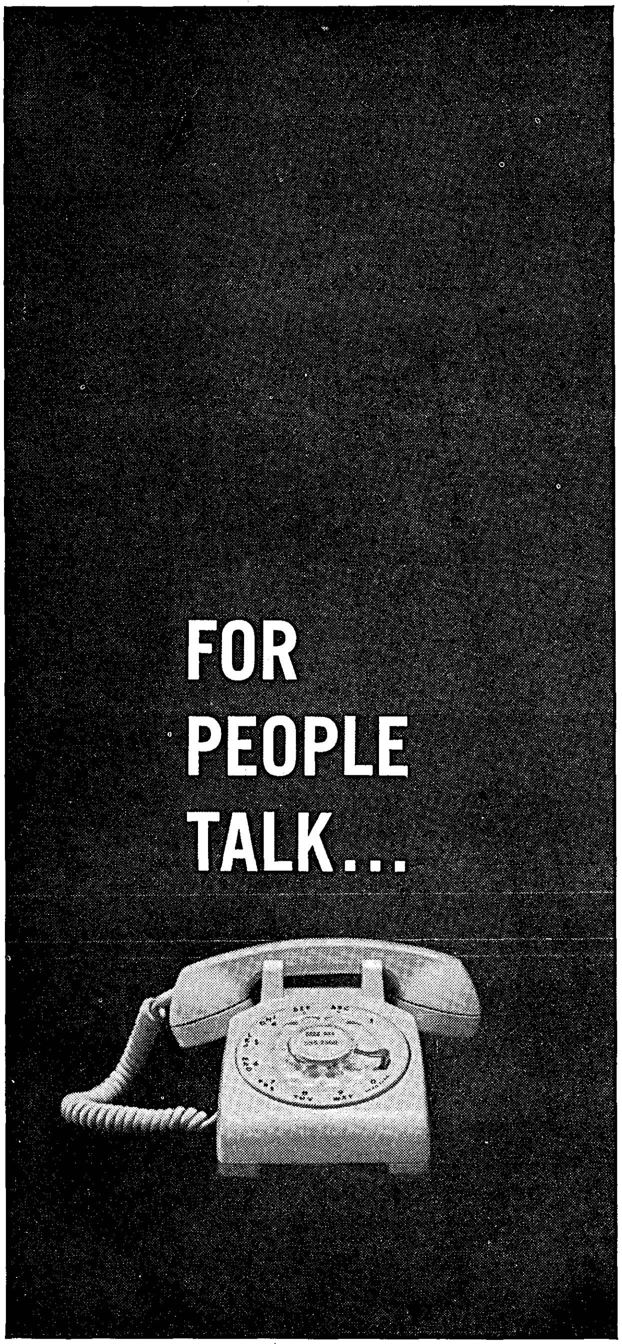
A Los Angeles firm, Associated Business Machines Sales, Inc., is offering a rental plan in which local EAM users can save 15% of the going monthly rental rate. The plan works in this manner: through the user, ABMS purchases the equipment outright, and then leases it back, with a mark-down of 15%.

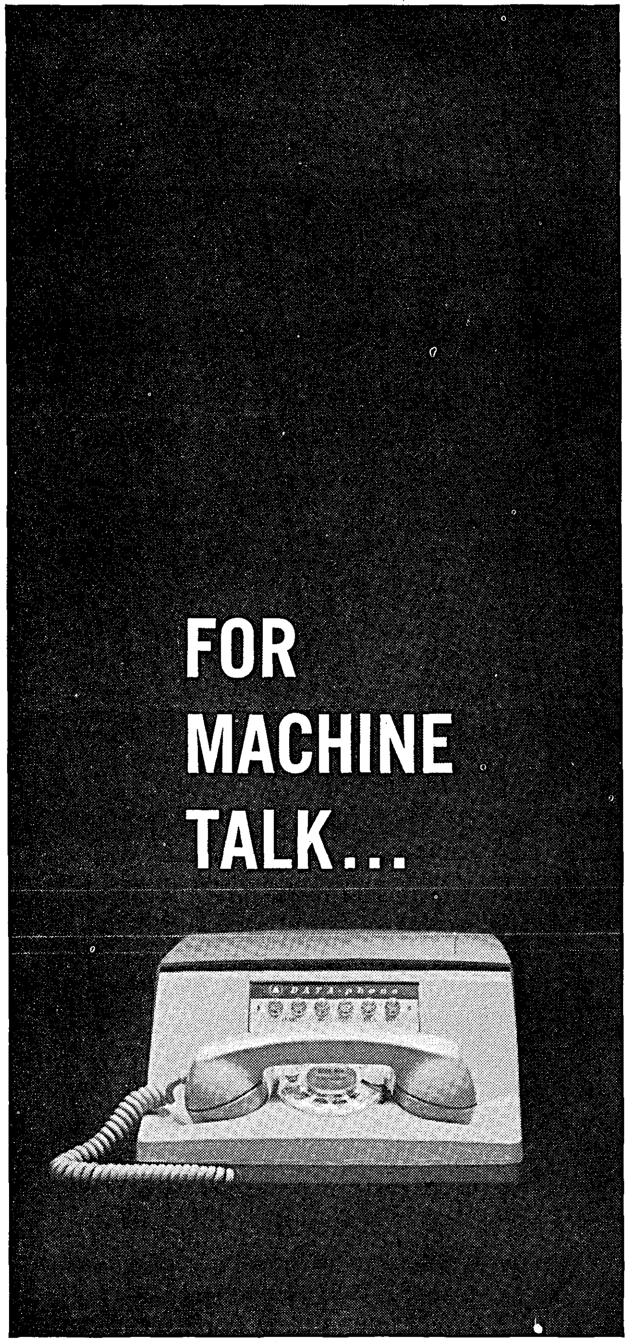
ABMS limits its business to existing users of EAM equipment. All taxes, service, maintenance, and insurance are included in the rental charge.

COMPUTER EXPORTS UP, IMPORTS DOWN

Export of computers during the first half of 1962 was 30.4% higher than the corresponding period of 1961, according to Department of Commerce figures. Representing 41.1% of the total exports of business machines, the shipment of computers abroad was valued at $69,333,131. The total value of all business machines exported was $168,889,026, a gain of 9.1%.

Computer imports also showed a gain, with a value of $2,834,438 recorded, up 34.2% over the first half of 1961. Foreign-built computers represented only 6.6% of the total value of business machines imported, however. Total business machine imports totalled $42,770,671, a drop of 9.4%.





Now your data processing machines can talk to each other by telephone—just like people.

Well—not exactly like people. The machines use the special new telephone shown on the right. It's called a DATA-PHONE data set. And with it they talk much faster than people—up to 2500 words per minute, and even faster when private leased lines are used.

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CIRCLE 17 ON READER CARD

EDITORS' READOUT

(Harold Bergstein, editor of Datamation, was seriously injured in an automobile accident on September 27. During Mr. Bergstein's convalescence, R. L. Patrick will serve as acting editor. — Frank D. Thompson, Publisher)

COMPLACENCY—A STABLE STATE
a guest editorial
by DAN McCRACKEN

Let's consider the history of computing's public image. For a long time nobody knew we existed, except for an occasional giant brain story and the TV election night nonsense. Then, maybe about 1958, the word "computer" came into general use; no longer did we have to add apologetically "you know, the electronic brains" when asked what we did for a living. Everybody knew that any computer could do in 3.2 seconds what would take 400 mathematicians six centuries. Now it has begun to dawn on the public that if this is true, computers might be able to replace *people,* not just mathematicians.

Did you see the TV show last fall in which a union man said something to the effect that there would be 10,000 computers installed this year and each of them would lay off 44 clerks? Have you seen the news stories about the retraining of workers laid off by automation? Have you seen the labor leaders' statements that labor must share in the productivity gains made by automation?

Mixed into these statements, of course, is huge ignorance about any possible difference between a computer and an "automated" coal mine, or, for that matter, an "automatic" pencil sharpener. That subtlety, however, has not penetrated the public consciousness, and shows no immediate signs of doing so. It's all automation. And automation means unemployment. And *that* gets right down into J. Q. Public's pocketbook, where these fears originate.

I seem to hear someone saying, "But it isn't all our fault, if by 'us' you mean the computer industry. The effect of *computers* on employment is far from clear, and, in any case, there *is* a difference between a computer and an automatic pencil sharpener." That's right, but let me introduce you to a hard fact of life: it's a lot easier to tell a lie or a half-truth than to tell the whole truth. If you don't believe it, try this exercise:

> Write an effective answer, in 17 words or less, to this statement: "There will be 10,000 computers installed next year and each of them will lay off 44 clerks." Make it catchy, give it as much emotional appeal to feelings of economic insecurity, and find a way to say it to 15 million people — the approximate number who saw the TV show on which the original statement was made.

Let's face it, we (automation, that is) are going to get all of the blame for unemployment, and no credit for anything. Besides the obvious blame from labor, we will get it from management, too: it will be claimed that management has no economic choice but to automate, little as they like what "it" does to people. I wouldn't be surprised to hear of a union contract that specifies that a computer must not be installed. Social ostracism of computer people within a plant will surely become commonplace. I predict, finally, that within this decade a computer will be bombed by a deranged, unemployed worker.

And what are we doing to stem the tide? As far as I can see, next to nothing. Not one person in the computer industry can challenge LIFE when it calls John Diebold "the elder statesman of automation." I thought AFIPS was going to do something; the total accomplishment to date seems to have been the hiring of a part-time PR consultant. Is BEMA interested? They surely ought to be, but where is the action?

Our turn as public whipping boy is coming, and soon . . . maybe it will go away if we ignore it. ■

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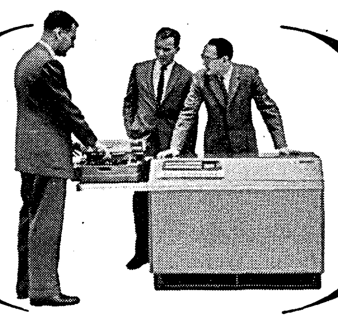

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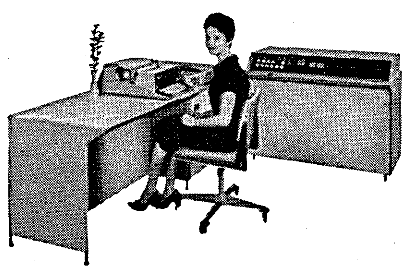


GENERAL PRECISION

COMMERCIAL COMPUTER DIVISION/GENERAL PRECISION, INC./BURBANK, CALIFORNIA

CIRCLE 19 ON READER CARD

For the fifth consecutive year, the RAND Symposium met one day before the Spring (formerly Western) Joint Computer Conference. Convening in Santa Monica, California, the Symposium departed from the previous years' format, where the participants were free to select a series of topics; this year, the Symposium was limited to a single subject: programming languages.

The Symposium, while having no legislaivet effect, is a meeting of individuals prominent in the industry who spend a day at RAND in the sharing of ideas.

The all-day session was tape recorded, a 208-page manuscript prepared, expurgated by participants, and further edited by DATAMATION to meet space requirements.

Chairman of the session was Robert L. Patrick, a RAND consultant. Other participants included: Paul Armer, RAND; George Armerding, RAND; Phil Bagley, MITRE; Howard Bromberg, RCA; Tom Cheatham, Computer Associates; Dick Clippinger, Honeywell; Joe Cunningham, USAF; Bill Dobrusky, SDC; Bernie Galler, Univ. of Mich.; Barry Gordon, IBM; Fred Gruenberger, RAND; Jerry Koory, SDC; Jack Little, RAND; Brad MacKenzie, Burroughs; Dan McCracken, consultant; Ascher Opler, Computer Usage; Charles Phillips, BEMA; and Dick Talmadge, IBM. Opinions expressed do not reflect individual corporate viewpoints.

Part One of the RAND Symposium appeared in the October issue of DATAMATON.

THE RAND SYMPOSIUM: 1962

part two — on programming languages

OPLER: In preparation for this meeting I wrote out some of the arguments against standardization. I decided that I would wear my anti-standards hat this time. (I have also a pro-standards hat.) Eventually the arguments boil down to two classes. One is the set of arguments against programming language standardization at this time. The other is the set of arguments against programming language standardization at any time.

The arguments *against standardization now* are:

1. Programming languages are changing too much.
2. Programming languages have not developed sufficiently.
3. Promising alternatives are just now appearing.

The arguments *against standardization at any time* are:

1. Administration is too time-consuming.
2. Poor past experience.
3. Adverse effect on computer progress.
4. Specialized languages are more efficient.
5. Programming languages are not the right level.
6. Language standardization is only a part of the solution.

ARMER: I'd like to hear Ascher elaborate on the point: "Alternatives are just now appearing."

OPLER: I think this is one of the most serious arguments against standardization right now. It seems that we're just at the beginning of a new period.

In the past it has been believed that the preparation of a compiler to translate from a source language to an object code has been a tremendous job—one that can't be done every day, that demands man-years of effort. New tools, such as syntax direction and table direction and the type of compilers that can be built on hierarchies and list structures, give to the future a freedom that we haven't had in the past. We will have freedom to agree on something radically new, implement it, test it, and if we don't like it, throw it out and iterate again. In the past we have had 20 to 50 man-years devoted to a compiler to the point where once you have created it you have too much of an effort expended—too much inertia to overcome—to try to change it. I am reminded of a remark by the late Dudley Buck, speaking about microminiaturization and printed circuits when he said that some day we may be able to write our computer instead of writing the programs that we want. With syntax direction, if you don't like the language you've developed today you can write a new one tomorrow. So one promising alternative is the release we now have from this vast implementation effort.

LITTLE: From the user's standpoint I hear you digging my grave. Right now they change them to the point where it's difficult to keep going. You see I think that testing of a language is done when you implement real jobs. If I'm going to have to implement real jobs some of which are obviously going to take longer than it takes you to write a new compiler, somehow our time phasing will never be in sync.

OPLER: I'm just thinking that in 1975 we will look back and feel that in 1965 we were just beginning to find out what the structure of these languages was. 1965 marked the time when the second big round of these experiments began to end. I feel that we have just begun to climb but have scarcely gotten off the toe of the curve. I hardly think that we can say now that we have reached the plateau; that we san say that we know enough now to set up our first standards.

My feeling is that we are at the beginning of a very exciting period of development. If we standardize now, we will be sorry. I do not think we can now look back to a long enough period in which various ideas have been tested and rejected.

LITTLE: I agree, Ascher, that we are probably on the verge of some very exciting times in developing the languages, but we are also on the verge of some very exciting times in implementing very large jobs, like Command and Control systems. If your argument doesn't carry over in some proportion to enable us to do these jobs either over or better now, we're in some sort of trouble.

OPLER: Let's consider all the effort that has gone into NELIAC and JOVIAL, for example. Supposing tomorrow someone comes up with a radically new language. Suppose this new language requires the expenditure of 30 to 50 man-years of effort to get it to the point where we can put it to use and see if it's any good. If we can write a syntax table for this new language so that we can give it to somebody and have a compiler in a few days, then we have given people more freedom to design languages. We are not then restricted to a small set of languages like the ones we have now.

DOBRUSKY: Ascher, I agree with that approach but I don't think we're smart enough to write such a processor yet. I don't think we can achieve the various measures of efficiency that have been described here such as fast compile time, efficient object code, easy training, and so on.

CLIPPINGER: I'm sure it would be desirable at some time in the future to have programming languages that are better than the ones we have now. On the other hand all the manufacturers are faced with the problem of providing COBOL for their customers. There are questions of interpretation that arise and it costs us money. It costs us money when we *can't* get an answer and it costs us money later on when we *can* get an answer. I think a good case can be made, particularly in the case of COBOL, for accelerating the process by which the language becomes defined. Just the fact that 15 manufacturers are implementing COBOL on 35 different machines makes a case, it seems to me, for declaring it to be standard at an early date. I think we need a period of use, for the languages we now have will provide a criterion for the improvements in future languages.

LITTLE: We need the use but we also ought to investigate what these criteria should be. For example, FORTRAN has been in use for quite a long time but if you try to go and get any statistics on how it operates you bump up against a pretty cold, hard wall. Usage alone doesn't do the job.

GORDON: COBOL is not a standard, de facto or anything else; just the fact that you have N manufacturers implementing something, on M machines, all called by the same name does not make it a standard. You know, and I know, Dick, that there are no standard programming languages in the commercial area today. One COBOL looks as much like another COBOL as FACT and Commercial Translator look the same.

CLIPPINGER: I agree with you, Barry, of course. What I meant was that the notion of COBOL has achieved a kind of acceptance which is extremely broad. There is something standard about it, although it is certainly not the language itself.

GORDON: The name is about the only thing that is standard.

KOORY: It's not that bad.

BROMBERG: I would much rather have the job of taking a Honeywell COBOL program and converting it so that it would be acceptable to an RCA COBOL translator than I would to take a COMTRAN program and convert it to any other machine.

GORDON: Even leaving Honeywell out of it, is it possible to take a COBOL program written for the RCA 501 and convert it to the 601 without a major rewrite?

BROMBERG: Of course it is. It is even easier because of the family relationship which can be accomodated automatically by the object compiler.

GRUENBERGER: I'd like to address a question to the manufacturers' representatives who are here. If you, the manufacturers, could have your druthers and the DOD said tomorrow morning, "KLUDGETRAN is it, by golly we're frozen!" (and let's assume that they could define KLUDGETRAN)—that's the language for Command and Control—would that make you happy? Or would you like to see this decision put off another five years? Define it anyway you want, but answer the question.

BROMBERG: If you have a language specification to which a number of people agree and they agree that this language would perform the job and you have one big fat user who says, "Yes, I'm going to use it" and if you have a strong authoritative body that is going to handle the interpretation, modification, and extension of the language, I think that we, as a manufacturer, would be glad.

GORDON: Now I know, Howard, why you insisted on those compound "IF" statements, but I agree with you anyhow.

My personal opinion is that if anyone were to come up with a proposed standard in this area tomorrow morning it would be premature by several years, and would be, in the long run, a bad thing for the industry.

GRUENBERGER: Then you'd be unhappy.

PATRICK: This is in the business area you're talking about, Barry, isn't it?

GORDON: No, he said Command and Control. The business language area is one in which we might be ready to standardize within two years, but in Command and Control I think it's farther away.

I'm of the evolution school. Perhaps the noun "standard" or the verb "standardize" needs some definition. To me the verb "standardize" means to declare or recognize as a standard. When I think of standardizing I do not think of creating a standard.

GRUENBERGER: All right, suppose we put it this way. We have a KLUDGETRAN definition and we have already implemented it on five machines. Now the proposal is made that this language we have which is a real hot-dog language—it does everything—(oh, there are a few things it doesn't do, like handle algebraic statements, or loops, and so forth) be made the standard Command and Control language.

GORDON: Then I'd say fine, let's publish the darn thing and let's see people jump to use it because it's so great. Then a year from now when 85% of the industry has embraced it, it is obviously a standard and let's say so then.

BROMBERG: Should we carry over the same exact remark that you just made, Barry, into the current real practical world as it now exists around COBOL?

GORDON: No, we can't.

BROMBERG: Why not?

GORDON: Because of the Defense Department.

PHILLIPS: They're the only ones who have a basic use for it. They're the only ones who would use Command and Control.

ARMER: But Bromberg put it into a different context, referring to COBOL. There's another way for the world to go. The DOD could rescind their statement about COBOL —that statement about they're not going to order a machine unless there is a COBOL translator for it.

PHILLIPS: You're going to have to read that thing, Paul; it doesn't say that.

PATRICK: Yes, but it works that way.

GORDON: Crabgrass doesn't say that it's going to take over the lawn, Charlie; it just works that way.

PHILLIPS: The statement says that you will purchase a machine that has a COBOL compiler available unless there are reasons why you don't need it.

PATRICK: Who judges? Has anyone done it?

MacKENZIE: I know what the directive says and I think I understand the reasons behind it, but is its intent carried forward into the invitations to bid? I don't believe it is.

PHILLIPS: All three of the departments are going through the problem now of deciding how and where to make their equipment selections. This has been going on for some time. There isn't a lot of selection that is done at the local level anymore. In fact, it hasn't been for some time. The ones who will be making equipment selections at the various echelons are fully aware of the fact that they don't have to conform to this directive if they don't have reasons to use COBOL.

CLIPPINGER: What you're saying expresses the psychology of the DOD user but from the psychology of the manufacturer—he has salesmen out there trying to sell his machines and the people he's trying to sell them to are saying "look at the GSA contract." Now can you choose freely whether you are going to use COBOL or not? The answer, of course, is pretty clear. You're going to do COBOL. It doesn't matter what it costs you, you have to do COBOL so that you get a fair chance to market your equipment.

ARMER: It seems pretty obvious to us that IBM is going to abandon Commercial Translator because of COBOL. I've never heard them say so explicitly, but you can judge by their actions.

GORDON: There were people who were unhappy about this in IBM but there wasn't really any choice.

PATRICK: It does seem as though DOD is a wet blanket here, whether you really intended to be or not.

PHILLIPS: It was intended to support COBOL, let's not be coy about it. You try to face these things positively. If you're going to support something you do it positively and we were supporting COBOL.

GRUENBERGER: I asked a question a little while ago on Command and Control and two of our alert manufacturers answered it, but two of them didn't seem to answer it and I'd still like to hear what they have to say.

CLIPPINGER: You won't catch me saying anything now.

MacKENZIE: The reason I haven't answered your question, Fred, it that I'm not familiar with this subject.

GORDON: That didn't keep me from replying and that's a fact.

CLIPPINGER: I'll answer anyway. The general frame of reference in which Honeywell works (and I don't think it's too different from others) is that if something is required because our users need it, and it will help to sell machines, then we'll provide it and we'd like it to cost as little as possible. We'd also like it to be as good as possible. If it is well defined, that will help us to get it done at less cost.

PHILLIPS: Fred, if you can compare today's situation regarding a Command and Control language with what we had in 1959 and 1960 with regard to COBOL, then I would offer this thought. At that particular point in time several manufacturers came to me and said, "Take a firm, strong, hand toward COBOL and push it. We'd like to have you." By this they meant that they'd like Defense to take a strong position on COBOL and push it.

GORDON: I would guess that neither IBM nor Honeywell were among those manufacturers because these are the two companies that had taken the initiative and put in some work in this area where a need was felt.

CUNNINGHAM: At the risk of going back just a little bit further in history, the Air Force attempted to get the manufacturers interested in developing a common language in 1957, with AIMACO. Only one manufacturer supported it. The others decided to develop their own common languages. So —

GORDON: But I think you're confusing two different things, Joe.

CUNNINGHAM: No, I'm only speaking to your point that IBM and Honeywell weren't interested in what the manufacturers had asked the Defense Department. I'm just going back a little further and pointing out that the Defense Department (the Air Materiel Command) had asked you to work with them in solving this problem long before you had anything but visions of COMTRAN.

CLIPPINGER: Is this discussion advancing the ball in any way?

PATRICK: I think it has one interesting implication. The military didn't know what they were asking for in 1957 and hence missinterpreted a response. We had FLOW-MATIC in 1957, which was just developing. This didn't have any of the facets that were advertised with COBOL. It was not machine-independent, and it did not materially raise the output of the programmer. Then Wright Field rewrote the thing into AIMACO. When COBOL was first launched the AIMACO translators weren't working. I know, because I was working for Clippinger at the time. That was all just sales talk and you guys couldn't even see through it. You had bought a pig in a poke and didn't know it.

PHILLIPS: Bear in mind that I did not indentify the level at which I was encouraged.

PATRICK: It's like a bunch of kids with their nose pushed against the glass of a restaurant and they're saying "Gee, Charlie, do something to get me a ticket." Some of us were inside eating and we didn't need any ticket. Charlie was busy redistributing the wealth and giving everybody on the outside a ticket. The people on the inside were supposed to help him redistribute that wealth. Note that sign on the wall: "You can't put garbage in one end and get fruit salad out the other."

GORDON: Let me go off at a slight tangent here. Armer raised the question a couple of times. "What should we be doing?"

Now perhaps I'm on a subject that's irrelevant to the current discussion. But we've been talking about standardization; standardization of character sets and formats and languages among other things. Armer asks what we should be doing? Maybe we should consider standardization of programmer levels. Maybe we should define what a guy ought to know before he calls himself a programmer. Maybe if we establish certain minimum standards of programmer competence we might then have a lot less trouble with worrying about standards of programming language and object code efficiency. How's that for where we should be going?

GALLER: There is too much of a shortage of people right now to enforce standards like that.

GRUENBERGER: It's not getting any better.

PATRICK: As an example, I will predict what our most commonly used language is going to be in the next few years: it's going to be SPS for the 1401. International Bullmoose is delivering eleven 1401's per calendar day, and they have 7,000 or so on back order. SPS is going to be your most popular language.

GRUENBERGER: You know, I've never seen a hot dog language come out yet in the last 14 years — beginning with Mrs. Hopper's A-O compiler (you'll pardon the expression) — that didn't have tied to it the claim in its brochure that this one will eliminate all programmers. The last one we got was just three days ago from General Electric (making the same claim for the G-WIZ compiler) that this one will eliminate programmers. Managers can now do their own programming; engineers can do their own programming, etc. As always, the claim seems to be made that programmers are not needed anymore.

DOBRUSKY: I'll take exception with you. The JOVIAL brochure says, "This is for programmers." You're going to need more of them.

ARMERDING: Okay. But to whom are these ads addressed? When G.E. puts out an ad like that or Honeywell puts out an ad, are they speaking to programmers? Of course not; these ads are not run in the *Communications* or in *Datamation*. They are run in *Business Week* and *Time* magazines and in the *Wall Street Journal*. Whom are they talking to?

PATRICK: They are talking to the same guys that didn't understand IBM's reluctance to get on the FLOWMATIC bandwagon. They're talking to the guys who buy the machines.

CLIPPINGER: You asked earlier whether any one would be willing to make statements as to whether or not we are on the right track. I'd like to pass along the experience of one of our customers who is using FACT. This is not intended to be an indication that I think we have the right answer. It indicates merely that what we have is going to appeal to some of the users in such a way that we aren't going to be able to let it drop. One of our users started in January to write a payroll application. The application involved daily, weekly, monthly and yearly runs. The effort represented the work of about one-and-a-half programmers from January through the end of March. The result is a complex of 18 integrated programs involving about 40,000 three-address instructions (roughly equivalent to 80 or 90,000 single address instructions). If you extrapolated this experience, this would be roughly equivalent to 360,000 single address object program instructions written in a man-year. The job concerned happens to be a data processing application, of course, with a real purpose and it is in operation. That's the sort of thing the users are looking for and that's what they're going to get. It costs us manufacturers a pile of dough. Admittedly, the object code is not as good as we'd like it to be; we can improve it. When we get through improving it, it still may not be as good as we'd like, but it will be good enough so that users will use it.

There may be better ways to do it, but I think English language coding is here to stay. We've got something that is going to do the users some good.

I'm working as hard as anyone in the United States in the direction of standardization, but you all seem to be quite skeptical of the rate at which we're going to accomplish anything in the way of creating useful standards. I'm not at all certain of what the right path is toward standardization. I do know that standardizing a programming language is an extremely complex business. I happen to think it's desirable, but I don't know to what extent we're going to succeed in it.

GORDON: I question your statement that you will not be able to abandon it simply because customers like it. I can assure you that this is no necessary impediment to abandoning something. We have been through this.

CLIPPINGER: It may be a daydream that *you* will be able to abandon Commercial Translator.

GORDON: It may be, but it looks as though we'll be able to. There may be some unhappiness on the part of some customers.

PATRICK: Have you ever thought of taking the Commercial Translator maintenance crew and have them put bugs back into it and use that as a way to kill it?

GALLER: Has IBM talked about a translator to go from Commercial Translator to COBOL to help your people change over?

GORDON: SHARE talked about that.

ARMER: I've been trying to coax people to say that they thought they were doing things right. I would like to challenge those people who say we're doing everything all wrong to indicate how things should be done differently. Gordon's suggestion is a good one, but it's not really a change in what we should be doing, but an addition. I refer to his suggestion on standards regarding what is a programmer.

GORDON: Yes, and stop designing languages for three-year-old programmers.

MacKENZIE: I think we ought to do two things differently, in a sense. I like the point about directing more attention at the level of users. In a way it is an argument against standardization, although I would not like to identify it as such. Another point is the constraint that exists at the hardware design level. I think a question well worth looking into is to what extent will research in problem-oriented languages reflect itself in proposed machine organizations. If you'll agree to remove these constraints, I think you'll see different types of machine organizations in the future.

GORDON: The machine organization itself, I think, is another argument against standardization, at least at this time. Take a look at committees such as the COBOL committee or the ALGOL committee. On any of these inter-company or industry-wide committees you have men who may have a darn good idea of things going on back in their plant relating to, in effect, unannounced hardware. It's darn difficult to be able to get up in a committee meeting and say, "Look you guys, we're announcing a machine next year. But it's not going to work this way at all." If you want any effort to go a certain way, you've got to be able to say why. If you're basing your ideas on things that will come along in the future, you can't say why. In effect, then, any of these committees will be working several years behind what any individual manufacturer could be doing. People at Honeywell can be working on systems to support future hardware that they can't talk about. It's the same with Burroughs, and even IBM.

This is a real limitation on any sort of committee action. The individual manufacturers, who can see what's coming up, can plan for it individually, but can't talk about it collectively.

BROMBERG: Are you saying that language functions may be precluded by machine design?

GORDON: *Influenced,* not precluded.

BROMBERG: It is possible then that one could come up with a machine that would make things like report writers and sort generators unnecessary?

GORDON: Okay, so what?

BROMBERG: I want to know what you're going to do to implement a language that you can't talk about because of proprietary machine design.

GORDON: I would tell you if I could talk about it.

LITTLE: There's an interesting point the other way around, though. If you once came up with a really good standard language, you would probably see a turnabout in the hardware. You may come up with general purpose languages and special purpose computers; that is, computers would be designed more and more to handle a particular language. That tends to stop the progress of machines.

MacKENZIE: It forces the progress to be directed in a particular way. For example, suppose that language A were really a standard language; certainly then some manufacturers might like to sell to the audience that was using language A. They should tend, in their development areas, to produce machine organizations that could efficiently handle language A.

GALLER: Do you really think that's true? Take FORTRAN. Let's assume that history might repeat itself and that there will be a super FORTRAN. (Some of us would like to see a super FORTRAN that would be amenable to Command and Control.) Now is it really the case that machine design has been so strongly influenced by the fact that FORTRAN has been so popular? I don't know. I think it's tremendous, though, that Burroughs took the step with the B-5000. I think it's the one really clear-cut example we have, but they may not succeed with that machine. But certainly any future machine, at least in the design stages, has to compare itself with the B-5000 to see if it can do better; or whether it should go in that direction. You hear all kinds of rumors that maybe IBM is moving in this direction, too. I don't really care whether they're moving in this direction or not, but they had better be thinking about it, and that in itself is good.

PATRICK: We've already seen new machines being selected on the basis of their compile time on a specific application and the object code execution on that same application.

TALMADGE: When Gordon and I were having our discussions on what Commercial Translator might be, there was a certain character who kept popping up: the poor accountant who was going to use this language. We started calling him "Joe Accountant." He became a much used (and abused) character. Now, my background is scientific computing and Gordon's is commercial so that I was always faced with this character whenever a question came up as to whether or not we should include a certain item in the language. The whole point was that Joe Accountant really didn't know anything about how to use the machine, and we were designing the language for him. If we could restrict the users of the language so as to be able to demand a certain level of competence, then we could do things in an entirely different way.

McCRACKEN: And all I'm saying is that you can design a language so that Joe Accountant can use it with very little difficulty, then you have still not begun to solve the training problem. You still have to teach him all these other things that I mentioned before. Once he has learned all those things, then he can understand a more difficult language.

GORDON: I'll go you one better. If you can design a language that Joe Accountant can learn easily, then you're still going to have problems because you're probably going to have a lousy language.

McCRACKEN: That's opinion.

GALLER: Not necessarily.

GORDON: Maybe you've been living in an ivory tower, Bernie. I've been working with Joe Accountant for a long time.

GALLER: All I'm saying is that it's not necessarily a bad language to work with just because you can teach it.

PATRICK: It may be rather weak though.

GALLER: Again, I say, not necessarily. I look at MAD. It's easy to teach, and it's wonderful to use.

GORDON: You're not teaching it to Joe Accountant; you're teaching it to Joe College on campus.

GALLER: All I said was, here was a counter-example.

McCRACKEN: What you're teaching to Joe Accountant is not a language in any case. Further, ALGOL is easy to teach.

GORDON: ALGOL is *not* easy to teach.

MacKENZIE: Galler can go off and teach things to students in college and have them understand them. They can be fairly complex things. You can go to a group of "professional" programmers and try to teach them these same things and run up against a brick wall. It has to do, I believe, with the open-mindedness with which people approach the subject.

GORDON: I still say that when you're working at the university level, particularly with math majors and engineers, you're dealing with a pretty select group. When you get out among the great masses who are going to be programming in SPS, these guys . . .

MacKENZIE: I think you're missing the point, Barry. I may be very presumptuous, but I think you can approach these people on the basis of "this is what you need to know to be able to use this thing" and they either never know the difference or they are willing to accept the approach on faith. When you go to a user or any environment of people who have done previous programming, frequently you find that they have preconceived notions – preconditioned ideas of what the terms are under which they will accept any new thing.

GORDON: Let's take the guy who graduated from high school at the age of 20 by going to school at night. Perhaps he left high school at the age of 14. He has never had elementary algebra and doesn't know what a negative number is. But after 15 years of running a tabulator he is suddenly one of your programmers.

LITTLE: I think by the nature of areas that people are in, sometimes, they are more open to learning certain things than other people are.

Take open shop people for example. We have an open shop operation here at RAND. I would suspect that you get a lot more reasonable response out of the engineers in the corporation than out of the psychologists, for example, but in a real world we have to go out and do jobs for these people. If you're going to design a language or a system that is to be used by these people, please recognize that there is a broad spectrum among any group. As a matter of fact, some of the really big jobs are done not for people who could grasp it if you gave them the chance, but for people who may *never* understand it. Furthermore, they don't have much of an interest.

PATRICK: The military is the best example you have there. They couldn't care less what your problems are: "Just tell me what supplies we've got out in the warehouse." They don't want to know how you do it.

OPLER: We consider that the COBOL user is a skilled systems analyst who understands both the machine and the system. There is the difference between the training level of a person who will use a data processing language well and the training level required to use an algebraic language.

Instead of visualizing the bank clerk knowing the complexity involved in the data description and the interplay between it and the machine procedure, we feel that probably the best user of the language will be the man who has not avoided systems analysis in the past. He can use such languages to get on the air quickly and to produce 250,000 instructions per year.

McCRACKEN: How long does it take to teach him systems analysis compared to how long it would take to teach him COBOL? Much longer. The language isn't the problem.

CLIPPINGER: What you're saying is the manufacturer ought to tell the customers that it takes good people to use this well. If you want to get by with very poor people, you do it at your own risk. You might expect to get something done, but it could be pretty bad.

GALLER: I was talking to some people who were getting ready for the 1401. They had been sending their tab people to school to learn how to program for the 1401. They were astounded when I recommended that they get at least one person who knows programming and doesn't know their business.

GORDON: But the salesman said you didn't have to!

BROMBERG: National Cash Register put out an interesting document that they called the "NEAT COBOL Manual." It's been a sort of vogue the last 12 months or so for everyone to flood the market with their COBOL manual, but NCR deviated slightly for about one quarter of the manual. Instead of talking about how well they had implemented COBOL, they talked about systems design. They made the following comment, which I thought was terriffic. They said, "COBOL is not a substitute for good systems analysis." This is just what I think the sense of this group is.

McCRACKEN: There's one thing that I think that COBOL is efficient at and that's wasting one hell of a lot of machine time if you use it wrong.

LITTLE: One thing we seem to be agreed on is that the training problem is a very important one. It seems to me that there's a lot more work going on in building compilers than there is in the problem of training.

ARMER: It's even hard to get people interested in this topic.

GORDON: I'd like to remind everyone about the fable about the emperor's new clothes. You remember, the con man convinces the emperor it's a great suit, that only the pure in heart can see it. So the emperor winds up walking around naked and no one has the guts to say so. And finally some kid says, "Hey, look he's naked!" and everyone realizes they've been had.

To put it bluntly, I think it's about time somebody had the guts to get up and say that the emperor is naked. The emperor, to be specific, is a very large segment of the computing industry. That includes users.

PATRICK: Like the guys that believe these ads.

GRUENBERGER: Doesn't it all come back to this same subject of training? COBOL, in the hands of a master, is a beautiful tool — a very powerful tool. COBOL, as it's going to be handled by a low grade clerk somewhere, will be a miserable mess. It's going to take 20 times as long to compile and 300 times as long to execute because he's going to manage to ruin it. Some guys are just not as smart as others. They can distort anything. This is true at any language level. We've surely seen it back at machine language level, we've seen it in FORTRAN; there is no reason to believe we won't see it with every one of the magic languages.

LITTLE: Right now I think the programmer is being asked to carry a lot of people on his back. Not only does he have to get the job done but he's asked to use a language that is designed for an ape. Added to that the government has bought different machines and put them back to back. How many of these things can you overcome and still do a reasonably good job? Especially if you perpetuate them. You continuously expect the programmer to bear more and more of this burden. Programmers can't keep making up for stupidity all the way along the line.

OPLER: I'd like to open up a new subject. What percentage of the total range of problems will magic languages eventually be able to handle?

LITTLE: We see evidence today that people are trying to push these magic languages into new areas. Take Command and Control as an example. Even leaving out things like training, would you use one of the current magic languages in this area?

GRUENBERGER: If a given language has no intrinsic goodies and is automatically lousy then we shouldn't even consider it. But if it has all the goodies in the world we're still supposed to be considering the question of whether or not it is good to have it common. I suspect that a lot of our discussion has been dealing with intrinsic goodies rather than with commonness.

GORDON: I'd like to take one last swipe at commonness. There are, I think, three levels of commonness; three dimensions, if you will. You could think of a programming language that is going to be common to both a 1620 and a 7094. Clearly, such a language is either going to place a tremendous burden on the 1620 or sell the 7094 tremendously short. Secondly, you could think of a language which is suitable both for matrix inversion and Command and Control work as well as payroll and inventory problems. Clearly, such a language is going to be pretty poor for one or all of these applications. Thirdly, you can think of a language that is going to be shared by your top level programmers as well as by your retread tab operators. Clearly, this language is either going to be hopelessly binding on the better programmers or it is going to swamp the retread tab operator terribly.

If you go further and try to think of one language that will cover both extremes in all three of the dimensions I named, you'll have a pretty hopeless task. To the extent to which you try to satisfy these mutually conflicting aims in these three different dimensions, you will weaken the language, and cut into its utility for any given application or use.

BROMBERG: We have talked about the situation before a language exists and we say, "What do we need for a Command and Control language?" Then we say, "We already have this particular language and it may be no good because it doesn't have some of the goodies that JOVIAL has." Let's consider that we have two languages now, and they are widely used and very popular. What are we going to do with them? They exist; we can't just say, "I'm against commonness." The languages are here.

PATRICK: It sounds like we need a rational program to get from A to B, where we're now at A. But the rational program doesn't seem to be to standardize at the stroke of a pen.

GRUENBERGER: Another thing we seem to need is some really elementary research. It's amazing how few honest facts were brought out today about common languages. For example, we don't seem to know any facts at all about the efficiencies of these languages in any sense that you want to describe efficiency. We haven't compared figures between MAD, ALGOL, NELIAC, and what-have-you. We've simply never measured these things. We've done no statistical studies either of machines, programs, or people. We might well consider exploring this large area of research before we jump.

BROMBERG: I think one of the problems is that there exists no convenient mechanism wherein all of us in this business can have a voice that is heard by the standards people and by the language extenders.

OPLER: Howard, I wish you could be present at a meeting of the SHARE COBOL group. These meetings are usually held in an auditorium that seats about 500 people. There are hordes of people there and they're all getting up and making suggestions like, "Why don't we take this statement out of the language," or "Why don't we put this statement in the language," and so on. Now this language is fairly sensibly held and maintained. But you can get too closely coupled to your own feedbacks. There are 100 suggestions proposed at every meeting. It might be better to have a small knowledgeable group that pays attention to the current needs rather than flinging open the doors and having everyone making suggestions at once.

PATRICK: Bromberg made a plea for a rational approach to this and you have turned it around and cited one irrational approach, Ascher. The open forum is not a very rational approach.

BROMBERG: What I'm really looking for is some practical form of language maintenance. I think it encompasses some of what you mentioned; namely, having a small nucleus who are actually doing this work.

McCRACKEN: You keep coming back and saying that COBOL maintenance is no good. I thought it was quite good. Is this not true?

PATRICK: It seems to be very slow to respond.

BROMBERG: Again, smallness by itself, is not a sufficient prerequisite for getting the job done. You have to have desire, knowledge, experience, and time. I would maintain that none of these exist on the COBOL maintenance committee in sufficient quantity.

PATRICK: Maybe we're ready to drag out the old proposals for a data processing institute. This is the sort of thing where you could get hold of these guys and let them do it as a full time assignment. We may be using the wrong people. This is the advantage of an institute.

BROMBERG: This might be a good point. Lots of the people on the COBOL committee have additional, separate responsibilities. They do not put in full time at it.

PATRICK: If you separated the men from IBM and RCA and other manufacturers and put them in one place, they'd have to get along eventually — they can't pick up the phone and ask to come home because no one is listening to their ideas.

OPLER: This better be housed on one of the off-shore islands.

BROMBERG: Without an authoritative organization it leaves the world open to perversions of interpretations of these common languages. Anyone can advertise, "Look, fellows, we now have a COBOL compiler." (Complete with pictures, as a matter of fact.) This certainly defeats what we're trying to do. So I put in a plea for a strong authoritative maintenance czar with two bull whips.

GORDON: I don't think you should enforce something until you have something worth enforcing. With premature standardization, forcing it is compounding the error.

BROMBERG: No one has standardized.

McCRACKEN: Don't give him a bull whip until you're sure there's something in his skull.

PATRICK: They may go hand in hand, though. You can't give someone the responsibility without the authority.

GRUENBERGER: Are you saying that we should have stronger design control?

BROMBERG: Absolutely.

GORDON: No, you're not. You're saying, "Let's take what we're stuck with now and make the best of a bad situation, by maintaining it stronger."

BROMBERG: What's involved in maintenance? There are three things: interpretation, modification, and extension. Modification may completely revise what we've got.

GORDON: Lots of luck. You know better than that.

BROMBERG: Why? It could, but it can't if every implementer goes his merry way and collects his own little ambiguities after the fact and presents them to the committee as accomplished facts. And what happens with the previous years' specifications? Suppose now some slow guy comes running into the committee with a dozen and a half proposals for last year's COBOL specifications. You'd have 15 guys faint.

GRUENBERGER: Are all you guys saying that what we ought to do is to perfect a higher level language, set up a maintenance committee with a czar and all that, and *then* worry about commonness?

BROMBERG: No, that in itself takes a giant step toward a guarantee of commonness.

GRUENBERGER: But you're also saying that we're not ready for commonness until those conditions are met, aren't you?

BROMBERG: I'm saying that we'll never have it until those conditions are met. I say we're ready and we're well overdue for it.

GRUENBERGER: Most of you indicated that you agreed it was a necessary condition but McCracken didn't agree. Why not?

McCRACKEN: I'm not an implementer and I'd like to hear more about the conditions here. I'd still like to hear more about the idea of agreeing beforehand that we're going to *try* to maintain commonness and work within that framework. We should find the best people we can, set up the committee first, and then agree to stick with it.

GRUENBERGER: You mean get commonness first before we have a language that is maintained?

McCRACKEN: It's a question of states' rights. Are all the states going to have to perfect their own government before we can have a federal government?

BROMBERG: The original CODASYL charter said just this: there are two reasons why we're going to establish this necessary committee function for the creation of what turned out to be COBOL. One is the provisions of an effective tool for the specification of data processing problem solutions and the other is to maintain some degree of compatibility. That was absolutely stated before one little line was ever written down as far as the COBOL specifications were concerned.

OPLER: How common? When we talk about a common language do we mean that we expect to take the card decks of the COBOL Procedure Division and whomp them into the machine, or do we mean that we read the program and then start working? If you mean exact compatibility, where you take the COBOL deck, read it in a machine and answers come out, forget it. If you're saying that compatibility can be obtained at very low cost, then it makes some sense.

ARMER: Where are we going to be two years from now? Are you saying that if I'm a guy who uses one manufacturer's machine that I'm in a sense no longer tied to him? Not that I can pick up my cards and run them in this new machine but that the cost of changing over is not as great as it is today? That maybe there is some transference of training, among my fairly talented programming staff?

McCRACKEN: That's precisely what I'm saying.

ARMER: Isn't that a big improvement over the state of things we have today?

McCRACKEN: It'll cost me $50,000 to change machines instead of half a million dollars and I'd say that's a lot better.

GRUENBERGER: Even though we pay a terrific price to get that conversion reduction down to $50,000?

GORDON: That's right, is it a matter of saving the $450,000 or is it a matter of paying it out in a different form, over a longer period?

ARMER: If we look at these goals instead of the goals that the common man in the data processing business thinks these goals are, then maybe we can do it a lot cheaper.

McCRACKEN: I'm just thinking about the guy that had to get himself machine B that he desperately didn't want. He's paying for it. He's paying machine rental every month without getting the compatibility.

DOBRUSKY: Standards and commonness are going to cost you at some level, I don't care where you put it. It's dependent upon these trade-offs and the long run of it in training. Perhaps it's completely intangible because we don't even recognize it.

GRUENBERGER: We've noticed that in industry there are certain costs that you can bury very neatly. And those that you can bury you don't see any more.

LITTLE: You can sit and talk about this all day, but tomorrow somebody starts a new job. Two years from now we'll have to face the fact that we have been using some of these new languages over the last two years, and if we aren't in better shape then, we've been kidding ourselves.

GRUENBERGER: At least most of our present programmers will have two more years of experience.

LITTLE: Yes, but they will all be supervisors someplace.

BROMBERG: I think we will be in substantially better shape. In a practicable fashion, people will be able to emancipate themselves from this slave market business with their present computer vendor. People will be able to look at the entire market.

GRUENBERGER: Barry, would you make that same speech?

GORDON: As far as emancipation is concerned I would like to point out that the electronic emancipation proclamation was written by IBM several years ago and it is called FORTRAN. Philco and Honeywell and CDC and a great many other people have made excellent use of it. Over the years it has proven itself to be quite valuable, for IBM, for IBM customers, for former IBM customers, for our competitors, and for the whole industry. Now, five years later, it is being seriously considered as a standard. In another half decade (or less, since we're getting smarter faster) we may be able to do the same thing in the commercial area. Maybe we can even do it in the Command and Control area and in other areas. I think you should first find out what you're doing before you legislate it into a standard.

ARMER: Is it not true in the Command and Control area that we have had experience with a few of these languages but at the time that somebody froze on COBOL there had been essentially *no* experience?

GORDON: Essentially that is correct. At the time that COBOL was chosen, there had been very little experience.

OPLER: A few weeks ago I was sitting with Dick Clippinger and we were trying to come up with a few figures to estimate what percentage of data processing problems now running in this country have been coded with the help of a data processing compiler. It's only a guess, but we concluded it was about one per cent. Our next question was, what percentage of the programs now being written in data processing are using a data processing compiler. Again it's just a guess but we estimated that it was less than 10 per cent. It would be interesting to see how these figures change in the next few years.

ARMER: Is it not apt to happen, particularly with respect to the small machines, that we'll find people abandoning these narrative languages and going back to assembly programs?

PATRICK: Because the machines are too small to compile on.

GRUENBERGER: Mr. Patrick here has devised an interesting test for compilers. He asks a simple minded question "How long would it take this compiler to compile a HALT?" We've got some figures on this, and they're very interesting.

BROMBERG: That sounds awfully impractical. Who wants to compile a HALT?

GRUENBERGER: We do, as a matter of fact.

BROMBERG: Well, we'll build it into our compiler. If you want to do it, it'll be a special case. We'll do it in 30 seconds.

GRUENBERGER: Yes, and that's exactly what happens. But just as a matter of fact (this is pertinent to what you just said, Ascher) we get times like 20 seconds in FORTRAN, 20 seconds in JOVIAL, 90 minutes in FORTRAN, on the tape 1620. I may be exaggerating that last one a little bit; maybe it isn't 90 minutes, maybe it's only an hour. When you go to small machines the threshold effect can kill you. In order to get the system chunking away so that you can compile *anything*, you have to chew up a fair amount of time.

MacKENZIE: You're just checking the algorithms that were used in implementation, not the commonness of the language itself.

McCRACKEN: But these are related.

ARMER: If you're talking about having a common language for small machines, when you can show that a common language for small machines is no good, then you're crazy.

GALLER: It's not the language, it's the translator.

BROMBERG: You're talking now about the overhead time that any system requires to do a certain amount of work. It just happens to be very high for a small machine.

PATRICK: Right, that's the intersect.

ARMER: I'd like to get more out of Bromberg about my statement that with small machines there's going to be a great movement back to assembly programs from the magic languages. Nobody seemed to argue out loud but you seemed to indicate that you would.

BROMBERG: I think that's wrong for two reasons. First, I would imagine that the type of individual who is working on these small machines would find it necessary, for their livelihood, to deal with these languages.

McCRACKEN: What does that mean?

BROMBERG: They're not programmers. They're tab people. These are the people who, when the 1401 came out, ran down the hall and put in an order for 6 of them. Now, they've got to use them. One way to get to use them is through one of these languages.

ARMER: And now all he's doing on his machine is compiling.

BROMBERG: Probably what he's doing is using his machine as a glorified tabulator.

GORDON: We have utility programs that do that without having to compile.

GRUENBERGER: Or generators.

BROMBERG: Well, you guys are going to have a COBOL processor for the 1401 aren't you?

PATRICK: Because the DOD said they had to have one.

GORDON: There is an announcement to that effect.

ARMER: A COBOL translator, I understand, exists for the 1410. Are we going to be throwing it out in six months?

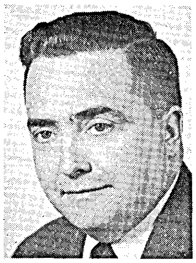
McCRACKEN: That isn't the whole story. I know of a 501 installation that does their coding in absolute octal. It isn't just a question of availability, or how good it is; there are a lot of other factors. They had the COBOL course.

OPLER: We know of one of the earliest cases of disillusionment of a user of a medium sized machine using a COBOL processor on a job that could be done easily in assembly language.

GALLER: We ought to keep clear the distinction between the language and the translator. We're judging languages in terms of the current translators, which is very unfortunate. ■

COMPUTER CHARACTERISTICS REVISITED

by CHARLES W. ADAMS, President
Adams Associates, Inc., Bedford, Mass.



"Tell me, daddy, which computer is best?" Number-One son asked the other day after thumbing hurriedly through the 76 entries in the September 1962, issue of Adams Associates Computer Characteristics Quarterly. "How should I know?" was the reply. *Never get into a debate with a six-year old* is my motto. Besides, I'm sure his second-grade class can ill afford a Minivac, let alone a Monrobot XI or any of the others even on the extreme low end, in terms of price, of our listings.

But this is also a question asked every day by serious-minded and perceptive businessmen. Our booklet, the contents of which are reprinted in the next few pages, does not seek to answer this question directly. Nor do any of the more elaborate multi-volume reporting services available from several sources. For one thing, the question as stated is unanswerable, except by a counter-interrogation: "Best for what?"

The most a pocket-sized compilation can do, we feel, is provide a reliable, up-to-the-minute list of the salient features of *all* computers which ought to be considered. From these, experienced computer people can readily decide which warrant detailed study to determine how well and inexpensively they can do the job required. The most a book-shelf compilation can do is provide, in readily-acessible form, all the information on prices, instruction codes, physical size, power consumption, and other information needed for detailed studies.

A good thing that is, too. If unequivocal or categorical answers were readily available, Adams Associates and its numerous competitors would lose a fascinating and potentially lucrative part of their business. People would no longer ask for our help in deciding on equipment; they would need us only on initial problem definition and actual program preparation. There would be no computer salesmen either — and precious few computer manufacturers!

So "what is best" can only be decided in reference to a given mix of applications, and even then only after considerably study. Such studies give rise to anomalies, however. Consider, for example, a fifty-fifty division of use between business and scientific applications. In such a case, a system twice as good on business as on scientific work will spend two-thirds of its time on scientific applications while one strong on scientific work will spend most of its time on business work.

Judging from both the enthusiastic response to the reprinted versions which have appeared annually in DATAMATION and the number of people and firms willing to shell out the modest yearly subscription fee to be kept up to date each quarter, a handy compilation of basic facts about available computers serves a useful purpose. Bowing to numerous requests, Adams Associates will shortly add to the Quarterly computers aimed primarily at process control, those built for military use, and foreign-made systems.

Many of these will appear in the December 1962 issue, and more will be added as rapidly as the data can be collected and verified. Even with this greatly expanded coverage, the material can be presented in the traditional plastic-bound folder as well as in the new 8½ x 11″ booklet useful for inclusion in reports, wall mounting, and the like.

Incidentally, we will have to up the price of the quarterly to $10 for an annual subscription and to $3.50 for a single issue. This is being done with regret — if not in response to many requests! ■

Allen Rousseau, editor of the Quarterly, checks out data with manufacturer. ("Never ask them; tell them and get them to confirm it — and don't depend entirely on the mails.")

Alder Jenkins, in charge of production, shows copy of new issue to Richard Hamlin, director of systems services. ("A new typographer again this time, but I think now it's really under control.")

For the third consecutive year, Charles W. Adams Associates, Inc., has offered DATAMATION readers the full use of the data which appears in the most recent issue of its quarterly compilation of the salient features of all commercially-available, stored-program electronic digital computers. As in the past, military, process-control and foreign computers are specifically excluded, though this omission will be corrected starting with the December issue of the Quarterly.

INDEX OF COMPUTER MANUFACTURERS

CHRONOLOGICAL LISTING

VACUUM-TUBE SYSTEMS
(still widely used)

3/51 — UNIVAC I
/53 — IBM 701*
7/54 — Burroughs 205
11/54 — IBM 650
/55 — Alwac IIIE
/55 — IBM 702*
8/55 — Bendix G-15
/56 — Burroughs E-101
3/56 — IBM 705
3/56 — UNIVAC 1103A
4/56 — IBM 704
9/56 — RPC LGP-30
11/57 — UNIVAC II
12/57 — IBM 305 Ramac
1/58 — UNIVAC File Computer I
8/58 — IBM 709
9/58 — UNIVAC 1105
12/58 — Burroughs 220

SOLID-STATE SYSTEMS

11/58 — Philco 2000-210
11/58 — Recomp II
10/59 — IBM 1620
11/59 — IBM 7090
11/59 — NCR 304
11/59 — RCA 501
1/60 — Control Data 1604
1/60 — UNIVAC SS 80/90
1/60 — LIBRASCOPE 3000
3/60 — Philco 2000-211
5/60 — Monrobot XI
5/60 — UNIVAC LARC
6/60 — IBM 7070
7/60 — Control Data 160
9/60 — IBM 1401
9/60 — RPC 9000
11/60 — DEC PDP-1
11/60 — General Electric 210
11/60 — RPC 4000
12/60 — Honeywell 800
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4/61 — NCR 310
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7/61 — CDC 160A
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8/61 — CDC 924
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9/61 — Burroughs B250
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12/61 — UNIVAC 490
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4/62 — ASI 210
7/62 — Burroughs B270-280
9/62 — DEC PDP-4

(Future Delivery)

ASI 420
Burroughs B5000
CDC 6600
CDC 3600
Honeywell 1800
IBM 7040
IBM 7044
IBM 7072
IBM 7094
Philco 2000-212
Philco 1000
RCA 601
UNIVAC 1107
UNIVAC III
UNIVAC 1004
SDS 910
SDS 920

*Many computers delivered in 1953 through 1958 but no longer being produced have not been included in this list; the 701 and 702 are not in the chart but appear here for old time's sake.

	CENTRAL PROCESSOR					FILE STORAGE: Magnetic Tape		Random Access	INPUT-OUTPUT EQUIPMENT				OTHER FEATURES						
Typical Monthly Rental / Monthly Rental Range	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Char-acters per Second / Buffering	Maximum Tape Units	Average Access Time	Cards per Minute (In / Out)	Paper Tape Char-acters per Second (In / Out)	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler

EXPLANATION OF COLUMN HEADINGS

Typical Monthly Rental: What a customer might pay for a system with basic peripheral equipment and, if available, magnetic tapes.

Monthly Rental Range: The first figure in parentheses is the cost, in thousands of dollars, of the minimum useful configuration. The second figure, where given, is the approximate cost of the maximum configuration likely to be ordered.

Add Time: Time required to acquire and execute one add instruction in millionths of a second. In drum machines, where add is lower than cycle time, maximum optimization has been assumed.

Cycle Time: Storage cycle time (including, for core storage, the total time to read and restore or, for drum storage, a full revolution in millionths of a second).

Storage Capacity and Type: Number of words or characters of addressable internal storage available, K representing thousands. (Example: "32K core" for the IBM 7090 indicates that 32,000 words of magnetic core are available.) "Fast" indicates a serial type area of fast access secondary storage.

Word Size: Number and type of digits comprising one storage word (a = alphanumeric, 6, 7 or 8 binary digits, depending on parity and addressing logic; d = decimal, 4 binary digits; b = binary, 1 binary digit).

Instruction Address: Number of separate storage addresses in a conventional instruction.

Thousands of Characters per Second: Transfer rate between computer and magnetic tape, measured in six-bit characters (one alphabetic, one decimal, or six binary digits) unless otherwise noted.

Buffering: Combinations of reading magnetic tape (R), writing it (W), and computing (C) can be performed simultaneously. (M) indicates that multiple simultaneous operations are possible.

Maximum Tape Units: Maximum number connectable to and addressable by the computer.

Random Access Capacity: Maximum number of BCD characters available (M representing million) in an external mass storage unit such as tape loop, drum or disc. Remarks indicate incremental units and characteristics of storage unit.

Average Access Time: Time required to locate a single record, including read-write head positioning and normal rotational access time (i.e., half the revolution time for drum and disc storage).

Peripheral Equipment: Speed of punched card, punched tape and line printer equipment available. For card and tape, the prime input equipment is listed above and prime output equipment below. Additional equipment is mentioned in the remarks if available. The column headed "Off-line Equipment" refers to a smaller satellite computer which can process data off-line ("same" means the on-line equipment can also be used off-line).

Other Features: Check indicates the special feature is obtainable. For index registers the maximum number available is shown. For console typewriters, O refers to a device capable of printing alphanumeric characters at the console; I/O refers to a console keyboard capable of supplying data to the computer and actuating the printing device. Floating-point arithmetic can be programmed in any system even though not a built-in feature; but only the latter is indicated.

Algebraic Compiler and Business Compiler: Dates indicate the availability of a compiler and remarks indicate its name (e.g., COBOL '61 means English language compiler representing 1961 specifications of COmmon Business Oriented Language).

SOLID-STATE SYSTEMS

CENTRAL PROCESSOR | FILE STORAGE (Magnetic Tape, Random Access) | INPUT-OUTPUT EQUIPMENT | OTHER FEATURES

S1

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
IBM 7030 STRETCH	$300,000[A] (200-)	5/61	1.5[C]	2.2	16-262K core	64b 1	62 MRWC[J]	256	710M 132m[M]	1000 250	— —	600	1401	√	16	√	√	I/O	—	—

A. Computer no longer marketed. C. Instruction look-ahead and overlapped core banks allow increased internal speed. J. Input-output under separate control. M. Access time varies from 51–231 ms depending on file organization.

S2

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
UNIVAC LARC	$135,000 (135-)	5/60	4[C]	4	10-97K core	12d 1	25 MRWC[J]	40	36M[L] 68m	[N]	[P]	[Q]	[R]	—	99	√	√	I/O	—	—

C. Instruction look-ahead and overlapped core banks allow increased internal speed. J. Input-output under control of a separate computer and it is possible to add a second computing unit. L. Up to 24 drums of 250,000 words each. N, P, Q, R. All UNIVAC peripheral equipment (including high speed film printer) can be used.

S3

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
CDC 6600	$120,000[A]	—	1.3	1.3	16-262K core	60b 1	30-83 MRWC	—	— —	1000 250	350 110	1000	—	√	√	√	√	—	—	—

A. Preliminary information not confirmed by manufacturer. System has not been formally announced by CDC.

S4

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
IBM 7094	$71,000 (56-75)	12/62	4[C]	2	32K core	36b 1	15-170[H] MRWC[J]	80	280M[L] 160m	250 100	— —	150	1401 same	√	7	√	√[V]	—	12/62[X]	12/62[Y]

C. Instruction look-ahead where some instruction references make two instructions available reducing number of instruction cycles allows increased internal speed. H. See information on tape speeds (IBM 7090, entry S6 and IBM 7080, entry S8). J. Data channels (up to 8) are separate input-output controls for up to ten tape units or peripheral equipments. L. IBM 1301 disc file has 56 million BCD characters per unit (up to five storage units). V. Double precision floating point available. X. FORTRAN. Y. COBOL.

S5

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
PHILCO 2000 Model 212	$68,000 (47-89)	/63	.75[C]	1 1.5	16-65K core	48b 1[G]	90-240 MRWC[J]	64[K]	167M[L] 135m	2000 100	1000 100	900	1000 same	√	8	√	√[V]	I/O	/59[X]	/62[Y]

C. Instruction look-ahead (4 level) and asynchronous, overlapped core banks allow increased internal speed. G. Instructions stored two per word. J. Two separate input-output processors, each of which controls up to 32 tape units. K. Magnetic tapes read in forward and reverse directions. L. Up to four disc file units of 5,242,880 words each (41,943,000 characters per disc) are available. V. Double precision floating point available. X. ALTAC (Fortran type). Y. COBOL '61.

S6

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
BM 7090	$64,000 (50-69)	11/59	4.4	2.2	32K core	36b 1	15-170[H] MRWC[J]	80	280M[L] 160m	250 100	— —	150	1401 same	√	3	√	√	I/O	/59[X]	12/62[Y]

H. For all 7000 series, 729 II tape units operate at 15K and 41.6K while 729 IV tape units operate at 22.5K and 62.5K. 729 V and 729 VI tape units (with 800 characters per inch density) operate at 60K and 90K respectively. (See IBM 7080, entry S8.) J. Data channels (up to eight) are separate input-output controls for up to ten tape units. L. IBM 1301 disc file has 56 million BCD characters per unit (up to five storage units). X. FORTRAN. Y. COBOL '61, COMmercial TRANslator (9/61).

S7

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
CONTROL DATA 3600	$55,000 (40-75)	4/63	1.3[C]	1.3	32-262K core	48b 1[G]	30-83[H] MRWC[J]	4096[K]	720M 100m	1000 250	350 110	1000	160A	√	6	√	√[V]	I	4/63[X]	4/63[Y]

C. Overlapped core banks allow increased internal speed. G. Instructions stored two per word. H. CDC Model 606 or IBM 729 tape units. J. Data channels (up to eight) are separate input-output controls for tape units and other peripheral equipment. K. Magnetic tapes are IBM compatible. V. Double precision floating point available. X. FORTRAN. Y. COBOL.

S8

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
IBM 7080	$55,000 (40-73)	8/61	11[C]	2 1	80-160K core 1K core	1a[F] 1	15-170[H] MRWC	40	280M[L] 160m	60 —	500 —	—	1401	√	0	√	—	I/O	8/61[X]	12/61[Y]

C. Add time assumes a five-character field. F. A variable-word length computer (see IBM 705, entry V5). H. The IBM 7340 (1963 delivery) Hypertape Drive, with cartridge load, will read in both directions or write 170,000 alphabetic (or 340,000 numeric) characters per second. (For 729 tape speeds see IBM 7090, entry S6.) L. IBM 1301 disc file. X. FORTRAN. Y. COBOL '61, COMmercial TRANslator (8/61).

S9

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
LIBRASCOPE 3000	$50,000 (25-)	1/60	16[C]	5	4-64K core	8a 1[G]	50 MRWC	1023	200M 90m	200 100	350 60	1000	√ same	√	11	√	√	I/O	—	—

C. Full cycle time; instruction look-ahead and overlapped core banks allow increased internal speed. G. Variable field addressing allows designation of operands from one to eight characters. Preliminary information not confirmed by publishers.

S10

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
UNIVAC 1107	$45,000 (32-60)	/62	4[C]	4 .6	16-65K core 128 film	36b[F] 1[G]	25-120 MRWC	180[K]	566M[L] 1/m	600 300[N]	400 300[P]	600 700	SS80/90	√	15	√	√	I/O	10/62[X]	12/62[Y]

C. Overlapped core banks and thin film memory usage allow increased internal speed. F. A half, third or sixth word may be addressed directly. G. Designators in each instruction permit use of virtual two or three-address instruction logic. K. Magnetic tapes read in forward and reverse directions. An IBM compatible tape unit is available. L. Each flying head drum unit (8 per subsystem with maximum of 15 subsystems) has a capacity of 786,432 words or 4,518,592 BCD characters (See Univac 490, entry S17 for disc file information). N. 150 cpm punch available. P. 110 ch/sec punch available. X. ALGOL, FORTRAN. Y. COBOL '61.

S11

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
PHILCO 2000 Model 210, 211	$40,000 (24-66)	11/58	15[C] .75	10 1.5	8-32K core	48b 1[G]	90 MRWC	16[K]	262K[L] 17m	2000 100	1000 100	900	1000 same	√	32	—	√	I/O	/59[X]	/62[Y]

C. Asynchronous, overlapped core banks allow increased internal speed. G. Instructions stored two per word. K. Magnetic tapes read in forward and reverse directions. L. Additional drums of 32,768 words (262,144 characters) each are available. X. ALTAC (Fortran-type). Y. COBOL '61.

SOLID-STATE SYSTEMS

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S12 HONEYWELL 1800	[illegible] [illegible]	/63	8	2	8-32K core	12d[F] 3	89-124[H] MRWC	64[K]	720M[L] 100m	800[N] 250[N]	1000[P] 110	150 900	same	√	61[T]	√	√	I/O	/61[X]	/61[Y]

F. Word size is 12d plus sign or 48b with binary and decimal arithmetic instructions included. H. Numeric information can be transferred at 133,000 or 186,000 ch/sec. K. Magnetic tapes read in forward and reverse directions with programmed error correction (Orthotronic count). L. Units of 12 (Bryant) discs contain 45 million BCD characters with increments of 24 discs up to a maximum of 96 discs. N. 240 and 650 cpm readers and 100 cpm punch available. P. 200 ch/sec reader available. T. Up to eight programs can be processed concurrently. X. AUTOMATH 800, AUTOMATH 1800 (/63), Fortran type. Y. FACT, COBOL '61 (/63).

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S13 CONTROL DATA 1604	[illegible] (19-35)	1/63	4.8[C]	6.4	8-32K core	48b 1[G]	30-83[H] MRWC	96[K]	— —	1300[N] 100	350 110	150 1000	160A	√	6	√	√	I/O	/60[X]	2/62[Y]

C. Overlapped core banks allow increased speed. G. Instructions stored two per word. H. CDC Model 606 tape unit operates at 30K (with 200 characters per inch density) or 83K (with 556 characters per inch density), while IBM tape units operate up to 62.5K. K. Compatible with IBM tape units. N. 100 and 250 cpm readers available. X. FORTRAN. Y. COBOL '61.

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S14 RCA 601	[illegible] [illegible]	/62	5.7 6.7[C]	1.5[D] 2.5	8-32K core	56b[F] 1-3[G]	33-120[H] MRWC	48	— —	600 200	1000 300[P]	1000	301	√	8[T]	√	√	I/O	/62[X]	9/62[Y]

C. Asynchronous, overlapped core banks allow increased internal speed. D. 604 central processor has faster staticizing and address modification than 603. F. Binary and decimal arithmetic instructions included. G. Variable length instructions (1, 2, 3, or 4 half-words) operate on character, half-word or word. H. Numeric information can be transferred at a rate of 180,000 ch/sec. P. 100 ch/sec punch available. T. 8 index registers available for each program. X. ALGOL. Y. COBOL '61.

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S15 IBM 7074	[illegible] (17-36)	11/61	10[C]	4	5-30K core	10d[F] 1	15-170[H] RWC[J]	40	280M[L] 160m	500 250	— —	150	1401	√	99	√[U]	√	I/O	/61[X]	2/62[Y]

C. Parallel adder circuit increases speed over serial circuit in IBM 7070 (see entry S18). F. Word size is 10d plus sign. H. See IBM 7090 (entry S6) and IBM 7080 (entry S8) for 729 and 7340 tape data. J. MRWC possible when four channels used. L. IBM 1301 disc file (see entry S18). U. Indirect addressing limited to scatter-read and gather-write operations. X. FORTRAN. Y. COBOL '61, COMmercial TRANslator (8/61).

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S16 IBM 7044	[illegible] (20-55)	3/63	5	2.5	8-32K core	36b 1	7.2-90[H] MRWC	50	280M 160m	250[N] 125	500 —	600	1401	√	3	√	√	I/O	6/63[X]	9/63[Y]

H. For tape information see IBM 7090 (entry S6). N. IBM 1401 can be connected on-line through input-output synchronizers or 800 cpm reader and 250 cpm punch and/or printer can be connected to I/O channel through 1414 synchronizer. X. FORTRAN. Y. COBOL.

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S17 UNIVAC 490	[illegible] [illegible]	12/61	4.8[C] 12	6	16-32K core	30b 1[G]	25-125[H] MRWC	192[K]	377M[L] 17m	600 150	350 110	600 700	—	√	7	—	—	I/O	/61[X]	10/62[Y]

C. 4.8μ is add time for repeat mode only. G. Half-word logical operations can be performed. H. Numeric information can be transferred at a rate of 175,000 ch/sec. K. Magnetic tapes read in forward and reverse directions. L. Each flying head drum unit (8 per subsystem with maximum of 12 subsystems) has a capacity of 786,432 words or 3,932,160 BCD characters. Disc units contain approximately 117 million characters each. X. NELIAC. Y. COBOL '61.

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S18 IBM 7070	[illegible] [illegible]	6/60	60[C]	6	5-10K core[E]	10d[F] 1	15-90 RWC[J]	40	280M[L] 160m	500 250	— —	150	1401	√	99	√[U]	√	I/O	/60[X]	2/62[Y]

C. Add time varies by number of digits in field to be added and does not include indexing time. E. Up to 30K core memory available. F. Word size is 10d plus sign. J. MRWC possible when four channels used. L. IBM 1301 disc file has 28 million 6-bit characters per 25 disc (50 surfaces of which 40 are used for storage) module or 43 million 4-bit characters stored in packed (8-bit) format. Model II 1301's have two modules or 50 discs. U. Indirect addressing limited to scatter-read and gather-write operations. X. FORTRAN. Y. COBOL '61, COMmercial TRANslator (8/61).

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S19 UNIVAC III	22,500 (16.5-30)	6/62	8	4	8-32K core	6d[F] 1[G]	25-133[H] MRWC	38[K]	√[L] —	700 300	500 110	700[Q]	same	√	15	√	—	I/O	12/62[X]	10/62[Y]

F. Word size is 6d plus sign. G. Instruction may process up to four data words. H. Numeric information can be transferred at a rate of 200,000 ch/sec. Model IIA tape units operate at 25K while Model IIIA units function at speeds of 120K to 133K dependent on internal logic variations of UNIVAC 1107, 490 and UIII. K. Magnetic tapes read in forward and reverse directions. L. Specifications not available. Q. 922 lpm for completely numeric data. X. FORTRAN. Y. COBOL '61.

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S20 HONEYWELL 800	[illegible] [illegible]	12/60	24	6	4-32K core	12d[F] 3	61-124[H] MRWC	64[K]	720M[L] 100m	800[N] 250[N]	1000[P] 110	150 900	same	√	64[T]	√	√	I/O	/61[X]	/61[Y]

F. Word size is 12d plus sign or 48b with binary and decimal arithmetic instructions included. H. Numeric information can be transferred at 96,000, 133,000 or 186,000 ch/sec. K. Magnetic tapes read in forward and reverse directions with programmed error correction (Orthotronic count). L. Units of 12 (Bryant) discs contain 45 million BCD characters with increments of 24 discs up to a maximum of 96 discs. N. 240 and 650 cpm readers and 100 cpm punch available. P. 200 ch/sec reader available. T. Up to eight programs can be processed concurrently. X. AUTOMATH 800, Fortran type. Y. FACT, COBOL '61 (/63).

System	[illegible]	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer-Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S21 BENDIX G-20	[illegible] [illegible]	4/61	15[C]	6	4-32K core	32b 1[G]	120[H] MRWC	500	62M[L] 90m	800 250	500 100	1000 300	same	√	63	√	√	I/O	2/62[X]	12/62[Y]

C. All arithmetic operations done in floating-point mode. G. Variable instruction length permits multiple operations. H. Numeric information can be transferred at 240,000 ch/sec. Independent search while computing. L. Bryant disc has capacity of 15.6, 31.2, 48.6 or 62.4 million 8-bit characters. X. ALCOM 2/62, FORTRAN 5/62. Y. COBOL '61.

SOLID-STATE SYSTEMS

System	Typical Monthly Rental / Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size / Instruction Addresses	Magnetic Tape: Thousands of Characters per Second / Buffering	Magnetic Tape: Maximum Tape Units	Random Access: Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S22 BURROUGHS B 5000	$16,200 (13.5-50)	/62	3[C]	6 17000	4-32K core 32K drum[E]	48b 0[G]	24-66 MRWC	16[K]	— —	800[N] 300	1000 100	700	B280	√	—[T]	√[U]	√[V]	I/O	/62[X]	/62[Y]
S23 RCA 501	$16,000 (11-26)	11/59	360[C]	15	16-262K core	1a[F] 2	33-66 RC, WC, or RW	63[K]	— —	600 200	1000 100[P]	600 900	same[R]	—	8	√[U]	—	O	—	/60[Y]
S24 IBM 7072	$15,800 (14-32)	/62	12	6	5-30K core	10d[F] 1	7.2-20[H] RWC	20[K]	— —	60 —	— —	—	1401	√	99	√[U]	√	I/O	/60[X]	12/62[Y]
S25 NCR 304	$15,000 (12.5-19)	11/59	600 120[C]	60	2-4K core	10a 3[G]	30 RW[J]	64[K]	— —	2000 250[N]	1800 60	680 900	same	—	10	—	√	I/O	—	8/61[Y]
S26 GENERAL ELECTRIC 210	$14,000 (10.5-36)	11/60	64	32	4-8K core	6d[F] 1[G]	30 RWC	13	— —	1500[N] 250[N]	200 —	1000[Q]	—	—	1	—	—	I/O	—	/61[Y]
S27 IBM 7040	$14,000 (9-36)	6/63	16	8	4-32K core	36b 1	7.2-90 MRWC[J]	50	280M 160m	250 125	500 —	600	1401	√	3	√	√	I/O	6/63[X]	9/63[Y]
S28 UNIVAC 1206	$13,000[A]	/58	9.6[C] 11.2	8	16-32K core	30b 1	25 MRWC	168[K]	377M[L] 17m	600 150	1500[P] 110	600 700	—	√	7	—	—	I/O	—	—
S29 ADVANCED SCIENTIFIC ASI-420	$12,500 (8.5-33.5)	/62	10[C]	2	4-32K core	42b 1	22.5-62 MRWC	64[K]	— —	800[N] 250	500 110	300	—	√[S]	√[T]	√	√	I/O	8/62[X]	—
S30 CONTROL DATA 924	$10,000 (8.7-20)	8/61	9.3[C]	6.4	8-32K core	24b 1	15-83[H] MRWC	96[K]	— —	1300[N] 100	350 110	150 1000	160A	√	6	√	—	I/O	—	—
S31 IBM 1410	$10,000 (6-32)	11/61	88[C]	4	10-80K core	1a[F] 2	7.2-90 RWC	20	280M[L] 160m	800[N] 250	500 —	600[Q]	1401	√	15	—	—	I/O	12/61[X]	12/61[Y]
S32 NCR 315	$8,500 (3.8-30)	1/62	48[C]	6	2-40K core	2a[F] 1	24-60 none	8	88M[L] 200m	2000[N] 250	1000 110	680[Q] 900	—	√	32	—	—	I/O	—	1/62[Y] 5/62[Y]
S33 HONEYWELL 400	$8,000 (4-15)	12/61	120	10	1-4K core	12d 3	32-89[H] RW	8	96M[L] 100m	800[N] 250[N]	1000 110	900	same	√	3	—	—	I/O	/63[X]	/63[Y]

S22 BURROUGHS B 5000
C. Instruction look-ahead allows increased internal speed. E. 2 drums available. G. Polish notation allows operations to be performed without designation of addresses. K. Magnetic tapes read in forward and reverse directions. N. 200 cpm reader and 100 cpm punch available. T, U. All addressing relative to Program Reference Table. V. Double precision floating point. X. ALGOL. Y. COBOL '61.

S23 RCA 501
C. Add time assumes five character field. F. Variable-word length computer using four character (tetrad) parallel transfer. K. Magnetic tapes read in forward and reverse directions. P. 300 ch/sec punch available. R. Card equipment and printer may be used off-line. U. Indirect addressing limited to scatter-read and gather-write operations. Y. COBOL '60.

S24 IBM 7072
F. Word size is 10d plus sign. H. Low-speed magnetic tape only; input-output version of the IBM 7070 (see entry S18). K. IBM 7330 tape units. U. Indirect addressing limited to scatter-read and gather-write operations. X. FORTRAN. Y. COBOL '61, COMmercial TRANslator (8/61).

S25 NCR 304
C. Micro-flow, single address instructions. G. Two words per instruction. J. In processing inactive records, RWC is achieved. K. Magnetic tapes have no space between records. N. 100 cpm punch available. Y. COBOL '61.

S26 GENERAL ELECTRIC 210
F. Word size is 6d plus sign. G. Double precision arithmetic instructions included. N. 400 cpm reader and 100 cpm punch available. Two 1200 MICR-document per minute sorter-readers can be multiplexed. Q. Printer can print magnetically encoded characters and also be used off-line. Y. CAP.

S27 IBM 7040
J. (See IBM 7044, entry S16.) 7094 data channels available for separate input-output control of up to ten peripheral units. X. FORTRAN. Y. COBOL.

S28 UNIVAC 1206
A. Price and information not confirmed by manufacturer. Price derived from estimated purchase price. C. 9.6μ is add time for repeat mode only. K. Magnetic tapes read in forward and reverse directions. L. Each flying head drum unit has a capacity of 3,932,160 BCD characters. P. 350 ch/sec reader available.

S29 ADVANCED SCIENTIFIC ASI-420
C. Includes indexing and I/O channel reference. K. Magnetic tapes are IBM compatible. N. Analog equipment buffer available. S. Data channel "traps" may be set by program to ignore or recognize an interrupt. T. Any memory location may be used as an index register. X. FORTRAN, Intercom Translator.

S30 CONTROL DATA 924
C. Overlapped core memory banks allow increased internal speed. H. CDC Model 606 tape unit or IBM 729 tape units. See tape information CDC 1604 (entry S 13). K. Magnetic tapes compatible with IBM tape units. N. 100 and 250 cpm readers available.

S31 IBM 1410
C. Add time assumes a five-character field. F. Variable-length instructions operate on variable length data fields. L. Up to five IBM 1301 disc units available in 28 million or 56 million alphanumeric characters each. N. Optical and MICR readers available. Q. See reference Q, IBM 1401 (entry S38). X. FORTRAN. Y. COBOL '61.

S32 NCR 315
C. Add time assumes a five or six-character field. F. Decimal format allows 3d word size. L. Magnetically encoded cards on a drum (CRAM) permit random and sequential file processing. Sixteen units with 5.5 million alphanumeric or 8.3 million BCD characters each. N. MICR documents can be read at 750 or 1620 per minute. Up to four similar peripheral devices may be attached to each peripheral I/O channel. Q. Numeric information only printed at 1750 lpm. Y. COBOL '61, 1/62-tape. 5/62-CRAM.

S33 HONEYWELL 400
H. Numeric information can be transferred at rate of 48,000, 96,000 or 133,000 ch/sec. L. Bryant discs in increments of 24 million BCD characters. N. 650 cpm reader and 100 cpm punch available. X. AUTOMATH 400, Fortran type. Y. COBOL '61.

SOLID-STATE SYSTEMS

CENTRAL PROCESSOR | MASS STORAGE (Magnetic Tape / Random Access) | **INPUT-OUTPUT EQUIPMENT** | OTHER FEATURES

S34

System	Typical Monthly Rental / Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
UNIVAC	$8,000	1/60		3400	2.4-7.6K drum[E]	10d[F]	25	10	240M[L]	600	500	600	—	—	3	—	—	—	—	/61[Y]
SS 80/90 Model I	(3.6-13)		85	850	.2-1.6K fast	1[G]	RC, WC[J]		385m	150	100									
Model II	$8,500		51	17	1.2K core		12.5-25	20							9					

E. STEP card and tape systems allow increments of 400 words drum and 200 words fast memory. F. Word size is 10d plus sign. G. Last part of instruction words indicates address of next instruction. J. In Model II, which will have core memory and magnetic tape, it is possible to achieve RWC with use of a second synchronizer. L. Up to ten Randex drum units (2 drums) have a capacity of 24 million digits each. Y. COBOL '60 compiled on UNIVAC II.

S35

PHILCO 1000	$7,010	/63	39[C]	3	8-32K core[E]	1a[F]	90	48[K]	—	2000	1000	900	—	—[S]	4	—	—	I/O	—	—
	(6-15)					1	RC, WC or RW		—	100	100									

C. Add time assumes a five-character field. E. Asynchronous core banks allow increased internal speed. F. Four character instructions operate on variable length data fields. K. Magnetic tapes read in forward and reverse directions. S. Dual program control facility present.

S36

GENERAL ELECTRIC 225	$7,000	3/61	36	18	4-16K core	20b	15-66	64	600M[L]	1500[N]	1000[P]	900	same	√	96[T]	—	√	O	1/62[X]	1/62[Y]
	(2.5-26)					1[G]	MRWC		158m	250[N]	110									

G. Binary, decimal and double precision arithmetic instructions included. L. Up to 32 Telex units of 16 discs each available. Each module capacity is 18.8 million characters. N. Two 1200 MICR document-per-minute sorter-readers can be multiplexed. 400 cpm reader and 100 cpm punch available. P. 250 ch/sec reader available. T. Three index registers standard; additional 93 optional. X. ALGOL functions as a part of GECOM. WIZ. Y. COBOL '61 as part of GECOM.

S37

BURROUGHS B280 & B270	$6,500[A]	7/62	777[C]	10	9.6K core	1a[F]	50	6	—	800[N]	1000	700	—	—	0	—	—	—	—	—
						3	none		—	300	100									

A. Model 270, when used in proof and transit operations, has up to two six-tally registers. For card system see entry 42a. C. Add time assumes five-character field. F. Instruction word is 12 characters. N. Two simultaneous readers available; 200 and 800 cpm in any combination. MICR documents can be read at 1560 per minute.

S38

IBM 1401 (tape)	$6,500[A]	9/60	230[C]	11.5	1.4-16K core	1a[F]	7.2-62	6	20M[L]	800[N]	500	600[Q]	—	—	3	—	—	I/O	12/61[X]	6/62[Y]
	(2.5-12)					2	none[J]		600m	250	150									

A. Typical rental for magnetic tape system. For card system see entry 48a. C. Add time assumes a five-character field. F. Variable length instructions operate on variable length data fields. J. Normally only magnetic tape start-stop time may be overlapped with computing but Processing Overlap Feature permits input-output operations to overlap computing. L. IBM 1405 disc with 10 million or 20 million alphanumeric characters each. N. Optical and MICR readers available. Q. Numeric information only printed at 1285 lpm. 1404 printer used for printing on cards. X. FORTRAN. Y. COBOL '61.

S39

RCA 301	$5,200	2/61	126[C]	7	10-40K core[E]	1a[F]	10-66	14[K]	176M[L]	800[N]	1000	1070	—	—	3	√	√[V]	I/O	—[X]	3/62[Y]
	(3.3-25)					2	RC, WC, or RW		100m	250	100									

C. Add time assumes an eight-character field. E. A 320 character position table is used for arithmetic operations in place of adder circuits in Models 350 through 353. F. Variable length data fields. K. Magnetic tapes read in forward and reverse directions. L. Up to two disc file (Bryant) units, each of four modules of 22, 44, 66 or 88 million alphanumeric characters, are available; or up to six record files of 4.6 million characters each also are available. N. 600 cpm reader and 100 cpm punch available. Optional MICR sorter/reader operates at 1560 documents per minute. V. Floating point operations available with Models 354 and 355. X. UMAC (University of Miami Algebraic Compiler). Y. COBOL '61.

S40

RW 130	$4,500	8/61	12	6	8-32K core	15b	15-41	16	—	14	300	150	—	√	—[T]	√[U]	—	I/O	—	—
	(2.5-6)					0-1[F]	none		—	—	60									

F. Instructions stored two per word when using the no-address mode. T, U. Index registers and indirect addressing available through micro-commands or "logands" portion of stored logic.

S41

GENERAL MILLS AD/ECS-37	$4,400[A]	7/61	80	20	4-8K core	37b[F]	15	64[K]	—	250	250	600	—	√	1	—	√	I/O	—	—
						1[G]	RWC		—	125	60									

A. No rental price announced. Price is derived from purchase price and does not include cost of magnetic tape units. F. Word size is 36b plus sign. G. Instructions stored two per word. K. Magnetic tape units are IBM compatible.

S42

CONTROL DATA 160A	$4,000	7/61	12.8	6.4	8-32K core	12b	15-83[H]	40[K]	—	1300[N]	350	150	—	√	0	√	—	I/O	/62[X]	—
	(2.2-9.5)					1[G]	RC, WC or RW[J]		—	100	110	1000								

G. Instructions use no address, direct address, indirect address, constant address and relative address modes. H. CDC Model 606 or IBM 729 tape units. J. Buffered version of CDC 160 (see entry S53). K. Magnetic tapes are IBM compatible. N. 100 and 250 cpm readers available. X. FORTRAN.

S42a

BURROUGHS B260	$3,800	11/62	777	10	9.6K core	1a	—	—	—	800	1000	700	—	—	0	—	—	—	—	—
						3	—		—	300	100									

A. Punched card input-output version of entry S37.

S43

DEC PDP-1	$3,600[A]	11/60	10	5	1-16K core	18b	15	64	—	100[N]	400	600[Q]	—	√	0	√	—	I/O	12/61[X]	—
	(2.9-15)					1	MRWC[J]		—	100	60									

A. No rental prices announced. Prices derived from purchase price and do not include cost of magnetic tape units. J. Up to 16 high speed input-output channels may be connected. N. 2000 cpm reader available. Q. Cathode ray tube display with light pen available. X. DECAL (Algol-type).

SOLID-STATE SYSTEMS

CENTRAL PROCESSOR | INPUT-OUTPUT EQUIPMENT

System	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute In / Out	Paper Tape Characters per Second In / Out	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S44 COMPUTER CONTROL DDP-19	$3,500[A] (2.3-)	5/61	10	5	4-16K core	19b[G] 1	15-62 MRWC[J]	64[K]	— —	400 —	1000 100	600	—	√	1	—	—	I/O	11/62	—
S45 HONEYWELL 290	$3,100 (2.5-4.5)	6/61	140	20	1-8K core 8-96K drum	18b 1	15 RWC	2	2M 158m	15 15	110 110	300[Q]	—	√	√[T]	—	√	I/O	12/61[X]	—
S46 ADVANCED SCIENTIFIC ASI-210	$2,600[A] (2.3-7.5)	4/62	10[C]	2	4-8K core	21b 1	22.5-62 MRWC	32[K]	— —	800[N] 250	500 110	300	—	√[S]	3	√	—	I/O	4/62[X]	—
S47 AUTONETICS RECOMP II	$2,500[A] (2.5-4.5)	11/58	 1080	9000 950	4K disc 16 fast	40b[F] 1[G]	1.8 none	4	— —	20 15	600[P] 150[P]	—	—	—	0	—	√	I/O	6/60[X]	—
S48 SCIENTIFIC DATA SDS 920	$2,500[A] (2.5-6)	9/62	16	8	2-16K core	24b 1	 MRWC		 —	200[N] —	300 60	300	910	√	1	√	—	I/O	12/62[X]	—
S48a IBM 1401 (card)	$2,500[A] (2.5-3.6)	9/60	230	11.5	1.4-4K core	1a[F] 2	— —	—	— —	800 250	—	600	—	—	3	—	—	—	—[X]	—
S49 RPC 4000	$1,900 (1.8-4.5)	11/60	 1000	17000 10000	8K drum[E] 128 fast	32b 1[G]	— —	—	— —	— —	500[P] 300[P]	—	—	—	1	—	—	I/O	/61[X]	—
S50 SCIENTIFIC DATA SDS 910	$1,700[A] (1.5-6)	8/62	16	8	2-16K core	24b 1	3.5-41[H] MRWC	32	— —	200[N] —	300 60	300	—	√	1	√	—	I/O	12/62[X]	—
S51 IBM 1620	$1,600[A] (1.6-5)	11/60	560 140	20 10	20-100K core	1d[F] 2	7.2-20 none	6	— —	250 125	150 15	—	1401	—	0	√	√	I/O	12/60[X]	—
S52 AUTONETICS RECOMP III	$1,500 (1.4-3)	6/61	1080	9300 1750	4K disc 16 fast	40b 1[G]	— —	—	— —	20 15	300[P] 150[P]	—	—	—	1	—	√	I/O	/62[X]	—
S53 CONTROL DATA 160	$1,500[A] (1.5-3)	7/60	12.8	6.4	4K core	12b 1[G]	15-83[H] none[J]	20[K]	— —	1300[N] 100	350 110	150 1000	—	—	0	√	—	I/O	/62[X]	—
S54 UNIVAC 1004	$1,500 (1.1-1.9)	2/63	150	8	961 core[E]	1a	— —	—	— —	300 200	—	300[Q]	—	—	—	—	—	—	—	—
S55 DEC PDP-4	$1,300[A] (1-)	7/62	16	8	1-8K core	18b 1	15 none	9	— —	200 100	300 64	600[Q]	—	√	0	√	—	I/O	—	—

S44 COMPUTER CONTROL DDP-19: A. No rental prices announced. Prices derived from purchase price and do not include cost of magnetic tape units. Word size expandable to 22 and 24b. J. Up to 16 program-addressable input-output channels operable in interrupt mode. Magnetic tapes compatible with IBM tape units.

S45 HONEYWELL 290: Q. 11 characters per line. T. Special single instructions permit the use of as many and any core memory locations as index registers. X. FAST, Fortran type.

S46 ADVANCED SCIENTIFIC ASI-210: A. Rental price does not include cost of magnetic tape units. C. Add time includes indexing and I/O channel reference. K. Magnetic tapes are IBM compatible. N. Analog equipment buffer available. S. Data channel traps may be set by program to ignore or recognize an interrupt. X. FORTRAN, Intercom Translator.

S47 AUTONETICS RECOMP II: A. Price does not include cost of magnetic tape units. F. Instructions stored two per word. G. Square root and absolute value instructions included. P. 400 ch/sec reader and 20 ch/sec punch standard, plotter available. X. SALT, SCOPAC (Fortran type).

S48 SCIENTIFIC DATA SDS 920: A. Rental price does not include cost of magnetic tape units. H. Magnetic tape units are IBM compatible. N. Graph plotters and analog conversion equipment are available. X. FORTRAN II.

S48a IBM 1401 (card): A. Card input-output version of entry S38. X. FORTRAN.

S49 RPC 4000: E. Drum offers dual access with two read-write heads operating in two tracks, and eight words of 1000μ access storage. G. The last half of the instruction word indicates the address of the next instruction. Repeat command allows groups of up to 128 words in memory to be operated on by one command at 250μ per word. P. 60 ch/sec reader and 30 ch/sec punch available. X. FORTRAN.

S50 SCIENTIFIC DATA SDS 910: A. Rental price does not include cost of magnetic tape units. H. Magnetic tape units are IBM compatible. N. Graph plotters and analog conversion equipment are available. X. FORTRAN II.

S51 IBM 1620: A. Price does not include cost of magnetic tape units. C. A 300 character position table is used instead of adder circuits in Model 1 only. Model 2 features normal adder circuitry. Add time assumes a five-character field. F. Variable-word length. X. FORTRAN.

S52 AUTONETICS RECOMP III: G. Instructions stored two per word. P. 10 ch/sec reader and 10 ch/sec punch standard, plotter available. X. AUTOCOM (Fortran-type).

S53 CONTROL DATA 160: A. Price does not include cost of magnetic tape units. G. Instructions use no address, direct address, indirect address, constant address, and relative address modes. H. CDC Model 606 or IBM 729 tape units. J. Magnetic tape start-stop time may be overlapped with computing. K. Magnetic tapes are IBM compatible. N. 100 and 250 cpm readers available. X. FORTRAN.

S54 UNIVAC 1004: E. Plugboard serves as instruction storage unit. Q. Numeric information only printed at 400 lpm.

S55 DEC PDP-4: A. No rental prices announced. Prices derived from purchase price. Q. Cathode ray tube display with light pen available. Analog conversion equipment available.

SOLID-STATE SYSTEMS

CENTRAL PROCESSOR — **INPUT-OUTPUT EQUIPMENT**

	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time in Micro-seconds	Cycle Time in Micro-seconds	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S56 PACKARD BELL PB 250	$1,200^A (1.2-6)	12/60	24	3070 12	2.3-16K delay^E 16 fast	22b 1	2 none	6	— —	400 —	300^P 110^P	500	—	—	1	—	—	I/O	5/62	—

A. Price does not include cost of magnetic tape units. E. Internal storage is magnetostrictive delay lines. P. 20 ch/sec reader and 20 ch/sec punch standard while plotter and analog conversion equipment are available.

	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time	Cycle Time	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
S57 MONROBOT XI	$700 (.7-1)	5/60	9000	12000	1K drum	32b 1	— —	—	— —	15^N 15	20^P 20	—	—	—	0	—	—	I/O	—	—

N, P. Facilities for three input and three output devices including teletypewriter, edge-punched card reader and punch, and a 16-key numeric keyboard.

SPECIAL INDUSTRY COMPUTERS (Solid-State)
Banking

	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time	Cycle Time	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
SP1 BURROUGHS B250	$4,200^A (2.8-6.7)	9/61	777^C	10	9.6K core	1a^F 3	— —	—	— —	200^N 100	1000 100	214	—	—	0	—	—	—	—	—

A. Includes central processor, ledger processor and card reader. C. Add time assumes five-character field. F. Instruction can be up to 12 characters in length. N. Magnetically encoded ledger cards can be read at 180 cpm. MICR documents read at 1560 per minute. Q. 214 lpm on up to three forms. See entry S37 for further data.

	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time	Cycle Time	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
SP2 NCR 310	$2,450^A (1.6-6.5)	4/61	12.8	6.4	4K core	12b 1	— —	—	— —	—^N —	350^P 110	900	—	—	0	√	—	I/O	—	—

A. Price does not include cost of magnetic tape units. A version of the CDC-160 (see entry S53). N. MICR documents read at 750 or 1620 per minute. P. 1000 ch/sec reader available.

	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time	Cycle Time	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
SP3 NCR 390	$1,850 (1.4-1.9)	5/61	11300	1200	200 core	12d 4	— —	—	— —	15^N 15	400 17	110^Q	—	—	0	—	—	I/O	—	—

N. Magnetic ledger card stores up to 200 characters in magnetic strips. Printed information appears on front of card. Q. Programmable printer allows any columnar arrangement on forms and reports.

VACUUM TUBE SYSTEMS — Still Widely Used

	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time	Cycle Time	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
V1 UNIVAC 1105	$43,000 (40-55)	9/58	44	8 34000	8-12K core 16-32K drum^E	36b 2	21 RWC	24^K	— —	120 —	200 60	—^Q	—^R	√	0	—	√	O	—	—

E. Interlace storage arrangement (address locations on drum spaced according to word times) reduces drum access time. K. Magnetic tapes read in forward and reverse directions. Q. On-line display unit available. R. 300 cpm reader, 120 cpm punch and 600 lpm printer available off-line.

	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time	Cycle Time	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
V2 IBM 709	$40,000 (28-50)	8/58	24	12 7000	4-32K core 4-16K drum	36b 1	15 MRWC	48	— —	250 100	— —	150^Q	1401 same	√	3	√	√	O	/59^X	10/61^Y

Q. On-line display unit available. X. FORTRAN. Y. COBOL, COMmercial TRANslator (9/61).

	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time	Cycle Time	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
V3 UNIVAC 1103A	$35,000 (25-45)	3/56	44	8 34000	4-12K core 16-32K drum^E	36b 2	13 none^J	12^K	— —	120 —	200 60	—	—^R	√	0	—	√	O	—	—

E. See –UNIVAC 1105 (entry V1). J. Magnetic tape start-stop time can be overlapped with computing time. K. Magnetic tapes read in forward and reverse directions. R. 300 cpm reader, 120 cpm punch and 600 lpm printer available off-line.

	Typical Monthly Rental Monthly Rental Range	Date First Delivery	Add Time	Cycle Time	Storage Capacity and Type	Word Size Instruction Addresses	Thousands of Characters per Second Buffering	Maximum Tape Units	Capacity Average Access Time	Cards per Minute	Paper Tape Characters per Second	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
V4 IBM 704	$32,000 (24-)	4/56	24	12	4-32K core 4-16K drum	36b 1	15 none^J	10	— —	250 100	— —	150^Q	1401 same	—	3	—	√	O	/57^X	—

J. Magnetic tape start-stop time can be overlapped with computing time. Q. 500 lpm printer available off-line and on-line display unit is available. X. FORTRAN.

VACUUM TUBE SYSTEMS — Still Widely Used

Listing / System	Typical Monthly Rental / Monthly Rental Range	Date First Delivery	Add Time in Microseconds	Cycle Time in Microseconds	Storage Capacity and Type	Word Size / Instruction Addresses	Thousands of Characters per Second / Buffering	Maximum Tape Units	Capacity / Average Access Time	Cards per Minute (In / Out)	Paper Tape Characters per Second (In / Out)	Printer Lines per Minute	Off-line Equipment	Program Interrupt	Index Registers	Indirect Addressing	Floating Point Arith.	Console Typewriter	Algebraic Compiler	Business Compiler
V5 IBM 705 III	$30,000	3/56	86^{C}	9	20-80K core	1a^{F}	15-62	60	—	250	—	150^{Q}	1401	—	0	√	—	O	/59^{X}	10/61^{Y}
I & II	(18-54)		119^{C}	17		1	RWC		—	100	—		same							
V6 UNIVAC II	$28,000	11/57	200	40	2K core	12a	25	16^{K}	—	—	—	—	—^{R}	—	0	—	—	I/O	/58^{X}	11/60^{Y}
	(25-30)					1^{G}	RWC		—	—	—									
V7 UNIVAC I	$25,000	3/51	282	242	1K delay^{E}	12a	13	10^{K}	—	—	—	—	—^{R}	—	0	—	—	I/O	—	/57^{Y}
	(20-30)					1^{G}	RWC		—	—	—									
V8 BURROUGHS 220	$17,000	12/58	200	10	2-10K core	10d^{F}	25	10	500M	300	1000	150^{Q}	—	—	1	—	√	I/O	/59^{X}	—
	(8-35)					1	none^{J}		—^{M}	100	60	1500^{Q}								
V9 UNIVAC FILE COMPUTER I	$15,000	1/58	8600	900	20 core	12a	10.4	10^{K}	1.8M^{L}	150	240	600^{Q}	same^{R}	√	0	—	—	I/O	—	—
	(8-21)			5000	1K drum^{E}	3	MRWC		17.6m	150	60									
Model II		1/62	3400	630	2K core															
V10 IBM 650	$9,000	11/54	700	4800	1-4K drum	10d^{F}	15^{H}	6	48M^{L}	155	60	150^{Q}	—	—	3	—	√	—	/57^{X}	—
	(3.7-16)			100	60 core	1^{G}	RC, WC		600m	100	—									
V11 BURROUGHS 205	$8,000	7/54		17000	4K drum	10d^{F}	6	10	200M	300	540	150^{Q}	—	—	1	—	√	I/O	/59^{X}	—
	(2-17)		1700	1700	80 fast	1	none^{J}		—^{M}	100	60									
V12 EL-TRONICS ALWAC III-E	$3,600^{A}	/55	1000	8000	4-8K drum	33b^{F}	21	16^{K}	—	100	200	150	—	—	1	—	—	I/O	—	—
	(1.6-4)					1^{G}	RC, WC		—	100	60									
V13 IBM 305 RAMAC Model I	$3,600^{A}	12/57			100 core	1a	15	4	5-40M	125	60	30-50^{Q}	—	√	0	—	—	I/O	—	—
	(2.8-6.5)		30000	10000	2K drum	2^{G}	RC, WC		600m	100	—	150								
Model II	(1.8-)	3/62	50000						5M	80										
									600m	50										
V14 BENDIX G-15	$1,500^{A}	8/55		29500	2K drum	29b	.43	4	—	100	400	100^{Q}	—	—	0	—	—	I/O	8/60^{X}	—
	(1.5-4)		540	1080	16 fast	1^{G}	RC, WC		—	100	100									
V15 RPC LGP-30	$1,300	9/56	2260^{C}	17000	4K drum^{E}	31b	—	—	—	—	200	—	—	—	0	—	—	I/O	/59^{X}	—
	(1.1-2)					1	—		—	—	20									
V16 BURROUGHS E-101	$875^{A}	/55	50000	20000	220 drum^{E}	12d	—	—	—	—	20	60	—	—	2	—	—	I/O	—	—
	(.9-1,400)					1	—		—	—	13									

V5: C. Add-time assumes a five-character field. F. Variable word length can be used as a fixed (five-digit) word. Q. 500 lpm printer available off-line. X. FORTRAN. Y. COBOL, COMmercial, TRANslator (9/61).

V6: G. Instructions stored two per word. K. Magnetic tapes read in forward and reverse directions. R. 240 cpm and 300 cpm card readers, 120 cpm card punch, 600 lpm printer and Unityper used off-line only. X. Math-Matic. Y. COBOL '60, Flow-matic.

V7: E. Mercury filled tanks are the storage media. G. Instructions stored two per word. K. Magnetic tapes can be read in forward and reverse directions. R. 240 cpm and 300 cpm card readers, 120 cpm card punch, 200 ch/sec paper tape reader; 50 ch/sec paper tape punch, 600 lpm printer and Unityper used off-line only. Y. Flow-matic.

V8: F. Word size is 10d plus sign. J. Magnetic tapes with addressable blocks can be searched concurrently with computer operations. M. Access time to tape loops is 1–9 seconds (dependent on size of file). Q. Printers buffered for on-line use and can be used off-line. X. ALGOL '58.

V9: E. In Model II, core memory is used instead of drum. K. Off-line sort-collate unit available. L. Up to ten Randex drums (6 million characters each—385m average access time) may be attached. Q. 800 lpm for pure numeric data. R. 240 or 300 cpm reader and 120 cpm punch available off-line.

V10: F. Word size is 10d plus sign. G. Address of next instruction indicated in last part of instruction. H. Tapes written in BCD (six-bit) or numeric (four-bit) format. L. Up to four Ramac disc files can store 12 million characters each. Q. Printer can be used off-line. X. FORTRANSIT.

V11: F. Word size is 10d plus sign. J. Magnetic tapes with addressable blocks can be searched concurrently with computer operations. M. Access time to tape loops is 2–17 seconds (dependent on size of file). Q. Printer buffered for on-line use (CARDATRON) and can be used off-line. X. ALGOL '58.

V12: A. Does not include cost of magnetic tape units. F. Half and quarter word operations are possible. G. Two, three or four instructions may be contained within one word. K. Magnetic tapes can be searched with computer operations.

V13: A. Does not include cost of magnetic tape units. G. Input editing, logical decisions and character analysis usually made through the 305 control panel. Q. "Stick" printer prints one character at a time.

V14: A. Does not include cost of magnetic tape units. G. Address of next instruction indicated in last part of instruction. Q. Analog devices, graph plotter and digital differential analyzer accessories available. X. ALGOL.

V15: C. Minimum execution time for any instruction. E. Interlace storage arrangement (address locations on drum spaced according to word times) reduces drum access time. X. ACT I (Fortran-type).

V16: A. Computer now being marketed as E-103. E. Pinboard serves as instruction storage unit.

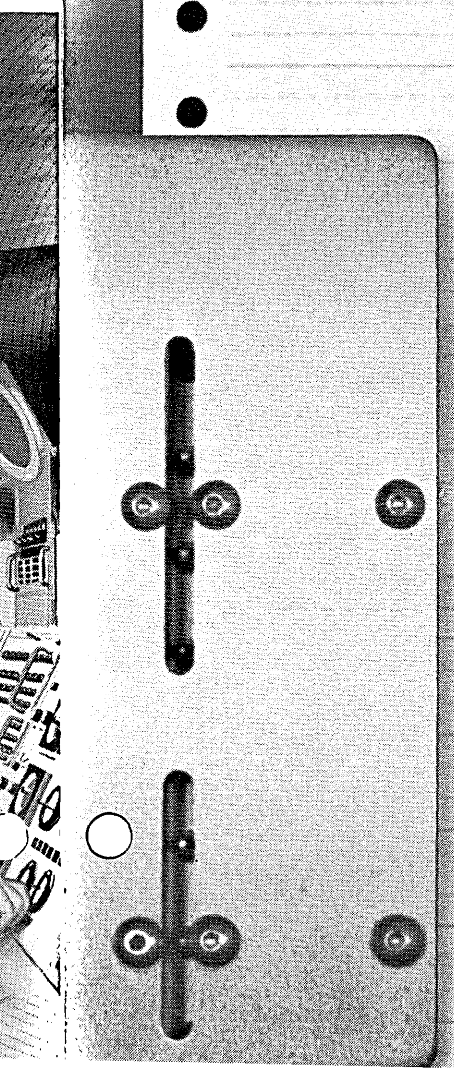
ERRATUM

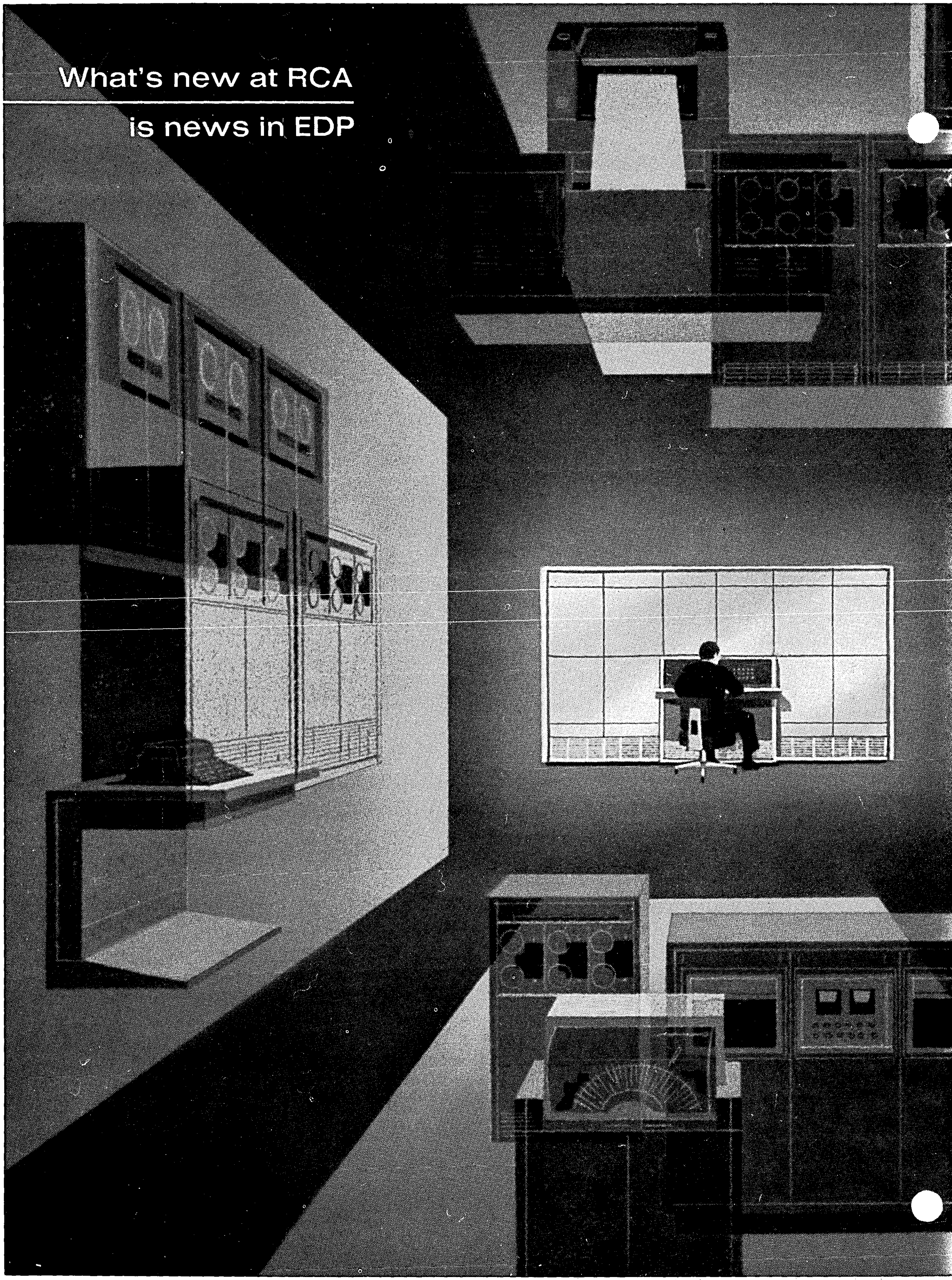
Listing S27: Should read 7904 data channels (instead of 7094, etc.)

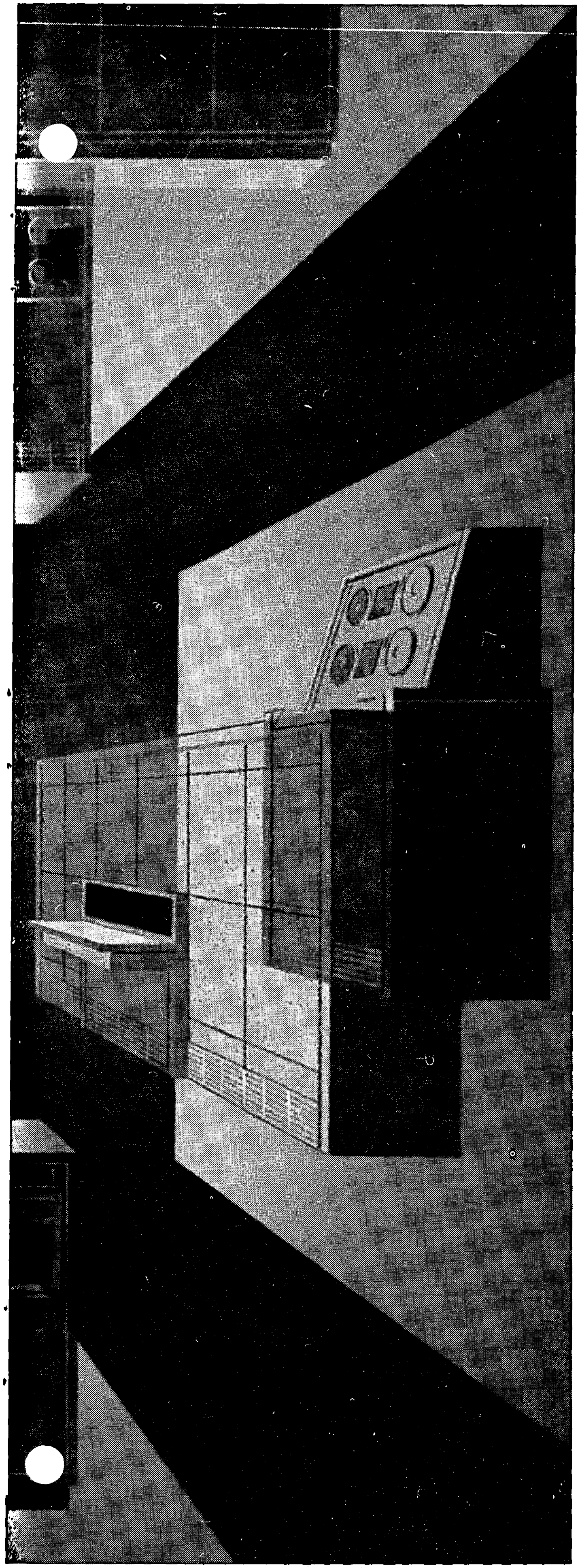
Listing S42a: Should read $3,800^{A}

Listing S51: Should read 560^{A}

Listing SP1: Should read 214^{Q}




What's new at RCA
is news in EDP



NOW...FROM ONE BASIC COMPUTER, MANY SYSTEMS FOR MOST EDP NEEDS

RCA 301, Today's Most Versatile Computer for Business, Science and Government

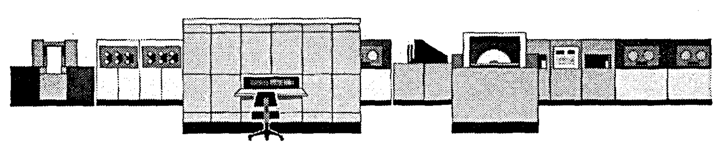
In the RCA 301 you will find a general-purpose computer that can do most of the jobs that have to be done in your business. Moreover, they can probably be done for less cost because the 301 offers great versatility, high volume capacity and a modular design that matches the equipment to job requirements.

CONSIDER VERSATILITY. The 301 is a business data processor and a scientific data processor. It is highly efficient in random access applications. It is excellent for serial processing and performs complex engineering and scientific computations . . . can solve statistical and management science problems.

CONSIDER TAPE SPEEDS AND STORAGE CAPACITY. You can choose from three different magnetic storage systems, including tapes in four speed and capacity ranges . . . from three sizes of high-speed memory. The RCA 301 lets you use peripheral equipment for virtually every type of input and output. *Modular design* permits you to select from these options as your needs dictate. You use and pay for only the computational speeds and capacities required!

A comprehensive package of software—programming aids—will help speed and reduce the cost of conversion and provide for efficient day-to-day operations. Automatic programming systems—301 COBOL, 301 FORTRAN and 301 UMAC—will supplement the broad ranged equipment configurations.

Name your EDP requirements. Chances are, an RCA 301 is the answer. Write RCA Electronic Data Processing, Cherry Hill, Camden 8, New Jersey.



The Most Trusted Name in Electronics

CIRCLE 20 ON READER CARD

DATAMATION QUARTERLY INDEX OF COMPUTING

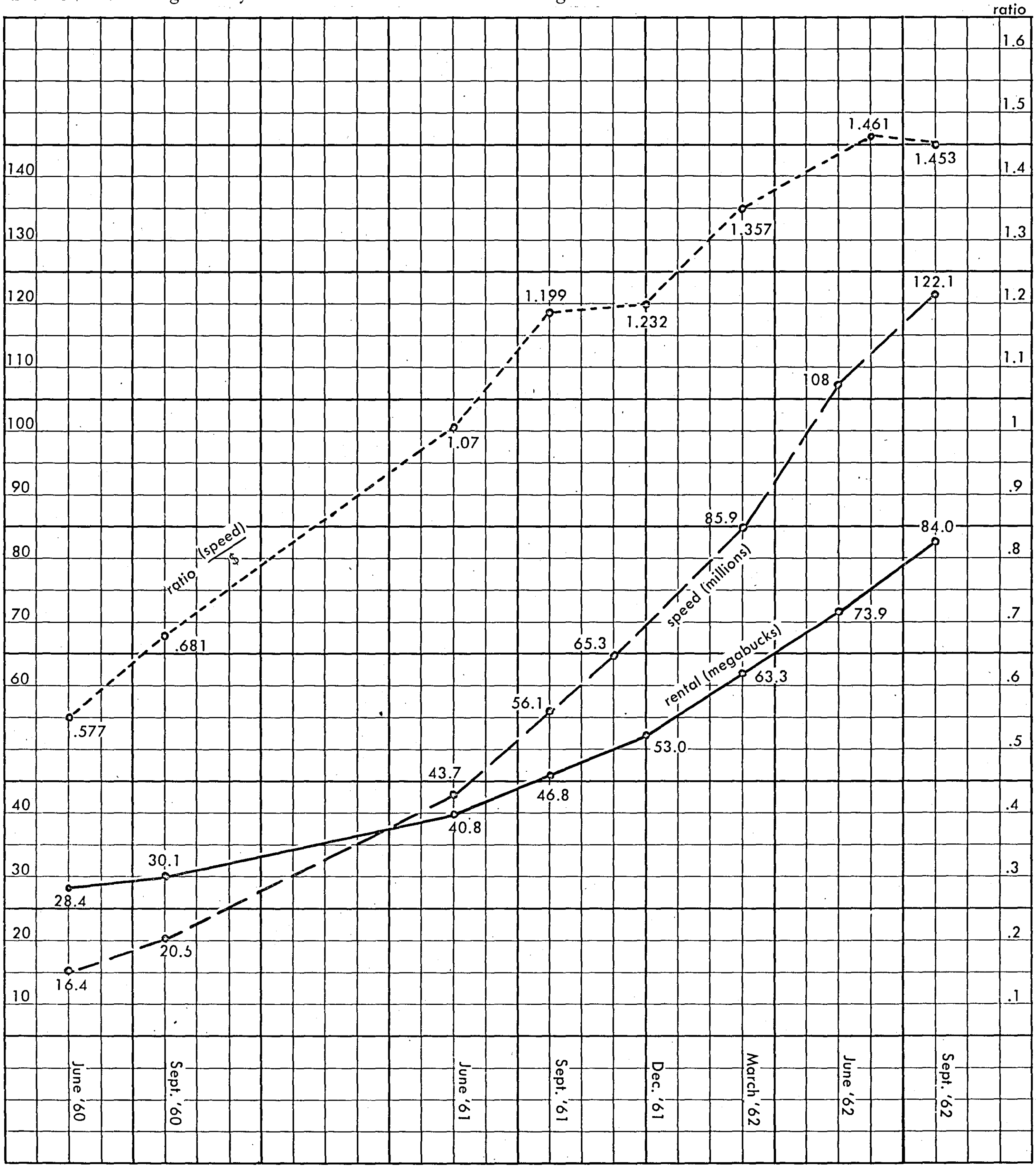
adjusted figures show leveling trend

The computing index for the third quarter of 1962 has been adjusted to reflect installation figures which were furnished by manufacturers to *Datamation's* census of computers, published in August, 1962. With clearer guidelines for estimating the number of installations, the statistics for the computing index show a leveling-off, when compared to previous reports. The approximations offered are derived from the specifications of larger systems and selected small-scale systems such as the 1401.

The number of ops/sec during the third quarter continued to show an upward trend, rising to 122.1 million ops/sec, a gain of 13.05% over the second quarter's mark of 108 million. This gain may be attributed to the continuing installations of the 7090 (now slightly under 200) and the 1401 (better than 3,750).

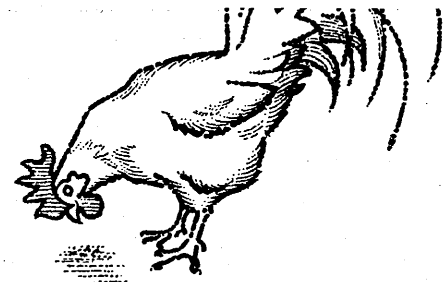
Monthly rentals show a total of 84.0 megabucks, representing an increase of 13.66% over 37.9 megabucks, the estimated machine rental figure for the second quarter of 1962.

The ratio of computer power per dollar, in line with the adjusted installation figures, turned slightly downward, from 1.461, the second quarter's figure, to 1.453, a loss of .54%. However, it is also felt that this condition continues to stem from the growth of small-scale computers, in the 1401 class, which offsets the lower operation/cost balance achieved by systems in the 7070/7090 range. ■

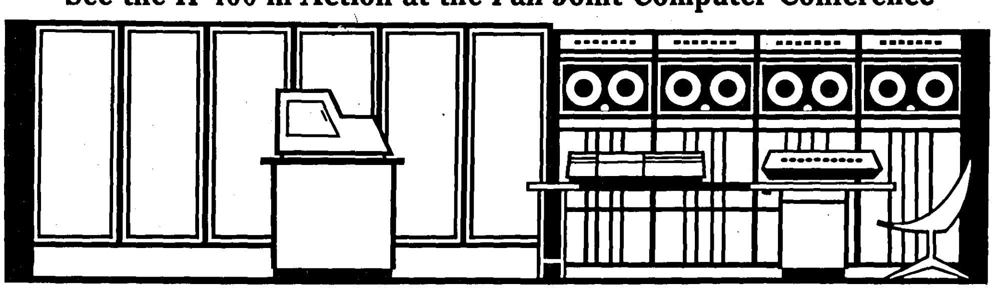


There's a little bit of chicken in all of us

One big trouble with being chicken is that you can wind up with nothing much to crow about. Consider, for example, the job of picking a computer. If you back off from the computer you honestly think is best and pick another one just because you think it's "safe", you're not doing yourself or your company (or us) any good. So be hard-nosed about it. Get plenty of facts from plenty of makers. Ask about performance. Ask about service. Ask about software. Ask about programming. Ask about training schools. Ask about delivery. Ask about Honeywell. We're eager to match our product and performance, point-for-point, against anything in the field. (When that happens, we usually manage to come out on top. We've got the installations to prove it.) You can reach us at Wellesley Hills, Mass.



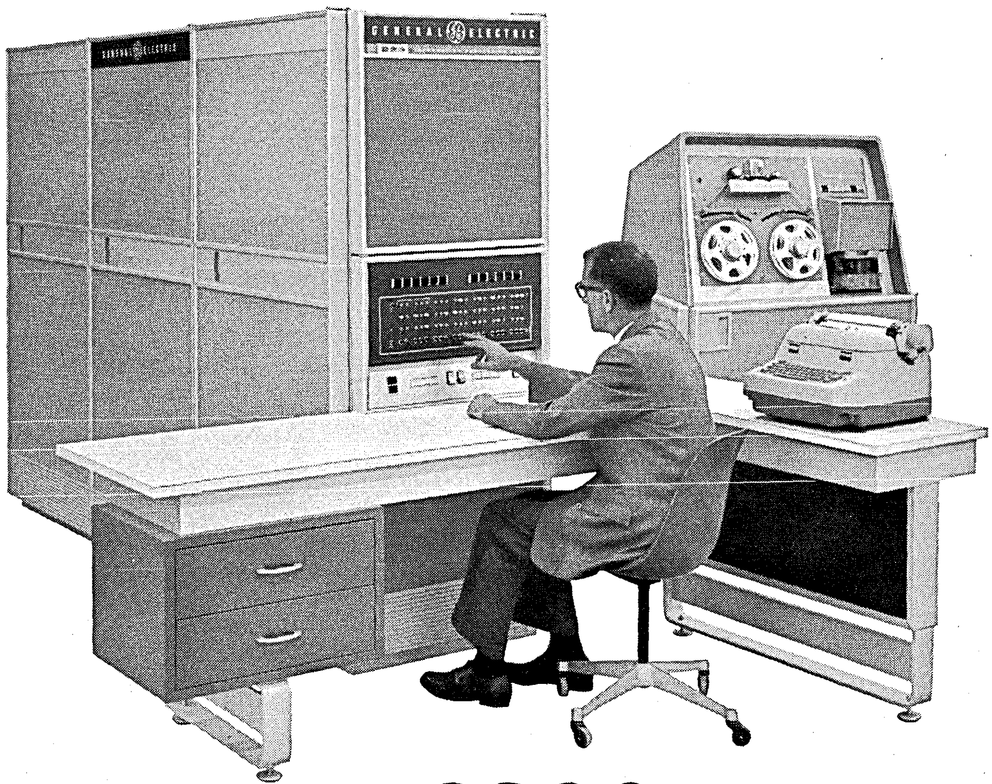
See the H-400 in Action at the Fall Joint Computer Conference



Honeywell

H HONEYWELL *Electronic Data Processing*

CIRCLE 21 ON READER CARD



$2390

is the monthly rental on a solid-state high-speed binary computer ideally suited to scientific applications—the GE-225

This low price includes a 4096 word magnetic core memory plus paper-tape reader and punch and the typewriter. For only $2675 you could have the same system with a card punch and reader in place of the paper-tape unit. This gives you all you need to handle scientific and engineering problems. You don't have to buy any "extra" features, and you can have 90 day delivery.

Why is the GE-225 such a successful scientific machine? Because it's designed strictly along big computer lines: high speed arithmetic, 18μs memory access, a full-scale scientific language, double-word capability, over 150 commands, including input-output.

And if you should decide to expand your system, look at the growing room you get. Internal memory can be increased to 16,384 words. Floating point hardware is available. You can add a full complement of peripheral equipment to handle high volume business data processing as well. And the GE-225 is capable of simultaneous read-write-compute of all peripheral units.

If you'd like to know more about how the GE-225 has been tailored to your scientific needs, write Mr. E. V. Scott, Manager of Scientific Sales, General Electric Computer Department, Section J11, Phoenix, Arizona.

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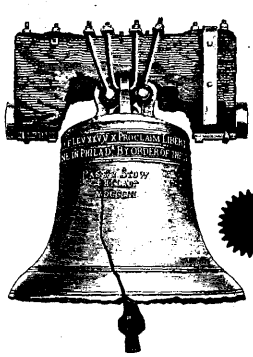
CIRCLE 22 ON READER CARD



Fall Joint

Computer

Conference

December 4, 5, 6, 1962.

Conference Particulars

Philadelphia will be the scene of the 1962 Fall Joint Computer Conference, to be held at the Sheraton Hotel, December 4-6. "Computers in the Space Age" has been selected as the conference's theme.

Twenty-eight technical papers will be presented, in addition to a panel discussion on Tuesday afternoon, "EDP as a National Resource—The Impact of Information Processing." All of the technical papers will be presented in the Grand Ballroom of the Sheraton, except for the parallel sessions on Wednesday afternoon, when one round of meetings will be held in the Pennsylvania East/West Room, and the other in the Grand Ballroom. Subjects to be covered include "Information Processing and Space Technology," "System Organizations," "Language and Systems," "Data Communication Systems," "Computer Technology," and "New Directions in Information Processing."

A conference innovation will be a series of evening discussion sessions, which is scheduled for Tuesday, from 8-11 p.m. Subjects will cover: "New Devices—Their Effect on Computer Technology" (Connie Mack Room); "Organization of Computers" (Independence Room); and "Computer Languages" (Constitution Room). Moderators for these sessions are, respectively, C. D. Simmons, Philco Corp.; R. W. Hamming, Bell Telephone Labs; and A. J. Perlis, Carnegie Institute of Technology.

The keynote speaker of the conference will be Robert C. Seamans, Jr., associate administrator of NASA, who will present a progress report, "The National Space Program." Sir Edward Playfair, chairman of International Computers and Tabulators, Ltd., London, England, will speak on "The Computer and Man," at the conference banquet, to be held Wednesday evening. Opening remarks prior to the keynote address will be made by E. Gary Clark, Burroughs Corp., program chairman, and J. Wesley Leas, RCA, conference chairman.

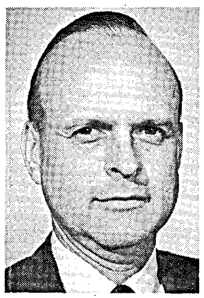
The exhibit area, containing approximately 150,000 square feet, will display the wares of 73 firms, in 170 booths. Pre-conference information stated that seven complete operating computer systems will be displayed.

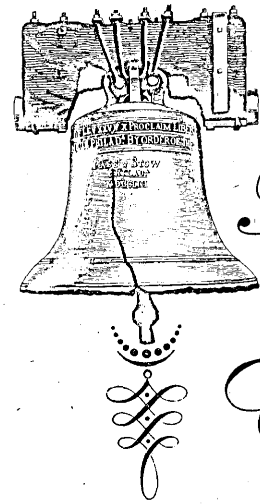
Students from a number of schools have been invited to attend a special session which will include talks by Dr. John Mauchly, Mauchly Associates, co-inventor of ENIAC, and Paul Chintz, of RemRand UNIVAC. Five selected students will present papers and participate in a panel discussion. In addition, more than 100 teachers will attend a dinner sponsored jointly by the FJCC and the Association of Mathematics Teachers of Philadelphia and vicinity.

Registration for the FJCC will be held in the lobby of the Sheraton. The schedule of registration fees is as follows: $8 for members of participating societies (IRE, AIEE, ACM, and Simulation Councils, Inc.); $10 for non-members, and $2 for students.

A copy of the proceedings will be provided without charge at registration for members and non-members. Post-conference copies of the proceedings will be available from Spartan Books, 6491 Chillum Place N.W., Washington 12, D.C. These copies will cost $4 for members and $8 for non-members.

Social events will include a cocktail party, and a program for the ladies. No field trips are planned. ■





The Conference: Concept and Highlights

by J. WESLEY LEAS

The computer industry has traveled far in the short decade of its existence. In spite of this burgeoning growth, conservative estimates point to even bigger things in the future—a future aptly termed the "Space Age."

Since we believe the 1962 Fall Joint Computer Conference would best serve its objectives by keeping its eye on the future, we chose as our theme, "Computers in the Space Age."

The keynote speaker, Dr. Robert Seamans, associate administrator of the National Aeronautics and Space Administration, was selected because he has done so much to take us across the threshold into the Space Age.

Key figures from the electronics industry and other walks of life were carefully selected to investigate analytically "EDP As a National Resource," since there is little doubt that we will be a significant society in the Space Age.

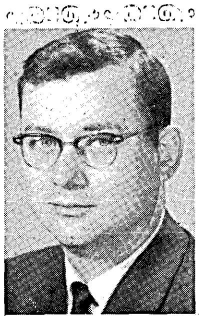
We have been particularly fortunate in obtaining Sir Edward Playfair, Chairman of International Computers and Tabulators, Limited, of England, as the principal speaker at the Conference banquet. He has chosen his provocative topic, "Computer and Man." Sir Edward brings an international viewpoint to the Conference, reflective of the fact that the "Space Age" is not limited to the continental boundaries of the United States.

Six technical sessions were included in the program, covering those major aspects of the computer industry and electronic data processing which give promise of significantly influencing future developments. Papers presented at these sessions were judged to have important technical impact, and are in keeping with the pervading futuristic philosophy of the Conference.

Recognizing that tomorrow's leaders are today's students, we have also invited students and teachers from a number of schools to attend a special session. Five youngsters have been picked to deliver papers and take part in a unique panel discussion.

The computer industry is as vital and intriguing as it is young. The 1962 Fall Joint Computer Conference was oriented to spread the infectious enthusiasm we in the industry feel.

This Conference was possible because of the realization by members of the Conference committees that they faced a mammoth challenge—and because they met that challenge in outstanding fashion. ■



The Technical Program: A New Approach

by E. G. CLARK

The philosophy behind the program planning of the 1962 Fall Joint Computer Conference represents some departure from previous meetings by employing serial sessions, whenever possible, by soliciting a large percentage of the papers, and by requiring complete drafts for review.

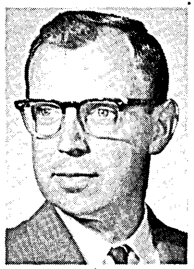
Since this is a joint conference, several disciplines and many specialties are represented. These twice-a-year conferences and other more specialized meetings provide considerable depth of coverage. These factors suggested that papers should emphasize breadth and be of general interest, rather than attempt to report work in detailed and highly specialized fields. Accordingly, a major program objective was to cover topics of general interest to the information-processing community, with particular emphasis on new and potentially important trends and techniques. It is hoped that this approach will broaden our attendees' view of information processing and be stimulating and thought-provoking.

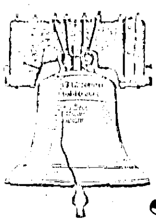
To be consistent with this objective, conflicts between papers of equal interest to an attendee were eliminated by planning serial, rather than parallel sessions (with one exception.)

Session chairmen were selected for their knowledge in a specific information processing area and then given free rein to plan and organize their sessions. They were instructed to solicit papers from groups doing work of known significance, and that they invite sufficient material to provide a worthwhile session so that unsolicited papers would strengthen the session, as opposed to relying largely on unsolicited material. In all cases, major emphasis was placed on the significance or impact of the work reported.

With such a philosophy in mind, it was felt that implementation was possible only if full drafts of papers were reviewed. By requesting complete drafts for review, a hardship was placed on authors and difficulty in obtaining up-to-the-minute reports was introduced. On the other hand, it was felt that this is the only technique that can assure suitability and acceptable quality of the papers to be delivered. In addition, it became possible for the session chairmen to work directly with the authors to shift emphasis or to include additional comments or topics to provide more comprehensive coverage. The total number of papers submitted was substantially less than previous years, when abstracts were required. The yield was considerably higher, however, and the quality uniformly high.

A final advantage realized by having full papers submitted, well in advance of the conference, was sufficient time for session chairmen to work with authors to prepare succinct, understandable, and appropriate verbal presentations. By this practice it was possible to minimize the need to read detailed and specialized technical reports, but increase the number of understandable and provocative papers. ■





An Industry's Challenge

by WILLIS H. WARE, Chairman of the Governing Board,
American Federation of Information Processing Societies

The member societies of AFIPS: ACM, AIEE, IRE, SCI, represent the greatest pool of technical ability and experience in the industry. On the eve of a Joint Computer Conference with the theme "Computers in the Space Age," I would like to forego the usual state of the union message and issue a call, a challenge, and an appeal to all members.

The technical and economic squeeze that our country is currently engaged in, is reason for all of us to look not to what we are doing, but to what more we can do, and to what direction our individual and joint efforts are leading.

The space age could not have come into being without the computer, but this does not end our responsibility. As we know, the computer represents the most powerful single tool the nation has to maintain and strengthen its capabilities. Ours is not a pedestrian business. We can never define our role and then rest on it.

It is urgent and ethical that we double our efforts in meeting with other disciplines to conserve national resources, to reduce waste, to further aerospace development, to help all areas of industry, government and education extend and realize their full contributions.

It is urgent and ethical that we also double our efforts in increasing our own power and capabilities in finding new methods of solution and areas of use, in lowering the cost of equipment and operation, in widening the education sphere.

The challenge and responsibility is to us, we are needed in full dedication for this nation to meet the economic and technical demands and requirements imposed by this age that we have helped create. ■

The Sponsor: AFIPS

The American Federation of Information Processing Societies (AFIPS), chartered in May, 1961, as a federation of societies representing computing interests in the United States, is an outgrowth of the National Joint Computer Committee that sponsored the well-known Eastern and Western Joint Computer Conferences.

AFIPS is the official United States member to the International Federation for Information Processing originated by UNESCO.

In addition to administrating the Joint Computer Conferences, the federation is assuming responsibility for public relations programs related to the information processing community. These include a national speakers bureau for service clubs, articles on major phases of information processing, taped interviews for radio distribution, and coordination of appearances of American scientists in foreign countries. Additionally, AFIPS provides experts in various areas for representation or consultation with government or civic bodies.

Officers of AFIPS are Willis H. Ware – chairman of the governing board; Margaret R. Fox – secretary, and Frank E. Heart – treasurer. Executive directors are Morris Rubinoff (AIEE); H. D. Huskey (ACM), and A. A. Cohen (IRE). Public relations committee members are J. D. Madden and Phyllis Huggins, chairman and public information director, respectively.

Member societies of AFIPS are the Association for Computing Machinery, The American Institute of Electrical Engineers, the Institute of Radio Engineers, and the Simulation Councils, Inc. ■

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Conference Facts

SPONSOR: American Federation of Information Processing Societies.

THEME: Computers in the Space Age.

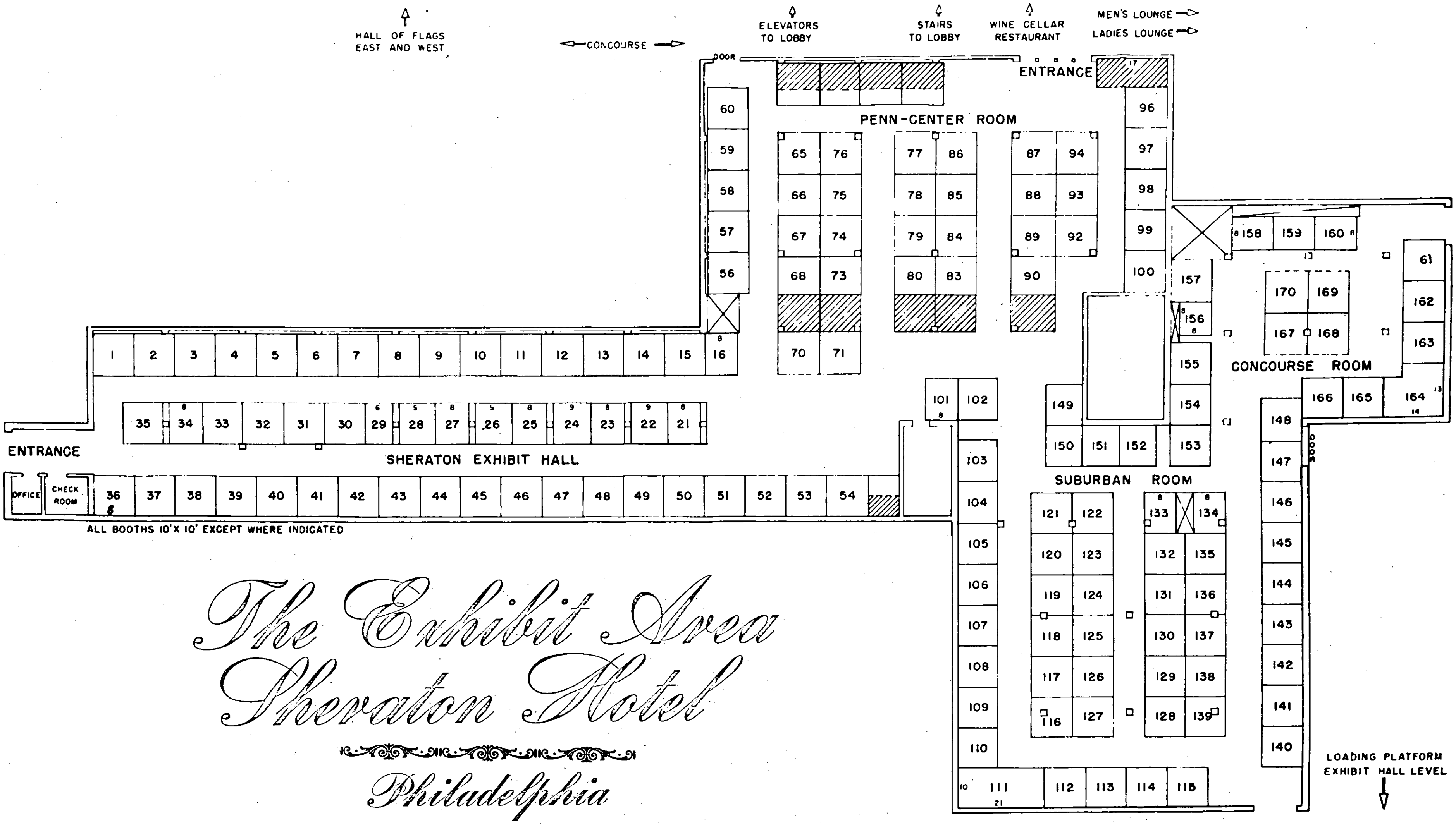
DATE: December 4th, 5th and 6th.

PLACE: Sheraton Hotel, Philadelphia.

SESSION TIMES: 9-12 noon; 2-5 p.m. (Afternoon session, Dec. 4th, starts at 3 p.m.).

KEYNOTE SPEAKER: Robert C. Seamans, Jr., associate administrator, NASA.

REGISTRATION FEES: Members of IRE, AIEE, ACM, and Simulation Councils, $8.
Non-members $10.
Full-time students: $2.


HALL OF FLAGS EAST AND WEST
CONCOURSE
DOOR
ELEVATORS TO LOBBY
STAIRS TO LOBBY
WINE CELLAR RESTAURANT
MEN'S LOUNGE
LADIES LOUNGE
ENTRANCE
PENN-CENTER ROOM
ESCALATOR TO LOBBY
CONCOURSE
GARAGE
ENTRANCE
OFFICE
CHECK ROOM
SHERATON EXHIBIT HALL
ALL BOOTHS 10'X 10' EXCEPT WHERE INDICATED
SUBURBAN ROOM
CONCOURSE ROOM
DOOR
LOADING PLATFORM EXHIBIT HALL LEVEL
The Exhibit Area
Sheraton Hotel
Philadelphia

Fall Joint Computer Conference

The Technical Program

Tuesday, December 4
MORNING SESSION

INFORMATION PROCESSING AND SPACE TECHNOLOGY
SESSION CHAIRMAN: Hugh Winn
Missile and Space Div., General Electric Co.,
Philadelphia, Pa.

PROCESSING SATELLITE WEATHER DATA—A STATUS REPORT (Part I)
C. L. Bristor, U. S. Weather Bureau, Sutland, Md.
Less than 500 radiosonde observations are currently available for the twice-daily three-dimensional weather analyses over the Northern Hemisphere, a coverage far less than that required for short term advices or input to numerical prediction computations. Global observations from operational satellites as a complement to existing data networks show promise of filling this need. Indications are that machine processing of the 240-odd million binary bits of data from each orbit can materially reduce the human work load in producing analyzed products for real time use.

PROCESSING SATELLITE WEATHER DATA—A STATUS REPORT (Part II)
L. I. Miller, U. S. Weather Bureau, Sutland, Maryland
This paper will expand on the logical design of the digital and non-digital handling system complex and cover data rates, command and control concepts and the executive program which manages the overall process.

DESIGN OF A PHOTO INTERPRETATION AUTOMATON
W. S. Holmes, H. R. Leland and G. E. Richmond, Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y
In this paper, approaches to the preprocessing portions of a photo interpretation automaton will be discussed. The extremely important evaluative work involving the following factors will be underscored: detection and recognition capability which must be quantitatively defined; and implementation problems for a prototype system which must be solved.

EXPERIENCE WITH HYBRID COMPUTATION
E. M. King, Jr., and R. Gelman, General Electric Company, Philadelphia, Pa.
This paper will review and compare characteristics of digital and analog computers, and list some of the advantages of mating the two to form a hybrid computing system. Some examples of actual hybrid simulations performed at GE's Missile and Space Division will be described. The future prospects of hybrid systems will also be discussed.

DATA HANDLING AT AN AMR TRACKING STATION
K. M. Hoglund, P. L. Phipps, E. J. Block, R. A. Schnaith and J. A. Young, Remington Rand Univac, St. Paul, Minn.
Data-handling procedures associated with downrange tracking stations will be discussed, with special reference to AMR station 12 at Ascension Island. An analysis of the mathematical and communications problems involved will be presented.

INFORMATION PROCESSING FOR INTERPLANETARY EXPLORATION
T. B. Steel, Jr., System Development Corp., Santa Monica, Calif.
This paper will examine the requirements imposed on the design of an information processing system serving as the nerve center of an unmanned interplanetary exploration vehicle. Considered will be the mission of such a vehicle, its operating environment, hardware design of the associated computer and the characteristics of the computer program.

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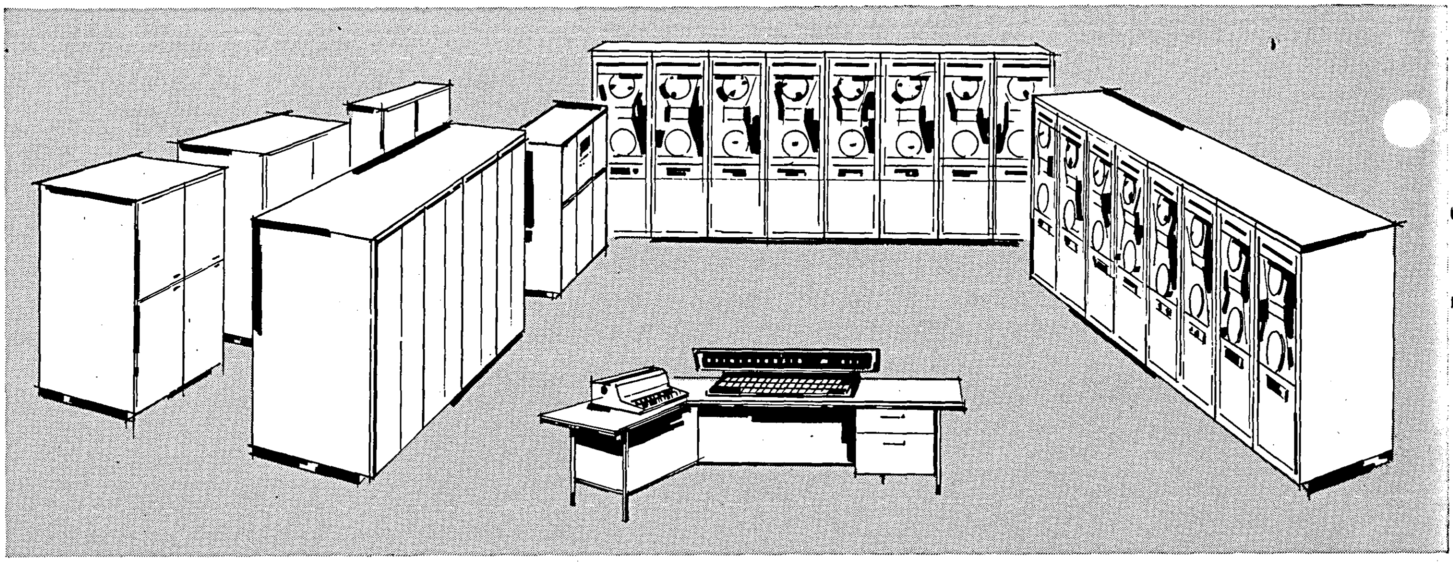

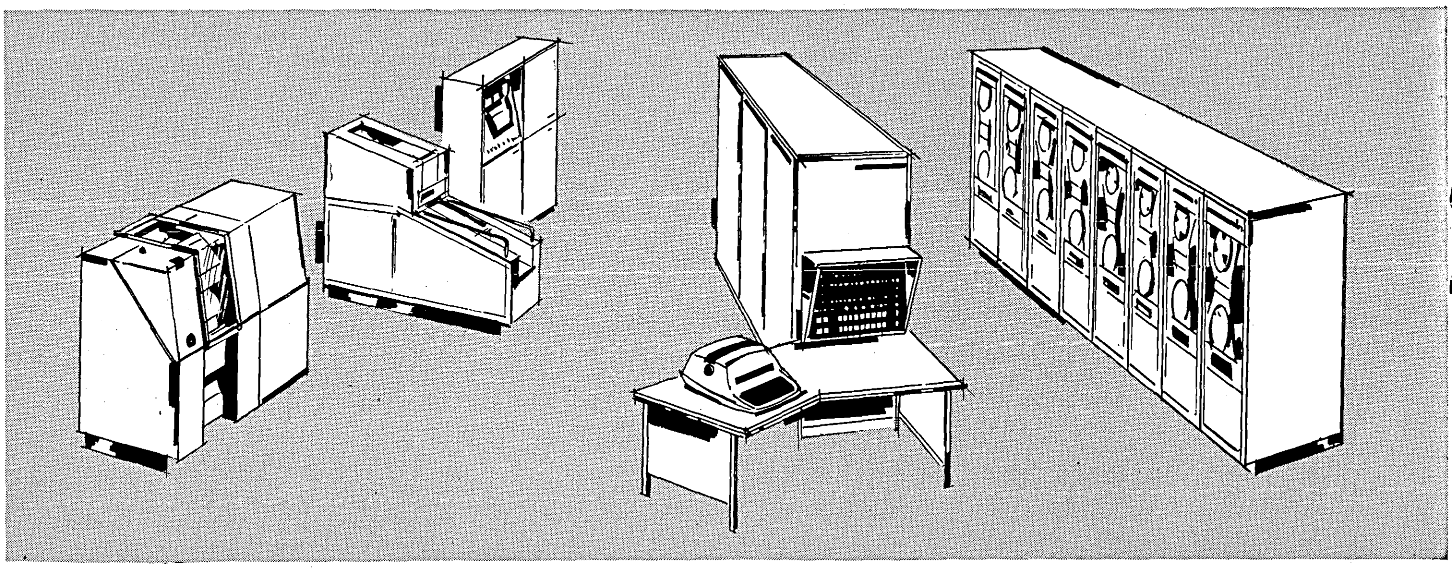

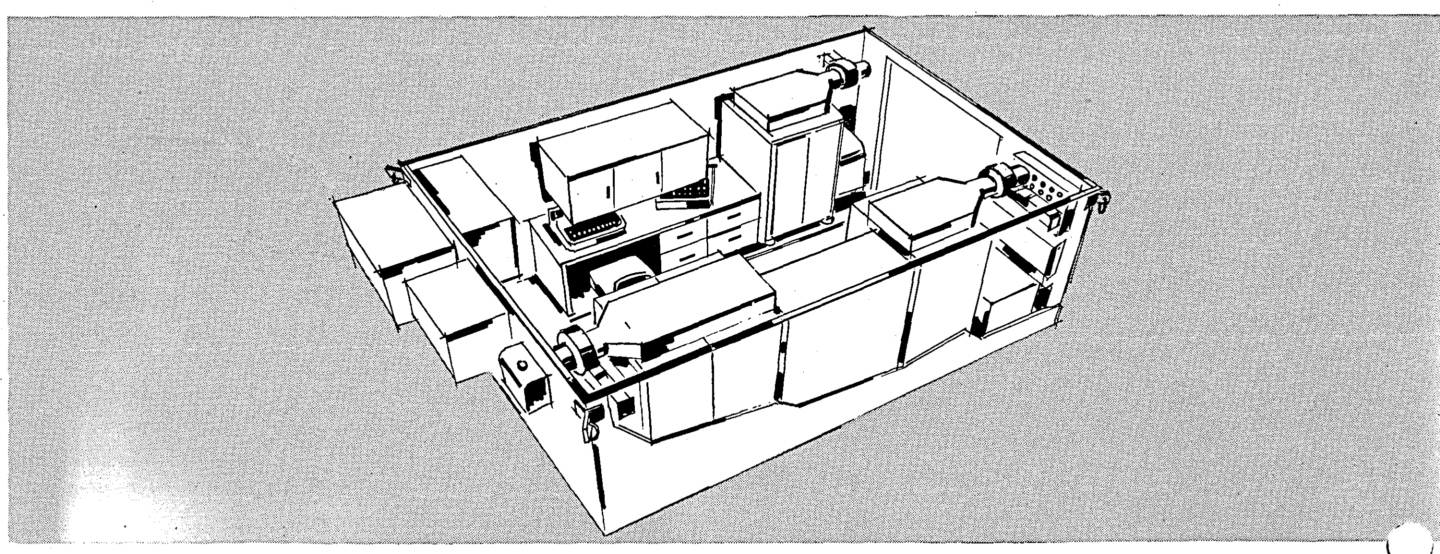

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Numbers Game—When you have a really fast computer with high precision and great capacity, how do you prove it? The Philco 212 System has impressive specifications—a 1.5-microsecond memory cycle . . . 360,000 word-per-second throughput . . . 960 KC magnetic tape transfer from four 240 KC high performance tapes simultaneously . . . asynchronous operation . . . 48-bit word length . . . 112 fixed and floating point arithmetic instructions. **Meaningful?** We don't think so. Actually, our 1.5-microsecond memory has greater effective speed through 4-way overlapped memory access and when we mention our .55 microsecond add for two full operands, people think we're talking cycle time. **Therefore:** Let us measure the power of the Philco 212 where it counts—against *your* present computer on one of *your* problems. Then you can find out what the Philco 212 can do for you. By the way, to date the 212 has been showing at least a 2 to 1 advantage over other available large scale machines.

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Versatility—The only character oriented computer that combines the advantages of variable word length and fixed word length operation without the disadvantages of either. Operates in fixed or variable word formats without special programming, including 12, 24, 36, 48 or 54-bit word sizes (or any other multiple of 6 bits). Can change between fixed word formats without reprogramming. **Full Satellite Capability**—Can communicate with all types of input-output equipment because of fast 3-microsecond core memory access. Links directly to Philco 212 core memory or tapes. Capable of autonomous action and decision. Can be used as an independent processor in remote locations for scientific *or* commercial application. **Non-obsolescence**—Asynchronous operation allows future developments to be integrated regardless of their timing cycles.

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Mobile—fly it, truck it, ship it, store it, and five minutes after a power connection is made BASICPAC can be operating. Shelter and computer are delivered as an integral unit. **Rugged**—drop it, bounce it, freeze it, drench it, use it in the Sahara or the Arctic, in a jungle or in mountains, and BASICPAC will still operate reliably. **Expandable**—basic system can be pre-wired for expansion of capability: Add more memory, add input-output, add real-time channels in the field *in hours.* **Real-time**—Communications converter provides up to seven real-time inputs and seven real-time outputs with multi-level priority interrupt. **Powerful**—12-microsecond memory cycle with 38-bit word. 40 instruction order code, expandable to 64.

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Do you want to know more about the Philco 212 computer, the 1000 or BASICPAC?

Or maybe you want information on the other computers in Philco's 2000 Series, the 210 and 211 computers,

or information on Philco software and service. We can suggest several alternatives.

Make an FJCC date

At the Fall Joint Computer Conference, we will be showing our Philco 1000, BASICPAC and C-3000 computers. And we will have trips to our nearby Willow Grove Computer Center for those interested in Philco 212 demonstration. We will be at booth 65-76. But if you aren't attending the FJCC, call in, write in or walk in for further information.

Remember?

It seems that a great deal of interest was created by our recent ad featuring a Fortran language program we had run on our 212 computer—a program written for our 211 incidentally. If you missed the ad and would like to try the program on your present computer, copies will be made available on request, or at the FJCC.

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Tuesday, December 4
AFTERNOON SESSION (3-5 p.m.)
EDP AS A NATIONAL RESOURCE— A PANEL DISCUSSION ON THE IMPACT OF INFORMATION PROCESSING
CHAIRMAN: Stanley Winkler, IBM Federal Systems Div., Rockville, Md.
MODERATOR: Willis H. Ware, The RAND Corp., Santa Monica, Calif.

Panel Members:
J. B. Carey, president, AFL-CIO International Union of Electrical, Radio and Machine Workers, Washington, D. C.
G. P. Harnwell, president, University of Pennsylvania, Philadelphia, Pa.
J. P. Nash, vice president, research, Lockheed Missiles and Space Div., Palo Alto, Calif.
A. L. Samuel, director of research communications, Thomas J. Watson Research Center, Yorktown, N.Y.
F. J. Weyl, deputy chief and chief scientist, ONR, Washington, D. C.

The advent of data processing and automation has had a significant impact on our way of life. Certainly, no human activity will remain unchanged or be unaffected by this technological explosion. How past developments are affecting us and how future advancements will change our mode of living will be the subject of this panel discussion—involving distinguished representatives from the fields of education, industry, labor, government and the scientific community.

Wednesday, December 5
MORNING SESSION
SYSTEM ORGANIZATIONS
SESSION CHAIRMAN: Arnold Shafritz, Auerbach Corp., Philadelphia, Pa.

PLANNING THE 3600
C. T. Casale, Control Data Corp., Minneapolis, Minn.
Planning of a large-scale digital computing system, with principal emphasis on the relationships among the various major system components, will be discussed in this paper. The planning framework in which the computer was developed will also be described. And the general characteristics of the computer system, as related to the system organization, will be covered, too.

D825—A MULTIPLE COMPUTER SYSTEM FOR COMMAND AND CONTROL
J. P. Anderson, S. A. Hoffman, J. Shifman and R. J. Williams, Burroughs Corp., Paoli, Pa.
This paper will discuss the design criteria analysis and design rationale that led to the development of the D825 Modular DPS. Emphasized will be the important role of an operating system in realizing the effective use of a complex of identical functional modules.

THE SOLOMON COMPUTER
D. L. Slotnick, W. C. Borck and R. C. McReynolds, Westinghouse Electric Corp., Baltimore, Md.
A report on a parallel network computer, the SOLOMON—Simultaneous Operation Linked Ordinal MOdular Network. This is a new system involving the interconnections and programming, under the supervision of a central control unit, of many identical processing elements (as few or as many as a given problem requires), in an arrangement that can simulate directly the problem being solved. The computer shows great promise in aiding progress in certain critically-important areas limited by the capabilities of current computing systems.

THE KDF.9 COMPUTER SYSTEM
A. C. D. Haley, The English Electric Co., Ltd., Kidsgrove, Stoke-on-Trent, England
This paper will describe the KDF.9 system, a general-purpose computer using a "nesting store" system of working registers. This "store" consists of a number of associated storage positions forming a magazine in which information is stored on a "last in, first out" basis. It will be shown that this basic idea leads to the development of a computer having an order code near to the ideal for evaluation of problems expressible in algebraic form.

Wednesday, December 5
AFTERNOON SESSION (Pennsylvania East/West Room)
LANGUAGE AND SYSTEMS
SESSION CHAIRMAN: R. S. Barton, Altadena, California

A COMMON LANGUAGE FOR HARDWARE, SOFTWARE, AND APPLICATIONS
K. E. Iverson, Thomas J. Watson Research Center, Yorktown, N.Y.
This paper will comment on the advantages of a single comprehensive programming language and examine the suitability of a language described earlier, illustrating by applications in a variety of areas. Applications treated will include microprogramming, associative memory schemes, automatic programming, the analysis of compound statements and transformations between parenthesis and parenthesis-free representations, search algorithms, sorting procedures, symbolic logic, and matrix algebra.

INTERCOMMUNICATING CELLS, BASIS FOR A DISTRIBUTED LOGIC COMPUTER
C. Lee, Bell Telephone Laboratories, Inc., Holmdel, N.J.
An information storage and retrieval system in which logic is distributed throughout the system will be described in this paper. The system is composed of cells, each cell being a small finite state machine which can communicate with its neighboring cells. Each cell is also capable of storing a symbol. There are several differences between this cell memory and a conventional system. With logic distributed throughout the cell memory, there is no need for counters or addressing circuitry in the system. The flow of information in the cell memory is, to a large extent, guided by the intercommunicating cells themselves. Furthermore, because retrieval no longer involves scanning, it becomes possible to retrieve symbols from the cell memory at a rate independent of the size of the memory.

ON THE USE OF THE SOLOMON PARALLEL-PROCESSING COMPUTER
J. R. Ball, R. C. Bollinger, T. A. Jeeves, R. C. McReynolds and D. H. Shaffer, Westinghouse Research Laboratories, Pittsburgh, Pa.
The task of evaluating the feasibility of the SOLOMON computer has led to investigations of problems which primarily involve elementary, simultaneous computations of an iterative nature. In particular, the solution of linear systems and the maintenance of real-time multidimensional control and surveillance situations have been considered. Within these very broad areas two special problems have been rather thoroughly studied and will be presented in this paper to demonstrate the scope and application of this computer.

Wednesday, December 5
AFTERNOON SESSION (Grand Ballroom)
DATA COMMUNICATION SYSTEMS
SESSION CHAIRMAN: James Owings, RCA, Camden, N.J.

DATA PROCESSING FOR COMMUNICATION NETWORK MONITORING AND CONTROL
D. I. Caplan, RCA, Camden, N.J.
The long-haul communications network is the backbone of military communications. It provides the coordination necessary for global military operations and logistic support. For maximum network effectiveness, a central monitoring and control function is necessary. This paper will describe system studies that have shown that automatic data processing is applicable to network monitoring and control and provides rapid and efficient network reaction to natural and man-made disturbances.

LOGICAL DESIGN OF THE "VADE" REAL-TIME PROCESSOR
F. O. Williams, Jr. and D. R. Helman, ITT Federal Laboratories, Nutley, N.J.
A report on a processor that can handle up to 128 teletype and 16 high-speed data lines; it exchanges fast memory and circuit speeds for reduced total hardware through timesharing and a unique input/output approach.

ON THE REDUCTION OF TURNAROUND TIME
H. S. Bright and B. F. Cheydleur, Philco Computer Division, Willow Grove, Pa.
This paper will marshal arguments supporting the practicality of greatly reducing turnaround delays without using huge memory or very costly types of communication facilities. Described will be a typical large relaxation calculation, giving operation parameters as executed on a modern computer, showing for this rather formidable example a break-in-point interval on the order of several seconds.

REMOTE OPERATION OF A COMPUTER BY A HIGH SPEED DATA LINK

G. L. Baldwin and N. E. Snow, Bell Telephone Laboratories, Inc., Holmdel, N.J.

Availability of wide-band transmission facilities on a nationwide basis, now made possible by the TELPAK service offerings, is expected to enhance the capabilities of the data communication industry. To gain more knowledge as to the usefulness and reliability of high-speed transmission, an experimental digital system operating at 42,000 bits-per-second was recently installed. The system has been in routine operation since February, 1962, providing rapid access to an IBM 7090 computer at Murray Hill, N.J., from new laboratories at Holmdel, N.J. This paper will present the significant technical aspects of the system, as well as the operating characteristics and results from the point of view of the computer user.

Thursday, December 6
MORNING SESSION
COMPUTER TECHNOLOGY

SESSION CHAIRMAN: Theodore H. Bonn, Remington Rand UNIVAC, Blue Bell, Pa.

DATA PROCESSING STANDARDIZATION PROGRAM

C. A. Phillips, Business Equipment Manufacturers Association, N.Y., N.Y.

This paper will cover a data processing standardization program which had its genesis in an action by the International Organization for Standards in late 1959. On a recommendation from Sweden, it was determined there was a need for a standards program in connection with computers and information processing. It is remarkable that the need for a standards program was recognized so early in the state of an art, whose principal tool, the electronic computer, is but fifteen years old.

MICROAPERTURE HIGH-SPEED FERRITE MEMORY

R. Shahbender, RCA, Princeton, N.J., and H. Amemiya, RCA, Camden, N.J.

Because of the increased cost of the required electronic circuitry, bit capacities are generally less than those of a coincident, current store. Impulse switching techniques, together with advanced fabrication technologies, are being used to reduce cycle times to the vicinity of 100 nanoseconds. This paper will present the results of this approach, establishing the feasibility of medium-size, random-access ferrite memories with cycle times of 100 nanoseconds.

MAGNETIC FILMS—REVOLUTION IN COMPUTER MEMORIES

C. Chong and G. Fedde, Remington Rand UNIVAC, Blue Bell, Pa.

A survey of the characteristics of an ideal memory element approached by magnetic thin films. Their performance in several experimental and production memories will be summarized. Reasons supporting the belief that they will replace ferrites in the memories of future computers will be offered.

HURRY, HURRY, HURRY

H. Campaigne, Office of Research, National Security Agency, Ft. George G. Meade, Md.

Greater and greater capacity has been achieved in computers, and to a considerable extent this increase has been achieved by faster components. The state of the art seems to be that large increases in speed will be achieved in the near future, but beyond that it will take ingenuity to break the natural barriers that present themselves. This paper will offer a commentary on this trend, reviewing the competing techniques involved (cryotrons, subharmonic phase elements, Esaki diodes, and thin magnetic films) and some of the impediments to progress such as inadequate instrumentation at these speeds.

CRYOTRONICS: PROGRESS AND PROBLEMS

W. B. Ittner, III, Thomas J. Watson Research Center, Yorktown, N.Y.

While cryotronics is, to some degree, a rather special technology, it has not been possible to show that cryogenic circuits possess, on balance, any functional advantages over circuits realizable in competitive technologies. Accordingly, the only real promise for cryogenics would seem to lie in the possible cost advantages which might, in principle, be realized through the batch manufacturing of large integrated circuit modules. That such an advantage can be realized in fact is, at present, somewhat problematic. The current state of the cryogenic technology will be reviewed in this paper, and an attempt made to project the cost structure which would appear to be realized in the near future.

M. L. Cohen, Arthur D. Little, Inc., Cambridge, Mass.

This paper will also cover cryotronic technology, discussing its basic limitations and major engineering problems. The basic limitations stem from certain specifics of the technology, such as gain-bandwidth products, impedance and signal levels, and the required low-temperature environment. The engineering problems are those associated with the transfer of a device from the laboratory to the production line. Reliability, electrical and mechanical strengths, quality control, yield rates and other economic problems have, at worst, a certain nuisance value in the laboratory, but are of vital importance in a production situation.

Thursday, December 6
AFTERNOON SESSION
NEW DIRECTIONS IN INFORMATION PROCESSING

SESSION CHAIRMAN: Benjamin Cheydleur, Philco Computer Div., Willow Grove, Pa.

SOME EXPERIMENTS IN THE GENERATION OF WORD AND DOCUMENT ASSOCIATIONS

G. Salton, Computation Laboratory, Harvard University, Cambridge, Mass.

It is impossible to identify, classify, encode, and organize items of information or requests for data without first determining the content or subject matter of the information to be processed. In most proposed automatic systems, this analysis is based on a counting procedure which uses the frequency of occurrence of certain words of word classes to generate sets of index terms, to prepare automatic abstracts or extracts, to determine certain word groups, and to extend or modify in various ways sets of terms originally given. This paper will present two automatic methods to aid in an effective subject analysis.

A LOGIC DESIGN TRANSLATOR

D. F. Gorman and J. P. Anderson, Burroughs Corp., Paoli, Pa.

The process of logic design of a computer is analogous to programming, using hardware for commands. Logic designers must frequently take imprecise narrative descriptions of computer systems, and applying experience, ingenuity, inventiveness, and considerable perseverance to transform the description into a running system. This paper will describe an attempt to provide systems and logic designers with a means to automate the repetitive and otherwise error-prone detail associated with much machine design, as well as to provide for making systems changes acceptable for a longer period of time, without encountering the logical design equivalent of program patches.

COMPROTEIN: A COMPUTER PROGRAM TO AID PRIMARY PROTEIN STRUCTURE DETERMINATION

M. O. Dayhoff and R. S. Ledley, National Biomedical Research Foundation, Silver Spring, Md.

A computer program useful for reconstructing the sequence of amino acids in a protein chain, knowing the structure of many small fragments of the protein obtained through chemical breakdown, will be described. This program has been used successfully to elucidate the sequence of the protein ribonuclease, comprised of 124 amino acids, from a hypothetical breakdown into about 100 overlapping fragments, each of which has on the average four amino acids.

IFS-INTERRELATED FLOW SIMULATION

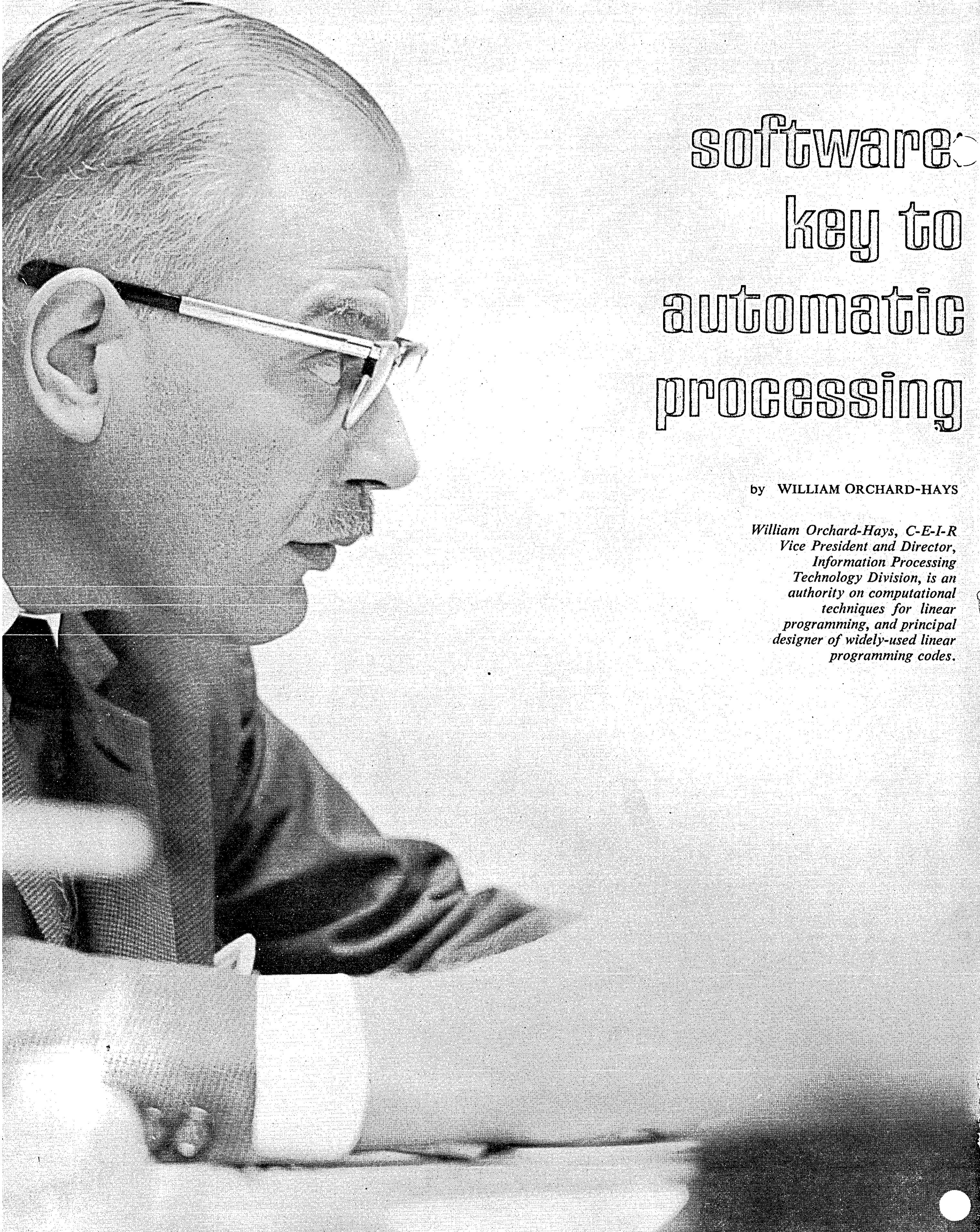
W. H. Dodrill, Service Bureau Corp., New York, N.Y.

A report on Interrelated Flow Simulation (IFS), which provides a numerical method for the behavioral simulation of a wide variety of flow systems—for chemical plants, petroleum refineries, etc.—will be offered in this paper. For design and analysis, it is necessary to estimate the behavior of specific systems. Obtaining these estimates is often complicated due not only to the intricacies of representing accurately the functioning of component units, but also to the complications introduced by recycles of dependent composition. IFS has been found to provide an easy-to-use method for such simulation.

A DATA COMMUNICATIONS AND PROCESSING SYSTEM FOR CARDIAC ANALYSIS

M. D. Balkovic, Bell Telephone Laboratories, Inc., Holmdel, N. J.; P. C. Pfunke, A T & T Company, New York, N.Y.; C. A. Steinberg, Airborne Instruments Laboratory, Deer Park, L.I., N.Y.; C. A. Caceres, U. S. Dept. of Health, Washington, D.C.

A data communication and processing system for cardiac analysis, now in operation, will be described in this paper. This system is composed of data-acquisition units, located in various parts of the country, a data processing unit, print-out devices, and data communication links which are set up as required. ■



software: key to automatic processing

by WILLIAM ORCHARD-HAYS

William Orchard-Hays, C-E-I-R Vice President and Director, Information Processing Technology Division, is an authority on computational techniques for linear programming, and principal designer of widely-used linear programming codes.

The high-speed computing industry has developed almost in its entirety during the past twelve years, anything before 1950 being antecedent and preliminary. Out of its many aspects, we can select three of primary importance:

1. Equipment or *hardware*
2. Programming systems or *software*
3. Specialized applications techniques

The first grew out of experience with the mechanical calculating machinery for three centuries, with punched card and paper tape equipment for five decades, and the rapid advance in electronics during World War II and the post-war years. The third grew out of mathematics developed for three millennia, from numerical analysis developed for five centuries, and the rise of operations research techniques during World War II and the post-war years. But the concept of programming systems has very little background. Apparently, the first recognition of the problem was by Babbage in the mid-nineteenth century, and this was only a sort of prophetic glimpse. Whatever development has taken place in the last dozen years has been done almost entirely by younger people, mostly with a bachelor's degree in mathematics or the physical sciences. Even today, there are only a handful of people fifty years of age who have substantial experience in computer programming.

Even during the explosive growth of almost everything in this twentieth century, the emergence of problems and arts which are new in *kind* is rare, though not unique. Piloting an airplane presented such a case, new in man's experience. So did accurate navigating of fast aircraft by airborne radar, which gives a rather weird sensation of indirect sight. The astronauts must find it odd to experience repeated settings and risings of the sun and the reciprocating of calendar days during a few hours in orbit. The visitor to a modern cigarette factory finds it difficult to comprehend the production of tens of millions of items per day in a relatively small plant. And the worker with radioactive materials must handle everything indirectly or remotely, and be aware of dangers he can neither see, hear, feel, taste, nor smell. Man's abstractions are becoming physical realities with which he must learn to live.

Intimate experience with programming a computer gives sensations much akin to those referred to in the preceding paragraph. This is why it has such an appeal to some people. It is easy to become addicted to it. Where else can a few strokes of the pencil define actions which will be repeated millions and billions of times and take place in a few millionths of a second? Where else can a person sitting at his desk devise complex iterative procedures which involve incredible amounts of arithmetic, but which he knows will be executed and give answers, as often as anyone wishes? Early programmers, like early pilots, practiced their art primarily for the thrill of it.

Now, just as pilots first learned to fly by the seat of the pants, so did programmers learn to control computers by personal, on-the-spot innovation and cleverness. But one can't fly a modern jet liner by the seat of his pants. Neither can a modern, high-speed, multi-million dollar computer be handled effectively by personal, uncoordinated innovation. There is this difference, however: one can, physically and literally, program a computer in this way, but not *effectively*. Although human lives will not be endangered, corporate lives may be, when playing with this much money and potential.

C-E-I-R has been involved in computing for over half of the twelve years of the growth of the industry, and individual staff members have experience extending over all of them. The company has been content to let larger corporations, with the resources and experience, develop the hardware—C-E-I-R has only made sure that it obtained the latest and best. The company has added to its staff specialists in various applications areas, and has used these people to form teams which have produced various applications systems. In the area of software, however, C-E-I-R has itself been a pioneer in basic development work. This experience is now bringing to fruition a comprehensive and standardized line of *software* packages which satisfy almost all users' needs. As widespread additional needs of its clients become apparent, C-E-I-R will expand this line. It is designed, however, to accept change, expansion, and specialization, without destroying the underlying functional unity.

This line of software will be produced first for the IBM 7090/94 EDPM's which C-E-I-R operates in many Centers. It will later be adapted to the IBM 7040/44 line. The software will be available either as part of an integrated computing service in its own Centers or on a fee basis for clients who operate their own equipment. C-E-I-R will also be happy to bid on preparing compatible software systems for other lines of equipment.

The philosophy C-E-I-R has evolved regarding software is predicated on a basic attitude of service. C-E-I-R does not believe, nor does it claim, that it is expert in all fields, nor that it can tell its clients how they should run their businesses. C-E-I-R does believe that it can offer its clients valuable services in helping them develop tools and skills which will enable them to do their jobs better. We offer computer-oriented services, and anticipate needs to the extent that we can do so. When the needs are special, we believe that our experience will result in developing more efficient, more suitable computing tools at less expense to our client than he would find elsewhere.

The frame of reference of our philosophy is one of continual change and variation. We are guided by the principle that change is a concomitant of modern business life, and that both change and changes in degree of change must be expected and planned for. We are convinced that no solution to a complex problem is final, nor that the validity of approach at one time is necessarily a permanent characteristic. Our software tools for building software are themselves designed for change.

What, in reality, the computer manufacturers have created is a new universe or realm in which man can work and apply his intellect. This is an unexpected result. What was intended to be a high-speed tool to assist man in massive clerical and computational chores has sprung to life as almost a new kind of organism. Whether this becomes a Frankenstein monster or not depends on the control mechanisms that are created via programming theory and systems. It is to this task that C-E-I-R has addressed itself through its Information Processing Technology Division.

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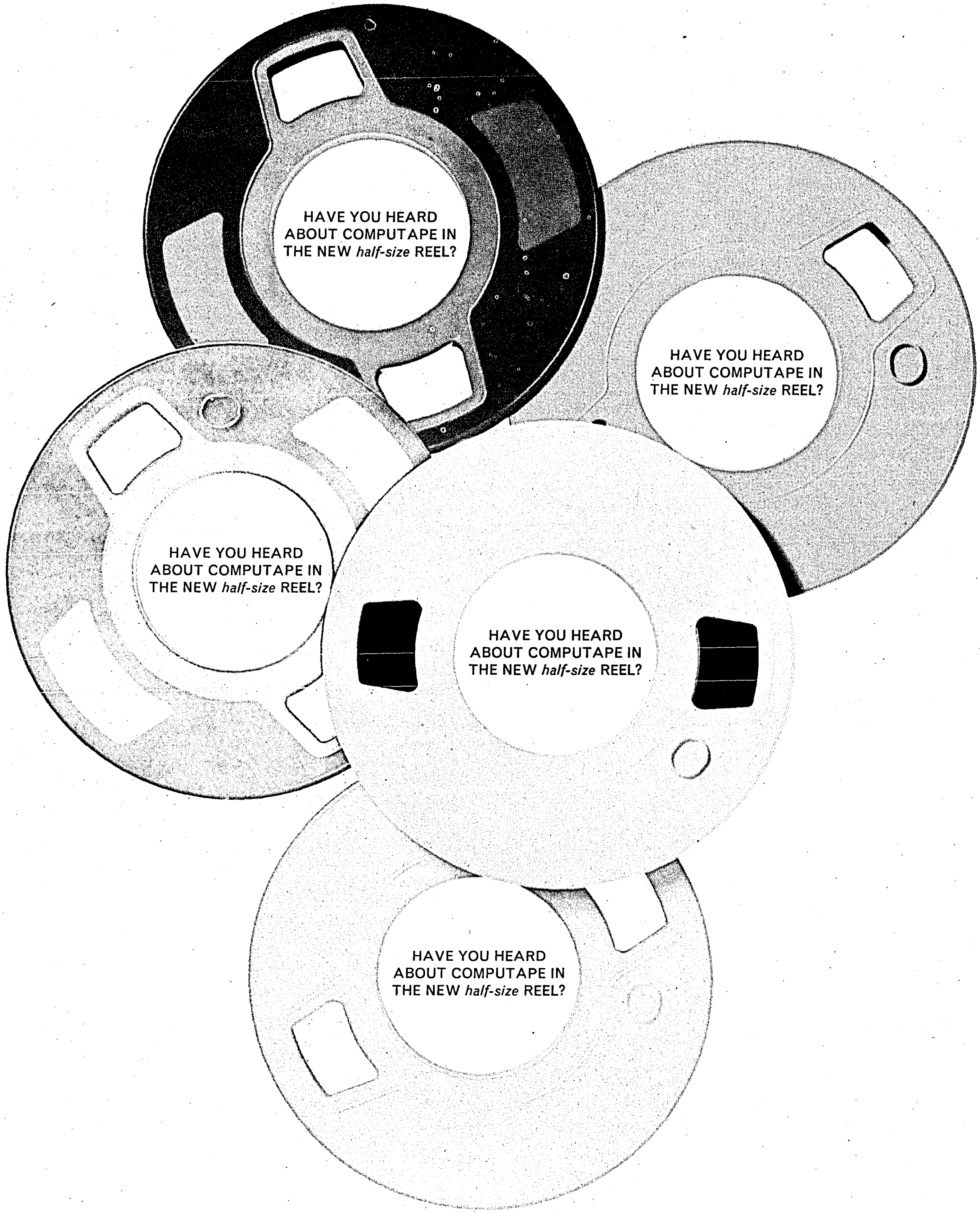

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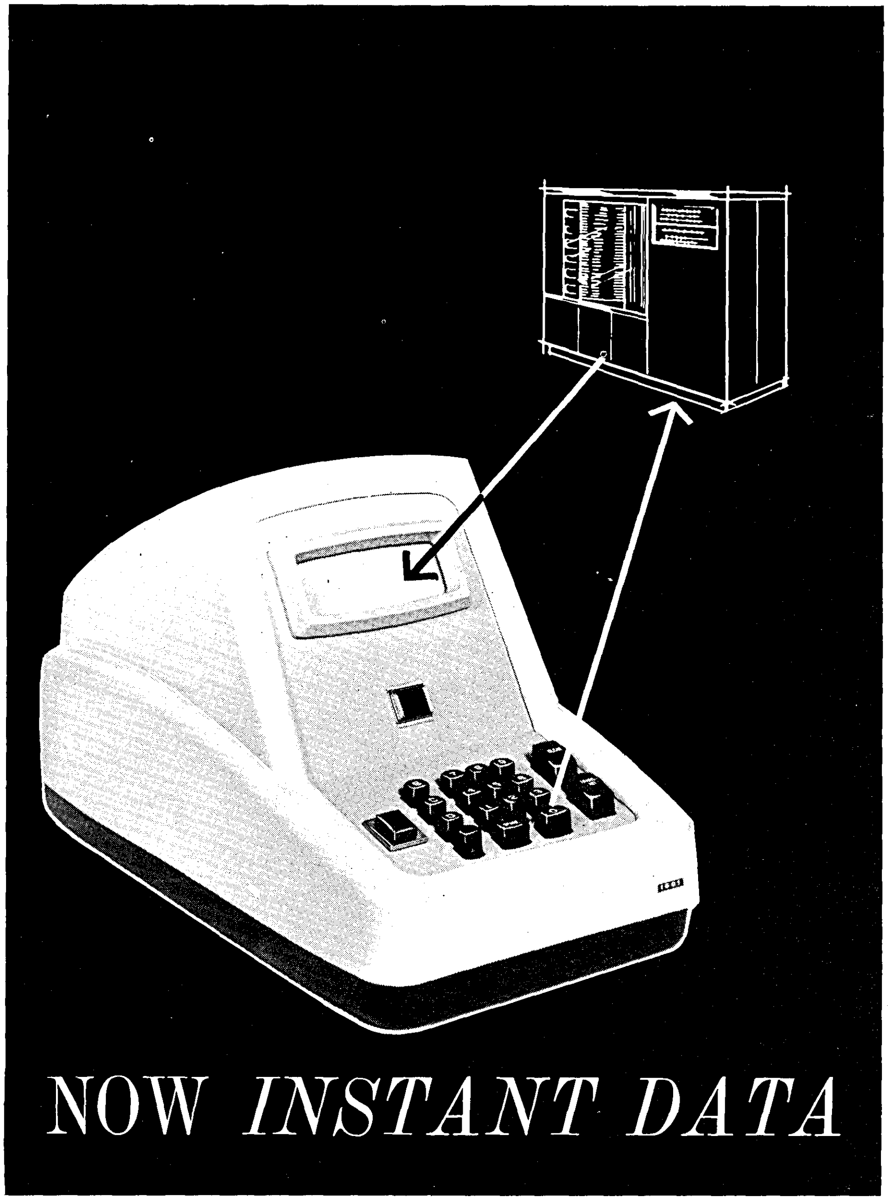

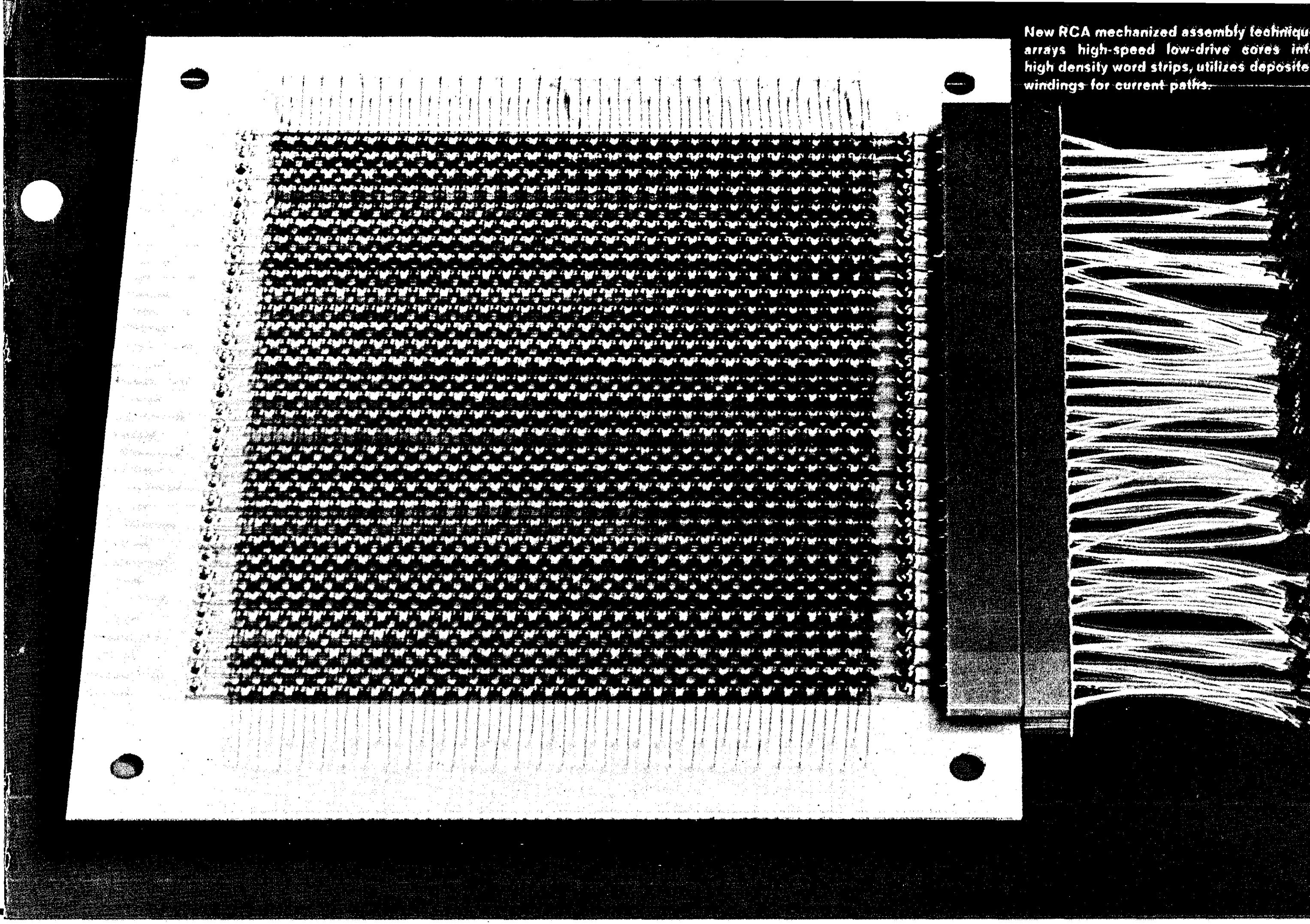

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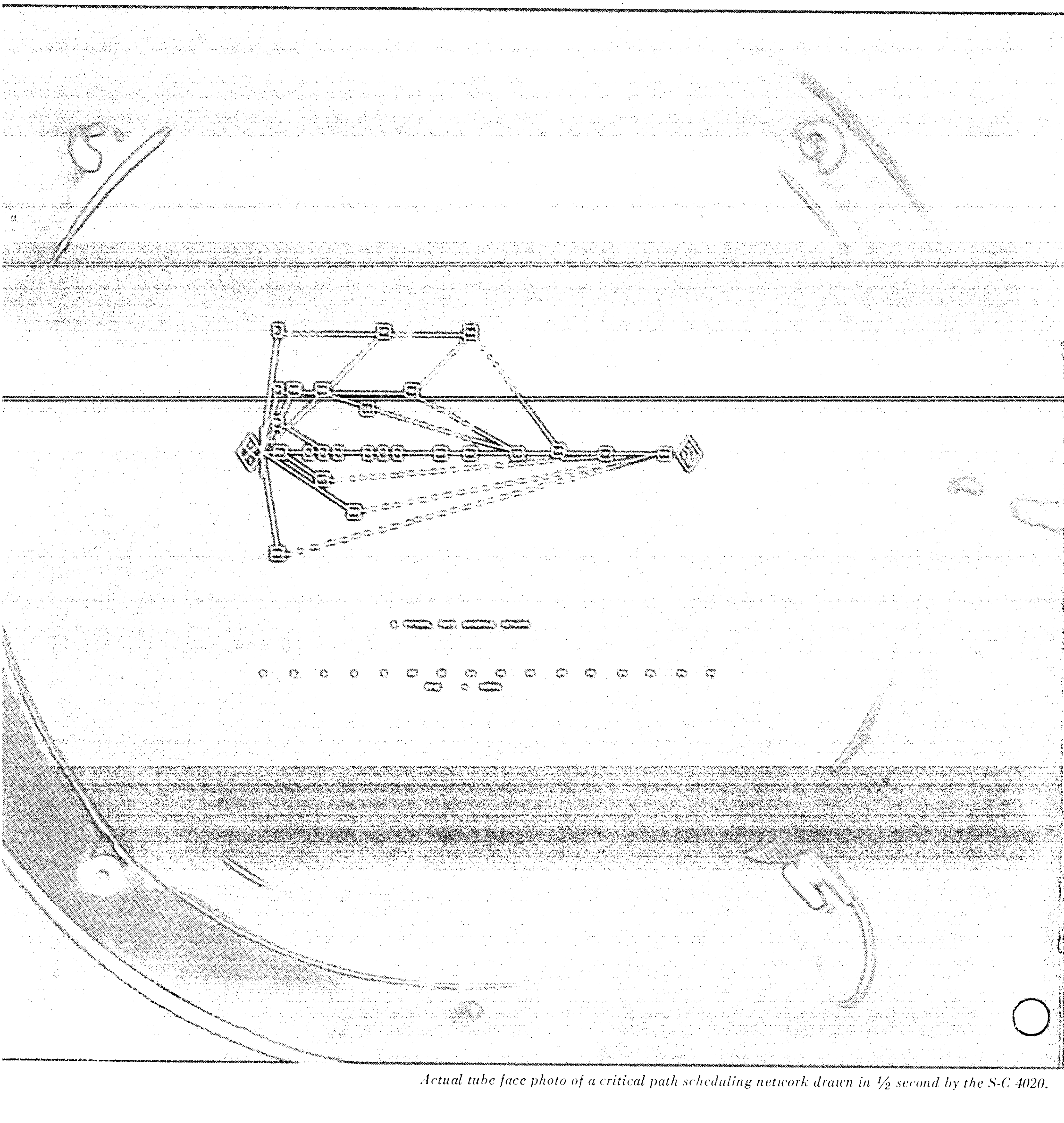

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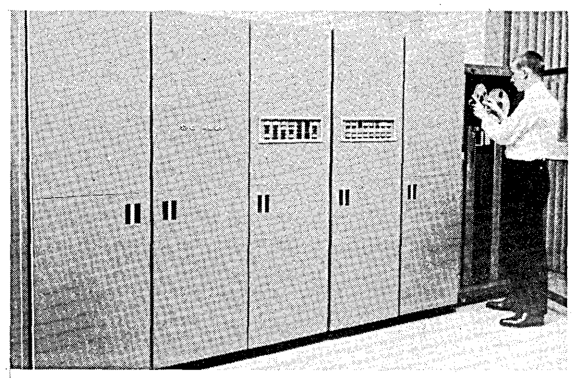

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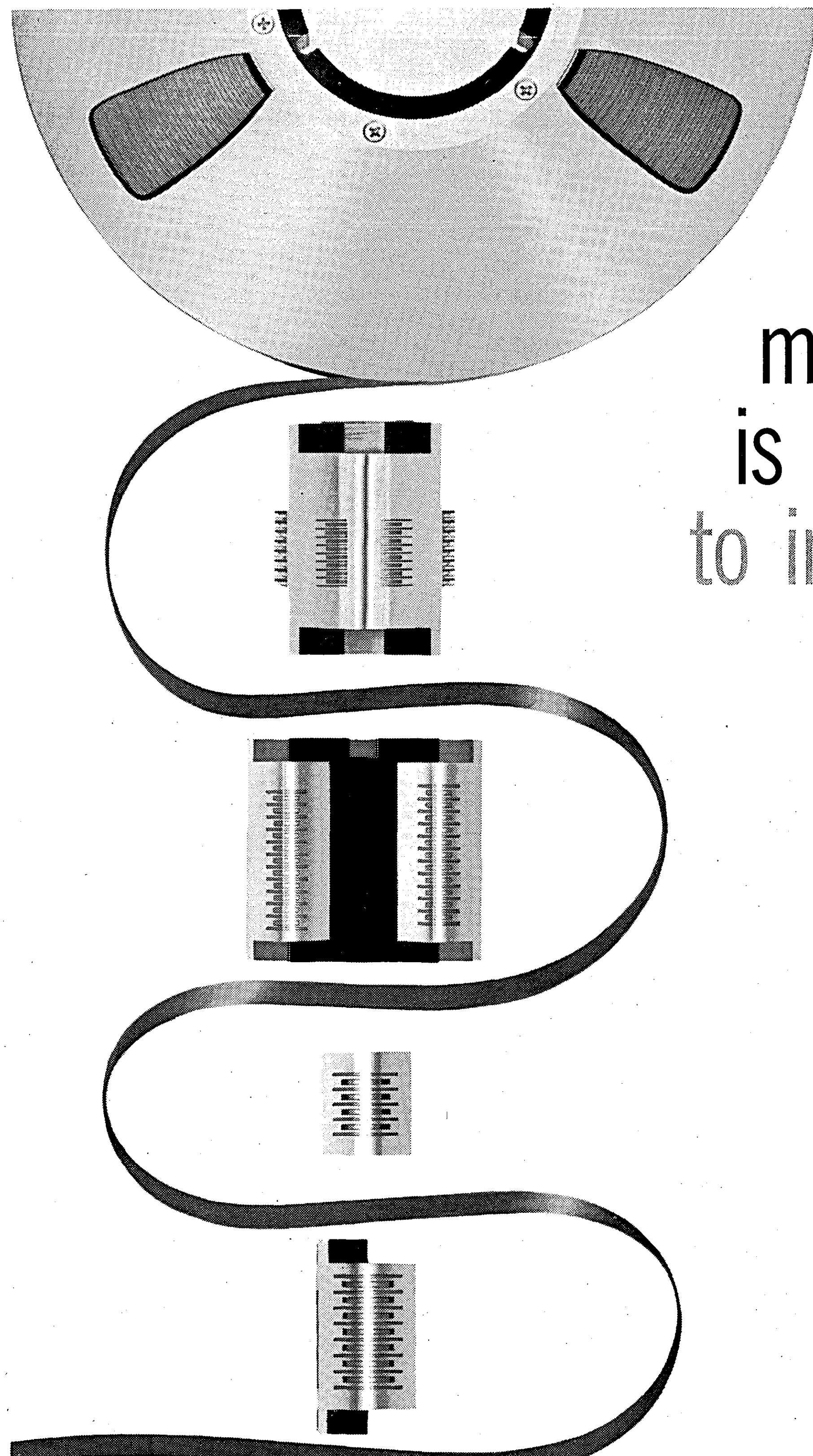

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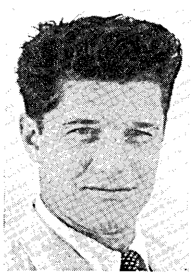
CIRCLE 36 ON READER CARD

MAINTAINING PREDETERMINED ACCURACIES IN DIGITAL RESULTS

by DAVID JOHN KEIL & ROBERT E. SMITH, Programming Research Dept., Control Data Corp., Minneapolis, Minn.



The necessity for checking accuracy at the digital output level is supported by Beer, Bellman, Householder, Wiener, [2], [3], [4], [7], and others. Many analysts point out that a system built upon abstractions is *deterministic* in nature, and as such, produces "paper and pencil" predictions. However, when constrained by machine characteristics of a digital computer, a system becomes probabilistic in nature, and as such, its structure must be redesigned on the basis of a careful analysis of its results. This is often referred to as the "feedback control" principle.

This report offers evidence to support the application of this principle as a technique that can be used to maintain, in the digital output results, the same degree of accuracies predetermined by the mathematical analysis. We shall claim: (1) that predetermined accuracies of primary mathematical functions, based upon mathematical logic, are particularly likely to deteriorate, at the digital output level, if *one* algorithm is used for *all* possible arguments; (2) the use of one algorithm for *all* arguments is grossly inefficient when execution times are considered; and (3) modification and redesign of analytical algorithms, after careful analysis of digital output results, can establish a model which will maintain the predetermined accuracies, and at the same time, provide efficient execution times.

The facts submitted in this paper are supported by a recent error analysis, [8], [9], of the basic circular—hyperbolic transcendental functions, and the exponential—logarithmic functions contained on the Library Reference Tape of one of Control Data Corporation's Compiler Systems. Although the computer used in the analysis was the CDC 1604, the findings are applicable to any computer.

The Use of One Algorithm For All Arguments. In recent years many logicians and numerical analysts have proposed various techniques as the "best" method of approximating the primary functions. The pendulum of logic has swung between classical power series, Chebyshev Polynomials, Padé approximations, Maehly's method, continued fractions, etc. Recently, many writers, including the authors of this report, have claimed that dependence upon one algorithm may lead to weakness rather than strength. As Bellman [3] states:

"The danger of subscribing too wholeheartedly to any particular type of mathematical analysis can not be stressed too emphatically . . . "

The authors of this report found, that in trying to maintain accuracies of function results, the presence of but *one* analytical algorithm often increased the possibilities of error deterioration. The reasons for this are many and include the following:

(a) One algorithm will often contain "trouble-spot" areas, where subtractions of intermediate results will wipe out all or most of the accuracy significance.

(b) It is difficult for one algorithm to maintain a high degree of accuracy at the extreme ends of the argument range. Applying extreme arguments to one algorithm is analogous to overloading a bridge beyond the safety margin of the center span.

(c) One algorithm often includes the technique of "nesting" in order to eliminate some multiplications. In many cases, nesting aggravates, rather than aids, the problem of accuracy maintenance.

An expanded description of each of these factors is pertinent, and follows:

Trouble-Spot Areas. If one algorithm is used for all arguments, trouble-spots will often appear. Trouble-spots are argument ranges, covered by the algorithm, where predetermined accuracies deteriorate at the digital output level. Sometimes trouble-spots can be predicted by graphical or analytical analyses. However, others only become apparent to the analyst at the digital output level, after he has sampled, either the whole argument range, or some suspected critical area. Once a trouble-spot area is identified, a graphical or analytical analysis can usually indicate the source of trouble.

The graphical curve of the function often indicates argument ranges where deterioration of accuracies are more likely to occur. Such areas generally appear in those portions of the curve where the rate of change of the slope approaches either zero or infinity. That deterioration of accuracies should occur in these regions is reasonable, when one considers that *analytical* statements such as:

$$X \rightarrow 0$$
$$X \rightarrow \infty$$

are often part of the structure upon which some algorithms rest. Both of these concepts encounter serious limitations when interpreted digitally since underflow—overflow logic and other machine characteristics become involved.

Analytically, one can predict trouble-spot areas by examining the function algorithm or predetermined logic and analyzing the subtractions and transformations that are involved. In some cases, it is possible for the subtractive logic of the computer to erase *all* or *more* significance than that intended or inferred by the analytical expression. Thus an analytical expression, $2X - 5$, may possibly *cease* to exist, in a digital sense, when certain digital arguments are applied to it.

Assume for example, the analysis of the arc hyperbolic secant, Y = ASECH(X).

$$Y = ASECH(X) = \log_e \frac{1 + \sqrt{(1-X)(1+X)}}{X}$$

To maintain accuracy in this algorithm, it is necessary that the logarithmic and square root calculations be done without error. Let us assume that such is the case. There yet remains the predictable trouble-spot, $1 - X$, in the radicand. For certain values of X, very close to 1, this subtraction can *not* digitally be made without error. Two alternatives appear: (1) use another algorithm for values of X close to 1, or (2) re-program the subtraction, in this particular range, so that the cause of error, (shifting when scaling is different), is removed. Often the second alternative is difficult or inefficient to accomplish programwise. If so, redesign of the initial algorithm by the first alternative is recommended.

Trouble-spots also often emerge from *digital* transformations. For example, it is a well known fact, and suggested by many analysts, [5], that for higher ranges of arguments of the cosine, it is better to use the sine of the complementary function. Thus:

$$\cos X = \sin (\pi/2 - X)$$

Analytically, the above transformation is straight forward, but *digitally* extreme caution must be imposed. Two aspects make "$\pi/2 - X$" a trouble-spot: (1) the subtraction itself, and (2) the fact that $\pi/2$ can not be exactly expressed in binary notation, and must be expressed by an approximation — which we refer to here, as $\pi/2_*$. If we assume, in this example, that the subtraction can be digitally performed without error, there still remains the problem of trying to express a "truer" value of $\pi/2$ in the computer. One method for accomplishing this is by double precision arithmetic as shown in the following example.

Calculate $\pi/2$, in binary, to *double* the precision carried by one computer word. Then perform the digital transformation as shown.

Word 1 $(= \pi/2)_*$	Word 2 $(= \triangle$ of $\pi/2)$
Significant part of $\pi/2$	"Delta" part of $\pi/2$

Double Precision Value of $\pi/2$

$$\text{Cos } X = \sin (\pi/2_* - X + \triangle)$$

Loss of Accuracy at the Extremities of the Algorithm. Each algorithm is generally a portion or part of a larger mathematical series or expression. The truncation of the series or expression establishes boundary thresholds within which predetermined accuracies are applicable. As arguments approach these boundary thresholds, the degree of accuracy guaranteed by the algorithm becomes more marginal. In the immediate neighborhood of the boundary thresholds, various machine characteristics, such as: rounding, shifting, overflow, and underflow, take on added significance, and tend to have a larger influence on the accuracies of the digital results. As a consequence of these factors loss of accuracy in digital results often appear when arguments near the extremities of the algorithm are used.

The tangent function is an example of this nature. If one algorithm is used for all arguments between zero and $\pi/2$, accuracies of digital results often deteriorate, when arguments close to $\pi/2$ are used. By carefully analyzing digital results in this neighborhood, it is usually possible to discern a threshold value above which accuracies start to deteriorate. For arguments above this threshold it is probably better to use the complementary angle $(\pi/2 - X)$ and the corresponding cofunction algorithm.

Lower limit arguments often meet with similar difficulties. The cosine function is an example. Again, the difficulty is due to the fact that approaching zero in an analytical sense, is not indicative of doing the same thing in a digital sense. Underflow characteristics often influence results at this point.

In concluding this section it is important to note that the rate of approach is also of extreme importance in maintaining accuracies at the extremities of the algorithm. Analytically, it is possible to approach a limit by increments which can be made as small as the analyst desires. Digitally this is not the case. The change from one argument to the next immediate lower or higher argument, is at least measured by *one* bit; and due to rounding, may even be more than one bit. As a consequence, the analytical algorithm which, "on paper," provides for arguments from 0 to 90 degrees, may actually only return accurate digital results for arguments from 0.125 to 89.75 degrees. Maintaining digital accuracies for extremity arguments is often a challenge to the programmer, and one that is often solved by modification and redesign of the analytical algorithm after analyzing the digital output results.

Nesting. The technique of nesting is generally used as an attempt to decrease the number of multiplications required in an algorithm. Thus, the algorithm, $ax + bx^3 + cx^5$, contains six multiplications in its original form; whereas, only four multiplications are required when it is nested as: $x\ [a + x^2\ (b + cx^2)]$. It is evident that nesting involves a sequence of operations which can be best described as follows: multiply, then add, multiply again, add, multiply again, add, etc. In many instances this sequence operates very efficiently as far as maintaining accuracies over the range being tested. When this is true, the nesting procedure is recommended since it is generally faster. However, indiscriminate use of nested forms, without careful analysis, is not recommended. There are many nested algorithms where the above sequence of "multiplies and adds" compounds the accuracy deterioration potential. This is often the case, when some of the constants in the nested form are negative. The "multiplies and adds" then become "multiplies and subtractions" with the possibilities that accuracy significance may be lost during the subtractions. Once error is introduced, by loss of significance, it is carried throughout the nested form — often with disastrous effect upon the final result.

One's first thought is that if error can be introduced by a nested expression, it will also be introduced by the equivalent unnested expression. Analytically, this is true but digitally the amount of error, and its effect on the final result, may be significantly less in the unnested form. Thus the error introduced by $bx^3 - cx^5$ may have little or *no* effect; whereas, the error introduced by $x^3(b - cx^2)$ may be very significant. The difference is usually due to the scaling sequences of the computer itself. In the former, scaling — which involves register shifting — may permit the subtraction to occur without losing significant bits; whereas, in the latter, cancellation of significant bits may occur because of difference in scaling before the two corresponding subtrahends (cx^5 and cx^2) are subtracted.

Execution Times. Computer analysts are just as anxious to make function routines faster as to make them accurate. The use of *one* algorithm for *all* arguments is not an efficient procedure with respect to execution time. This fact is fairly obvious, since the number of terms required to meet the accuracy criterion is dependent upon the size of the argument itself. Since many arguments require only a few terms of the algorithm, it is not efficient, time-wise, to run all arguments through the entire algorithm. The well known sine function is used as an example,

$$\text{sine } x = x - \frac{x^3}{3!} + \frac{x^5}{5!} \text{ ------------.}$$

For some arguments, calculation of terms beyond the first term constitute no significance to the first term. In other words, terms beyond the first are so small, they can be neglected. For such arguments, only the first term is required and the algorithm can be redesigned to:

$$\text{sine } x = x$$

For still other arguments, only the first two terms are required; for others, the first three terms, etc.

If the computer being used is capable of performing a fast threshold search or table look-up, it is more efficient to redesign the mathematical algorithm so that the minimum number of terms, satisfying the accuracy requirements, be used for each unique argument.

Using this philosophy, it is possible to design mathematical algorithms [10] that are partitioned by threshold values so as to maintain desired accuracies, and at the same time, require computation of only those terms that significantly affect the results. Under such a system, not only are predetermined accuracies maintained, but an efficient balance between accuracy and timing is established.

Importance of Logic Modification and Redesign. Too often the analyst assumes that the abstractive logic, upon which the algorithm is built, will insure accurate and predetermined results. Yet even if such were the case, and evidence already presented indicates the opposite, there are other reasons for modifying and redesigning the initial algorithm on the basis of feedback from digital results. Some of these deserve further description.

(a) Feedback indicates more exact thresholds than those predetermined by abstractive reasoning,
(b) Feedback indicates thresholds beyond which digital results remain constant,
(c) Feedback often indicates areas where new or redesigned logic can be more efficient.

More Exact Thresholds by Feedback. To adequately define and measure every conceivable computer characteristic, so as to be able to arrive at an exact, predetermined, and analytical threshold value, is not only difficult, but also very impractical. By analysis, one is usually better able to *approximate* the threshold value without taking into account the machine characteristics of the computer. Then, after an anlysis of digital results, the initial, approximate threshold can be modified to more closely conform to the exact threshold value.

Assume for example, one wishes to determine a digital threshold, x, so that the expression, log 2/x, can be used to evaluate

$$\log \frac{1 + \sqrt{1 - x^2}}{x}$$

Analytically, it is evident that as x approaches zero, the latter expression approaches the former. The question is: how close to zero must the argument be, before accurate digital results can be found by using this simpler expression?

For this example, assuming that ten decimal digit accuracy is desired, the analyst might analytically arrive at a predetermined threshold as follows:

if $x^2 < 0.1\ (10)^{-10}$, the term is negligible,
and $1 - x^2 = 1$
and $$\frac{\log_e 1 + \sqrt{1 - x^2}}{x} = \log_e \frac{2}{x}$$

therefore: $x < 0.33\ (10)^{-5}$ is the predetermined threshold.

This threshold value should now be tested by the analysis of digital results. This is done by calculating log 2/x for many arguments in the neighborhood of the threshold, and checking the validity of the corresponding digital results. Such an analysis will indicate the possibility of raising the predetermined threshold without loss of accuracy.

It might be of interest to the reader to know that a threshold for this example was established by following the previously outlined procedures. The feedback from the digital analysis indicated it was possible to modify the initial threshold from $.33\ [10)^{-5}$ to $.441\ (10)^{-5}$.

Stability of Digital Output Recognized By Feedback. As arguments approach limiting values of algorithms, digital results generally tend to stabilize and remain constant. An analysis of digital results enables one to identify thresholds where stabilization takes place.

Not only do these threshold values add corresponding benefits in simplicity to the program, but execution times are decreased significantly. Without feedback at the output level, these threshold points would be very difficult to determine. Following are a few of the thresholds recently found in a research project where thresholds of this type were desired:

Function	Threshold	Constant Value of Function
$Y = \sin x$	$1.5707 < x < \pi/2$	$Y = 1$
$Y = \text{arc tan } x$	$x > 3076$	$Y = \pi/2 - 1/x$
$Y = \tanh x$	$x > 12.5$	$Y = 1$ (one bit under 1)
$Y = \text{arc csc } x$	$x > 10^5$	$Y = 1/x$

More Efficient Logic From Feedback. Frequently, analyses of digital results disclose inaccuracies, which in turn, lead to redesign or modification of initial algorithms. The case below is an example:

In analyzing reasons for slight inaccuracies in digital results for the function, $Y = e^x$, it was evident that the basic algorithm was not returning high precision accuracies. The algorithm being used was:

$$Y = e^x = 2^n\ e^{x - n\ln 2}$$

For certain arguments, the term, $e^{x-n\ln 2}$, was difficult to evaluate without some deterioration of accuracy. The analysis indicated the source of difficulty to be the subtraction, x-nln2.

Another algorithm was studied which involved the following:

$$Y = e^x = e^n \cdot e^{x-n}$$

In this case, using the same arguments, e^{x-n} returned accurate digital results, and a technique was found for evaluating e^n accurately.

This example indicates that anlysis of digital results often leads to complete redesign of analytical logic. The digital results thus demonstrate inadequacies or weaknesses that might otherwise go unnoticed, and force the analyst to make renewed efforts — often in an opposite direction.

It is not uncommon to find functions where arguments falling within one portion of the curve will maintain predetermined accuracies; but marginal inaccuracies will appear in the remaining portion of the same curve. For example, the arguments falling below $\pi/4$ in the tangent curve as compared to those arguments falling above $\pi/4$. In such cases, the analysis of digital results may indicate a "cross-over" threshold, and the mathematical model can then be modified to provide two separate algorithms for arguments falling above and below this threshold. It is not uncommon in such cases, to evaluate all arguments in the portion of the curve which returns accurate digital results. This is done by transforming the argument falling in one portion of the curve to an equivalent angle in the other portion. Again, this technique is possible only if error is not introduced as a result of the transformation.

Conclusions. From this research, have come increased evidence to support the principal of feedback control in order to assure accuracy of basic function results. It is not sufficient to assume that accuracies predicted by analytical theory will carry through to output results. As previously claimed by Beer, Bellman, Leonides, and Wiener [2], [3], [6], [7], it is necessary to modify and redesign the original analytical analysis on the basis of the actual results obtained.

Differences between theory and results are usually due to: truncation of parameters and constants, intermediate subtractions of almost equivalent sub-results, using one algorithm for all arguments, machine characteristics that are difficult to fully control, and the inability to *digitally* perform — without error — cetrain analytical transformations and equivalences.

The use of output results to modify and redesign the original theoretical algorithms makes it possible to maintain a high degree of accuracy of function results throughout the argument range. With such a technique there is no excuse for the programmer to permit accuracy deterioration within "strange" or "unusual" regions of the function. ■

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THE IBM 1440

complete with six-packs

The IBM 1440, described as a new low-cost data processing system, has been introduced by IBM. The system, which features a new storage facility—disc storage drives with interchangeable packs—was designed for businesses which do not require a computer in the 1401 class, but have a need for processing capability beyond punched card equipment.

Monthly rental prices for the 1440 range from approximately $1,500 to $6,500. Purchase prices are from approximately $90,000 to $315,000. A minimum configuration includes console, processing unit with 4K positions of core storage, and card read-punch. Monthly rental for the first 1311 disc drive is $650; additional drives will rent for $375 each. Disc packs must be purchased for $490 each. The computer will be delivered on an 18-month schedule.

The disc pack has a storage capacity of nearly three million alphameric characters. Each pack contains six, 14-inch magnetic discs, which may be utilized for either random or sequential applications. Access time is within 250 milliseconds. Up to five drive units can be used with the system.

Processor arithmetic speeds are: add and substract, .2 milliseconds; multiply, 1.9 milliseconds; divide, 2.6 milliseconds. The latter functions are accomplished by programmed subroutines. A multiply-divide feature is available that increases operating speed and conserves storage space.

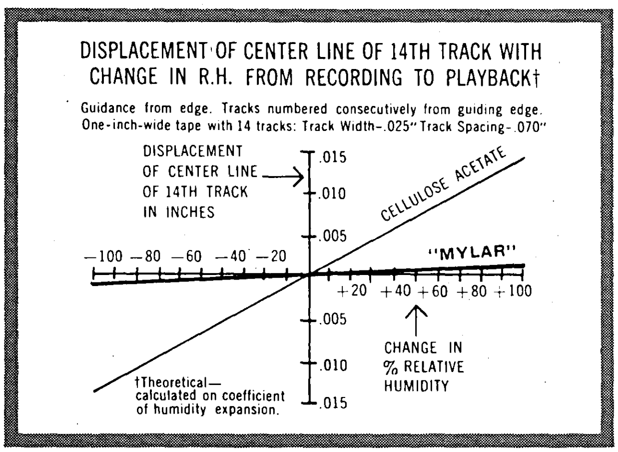
Other new components are the 1442 card read-punch, a columnwise reader which reads 80 column cards at up to 300 or 400 cards per minute. Punching speed is from 50 to 180 cpm. A second model will punch at 91 to 270 cpm. The 1443 printer operates at speeds of from 120 to 430 lines per minute, using a single type bar moving horizontally across the paper. Printing speed is 150 lpm with the 52 character bar, which includes 26 alphabetic, 10 numeric and 16 special characters. A 13-character numeric bar allows printing at speeds up to 430 lpm. Type bars may be interchanged by the operator with a minimum of effort. A second optional console includes a Selectric typer as an I/O printer.

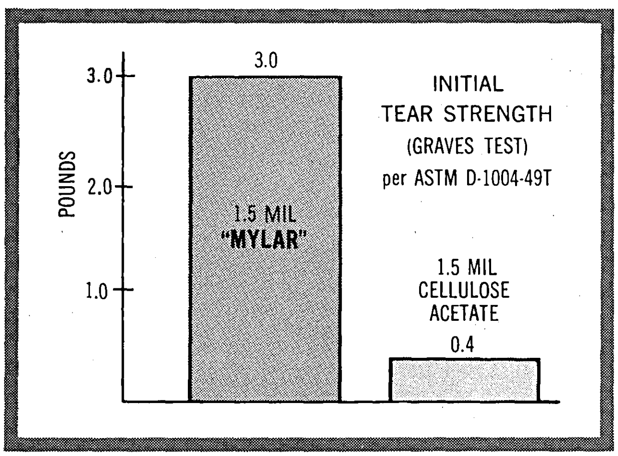
Software support includes Autocoder; I/O Control System; Disc Storage Organization Program; Disc Storage Utilities Program; a Report Generator; and Sort. The logic of the internally-programmed 1440 is arranged similar to the 1401.

The 1311 disc storage drive can also be used with the 1401, 1620, 1710 (and presumably others on an RPQ basis). Rental of the first drive on a 1401 is $1000; for the 1620 and 1710, $800. ■

Operator loads a disc pack on a 1311 disc storage drive. Other components of the 1440 system are the console, card read-punch, and the processing unit.

GUARD AGAINST GARBLED SIGNALS WITH RELIABLE TAPES OF MYLAR®





An unreliable tape can shrink or swell—cause garbled signals because the tape tracks shift laterally away from the recording and playback heads. With tapes of dimensionally stable "Mylar"* polyester film you get accurate results . . . valuable programming time is saved.

"Mylar" is strong—has a tear strength seven times greater than ordinary plastic of equal gauge. Tapes of "Mylar" resist edge nicks, stretching or breaking from sudden stops and starts. "Mylar" is durable—is not affected by humidity or adverse temperatures. And because it contains no plasticizer to dry out, "Mylar" does not become brittle in storage over long periods of time.

Why not safeguard your valuable program time by choosing reliable tapes of "Mylar". To be sure you'll get top performance, insist on a base of "Mylar" on your next order for magnetic tape. Send for free booklet of comparative test data. Du Pont Company, Film Dept., Wilmington 98, Delaware.

*"Mylar" is Du Pont's registered trademark for its brand of polyester film. Only Du Pont makes "Mylar".

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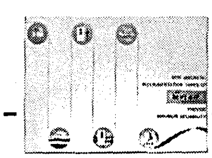


E. I. du Pont de Nemours & Co. (Inc.)
Film Department, Room #12, Wilmington 98, Delaware

Please send free, 12-page booklet of comparative test data to help me evaluate magnetic-tape reliability.

Name__________ Position__________

Company__________

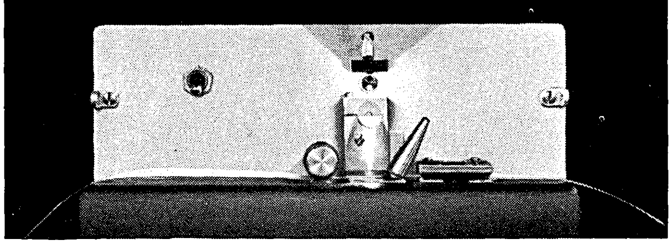
Address__________

City__________ Zone____ State__________

CIRCLE 37 ON READER CARD

How much does it cost to get Digitronics photo-electric reliability in your tape reader?

$745



It used to cost over $2000—if you installed a Digitronics high speed photo-electric unit. So, with regret, many designers remained wedded to electro-mechanical readers. Now, however, at speeds to 300 cps, stepping at 100 cps, you can design-in a Model 2500 Digitronics photo-electric perforated tape reader for only $745.

Best of all, the Digitronics quality is still here—right down to the finely machined parts, stainless steel corrosion-resisting parts, self-adjusting brake, solid state circuitry, and other important design features.

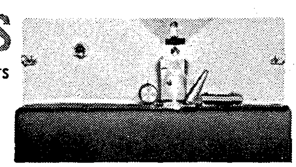
True, this is a simpler reader, with fewer sophisticated functions and capabilities. But for lower speed applications, long the domain of electro-mechanical readers, there's nothing finer than this new product. Find out about the Model 2500 today.

Should you have more sophisticated requirements, Digitronics can provide you with readers capable of accommodating 5 to 8 level tape interchangeably at 60 to 5000 cps. Tape handlers are also available for 5 to 8 level tape up to 1000 cps.

For more information, write Digitronics Corporation, Albertson, New York.

DIGITRONICS PERFORATED TAPE READERS

Where every bit counts



See this equipment at Booths 77-79 at the EJCC.

CIRCLE 24 ON READER CARD

NEWS BRIEFS

CALL FOR PAPERS FOR '63 SPRING JOINT CONFERENCE

Deadline for papers to be submitted for the 1963 Spring Joint Computer Conference has been set for December 1, 1963. The conference will be held May 21-23, at Cobo Hall, Detroit.

The program is being planned to include sessions in these interest areas: programming; analog and hybrid systems; artificial intelligence; algorithms in business data processing; machine organization (including hardware/software interplay); new logic and memory devices; data acquisition, transmission, and display; and information retrieval (including applications).

Accepted papers will be published in hard-bound proceedings, which will be made available at the conference. Authors should send five copies of a draft of the complete paper, beginning with a 100-150 word abstract, to: B. W. Pollard, Chairman, Program Committee, 1963 Spring Joint Computer Conference, Burroughs Corp., 6071 Second Avenue, Detroit 32, Mich.

The general chairman of the conference, E. C. Johnson, has named his executive planning staff, to include: vice-chairman, D. E. Hart, General Motors Research Laboratories; secretary, R. C. Sims, Bendix Research Laboratories; treasurer, D. V. Burchfield, Touche, Ross Bailey and Smart; technical program chairman, B. W. Pollard; associate chairman, B. A. Galler, University of Michigan; exhibits, W. R. Forsythe, IBM; exhibits, A. D. Meacham, American Data Processing, Inc.

CARNEGIE TECH RECEIVES $400,000 DOD GRANT

Carnegie Institute of Technology has received a $400,000 grant from the Advanced Research Projects Agency of the Department of Defense for research in the areas of computer programming, language, programming theory, artificial intelligence, interpretation of natural languages, man-computer reaction, and computer design.

While ARPA is primarily interested in military command and control, the agency is supporting a broad program of studies whose eventual applications are not limited directly to military matters.

The grant will supply funds for part-time support of research conducted by A. J. Perlis, head of the mathematics department; Allen Newell, professor of systems and communication sciences; Bert Green, new head of the psychology department, and six research assistantships for graduate students and post-doctoral fellows. A considerable portion of the grant will go toward the purchase of new equipment for use with the school's Bendix G-20.

TRW DEVELOPS COMPUTER DISPLAY

A man-machine communicator, called the TRW—80 Control/Display Console, has been announced by Thompson Ramo Wooldridge Inc. The push-button operated device is designed to work with virtually any general purpose computer now in existence or under development.

The console will enable an operator to command a computer in English language terms to perform and display computations, draw maps or diagrams to his specifications, store in memory graphs which were drawn electronically on the face of the TV-type tube, and display tables of information, from data in memory.

IPL-V USED FOR PRODUCTION PROGRAM

A production program written in IPL-V will be delivered to Hughes Aircraft Corp. by Mesa Scientific Corporation, Inglewood, Calif. The program, called VAP (VATE Assembly Program), will be implemented by Hughes for its testing and checkout complex, Versatile Automatic Test Equipment.

The problem, as described by Mesa, was to produce minimum-latency, real-time object programs for VATE's 42K-word memory, multi-programmed drum computer, and dictated the use of a language that would permit a recursive definition of the location assignment task. The source language to be assembled by VAP was required to permit unlimited incorporation of macro-codes, to include multiple nesting of macros.

IPL-V, developed at The RAND Corporation as a list processing language, was selected by Mesa as the only system with the required flexi-

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SCOPT BULLETIN #10
October 4, 1962

ACM STANDARDS COMMITTEE
SUB-COMMITTEE ON PROGRAMMING TECHNOLOGY

The output of SCOPT will not be published in full in the Communications of the ACM as previously reported to you. In view of IFIP and U.S. Government activities, the ACM Council, and in particular the new chairman of the ACM Standards Committee, Dr. Saul Gorn, has determined that "ACM cannot, and should not, attempt a belated glossary of our own at this moment."

In view of this decision, I have been asked to "call a final meeting of SCOPT as a working session to extract a formal preliminary glossary, say the one hundred most interesting items for immediate publication in the Standards Section of the Communications."

You are hereby invited to attend an all day working session of SCOPT to be held on Thursday, October 25th beginning at 9:30 a.m. at the Moore School of Electrical Engineering in Room 129.

Material produced by SCOPT will be available for evaluation and selection for publication. I would like to thank you all for your cooperation over the past twenty six months. I hope that each of you will be able to attend the meeting on October 25th.

W. Barkley Fritz
Chairman, Sub-Committee
On Programming Technology

AN ANALOG COMPUTER TO YOUR ENGINEERING LAB

A "fully expanded" 20-amplifier PACE® TR-10 analog computer can be delivered to your office or laboratory for as little as $50 a week and the larger 48-amplifier TR-48 computer is yours for a few dollars more. Both of these machines can provide your research or engineering staff with a unique understanding of the dynamics of complex systems, making system design and optimization simpler and faster. Thus, for a fraction of the salary of the average engineer, you can significantly expand the creative output of your present engineering or research effort. This is the reason why hundreds of these computers are already operating in research and development laboratories throughout the world. ☐ The TR-10 and TR-48 computers are fully transistorized and virtually maintenance free. They can be set up on your desk and plugged into any 110-volt outlet. They can be easily understood and readily operated by your present engineering staff and require no extensive operator or programmer training. Here, then, is the "individual engineer's" computer available at a rental rate that makes it practical for every laboratory. ☐ EAI has several advantageous leasing plans. Whether you are interested in lease or purchase, write for full information on these desk-top analog computers today.

EAI

ELECTRONIC ASSOCIATES, INC. *Long Branch, New Jersey*

CIRCLE 38 ON READER CARD

bility and capability of incorporation in the operation system of Hughes' 7090.

SYLVANIA READIES COBOL FOR MOBIDIC

Sylvania Electric Products Inc. has received a $544,000 U. S. Army contract for development of a COBOL compiler for use with its MOBIDIC systems. Initial applications of the compiler will be for programs of a scheduled MOBIDIC installation in Europe. Four Army MOBIDIC systems are currently operating.

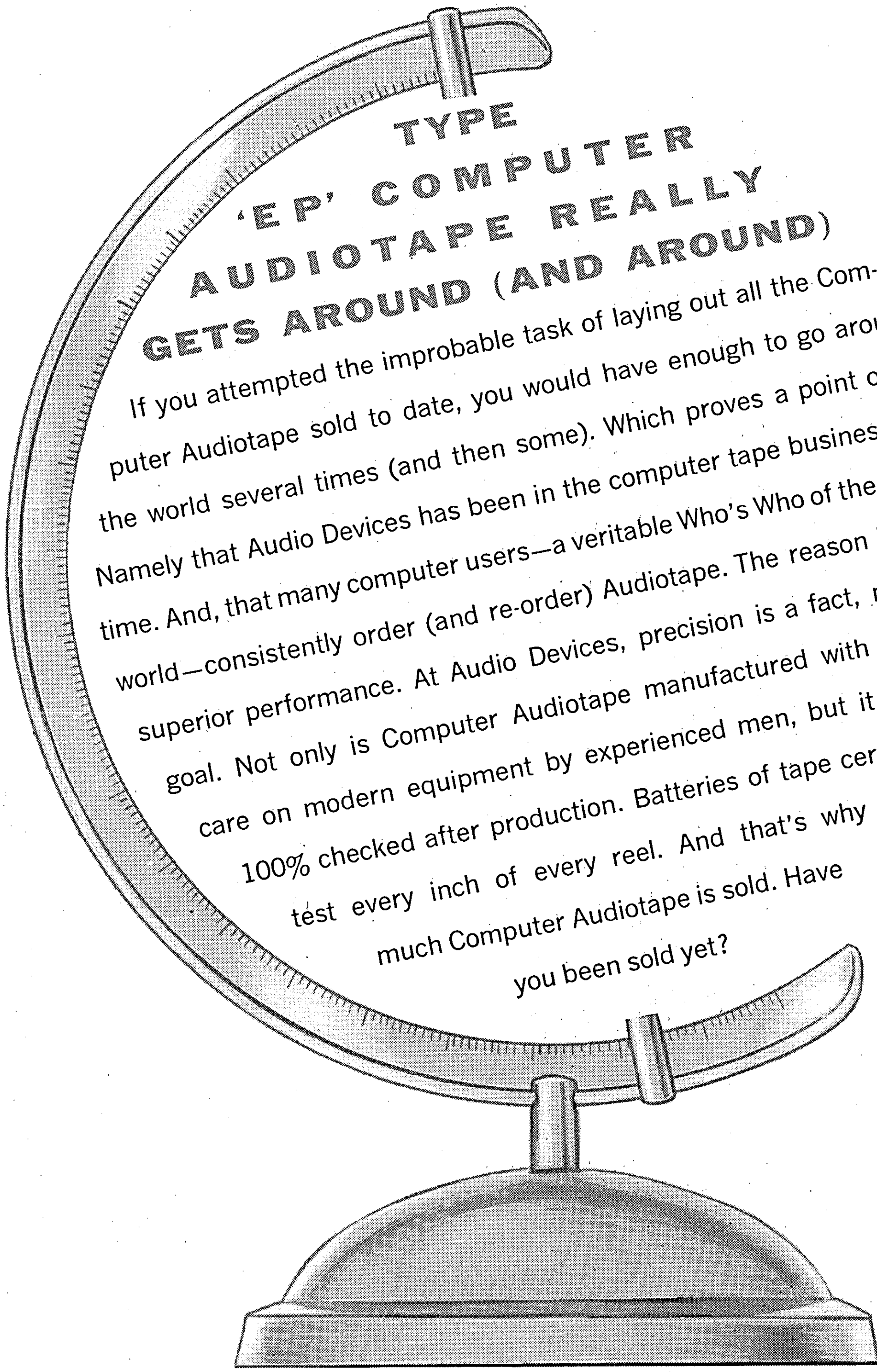
Alvin H. Hatch, manager of Sylvania's applied programming department, stated: "Once a computer is equipped with a COBOL compiler, it can utilize any program written in COBOL, even through the program was written for a computer of an entirely different make. For instance, the COBOL program we will write for MOBIDIC can be used, if necessary, on any computer anywhere in the world, providing that computer has a COBOL compiler."

The delivery date was not specified, and no schedule of compatibility tests was mentioned in the Sylvania announcement.

● C-E-I-R, Inc., has been awarded a contract by the National Science Foundation to conduct a design study of a system for the organization and maintenance of a mechanized file of the world's scientific and technical information sources and services. The study will be under the direction of Donald A. Melnick, director of OR at C-E-I-R's Washington center.

● An NCR 315 is in operation at the Meadow Brook National Bank, West Hempstead, N.Y., which will process the bank's 130,000 demand deposit accounts. During the next two years, it is expected that all other major volume departments will also be computerized.

● Preliminary tests have been concluded by Lockheed Electronics Co., division of Lockheed Aircraft Corp., on units of a system which will be used in the petroleum industry's first computer-controlled oil field. The system will consist of automatic well test programming; oil, gas and water volume measurement, which will be reported, with well and site identity, to an IBM 1620. The computer will

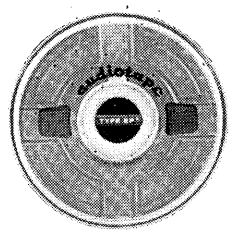


TYPE 'EP' COMPUTER AUDIOTAPE REALLY GETS AROUND (AND AROUND)

If you attempted the improbable task of laying out all the Computer Audiotape sold to date, you would have enough to go around the world several times (and then some). Which proves a point or two. Namely that Audio Devices has been in the computer tape business a long time. And, that many computer users—a veritable Who's Who of the business world—consistently order (and re-order) Audiotape. The reason is simple: superior performance. At Audio Devices, precision is a fact, not just a goal. Not only is Computer Audiotape manufactured with extreme care on modern equipment by experienced men, but it is also 100% checked after production. Batteries of tape certifiers test every inch of every reel. And that's why so much Computer Audiotape is sold. Have you been sold yet?

For complete information and specifications on Computer Audiotape, the extra precision tape, write to Dept. D:

AUDIO DEVICES INC. 444 MADISON AVE. NEW YORK 22, N. Y.



CIRCLE 40 ON READER CARD

provide programmed control of all field operations and memory storage for data which is received from the field. Gage readings will be reported as received, as well as weekly and monthly reports.

● International Telephone and Telegraph Corp. has acquired National Computer Products, Inc., Lawrence, Mass., a leading supplier of diodes to the computer industry. It is planned to maintain operations under the same management and continue production in Lawrence, retaining the name of National Transistor as an operating subsidiary of ITT. Purchase price was not disclosed, but the transaction involved an exchange of ITT stock for National's assets.

● Datatrol Corporation sales for the fiscal year ending July 31 totaled $551,783, president Hugh P. Donaghue reported to stockholders. Although the firm showed a net loss of $49,940 on a volume of $197,799 for the first six months of the reporting period, a profit of $22,483 was established on a volume of $353,984 during the second half.

● Autonetics has announced a reduction in price for the floating point option on the RECOMP III, from $500 per month to $180. Also announced was the availability of the RECOMP X-Y Digital Incremental Plotter and tab card adapter equipment.

CIRCLE 100 ON READER CARD

● Four GE-225s have been ordered by NASA to provide scientific and engineering data analysis on design of the Saturn booster vehicle at the George C. Marshall Space Flight Center, Huntsville, Alabama.

● The Proceedings of the Large-Capacity Memory Techniques for Computing Systems, based on a Symposium sponsored by the Information Systems Branch, Office of Naval Research, has been published by The Macmillan Co., 60 Fifth Ave., New York City. Publication price is $11.

● Librascope Division of General Precision has announced the development of what they term one of the world's smallest, high-capacity, general purpose computers for rugged military applications. The computer, called the L-2010, has a mag-

CIRCLE 41 ON READER CARD

netic-disc memory capacity of 4096 words and is priced in the $40,000 range. Weight of the machine is 60 pounds, and measures two cubic feet in volume. Access time is 79 usec. I/O devices include keyboard and paper-tape reader for input, and 100 cps paper-tape punch, typewriter, and control panel display for output.

CIRCLE 101 ON READER CARD

● Beckman Instruments, Inc., has received contracts totaling 1.5 megabucks from the Boeing Company for three analog computer systems to be used in the design of the X-20 Dyna-Soar manned space glider. The systems will be used for thermal, propulsion, flight control and other engineering design development investigations on the X-20 program.

● Georgia Tech is sponsoring a five-day course, Mathematics of Information Storage and Retrieval, to be held in Atlanta, December 3-7. Principal Instructor for the course will be Robert M. Hayes, president, Advanced Information Systems Co., and vice president, Scientific Division, Electrada Corp. Registration fee is $150. For more information, contact the Director, Department of Short Courses and Conferences, Georgia Institute of Technology, Atlanta 13, Ga.

● The Auerbach Corporation, Philadelphia, has formed a Business Information Systems group. Named as manager was Norman Statland, who stated that the group will provide services in three application areas: new systems development, current systems evaluation and conversion, and advanced-systems development.

● The U.S. Air Force has awarded a $331,000 contract to General Dynamics/Electronics-San Diego for an S-C 4020 high speed microfilm recorder and accessories. The device will be utilized at Wright Patterson AFB, Ohio.

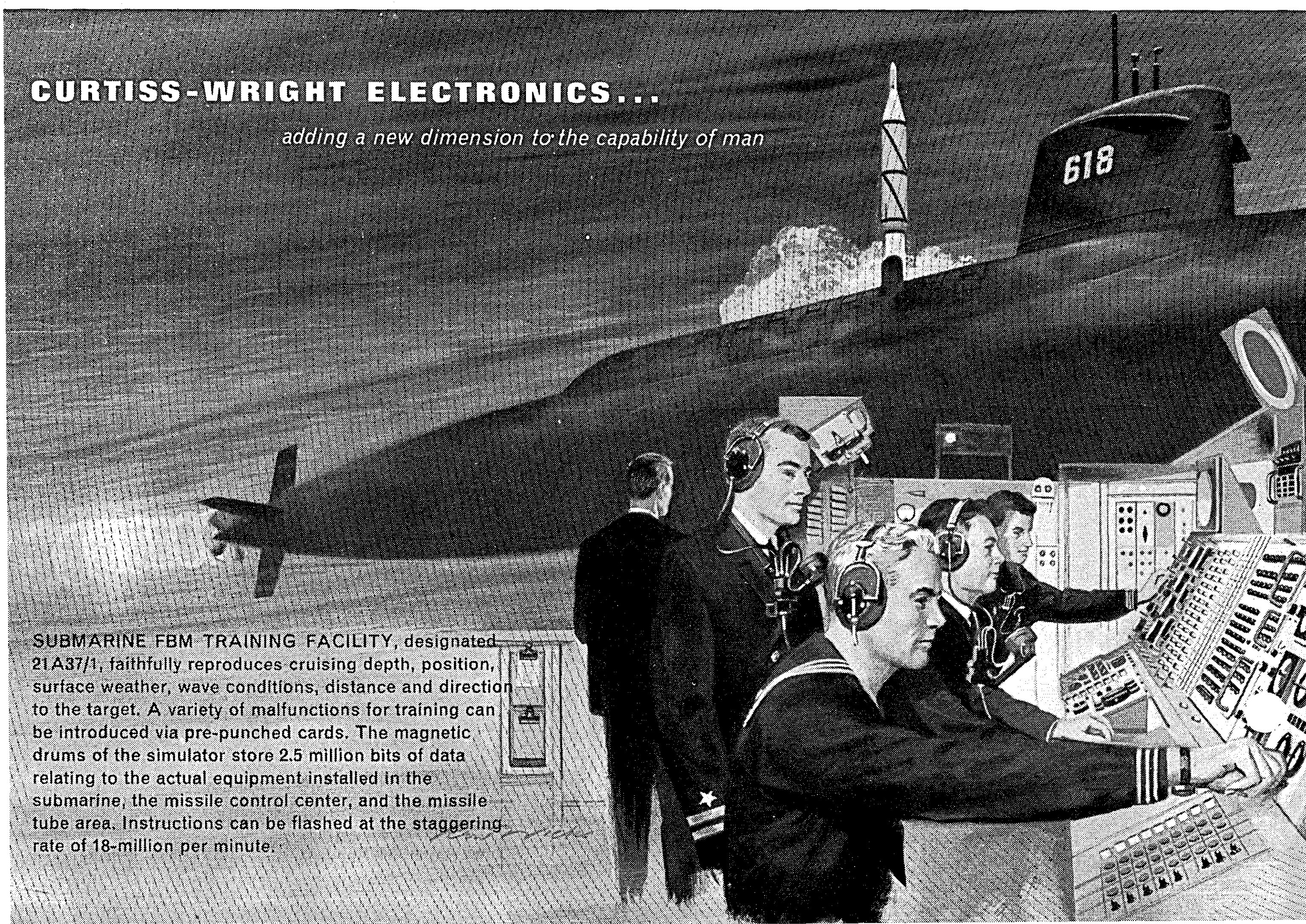
● An IBM 705 to IBM 1410 Translation System for translating 705 Autocoder programs into 1410 Autocoder has been developed by the New York Division of Computer Sciences Corporation. Running on the 705 II using 705 Autocoder listing tapes as input, the system examines the intent of the 705 instructions and produces 1410 instructions to accomplish the same functions. All 705 II op codes are translated, while a few logical operations, peculiar to the 705, are recognized by the system as not directly translatable and marked for programmer review.

CIRCLE 102 ON READER CARD

● IBM World Trade Corporation has begun construction of a data processing education center at Cuernavaca, Mexico, the first in Central America. The center's primary role will be to provide instruction for area business executives and government officials in data processing.

● C. F. Braun & Co., Alhambra, Calif., engineering and construction firm, has ordered a Burroughs B5000, with 4096 words of memory, four mag tape units, card reader, card punch, and printer. Delivery is for early 1963.

● General Electric Computer Department has opened an information processing center in Schenectady, N. Y., to service businesses in Eastern New York State and western New England. Other centers GE plans to establish will be located in New York, Chicago, Dallas, Phoenix, Washington, D. C., and Sunnyvale, Calif. The



Schenectady center will be equipped with a GE-225.

● The Honeywell compiler, FACT (Fully Automatic Compiling Technique), has been translated into German. By using a lexicon, programmers will be able to use the same rules of the compiler as is done with the English version. The German translation was developed to promote sales of the Honeywell 800 in Europe.

● Clifford G. Green, president of Statistical Reporting and Tabulating Ltd., Toronto, has been elected president of the Association of Data Processing Service Organizations. Other officers named were H. W. Robinson, president, C-E-I-R, Inc., vice president; William Levy, president, Nationwide Tabulating Corp., Hempstead, N.Y., treasurer.

● The Teleregister Corporation will install a real-time inventory system of airline seat availability at Air France headquarters, Paris, in March, 1963. The system, known as a Magnetronic Reservisor, will be the first of its type to be installed in Europe. Purchased outright by Air France, the system will include two real-time computers and 150 directly-connected agents' handsets.

● Northrup Institute of Technology, Inglewood, Calif., has inaugurated a new $200,000 computer center, which will offer computer training to engineering students. The center will include an IBM 1620 with 20K positions of memory and a 1622 card readpunch. Robert V. Jamison will be in charge of computer instruction.

● A Ferranti Argus 100 will be used on-line for guidance and control of a new radio telescope to be installed at Jodrell Bank, England, during 1963. The computer will be directly connected to the telescope for continuous control over its movements, and will also be used to log astronomical data obtained with the telescope. This data will be transmitted to the Ferranti Atlas computer at Manchester University for interpretation.

● The U.S. Diplomatic Communications Service has put into operation an ITT 7300 ADX Automatic Exchange System, which will link Washington and Paris with embassies and legations throughout Europe, Africa and Asia. Installed in the American embassy in Paris, the system is adaptable to a wide variety of government and commercial on-line, real-time applications.

● Martin Company computer centers in Denver and Baltimore will be linked by two IBM 7287 data transmission terminals, which will make possible continuous peak scheduling and loading at the Denver center. The equipment was leased to meet an anticipated overload this fall at Denver, where Martin is concentrating its efforts on the Titan I, Titan II, and Titan III programs. Originally scheduled for June 1963 installation, delivery was advanced to mid-October.

● Traffic on a five-mile stretch of a Chicago expressway is being observed by a Pilot Detection System, a system of automated traffic surveillance for research in traffic improvement. A joint project of the U.S. Bureau of Public Roads, the State of Illinois, Cook County, and the City of Chicago. Thompson Ramo Wooldridge Inc., RW Division, was responsible for technical management. The system uses ultrasonic traffic detectors at seven critical points along the route. Readings are transmitted

One of a series briefly describing GM's research in depth

At the Holland Tunnel, traffic is stopped to make it go: Why?

In their theoretical studies of traffic flow, scientists at the GM Research Laboratories have been developing mathematical models to describe how one car follows another. To check the validity of these models, mass flow experiments were conducted in the Holland Tunnel in close collaboration with The Port of New York Authority which is trying to relieve congestion at this vital traffic artery.

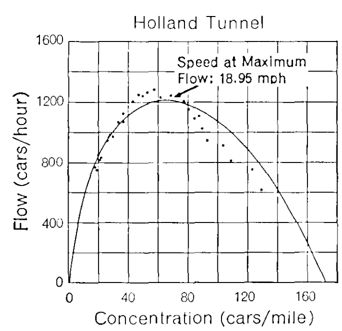
Observations indicated that the car-following models do give a highly consistent description of the steady-state stream of traffic. One interesting point: Both car-following theory and analysis of mass flow data showed that the optimum speed for maximum traffic flow in the tunnel is a surprisingly low 19 mph.

These cooperative studies are contributing significantly to the evolution of unique traffic control systems by the Port Authority for the Holland and Lincoln Tunnels. With the control system now being developed, the number of vehicles allowed to enter per minute is automatically adjusted as the speed and density of traffic in the tunnel changes. Test results to date show a significant reduction in congestion and increase in traffic volume during rush hours.

At General Motors, we believe information from such fundamental traffic studies may well have wide applications . . . for the cars, drivers, and perhaps, automatic highways of the future.

General Motors Research Laboratories

Warren, Michigan



Curve is a "least squares" fit of theoretical car-following model to mass flow data.

CIRCLE 42 ON READER CARD

to analog devices, recorded on punched tape and analyzed by a digital computer.

● Computer Sciences Corp. has opened a Houston, Texas, division to serve clients in the south and southwestern areas. The new office will augment the firm's general offices in Los Angeles, and its New York division. The new facilities will be headed by Harold Leone.

● C-E-I-R, Inc., has arranged to sell 50,000 shares of common stock to Investor's Variable Payment Fund, Inc., Minneapolis. The transaction is the second involving C-E-I-R and IVP. In August, 1961, IVP bought 24,000 shares and also acquired two megabucks in C-E-I-R convertible debentures.

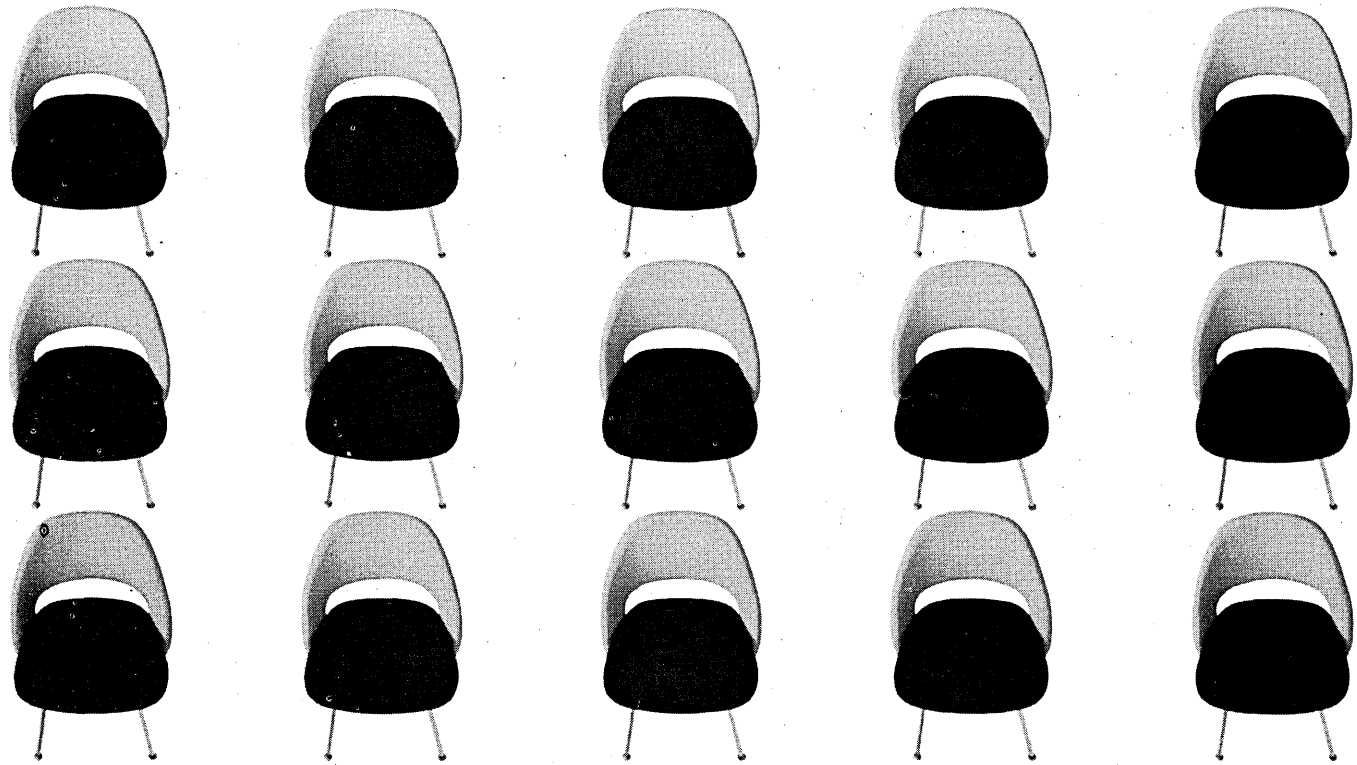
● Plans to establish a small basic research laboratory in Japan have been announced by IBM. The facility will be operated as a branch of the recently organized subsidiary, IBM Research Laboratory, Inc., which will conduct IBM's overseas research activities. Following overseas employment policy, IBM plans to hire Japanese nationals.

● The Montgomery County (Md.) Court has enjoined Computer Dynamics Corp. from soliciting claims automation business from the U.S. Bureau of Old Age and Survivors Insurance, Social Security Administration, for a period of five years. In addition, the court assessed the costs of the recent hearings, incurred when C-E-I-R, Inc., brought a suit against the firm composed of former C-E-I-R employees. The costs amounted to $3,211.75, and the court directed the Assignment Commissioner to inquire into damages.

● Mauchly Associates, Inc., has introduced a new SkeduFlo analog computer, Model NTC-18, which is small enough to be carried as luggage when taken on a plane. The computer has a capacity of 18 jobs, and is a scaled-down version of the larger 100-job SkeduFlo currently under development. The NTC-18 carries a price tag of $1800.

CIRCLE 103 ON READER CARD

● The ACM Sort Symposium, which will be held November 29-30, at the Nassau Inn, Princeton, N.J., will em-



COMPUTER PROGRAMMERS: by electing to occupy one chair amongst many, or by choosing to sit in concert with a select few—you alone can determine the character of your programming career in the breath-taking future of computery . . . With Computer Concepts, Inc., a young organization staffed with seasoned veterans of the computer industry, you will explore such areas of information processing as command control, machine translation, systems programming, and simulation and war-game programming . . . If you have a minimum of 2 years experience on IBM 704/709/7090 computers, let's sit down and have a talk about your future. Address resume to Computer Concepts, Inc., the soft-ware-house of programming ingenuity, 1012-14th Street, Northwest, Washington, D. C.—Branch offices in New York City and Los Angeles.

COMPUTER CONCEPTS!

CIRCLE 77 ON READER CARD

phasize the latest techniques implemented by computer manufacturers and users and on hypothetical solutions for future generation computers. It is anticipated that new techniques for computers having special peripheral devices, i.e., disc, paper tape, drum storage, etc., will be presented. Further information regarding the symposium may be obtained from Mrs. L. R. Becker, Applied Data Research, Inc., 759 State Rd., Princeton, N.J.

● The Service Bureau Corporation is providing computer services and time on the IBM 7090/1401 system installed by the Armour Research Foundation of Illinois Institute of Technology. Under an agreement with ARF, SBC purchases time on the 7090 and then makes it available to area firms.

● Ford Motor Co. will install a Philco 211 in its offices in Dearborn, Mich., it was announced recently. The central processor will have a 1.5 usec memory, memory capacity of 32,768 48-bit words, plus index register and floating point. Configuration will include 16 mag tape units, and two universal controller systems, each with two tape units and one card reader, one card punch and one high-speed printer.

● Oregon College of Education, Monmouth, has announced development of an educational computer called SPEDTAC (Stored Program Educational Transistorized Automatic Computer). The computer is a serial, single address, fixed point binary device, with a magnetic disc memory of 256 15-bit words, and an average access time of 8.3 usec.

● Cities Service Petroleum Company headquarters in Bartlesville, Oklahoma, has installed an IBM 7070/1401 system. The equipment replaces a 650 plus much of the firm's EAM equipment.

HEALTH SERVICE GRANTS AID UCLA COMPUTER CENTER

A three megabuck computer center at the UCLA Medical School has been made possible by grants from the U. S. Public Health Service, according to an announcement by UCLA Chancellor Franklin D. Murphy. Hub of the new center will be an IBM 7094, which is expected to be in oper-

ation before the end of the year.

The outgrowth of a research project initiated August, 1961 by Drs. W. J. Dixon and F. J. Massey of the Departments of Preventive Medicine and Public Health, the center is a joint project of the Schools of Medicine and Public Health.

Activities planned include the processing of medical research data; analysis of data such as brain wave recordings, electrocardiograms, and blood flow data, which will be input directly from the laboratory to the computer; memory storage of patient data, and training programs to acquaint students with the medical uses of computers.

N. Y. STOCK EXCHANGE TO COMPUTERIZE TRADING

The New York Stock Exchange has announced plans to implement a new computer system by early 1965 which will feature two specially-designed devices: an optical reader, which will transmit sales and bid-asked information directly from the trading floor to a computer; and a voice assembler, which will compose messages from a pre-recorded electronic vocabulary and speak them over the telephone to member subscribers of the Exchange's Quotation Service.

A contract for the system was signed recently by the NYSE and IBM, which will manufacture and install the computer system, and the N. Y. Telephone Co., for special communications facilities. Rental for the system will be 1.8 megabucks yearly.

The installation will include two 1410s and two IBM 7750 programmed transmission control units. A major component will be a N. Y. Telephone designed access switching system, which will link the computer center with direct private telephone wires of the Quotation Service.

C-E-I-R'S FIRST 7094 DEBUTS IN SAN FRANCISCO

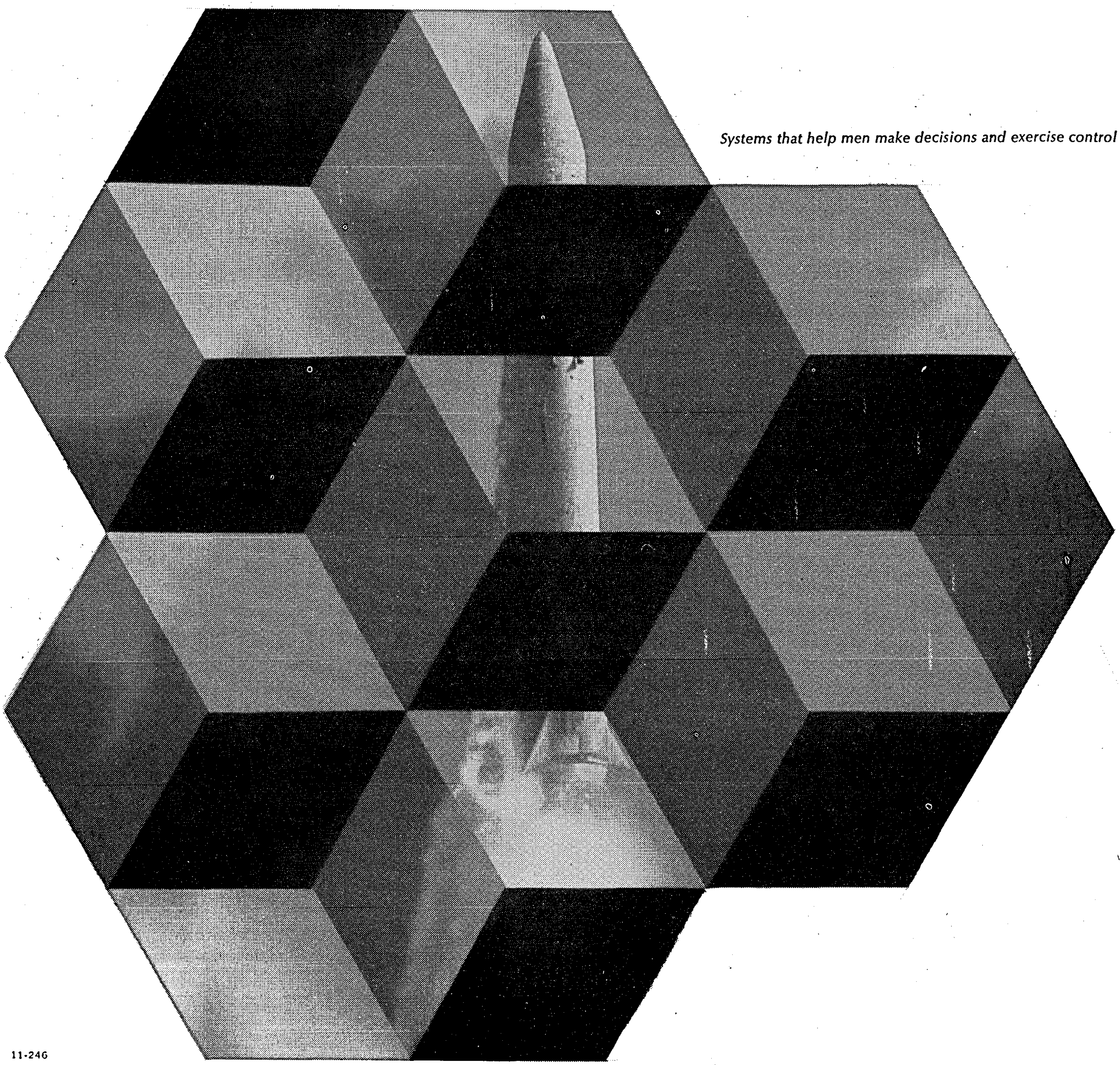
The San Francisco Center of C-E-I-R, Inc., has converted its 7090 to a 7094, the first of eight 90s, operated by C-E-I-R in the U. S. and abroad, scheduled for conversion. The changeover, including installation and system testing, is estimated to take 72 working hours.

Dr. Herbert Robinson, C-E-I-R president, said that virtually all programs written for the 7090 will run without change and at higher speed on the 7094, proving compatibility and ease of changeover on jobs now processed by C-E-I-R's equipment.

Decision-Making: Hostile or not Hostile?

A few years ago this decision was relatively simple. The action that followed was relatively simple. Today the consequences of this type of decision-making can be enormous, affecting world-wide forces and events. The decision itself may trigger an incredibly complex series of interacting decisions and controls. In making these compressed-time decisions, commanders use man-machine systems which provide information processing assistance. The development of these large systems is the work of scientists, engineers and computer programmers at System Development Corporation. The system is their concern, not the actual design of hardware. Specifically, they contribute in these key areas: defining the requirements of the system, synthesizing the system, instructing the computers within the system, training the system, evaluating the system. Throughout they seek to optimize man-computer relationships and to develop a system which grows and changes with the needs of the decision-makers who use it. Computer programmers, human factors scientists, operations research scientists and systems-oriented engineers interested in joining a close interdisciplinary effort are invited to write concerning new positions in this expanding field. Address Mr. A. D. Granville, Jr., SDC, 2401 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D.C., Lexington, Massachusetts; Paramus, New Jersey; and Dayton, Ohio. "An equal opportunity employer."

SDC
System Development Corporation



Systems that help men make decisions and exercise control

11-246

CIRCLE 303 ON READER CARD

BOOK capsules

THEORY AND APPLICATIONS OF INDUSTRIAL PROCESS CONTROL, by L. M. Zoss and B. C. Delahooke, 1961, Delmar Publishers, Inc., Mountainview Ave., Albany 5, N. Y., 256 pp., $5.75.

This book discusses the basic principles of instrument application and process design and is developed in two parts: Basic Principles and Specific Applications. The explanations of the various industrial applications of Part II make use of the fundamentals discussed in Part I.

HIGH-SPEED ANALOG COMPUTERS, by Rajko Tomovic and Walter J. Karplus, 1962, John Wiley & Sons, Inc., 440 Park Avenue South, New York 16, N. Y., 255 pp., $9.95.

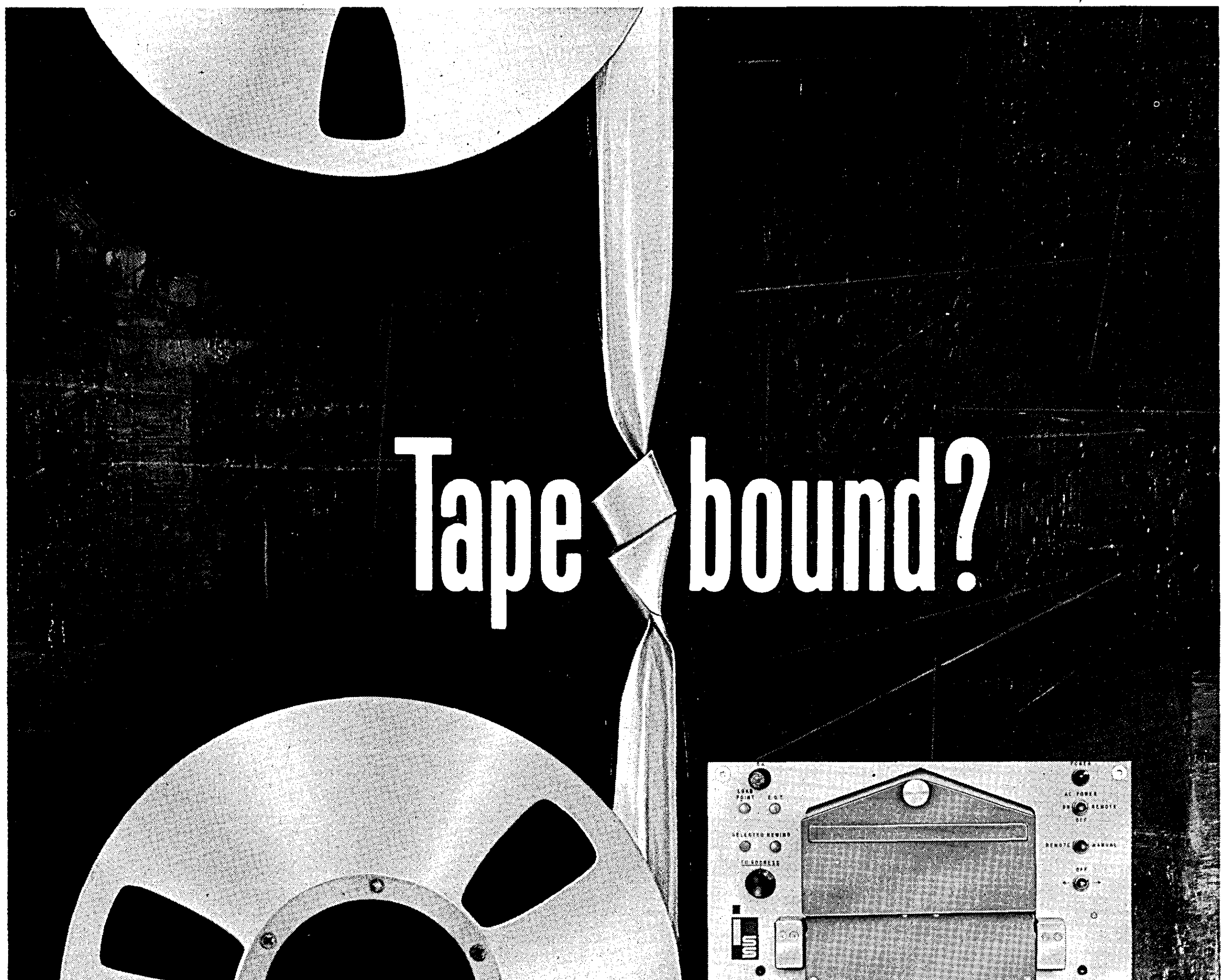
This book is designed to introduce the electronic devices and circuits that constitute a repetitive computer facility and to survey applications to engineering problems. Also covered is theory of computer programming, error analysis and scaling in terms of their relation to fundamental mathematical disciplines.

COMPUTER APPLICATIONS IN THE BEHAVIORAL SCIENCES, edited by Harold Borko, 1962, Prentice-Hall, Inc., Englewood Cliffs, N. J., 634 pp., $11.65.

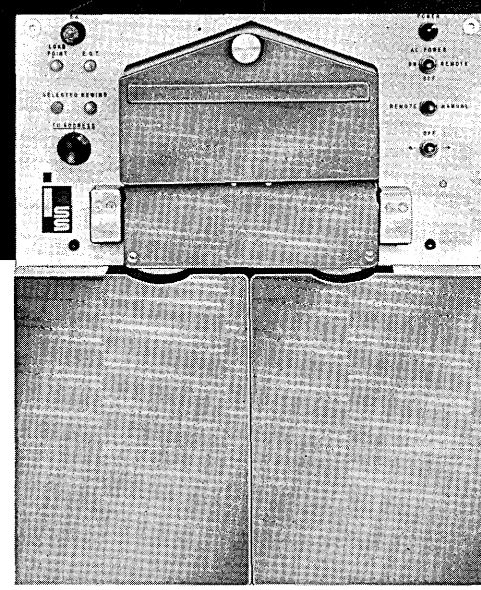
Written expressly for the social scientist who is not a computer specialist, this book provides a general introduction to computers and specific information on their use as research tools. Emphasis is placed on the non-computational use of the computer. Part one describes computer systems; the second part covers functional components of a computer system; the third part encompasses a variety of computer applications contributed by educators and scientists.

REDUNDANCY TECHNIQUES FOR COMPUTING SYSTEMS, edited by Richard H. Wilcox and William C. Mann, 1962, Spartan Books, 6411 Chillum Place N.W., Washington 12, D. C., 404 pp.

Based on a symposium sponsored by the Information Systems Branch of the Office of Naval Research and Electronics Division of Westinghouse Electric Corp., the book focuses attention toward new ideas, research, and developments which would lead to the introduction of redundancy techniques in forthcoming computer systems.



■ Most computers are. In the dynamic computer field, the irresistible force of information storage requirements has met the immovable object of density and speed limitations. Creative ISS research has removed the immovable object . . . with the unique result that ISS Tape Systems store more information in a given space at speeds far exceeding any storage system in existence. We're young, but we point with pride to our newest example . . .



ISS DK-3 MAGNETIC TAPE UNIT

■ With a packing density of 32,000 bits/sq. inch, DK-3 offers unparalleled storage per dollar, and excellent tape speed and access time. Pneumatic capstans maintain reliable operation. (There are no reels — only two 7" x 9" cartridges). The cost of owning and operating DK-3 is a fraction of the cost of comparable units.

See the new DK-3 — and other cost-cutting ISS products — in action at the

JOINT COMPUTER CONFERENCE

Park Sheraton Hotel • Philadelphia, Pa. December 4, 5, 6 / ISS Booth #108

INFORMATION STORAGE SYSTEMS, INC.

222 Wanaque Avenue • Pompton Lakes, New Jersey • Phone: Code 201 - TE 9-0001

MERGERS & new firms in DP

A new firm, Automatic Digital Documents Co. has been founded in San Diego, Calif., by John E. Steely, Jr., and Edward J. Records. The firm plans to develop an automatic documenting system program, establish a network of service centers which would offer document preparation, and pursue further developments in the field.

CIRCLE 106 ON READER CARD

National Computer Analysts of New York, Inc., is now known as Computer Methods Corporation. The firm plans to place increased emphasis on systems-type services, including feasibility studies, evaluation of manufacturers' proposals, systems analysis, design and development, PERT, simulation techniques, and project and program management.

CIRCLE 107 ON READER CARD

Richard O. Endres, who resigned recently as president of Rese Engineering, has formed a new firm called Computer Instrumentation Corporation. The new company, located in Philadelphia, has purchased the magnetics test equipment product line from Rese, and will continue design, manufacturing and sales operations. Products include advanced magnetic core and plane test equipment.

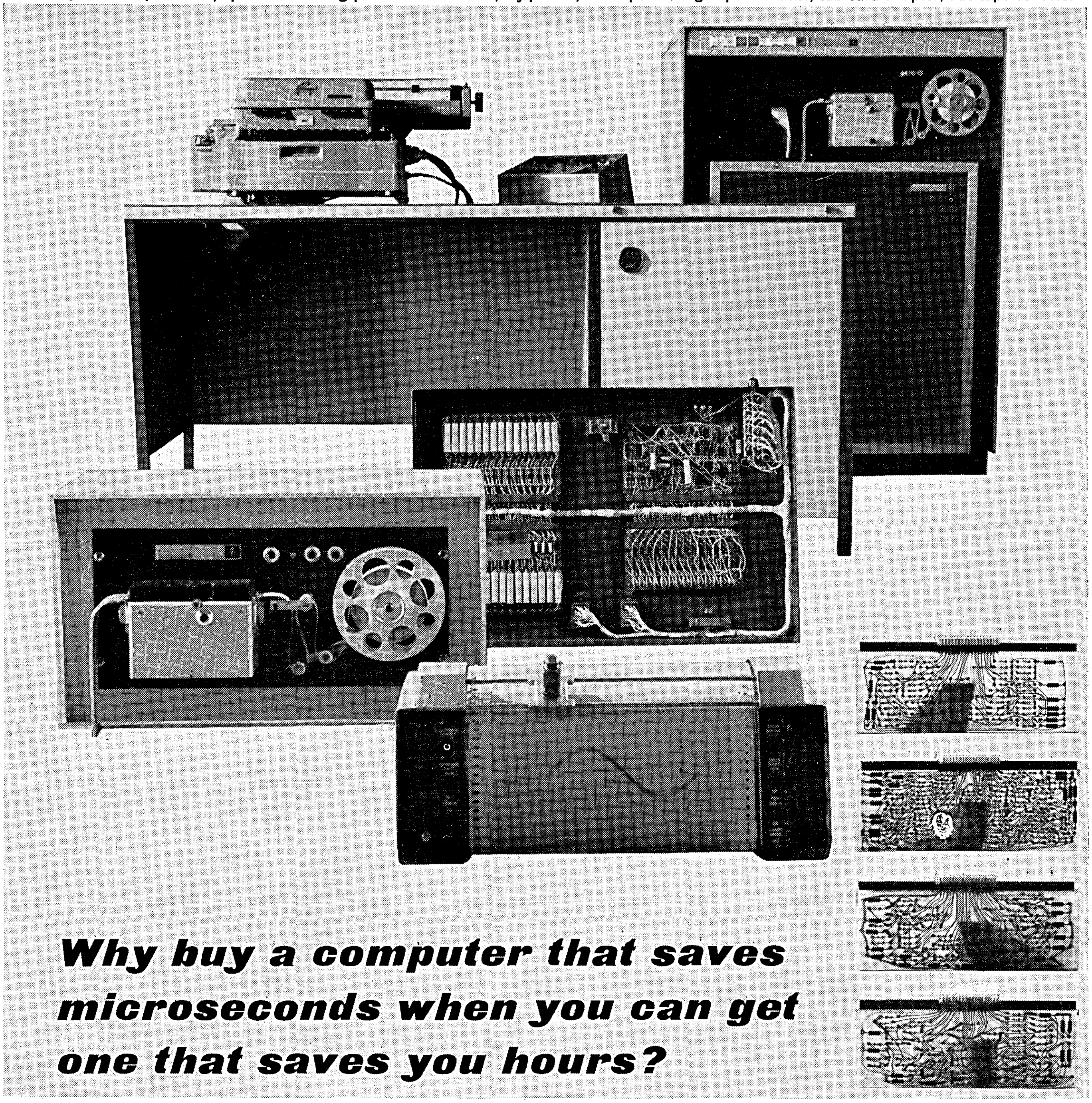
CIRCLE 108 ON READER CARD

Photonetics Corp., Walker Valley, N.Y., has opened a new laboratory for the development, testing, and manufacturing of thin-film and microminiaturized components. The firm is also engaged in products utilizing electroluminiscent and photoconductor elements, and solid-state display panels.

CIRCLE 109 ON READER CARD

Robert W. Hughes, formerly vp and director of operations at ITT/Information Systems Division, has founded Data Trends, Inc., located in Moutain Lakes, N. J. The firm will provide programming, engineering, and consulting services in the computer and communication field. W. H. Highleyman, technical director and the firm's co-founder, will be in charge of engineering activities. He was previously associated with Bell Telephone Labs.

CIRCLE 110 ON READER CARD



RECOMP® III and optional equipment—floating point circuit boards, x-y plotter, Facitape 510 high speed reader, tab card adapter, Facitape console.

Speed is important. But computer operating speed is just a small part of the story. Save a few microseconds here and there and you haven't saved much.

More important is total problem solving time.

In the small scale computer field there's a computer that marks savings in terms of hours... not microseconds.

It is called Recomp III. And it leases for just $1,495.

Recomp III can save you hours in problem solving because it's simple to program and easy to operate. Here's why:

1) large 40-bit word with 12 decimal digit accuracy; 2) 4096 word memory with 49,000 decimal digit capacity; 3) built-in index register; 4) optional floating point hardware; 5) simplified command structure; 6) advanced programming aids.

The $1,495 lease price for Recomp III gives you a ready to operate computer complete with typewriter and 8 channel paper tape input/output equipment. However, if you wish to expand its capabilities, there is a complete line of peripheral equipment available.

The one sure way to find the computer that will save you the most time is through your own feasibility study. And no feasibility study is complete without Recomp. Put Recomp side by side with any comparable computer on the market. Let the facts speak for themselves.

We'll be glad to help you get all the facts. Write today for a helpful guide: "How to Conduct a Computer Feasibility Study."

Write: Recomp, Department 511, 3400 East 70th Street, Long Beach, California.

Recomp

Recomp is a product of Autonetics Industrial Products — Autonetics is a Division of North American Aviation

CIRCLE 51 ON READER CARD

Big computer Fortran for desk-size computer users

THE NEW, EXPANDED, CURRENTLY OPERABLE 160-A FORTRAN . . . when run on this system . . . COMPILES 125 STATEMENTS PER MINUTE (Average), EXECUTES FLOATING ADD IN 1 MS AND FLOATING MULTIPLY/DIVIDE IN 1.5 MS

The Fortran program written below might have been written for a large-scale computer system. Actually, it is a program written in Control Data's new 160-A Fortran . . . a Fortran which provides large-scale power and sophistication to users who need desk-type computer compactness.

The new 160-A Fortran features the following language characteristics: Complete I/O versatility . . . cards, paper tape, typewriter, line printer and magnetic tape ■ Fixed point, floating point and Boolean arithmetic, allowing mixed fixed and floating point expressions. ■ Common, Dimension and Equivalence statements allowing variables of up to three dimensions.

But these features are not the entire story. The real proof is in the computing . . . the ease of programming and the time required to execute. For instance, the DO-LOOP written below is executed in 4.5 seconds.

Get a complete description of this new 160-A Fortran system as well as other Fortran systems utilizing various computer configurations that start as low as $1500/month. Contact your nearest Control Data representative today.

EXAMPLE: 160-A FORTRAN PROGRAM

```
1  Format (8H CDC160A/5F10.8)
   DIMENSION A(5,5,5)
2  READ INPUT TAPE 1, 1,
  X(((A (I,J,K), I=1,3), J=1,3), K=1,5)
   SUM = A(2,1,5) + 4
   B = 11111.0
   DO 3 I = 1,1000
3  SUM = SUM + B**2
   WRITE TAPE 2, A SUM
   GO TO 2
   END
```

ABOVE 160-A FORTRAN TAPE SYSTEM

- 160-A Computer with 8192-word core memory
- New, optional multiply-divide unit, especially designed for Fortran (168-2 Arithmetic Unit)
- New Control Data 603 pneumatic tape drives, providing high reliability (75″/sec.; 200 and 556 bpi; 15 and 41.7 kc)

Offices: Albuquerque • Beverly Hills • Birmingham • Boston • Chicago • Cleveland • Dallas • Dayton • Denver • Detroit • Honolulu • Houston • Ithaca • Kansas City • Minneapolis • Newark • Norfolk • Orlando • Palo Alto • Philadelphia • San Diego • San Francisco • Washington, D.C.

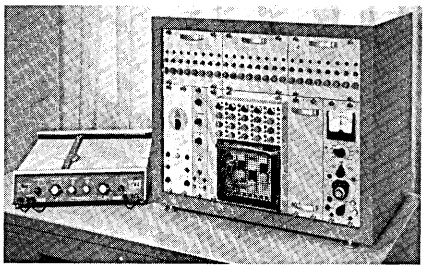
CONTROL DATA CORPORATION

8100 - 34th Avenue South, Minneapolis 20, Minnesota

NEW PRODUCTS

24-amplifier analog computer

The portable AD-2-24PB features removable patch panels which permit problems to be stored at a price of $115 each. High-speed repetitive operation can be introduced by a switch



which allows selection of compute periods ranging from 1.000 to 0.025 second. The basic computer is priced at $3,000. APPLIED DYNAMICS, INC., 2275 Platt Rd., Ann Arbor, Mich. For information:
CIRCLE 200 ON READER CARD

dp system

The SC-1 has a numerical code capacity of 9999. Its central console can handle up to 49 information stations. The basic system with 20 stations of 10-card capacity each can be installed for approx. $10,000. DYNA-LOG ELECTRONICS CORP., 380 Great Neck Rd., Great Neck, L.I., N.Y. For information:
CIRCLE 201 ON READER CARD

five stage shift register

Each stage of the 408 register has its own set and reset inputs, assertion and negation outputs and neon indicator. Transfer set, transfer reset, common shift and reset busses are connected to all stages. Price of the 408 is $119. NAVIGATION COMPUTER CORP., Valley Forge Industrial Park, Norristown, Pa. For information:
CIRCLE 202 ON READER CARD

ax 12 silicon circuit module

Three identical Schmitt trigger circuits are contained in each of these new modules. Each circuit utilizes silicon semiconductors and capless carbon film resistors. Price of the AX 12 is $175. SCIENTIFIC DATA SYSTEMS, INC., 1542 15th St., Santa Monica, Calif. For information:
CIRCLE 203 ON READER CARD

digilab

This unit provides a single integrated console containing all components needed for breadboarding digital networks or laboratory instruction in digital elements and techniques. The logic elements supplied include one-shots, flip-flops, inverters, clock, indicators, diode AND gates, R-C AND gates, OR gates, and control packages. The unit is priced at $895. TECH SERV, INC., 5451 Holland Dr., Beltsville, Md. For information:
CIRCLE 204 ON READER CARD

data communications center

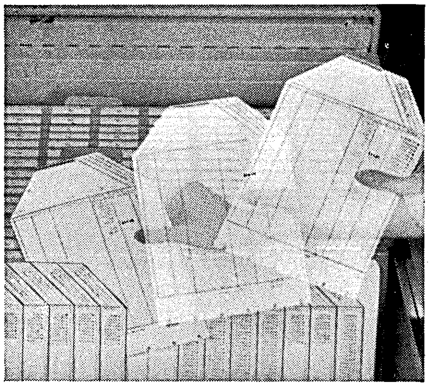
A perforated tape preparation and bi-directional communications center combines the Mark 50 (perforator, reader, transmit, receive and error detection equipment), the Selectric typewriter and Data Phone System. The user can prepare data tape as a by-product of a typing operation and later can transmit the data at 750 words per minute. The data is received at the same speed and is recorded on perforated tape, followed by printout at 155 words per minute. The Mark 52 and 53 systems can check errors prior to sending, during the receiving process or as a re-read operation after receiving. TALLY REGISTER CORP., 1310 Mercer St., Seattle, Washington. For information:
CIRCLE 205 ON READER CARD

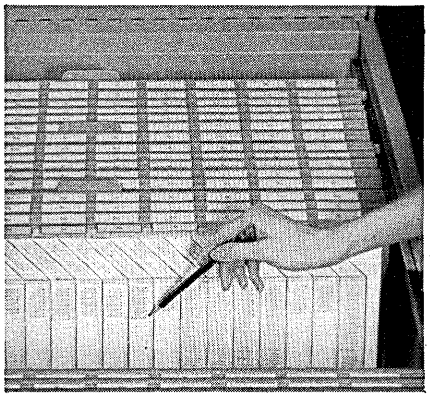
reed switch relays

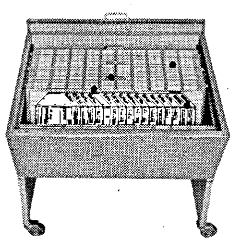
Type G CR120 will perform up to 900 cycles per second and can operate in 1.0 to 1.5 milliseconds. The relay is available in three configurations including plug-in, printed-circuit, and solder tab types. GENERAL ELECTRIC CO., Schenectady 5, N.Y. For information:
CIRCLE 206 ON READER CARD

differential amplifier

This 10 kc amplifier, model 461, features an input impedance of 1000 megohms, low full bandwidth noise of 4 μ v referred to input and a common mode rejection of 120 db







NEW PRODUCTS . . .

from 0 to 60 cps for all gain settings from 1 to 1000. The 461 has a gain accuracy of 0.1% and provides fixed gain settings of 1, 3, 10, 30, 100, 300 and 1000. PACKARD BELL COMPUTER, 1905 Armacost Avenue, Los Angeles 25, Calif. For information:

CIRCLE 207 ON READER CARD

data storage

The Monro-Card magnetic record is the size and shape of an ordinary tabulating card but is available with capacities of either 1,500 or 800 digits of information. Stored information can be up-dated, changed or erased without destroying the original data document. LITTON INDUSTRIES, BUSINESS MACHINES GROUP, 555 Mitchell St., Orange, N.J. For information:

CIRCLE 208 ON READER CARD

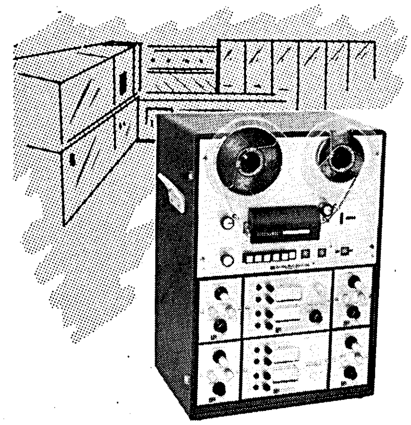
mag tape transport

Start/stop, reverse/stop and forward/reverse operations may be made on the MT-120, at a rate up to 200 commands per second. Data transfer rates up to 242,000 bits per second are possible using the company's contiguous double-transition high-density recording techniques, and up to 62.5 kc using standard techniques. POTTER INSTRUMENT CO., INC., Sunnyside Blvd., Plainview, N.Y. For information:

CIRCLE 209 ON READER CARD

numerical control system

This system has been developed for applications on plotting tables or drafting machines and includes a control unit, a drive for the plotting pen, and a feedback system for controlling pen movement accuracy. The control unit can be equipped to accept data on either punched or magnetic tape, and can automatically command plot-



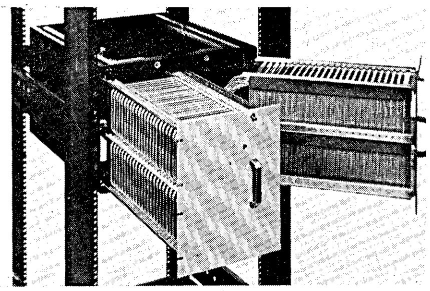
NEW PRODUCTS . . .

ting speeds of up to 500 inches per minute. BENDIX CORP., INDUSTRIAL CONTROLS SEC., 21820 Wyoming Ave., Detroit 37, Mich. For information:

CIRCLE 210 ON READER CARD

digital logic module

A high-density slide-out BLOC has been developed for S-PAC digital logic module loading. Four models have been added to the basic line of loading BLOCs to hold from 50



to 200 modules in standard 19" wide by 22" deep racks. COMPUTER CONTROL CO., INC., 983 Concord St., Framingham, Mass. For information:

CIRCLE 211 ON READER CARD

portable recorder

The Port-A-Tape system records data on standard five channel teletypewriter paper tape through a 10-key handset that is connected to a portable paper tape punch unit. The system is self-powered and can record up to 40,000 characters from one charge. DATA DYNAMICS INTERNATIONAL, 16 North 49th St., Birmingham, Ala. For information:

CIRCLE 212 ON READER CARD

digiswitch

Both a binary-coded-decimal output and a simple 10-position output from a standard switch module are provided by the 334 digiswitch. Any number of modules may be ganged for back or front mounting. DIGITRAN CO., 855 S. Arroyo Pky., Pasadena, Calif. For information:

CIRCLE 213 ON READER CARD

delay line

The TD-4 is able to store up to 6,000 bits at a digit rate of 2 Mc in a non-return-to-zero mode at a cost of two cents per bit for the line itself. The TD-4 is priced at $125. SONIC MEMORY CORP., 494 Oak St., Copiague, N.Y. For information:

CIRCLE 214 ON READER CARD

film base ribbon

The SF-100 plastic-film ribbon enables tabulating, data processing and addressing equipment to produce printed information which is perma-

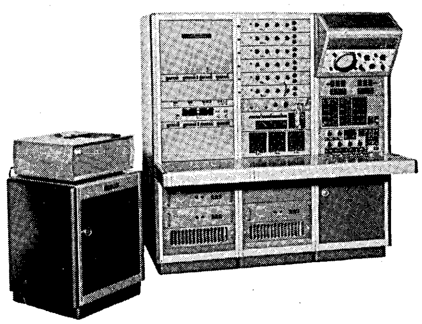
NEW PRODUCTS . . .

nent and smudge proof, according to the company. The SF-100 allows more than twice the length of material to be wound on a spool than fabric ribbons. COLUMBIA RIBBON & CARBON MANUFACTURING CO., INC., Herb Hill Rd., Glen Cove, N. Y. For information:

CIRCLE 215 ON READER CARD

automatic test system

Model 2145A universal memory plane and stack tester has been designed for analyzing the operations of all coincident-current and word-organized magnetic memories by testing under conditions similar to those encountered in working memory systems. The unit



can test coincident-current memories of up to 16,384 words and word organized memory arrays holding up to 128 words, each with up to 128 bits per word. COMPUTER INSTRUMENTATION CORP., Route 38 and Longwood Ave., Cherry Hill, N.J. For information:

CIRCLE 216 ON READER CARD

code translating system

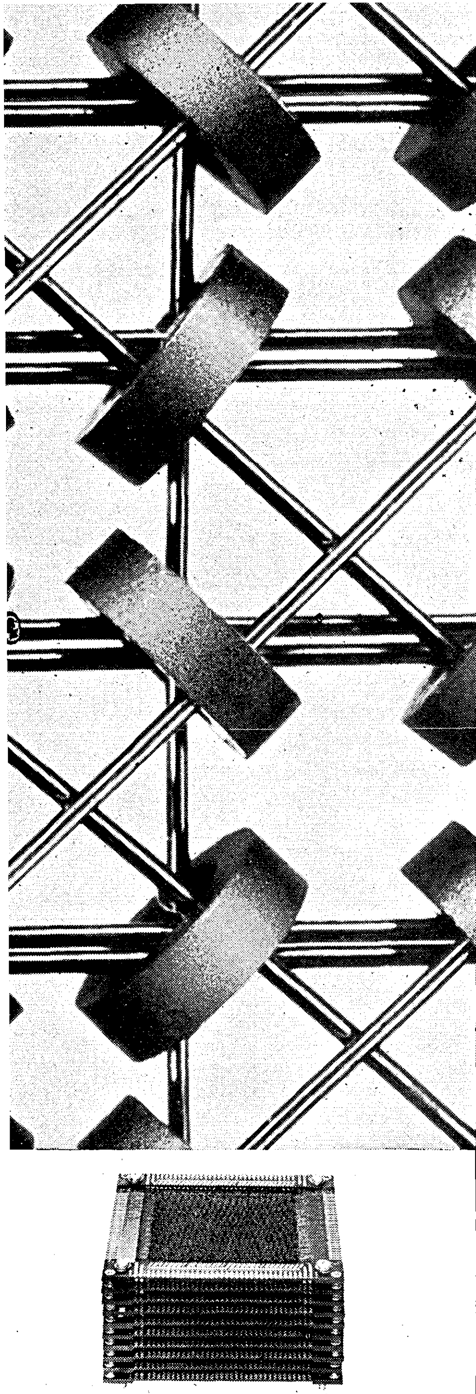
Model K-177 universal code IBM card to paper tape converter has been specially designed for the graphic arts industry. The K-177 is equipped for converting all types of 80-column cards—punched with non-Hollerith as well as standard IBM coding—to 5, 6, 7, or 8-channel paper tape. SYSTEMATICS, 3216 W. El Segundo Blvd., Hawthorne, Calif. For information:

CIRCLE 217 ON READER CARD

random access core memory

The Ministore has a range of storage capacities from 64 to 1024 words of 2, 4, 6, or 8 binary bits. Read/write cycle time between random access locations is 30 microseconds. All inputs and outputs are at standard logic levels of 0 and -6 volts. The memory operates on either a read/regenerate cycle (unload) or a clear/write cycle (load) which are initiated by separate commands. RESE ENGINEERING INC., A & Courtland St., Philadelphia 20, Pa. For information:

CIRCLE 218 ON READER CARD



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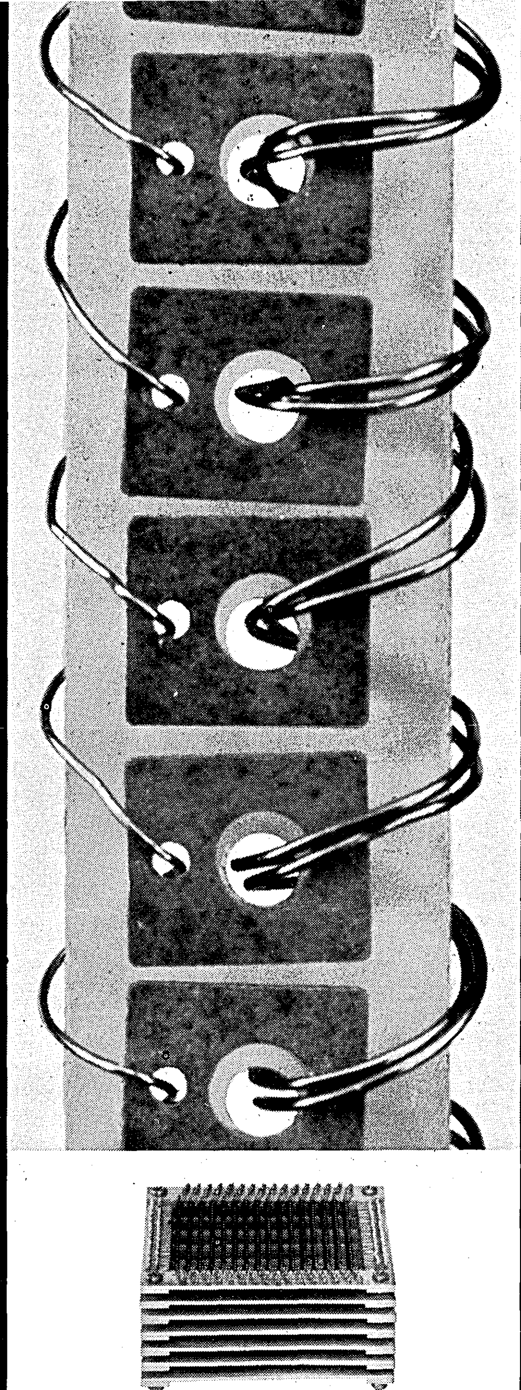

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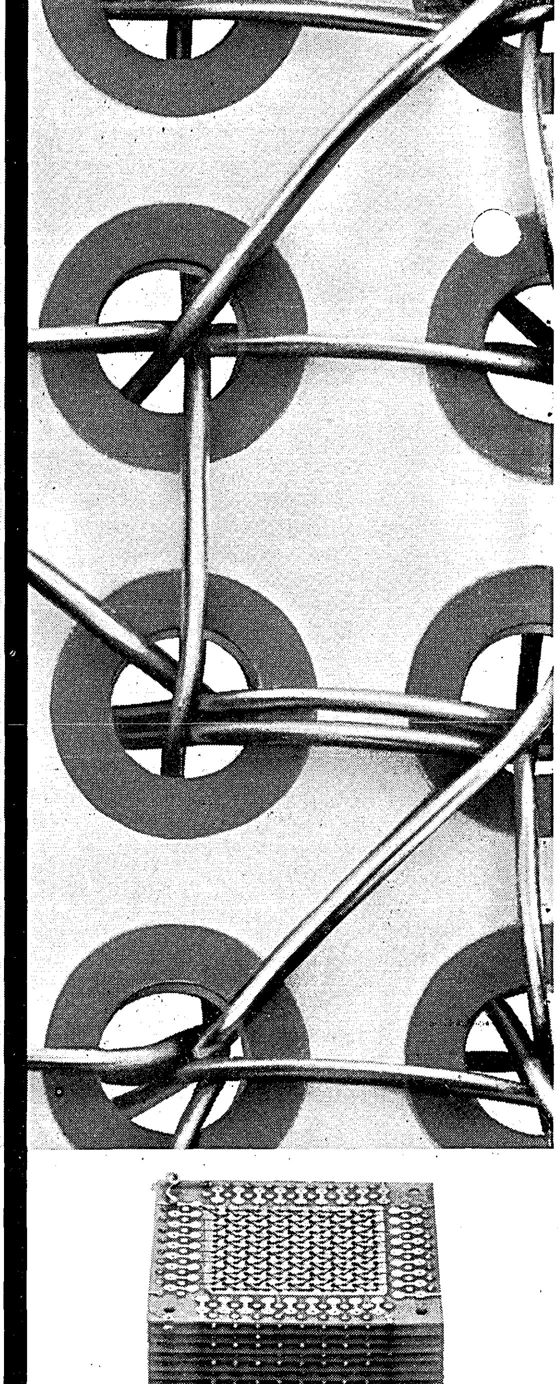

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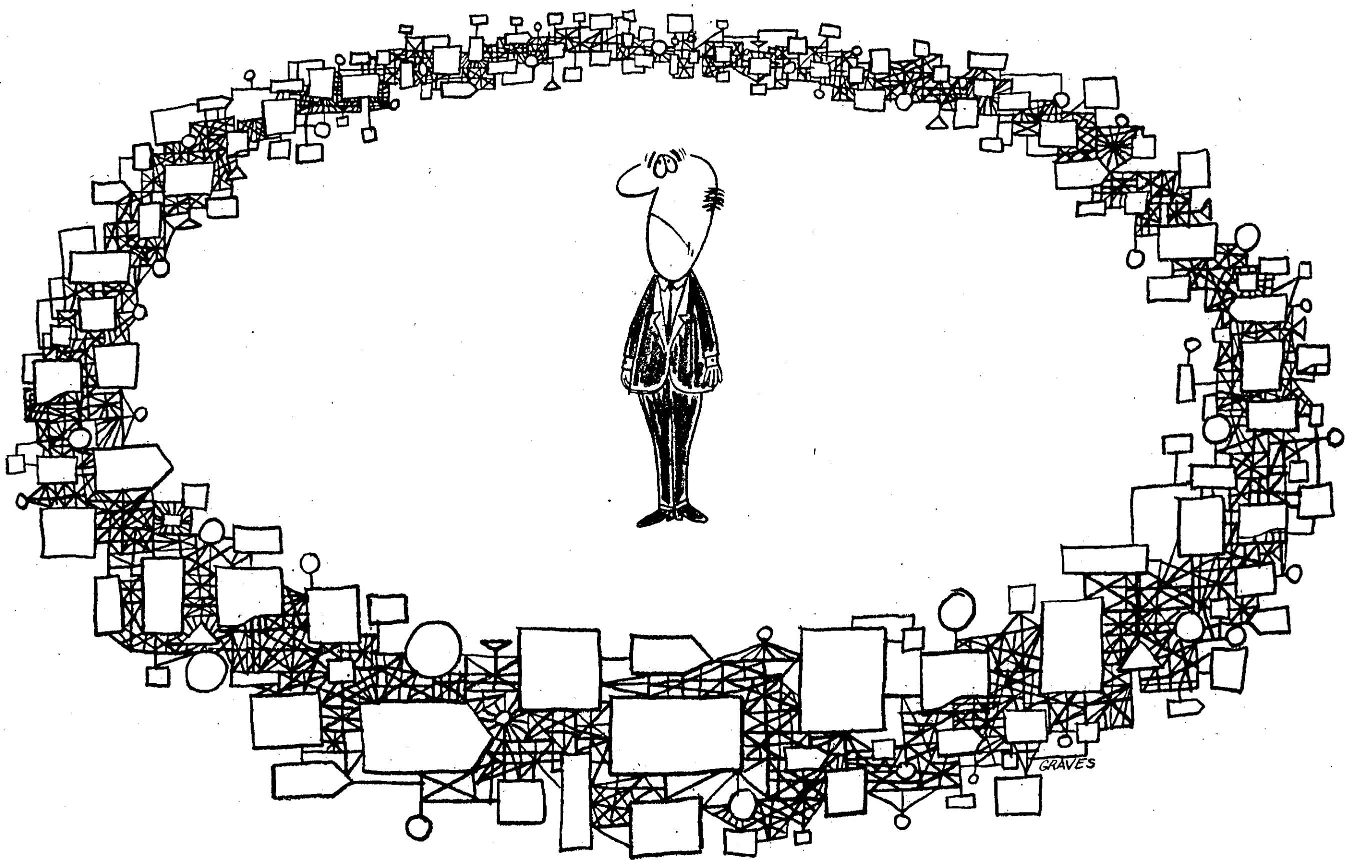

GRAVES

people IN DATAMATION

■ The appointment of Frank T. Cary to the position of vice president, field operations, has been announced by IBM's Data Processing Division. He will be responsible for the division's field operations, including marketing, service and administration. Previously, he was assistant director of IBM's corporate staff, and had also been president of the Service Bureau Corp.

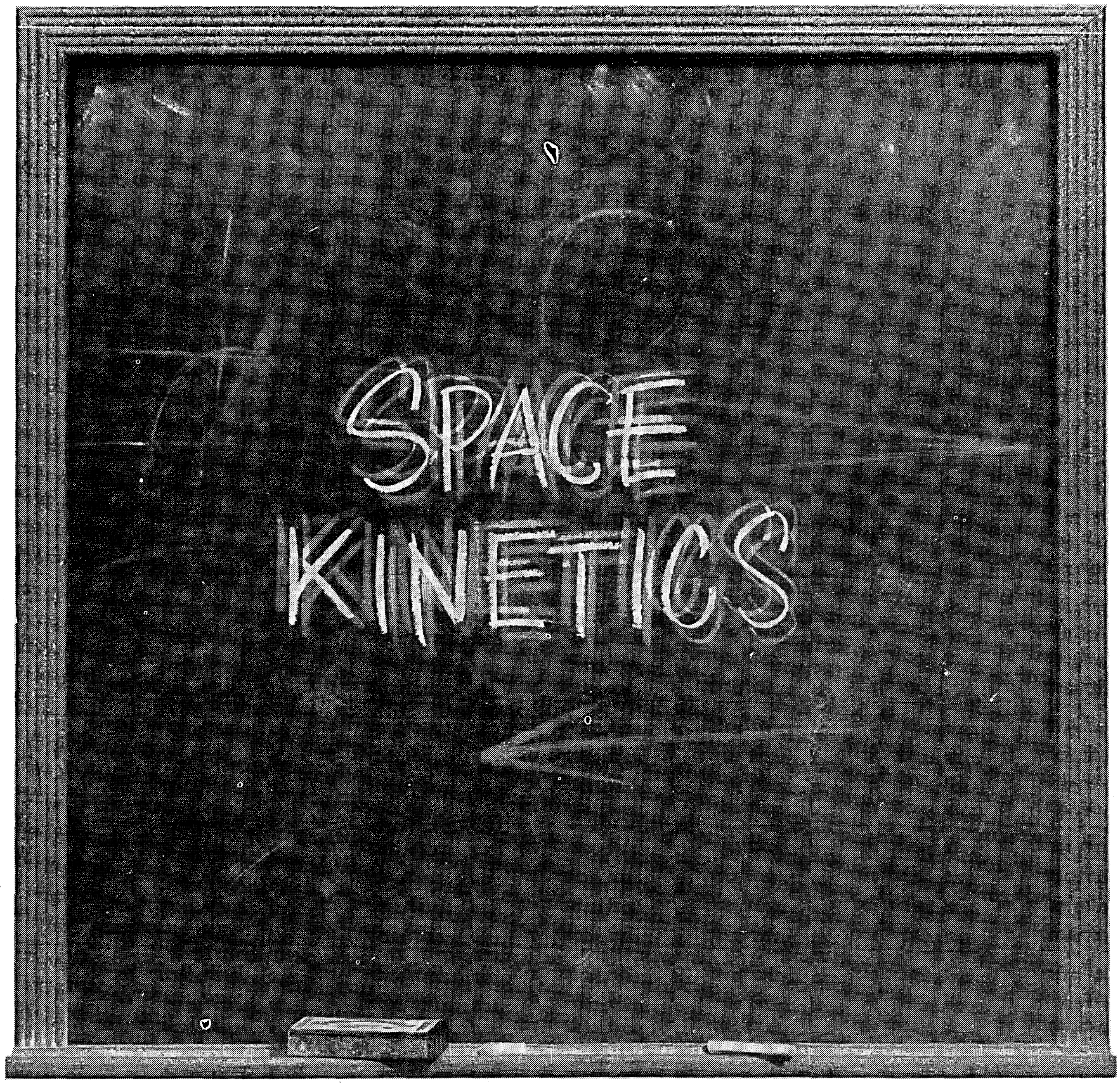
■ William R. Irion has joined Battelle Memorial Institute as a senior mathematician in the computation center, where he will work in the development of programming systems and study the use of computers in scientific research. He had previously been associated with North American Aviation in Los Angeles and Columbus, Ohio.

■ Herbert F. Mitchell, Jr., has been appointed vice president/advanced systems development by The Teleregister Corporation. Prior to his new position, he had been with Collins Radio Co., where he worked on the design of a stored logic communications processor. He has also been with Honeywell and the Univac division of Sperry Rand. A charter member of ACM, Mitchell is also a member of IRE and AIEE.

■ Robert B. Gregory has joined the Aeronutronic Division of Ford Motor Co., Newport Beach, Calif., as a systems engineer. Gregory was formerly president of Associated Data Centers, Inc.

■ Frederick C. Davidson, Jr., has been named supervisor of data applications at Sylvania Electric Products' Data Processing Center, Camillus, N.Y. Davidson had been supervisor of systems and procedures for the firm's Electronic Tube Division previously.

■ Richard S. Beverly has joined the staff of Planning Research Corp., Los Angeles, as an associate in the firm's information systems division. He was formerly associated with The RAND Corporation, Thompson Ramo Wooldridge Inc., and ITT-Kellogg.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NEW LITERATURE

COORDINATOGRAPH: An eight-page brochure offers a description of this automated X-Y plotter with digital I/O. How the unit is utilized for laying out printed circuits, turbine blades and airframe and marine lofting is detailed. AERO SERVICE CORP., 201 E. Courtland St., Philadelphia 20, Pa. For Copy:
CIRCLE 130 ON READER CARD

PRINTERS: All current models of complete high speed printer systems manufactured by this company are presented in a 12-page brochure. Also described are typical systems developed for government and military use. ANELEX CORP., 150 Causeway St., Boston 14, Mass. For copy:
CIRCLE 131 ON READER CARD

330 DIGITAL CONTROL COMPUTER: This color booklet gives examples of the performance of the 330 and describes analog inputs, digital inputs, memory capacity, command structure, program interrupt and outputs, etc., as applied in the fields of primary metals, process industries and electric power. TRW COMPUTERS CO., 8433 Fallbrook Ave., Canoga Park, Calif. For copy:
CIRCLE 132 ON READER CARD

DIGITAL CIRCUIT MODULES: Product descriptions, specification tables, schematic drawings, symbols, loading information, and data regarding equipment related to the T- and CT-series modules is offered in this 80-page catalog. ENGINEERED ELECTRONICS CO., 1441 E. Chestnut Ave., Santa Ana, Calif. For copy:
CIRCLE 133 ON READER CARD

DIGITAL LOGIC: This 64-page catalog describes the company's digital products and services. Also included are explanations of number systems, binary logic and basic logic operations fundamental to an understanding of Boolean algebra. The catalog has been designed as an aid in the specification of complete hardware assemblies. DATA SYSTEMS DIV., HARMAN-KARDON, INC., Plainview, L. I., N. Y. For copy:
CIRCLE 134 ON READER CARD

PERT: This report includes discussions on the commercial uses of PERT, its approach, its initial planning values, and operating values. Charts and statistics are included. BOOZ, ALLEN & HAMILTON, INC., 135 S. LaSalle St., Chicago 3, Ill. For copy:
CIRCLE 135 ON READER CARD

H PAC DIGITAL LOGIC MODULES: This 12-page brochure presents a full line of compatible modules, including a 2,000-bit capacity recirculating memory PAC and a variable frequency clock PAC. Technical descriptions, specifications, logic diagrams, loading rules, typical waveforms, packaging

techniques and auxiliary equipment are given. COMPUTER CONTROL CO., INC., 2251 Barry Ave., Los Angeles 64, Calif. For copy:
CIRCLE 136 ON READER CARD

1620 PLOTTERS: The use of digital incremental plotters for graphing data output of 1620s is the subject of this brochure. Also described is the hookup of plotters to the output unit through use of an adapter. Specifications of these plotters are given. CALIFORNIA COMPUTER PRODUCTS, INC., 8714 E. Cleta St., Downey, Calif. For copy:
CIRCLE 137 ON READER CARD

COLLECTADATA 30: Highlighted in this 36-page booklet is the operation and components of a new data collection system. Also included are descriptions of various transmitters, badge reader, receiver console, control console and cable system. FRIDEN, INC., PROMOTION PLANNING DEPT., 97 Humboldt St., Rochester 2, N.Y. For copy:
CIRCLE 138 ON READER CARD

ORTHOLOG COMBINER: This bulletin highlights a magnetic tape editing system and describes how the combiner generates a single composite tape from the best data contained on pairs of tapes. TECHNICAL PUBLICATIONS, GULTON INDUSTRIES, INC., 212 Durham Ave., Metuchen, N. J. For copy:
CIRCLE 139 ON READER CARD

G-20 PROGRAMMING SUPPORT & SERVICE: This illustrated bulletin describes customer services for users of the G-20 including systems analysis, applications, programming systems, program testing, Users Organization, program library, manuals, personnel training and equipment support. BENDIX CORP., COMPUTER DIV., 5630 Arbor Vitae St., Los Angeles 45, Calif., For copy:
CIRCLE 140 ON READER CARD

TRACKLOK: This booklet contains a description of a new accessory to be used for redundant predetection recording systems. A summary of the method used in controlling skew through electrically variable delay lines is presented. MINCOM, 2049 S. Barrington Ave., Los Angeles 25, Calif. For copy:
CIRCLE 141 ON READER CARD

MAG TAPE SYSTEM: The DR-2700 is the subject of this four-page bulletin. Included are discussions on the transport, vacuum and auxiliary tape storage, read and write electronics, magnetic heads, features and general specifications. CONSOLIDATED ELECTRODYNAMICS CORP., 360 Sierra Madre Villa, Pasadena, Calif. For copy:
CIRCLE 142 ON READER CARD

BLOCK READERS: An eight-page brochure describes automatic program control using the block concept, specifications for 11 block readers, typical applications and other accessory equipment which includes automatic tape spoolers, a tape preparation center, and a program simulator. ELECTRONIC ENGINEERING CO. OF CALIF., SALES DEPT., Box 58, Santa Ana, Calif. For copy:
CIRCLE 143 ON READER CARD

SOLID-STATE CIRCUITS: The sixth volume in the Computer Basics Series presents a practical treatment of arithmetic and transistorized logic circuits, and magnetic core devices. Cost of this 224 page book is $4.95. HOWARD SAMS & CO., INC., 1720 E. 38th St., Indianapolis 6, Indiana.

DESK-TOP ANALOG COMPUTER: A 12-page booklet includes descriptions and illustrations of the basic TR-10 computer, the interchangeable, plug-in components, and accessories. A section on the prepatch panel and descriptions on how the computer can

minus one for paper

	S	P	R
S	0	1	-1
P	-1	0	1
R	1	-1	0

The payoffs are known. The Scissors-Paper-Rock game matrix* provides a mathematical abstraction of the conflict situation. Now a Game Theory analysis can be performed. Its objective is to answer the question of how best to play the game. Strategy options in real-life conflicts are exceedingly more complex. To select the optimal course of action is the major move in our global game. To this end do our engineers design command and control systems today for tomorrow's offensive and defensive moves. If you seek to devote your scientific skills to determining long-range strategies and their associated tactical systems, you will find us genuinely receptive to your original thinking. Engineers, mathematicians, and scientists are cordially invited to apply. A good first move would be to send your résumé to Mr. Harry M. Laur at 6700 Eton Avenue, Canoga Park, California. He will counter with an immediate response. Litton Systems, Inc. is an equal opportunity employer.

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*Williams, J. D., *The Compleat Strategyst*

NEW LITERATURE . . .

be expanded for solving complex problems are also offered. ELECTRONIC ASSOC., INC., Long Branch & Naberal Aves., Long Branch, N.J. For copy:
CIRCLE 144 ON READER CARD

ANALOG TO DIGITAL CONVERTER: This brochure describes in block diagram form the basic operation and theory behind the A to D converter. DAYSTROM, INC., TRANSICOIL DIV., Worcester, Penna. For copy:
CIRCLE 145 ON READER CARD

PROJECTION READOUT: This illustrated catalog on one-plane rear projection readouts includes descriptions of standard readouts with maximum character sizes from 5/8″ through 3 5/8″, bina-view self decoding readouts, and cue indicator switches with push-button display screens. INDUSTRIAL ELECTRONIC ENGINEERS, INC., 5528 Vineland Ave., N. Hollywood, Calif. For copy:
CIRCLE 146 ON READER CARD

AUXILIARY EQUIPMENT: This 80-page illustrated catalog contains information on the company's line of data processing auxiliary equipment including binders, reel handling and storage equipment, and card reference equipment. TAB PRODUCTS CO., 550 Montgomery St., San Francisco 11, Calif. For copy:
CIRCLE 147 ON READER CARD

RELAY CODED CONTROL SYSTEM: The Rolkode solid state system which operates over two channels of frequency shift carrier is presented in this 16-page development sheet. System ratings, coding, counting principles, and electronic equipment used with Rolkode are described. GENERAL RAILWAY SIGNAL CO., P.O. Box 600, Rochester 2, N.Y. For copy:
CIRCLE 148 ON READER CARD

REED RELAYS: Information on Dunco encapsulated and magnetically shielded basic reed relays, pulse reed relays, crosspoint reed relays, magnetic latch relays, infinite margin reed relays and crystal can reed relays is given in this 12-page catalog. STRUTHERS-DUNN, INC., Lambs Rd., Pitman, N.J. For copy:
CIRCLE 149 ON READER CARD

DIGITAL PLOTTING: This four-page brochure is on the use of digital incremental plotters for graphing data output of 1620s. Specifications and illustrations are given. CALIFORNIA COMPUTER PRODUCTS, INC., 8714 E. Cleta St., Downey, Calif. For copy:
CIRCLE 128 ON READER CARD

SCIENTIFIC COMPUTER: This bulletin includes features, specifications and a discussion of supporting software for the 225. GENERAL ELECTRIC CO., COMPUTER DEPT., Deer Valley Park, Phoenix, Ariz. For copy:
CIRCLE 129 ON READER CARD

Programmers

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The Programming Systems Division of Honeywell EDP is one of the first software-based divisions in the computer industry. With their own specially constructed facility in suburban Boston, Honeywell programmers engage in assignments involving the design and development of COBOL, FACT, ALGOL – type Compilers, Executive Routines, Scientific Libraries, and other advanced software packages.

Backed by the Honeywell Corporation's 75 years of technical management experience, we've created and produced a growing line of business and scientific digital computer systems that include the H800, H400 and H290. Earlier this year our powerful new computer system, the H1800 was announced. Compatible with the H800 and H400, it has broadened and deepened the software production requirements of our Programming staff and has helped create many new additional career opportunities for Honeywell Programmers.

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Employment Supervisor
Programming Systems Division
60 Walnut Street, Dept. 687
Wellesley Hills 81, Massachusetts

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Several career positions are available in Washington, D.C. and other areas throughout the United States. The tremendous acceptance of our H800, H400 and H1800 systems for government-scientific applications has made us one of the fastest growing marketing teams within the Honeywell corporate structure. Ideally, the men selected for these new positions will have knowledge of the scientific applications of large-scale computer systems, with experience in programming, sales or data processing. In addition, experience or proven interest in work involving the requirements of Federal Government, its agencies or similar large-scale customer will be considered particularly advantageous.

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Will be expected to represent us effectively in proposals to government accounts. Knowledge of scientific applications, using large-scale systems is required.

Systems Service Representatives

Will assist in sales effort by contributing technical systems design support and will aid Honeywell customers in planning, programming and installing systems. These assignments are in Washington, D.C. and throughout the U.S. Relocation expenses will be paid.

Address your resume to:
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Sales Manager
Federal Systems Marketing Div.
1801 North Moore St., Dept. 686
Arlington, Virginia

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Recognized as the company that is setting the pace in the digital computer field, Honeywell EDP is one of the fastest-growing divisions in the Honeywell Corporation. The Education Division of Honeywell EDP has kept pace with this growth, creating unequalled opportunity for advancement and increasing responsibility for qualified men.

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In addition to periodic salary reviews and modern working conditions, Honeywell offers a tuition assistance program which may be used at any of the 38 universities and colleges in the Greater Boston area, and a working environment which allows for unlimited career advancement.

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MR. JOHN O'SULLIVAN

Employment Supervisor
Education Division
60 Walnut Street, Dept. 684
Wellesley Hills 81, Mass.

Honeywell
H *Electronic Data Processing*

Sales and Systems Service Representatives

GROW

with the Commercial Marketing Division of Honeywell EDP.

The tremendous acceptance of Honeywell's second-generation business and scientific digital computer systems has created once-in-a-career opportunities for men with experience in business systems and procedures, programming and systems installation.

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Will represent us effectively at all levels of customer management and be required to make sales presentations, prepare detailed proposals, and demonstrate qualities of initiative and leadership. Knowledge of business and scientific applications using computer systems and expressed interest in sales is required.

Systems Service Representatives

Will assist in sales effort by contributing technical systems design support and will aid Honeywell customers in planning, programming and installing systems. Should have programming and systems analysis experience on magnetic tape computers.

Assignments are available throughout the U.S. Relocation expenses will be paid.

Address your resume to:
MR. JOHN O'SULLIVAN
Employment Supervisor
Commercial Marketing Division
60 Walnut Street, Dept. 685
Wellesley Hills 81, Massachusetts

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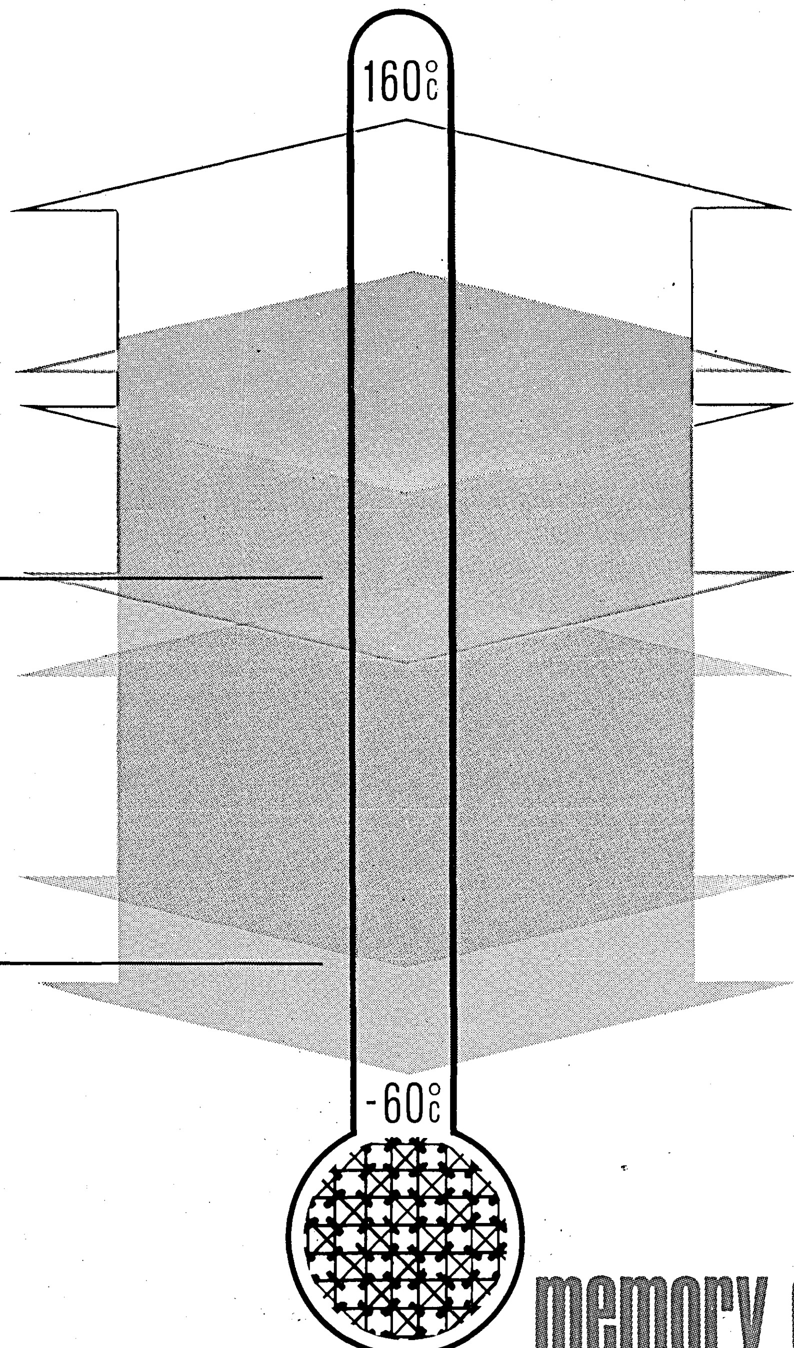

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