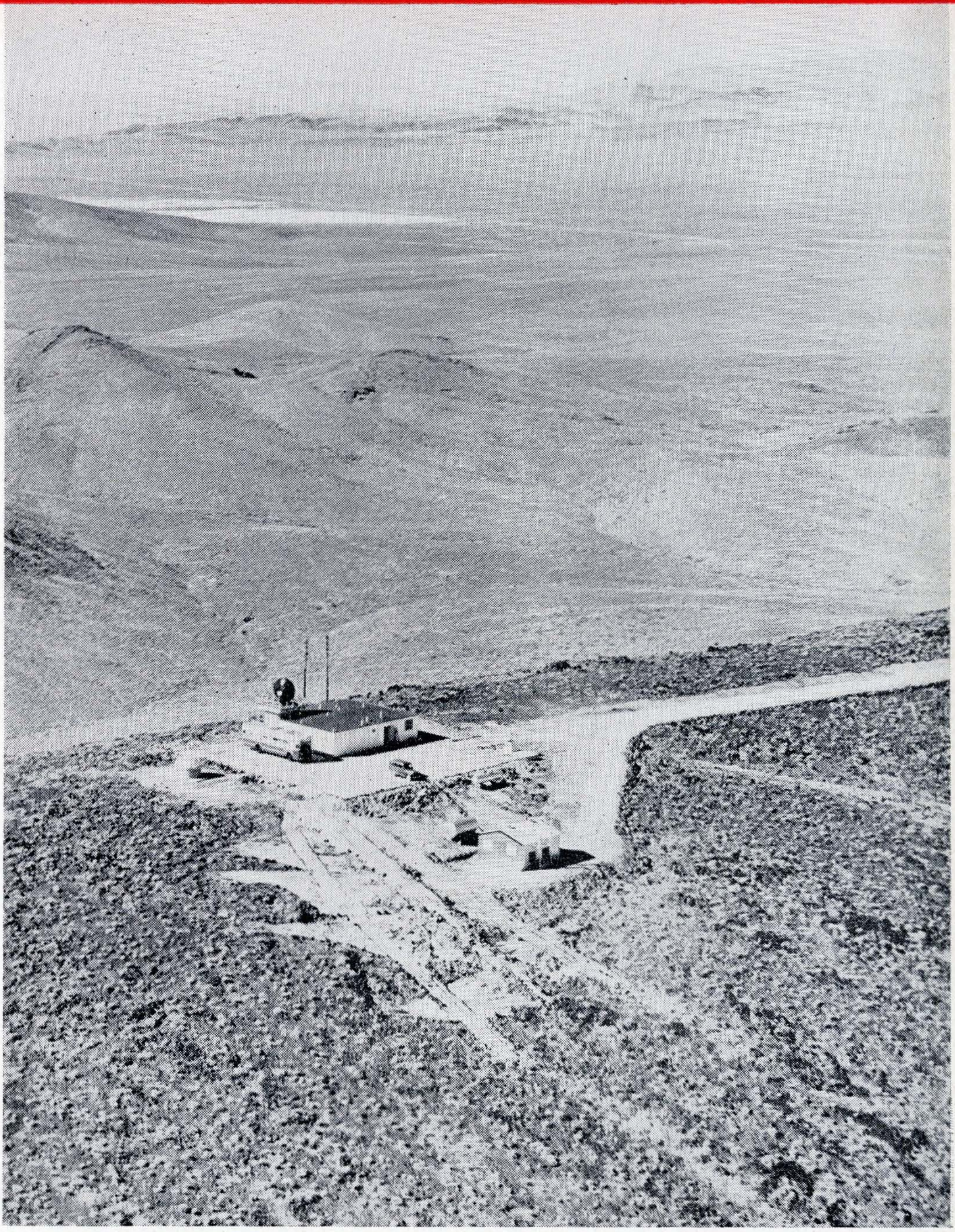
COMPUTERS
and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS



Computer Power: A Public Utility?

Blueprint for a Library

International Conference on Information Processing

APRIL 1959

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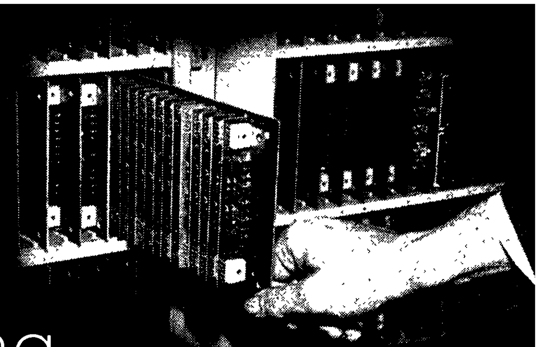
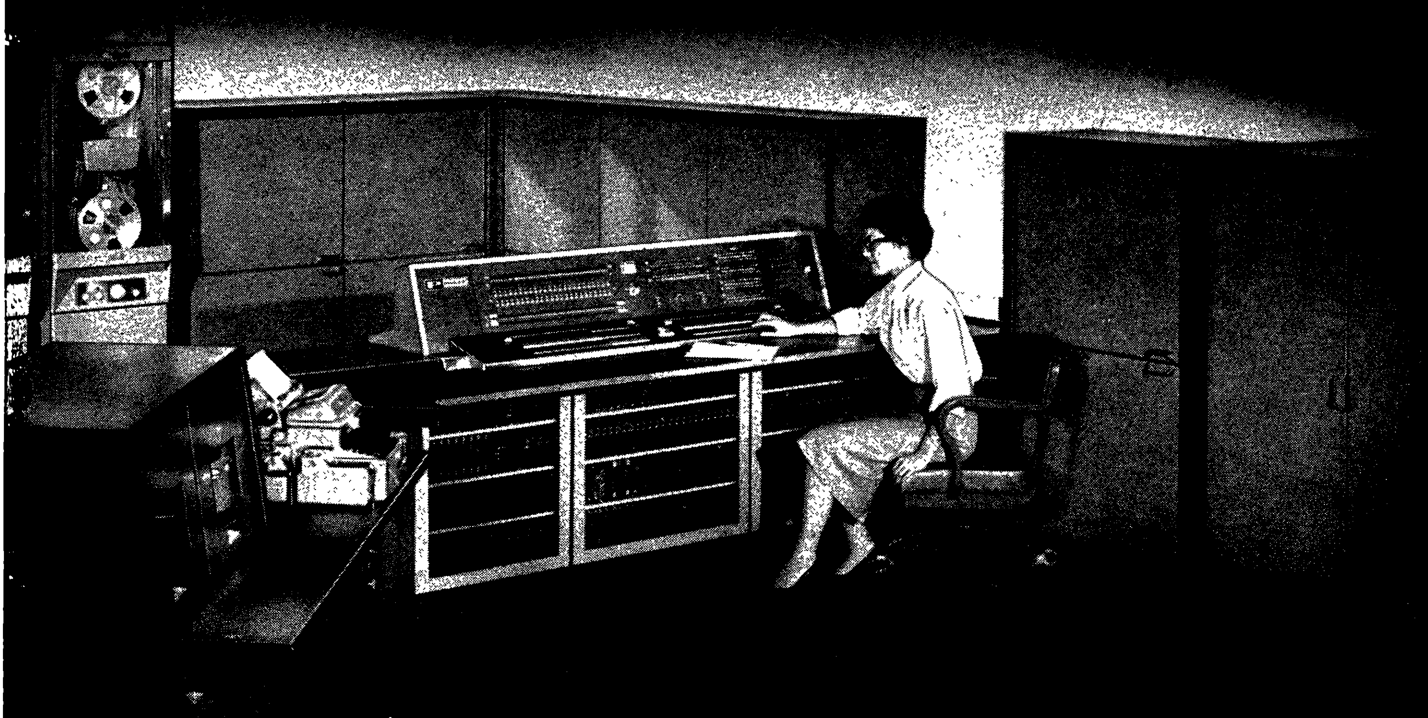
VOL. 8 - NO. 4

The Ultimate in Advanced Data Processing





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COMPUTERS

and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS

Volume 8
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APRIL, 1959

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September 1951

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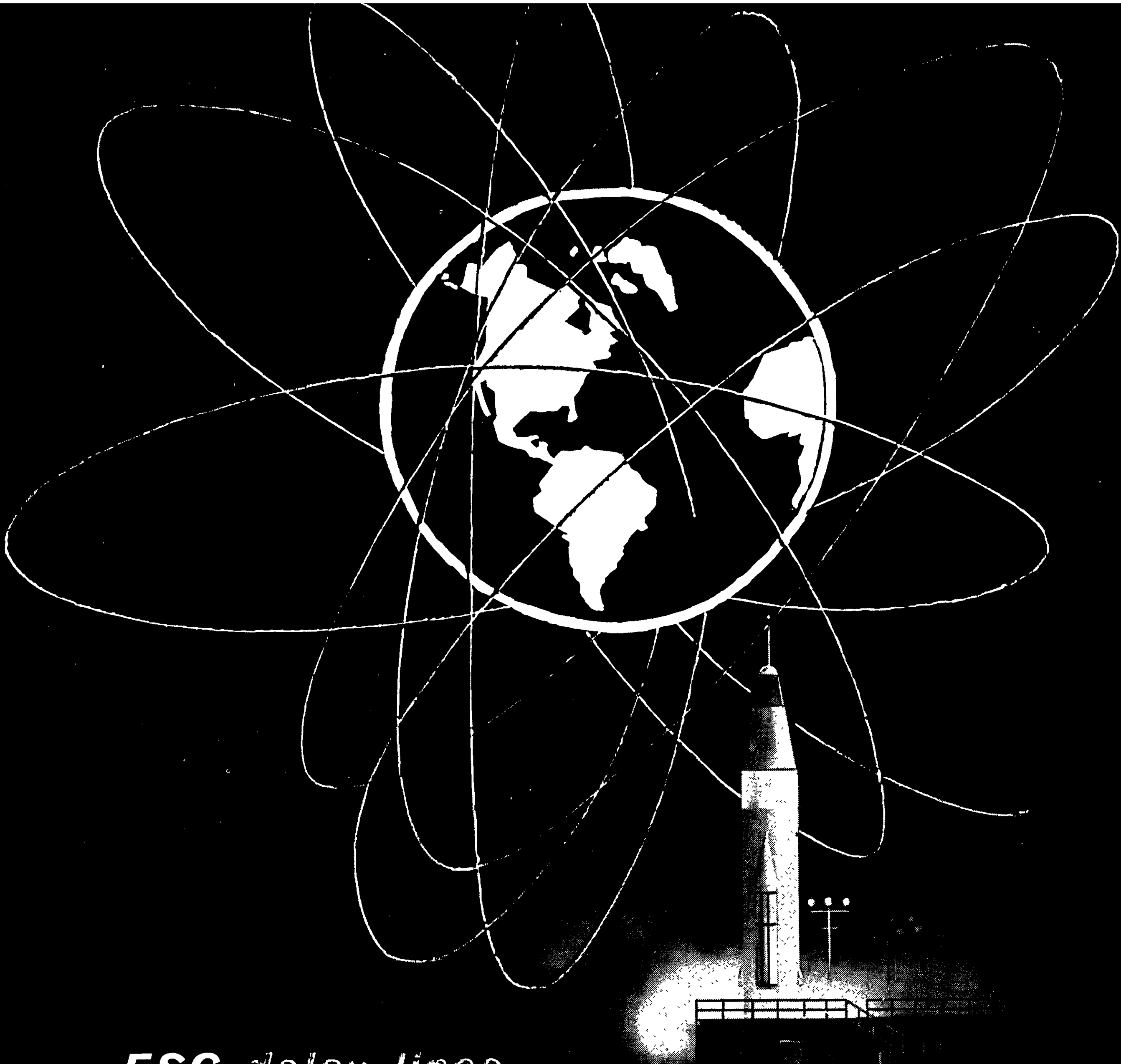
FRONT COVER

ARTICLES

READERS' AND EDITOR'S FORUM

REFERENCE INFORMATION

INDEX OF NOTICES



ESC *delay lines* *take off with America's talking satellite*

On December 18, 1958, the world entered a new era of communications with the successful orbiting of an Atlas ICBM—the Talking Satellite that broadcast President Dwight D. Eisenhower's Christmas message to the world. Circling the earth at a speed of more than 17,000 mph, the Talking Satellite repeated the President's message, erased it, and received and rebroadcast new messages in both voice and code.

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Readers' and Editor's Forum

EDUCATION AND COMPUTERS

I.

For some time it has been clear that much is not good in education in the United States, and this fact affects education for the field of computers as well as education for other fields.

A year ago, in the April 1958 issue of "Computers and Automation" the following appeared (p. 28):

To: All readers of **Computers and Automation**

To obtain more good computer people requires better education in elementary and high schools — in science, in mathematics, and in the fundamentals — reading, writing, and arithmetic.

To obtain better education in these subjects requires work by aroused persons in every community of the United States — persons aroused to pull education in the United States up to higher standards of accomplishment.

We are starting the publication of a very simple and informal monthly report "Better Education." If you are stirred up about inadequacies in the education that your children are receiving in your community, you are invited to write us, and we will send you at least one issue of "Better Education" free.

Since that time ten issues of "Better Education" have been published and have been sent to subscribers ($1.00 a year), by the publishers of "Computers and Automation."

II.

Another step is now being taken. The following letter is scheduled to appear in the current April issue of "Communications of the Association for Computing Machinery."

To: All Members of the Association for Computing Machinery.

From: Edmund C. Berkeley, Chairman, A.C.M. Secondary Education Committee, 815 Washington St., Newtonville 60, Mass.

The quality of education in elementary and secondary schools is one of the most important factors bearing on the training of young people for doing good work in mathematics, science, and computing machinery.

As chairman of this committee of the Association, I am eager to find out the names and addresses of all ACM members who are interested in and concerned about the quality of education in:

reading,	mathematics,
writing,	science, and
arithmetic,	related subjects

— the quality of such education actually being produced in the schools in their neighborhoods.

The plan is: to form an "ACM Division For Better Education"; to put together and distribute a list of names and addresses of all ACM members interested in this field; to set up in this ACM division close contact between all such members; and to exchange information and discussion, and if feasible, arrange local meetings. This plan has the approval of Dr. Paul Brock, Chairman of the Education Committee of the ACM, and Dr. Richard W. Hamming, President of the Association.

With 30 to 50 percent of young people entering college who cannot read adequately for college work, our concern must reach beyond the territory of just mathematics, science, and automatic computers in junior and senior years of high school.

Would you please return the following reply form (or a copy of it) if you are interested in being in the ACM "Division For Better Education"?

If you have any remarks, comments, ideas, suggestions, references, etc., related to this subject of better education, I will be glad to receive them.

If you would like to work on any projects in this division, please tell me.

- -

REPLY FORM (may be copied on any piece of paper)

To: E. C. Berkeley, Chairman
ACM Secondary Education Committee
815 Washington Street
Newtonville 60, Massachusetts

☐ I am interested in better education and its relation to automatic computers. Please include me in the "ACM Division for Better Education."

Remarks ____________________

My name and address are attached.

- -

III.

At the same time as the ACM Division on Better Education is being established, **Computers and Automation** is establishing a "C&A Division on Better Education." We speak:

To: All Readers of Computers and Automation who do not happen to be members of Association for Computing Machinery.

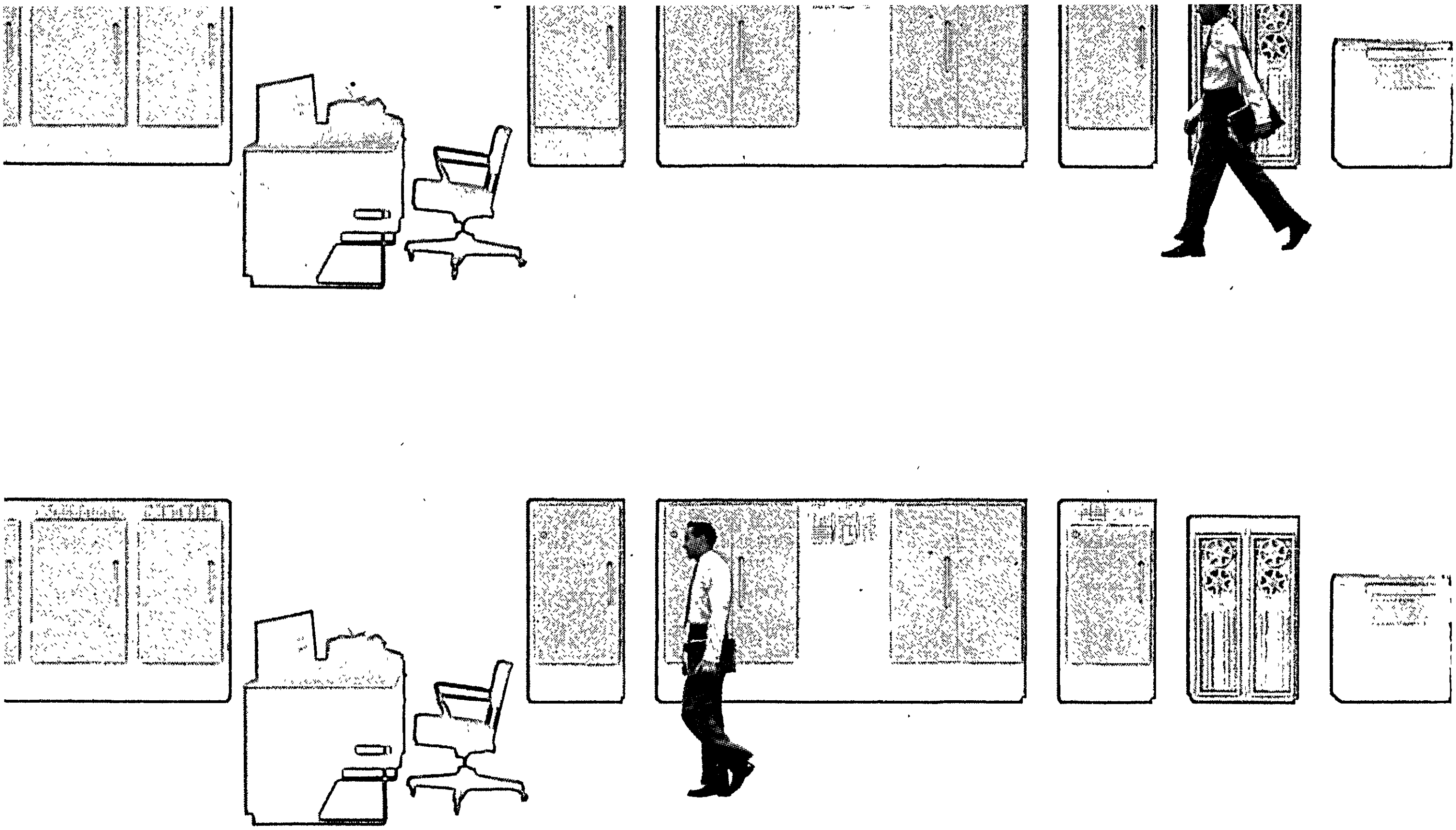
In reference to the above letter, if you are interested in being in the C&A Division for Better Education (which will operate in parallel with the corresponding ACM division and for the same purposes), will you please return the following reply form (or a copy of it)?

- -

REPLY FORM (may be copied on any piece of paper)

To: E. C. Berkeley, Editor
Computers and Automation
815 Washington Street
Newtonville 60, Mass.

☐ I am interested in better education and its relation to automatic computers. Please include me in the "C&A Division for Better Education" since I am not a member of the ACM.



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Designed to handle with ease a wide range of computational problems, the Burroughs 205 is delivering results daily in a great variety of scientific and business applications... from refinery design to inventory control, wind tunnel test analysis to insurance premium billing, telemetered data reduction to operations research. The 205 was selected to work on these and countless other tasks because of its speed, 4080 words of memory, ease of program loading, vast magnetic tape storage capacity and multiple-card processing versatility... features which make the 205 today's best dollar-for-dollar computer value. The 205 is just one part of a complete line of Burroughs electronic data processing equipment, helping hundreds of industrial users to save precious man-hours and to solve important problems. Write for 205 brochure, ElectroData Division, Pasadena, California.

Burroughs Corporation

"NEW DIMENSIONS/in electronics and data processing systems"

Remarks ——————————————————

My name and address are attached.

- -

We very much hope that through the launching of these two cooperating "Divisions for Better Education," the cause of better education in the United States may be advanced.

REFERENCE AND SURVEY INFORMATION PUBLISHED IN "COMPUTERS AND AUTOMATION"

One of the areas in which **Computers and Automation** has concentrated since it began in 1951 has been the publishing of reference and survey information relating to our field: "computers and data processors — the automatic handling of information — and applications and implications, including automation."

We now publish more than 20 kinds of reference information. It may be of interest to put down the latest inventory (retrospective and prospective) of these kinds:

Organizations:
- Roster of Organizations in the Computer Feld (June 1958; next one, June 1959)
- Roster of Consulting Services (June 1958; next one, June 1959)
- Roster of Computing Services (June 1958; next one, June 1959)
- Survey of Computing Services (July 1958)

Computers and Data Processors:
- Survey of Special Purpose Digital Computers (Sept. 1958)
- Survey of Commercial Computers (Nov. 1958)
- Annual Computer Census (May 1958)
- Types of Automatic Computing Machinery (Nov. 1958)
- Roster of Automatic Computers (June 1956)

Products and Services in the Computer Field:
- Products and Services for Sale or Rent (June 1958; next one, June 1959)
- Classes of Products and Services (June 1958)
- Types of Components of Automatic Computing Machinery (Nov. 1958)
- Survey of Basic Computer Components (Feb. 1959)

Applications:
- Important Applications of Computers (Oct. 1958)
- Novel Applications of Computers (Mar. 1958, Mar. 1959)

Markets:
- Computer Market Survey (May 1957; next one, May 1959)
- The Market for Computers in Banking (Sept. 1957)
- The Market for Computers in the Oil and Natural Gas Industry (Nov. 1957)

People:
- Who's Who in the Computer Field (various issues)

Pictorial Reports:
- 1958 Pictorial Report on the Computer Field (Dec. 1958)
- A Pictorial Manual on Computers (Dec. 1957, Jan. 1958) (reprint available)

Words and Terms:
- Glossary of Terms and Expressions in the Computer Field (Oct. 1956, reprint available)

Information and Publications:
- Books and Other Publications (many issues)
- New Patents (many issues)
- Computer Talks (many issues)
- Survey of Recent Articles (March 1959; April 1959)

With the ever-increasing expansion of the computer field, the field of automatic handling of information, it is easy to predict that more and more reference information of these and other kinds will need to be published; and this we shall plan to do. For it is a fact that reference information of the kind here described is not computable from automatic computing machinery — instead, it comes from collecting observations and reports about the real world. To use mathematical language, it consists of observational, not analytic truths.

EXPRESSION AND REPORTING OF VIEWS ON SOCIAL RESPONSIBILITY

James J. Lamb
Fellow, I. R. E.
South Norwalk, Conn.

To the Editor:

I have been following with great interest your editorial effort regarding social responsibility of computer scientists, and most heartily applaud you for it.

It seems to me you have done an especially fine thing in making inquiry of other publication editors, and making the results known in the excellent piece in your December '58 issue ("Editorial Policy of 50 Technical Magazines on Publishing Discussion and Argument on the Social Responsibility of Scientists and Engineers," in **Computers and Automation**, vol. 7, no. 12, Dec. 1958, pp 21-26).

It is very heartening to learn from this that there is a preponderance of sensibility regarding social responsibility among the editors, even evident in those who obviously are under publishers' restraint.

The letter from E. K. Gannett, Managing Editor of the I. R. E. Proceedings and other Institute publications, while strictly answering your questionnaire, does not tell the whole story regarding the forward-looking publication accomplishment of the I. R. E. generally, in non-technical material bearing on social (and even ethical) aspects of technology relating to and involving computers. This, quite properly, has been shown in papers published in the I. R. E. "Transactions on Engineering Management," one sample being my own paper "Automation — Its Moral and Spiritual Implications," PGEM ("Proceedings of the Technical Group on Engineering Management"), Vol. EM-5, No. 1, March 1958.

More power to your hand in the good work.

THE PHILOSOPHY OF COMPUTERS IN SOCIETY AND THE RESPONSIBILITY OF COMPUTER PEOPLE IN SOCIETY

For the first time in a major meeting of computer people, the subject of the responsibility of computer people in society and the philosophy of computers in society has been organized as a session of papers. This occurred in the Western Joint Computer Conference meeting in San Francisco, March 3-5, 1959, with a session and papers as follows:

[Please turn to page 20]

COMPUTER POWER: A PUBLIC UTILITY?

Alan O. Mann
Commercial Coordinator of Computers and Automation
Philco Corp.
Philadelphia, Pa.

(Based on a talk at the Annual Electronics Conference, American Management Assoc'n, New York, March 2-4, 1959)

Electronic Power

.... Today, my topic is "Power," and, although unorthodox, my text is from the 62nd Psalm — "God hath spoken once; twice have I heard this; that power belongeth unto God."

* * * *

Keeping this prophetic note in the backs of our minds, let's give some thought to what we in business have been doing with our custodianship of electronic power.

First, we note our constant emphasis on bits and pieces of our information-handling problems rather than on the whole. It is impressive to note, in countless conversations with lower and middle managers who are doing work in this particular area, their almost universal acknowledgement that their piecemeal methods and attacks are not right. They volunteer acknowledgements that what they're doing now is too limited in scope and less than satisfactory but the **best they can do.** They claim that it is the best they can do because of limitations which upper management imposes upon scope — limitations on costs primarily, founded in many instances on surmisals, misunderstandings or assumptions arrived at without basis in fact or logic. So, in general, it would appear that we are still required to determine the **feasibility** or advisability of computers in **applications;** we pre-select rather than determine first the over-all needs of our particular business in the light of how they might be resolved with the help of available and attainable electronic power. .

Emphasis on Managing an Enterprise

In the most recent issue of the Harvard Business Review, Peter Drucker made some cogent statements concerning the present status of management science. Perhaps because the electric computer is or will be inextricably tied up with management science, it seems to me that some of Mr. Drucker's statements apply equally to the present status of computer application in business. As I read his statements now, keep in mind the fact that **he** applied them to management science but that I am inferring their possible applicability to computer uses to date. Here we go:

> "The bulk of the work today concerns itself with the sharpening of already existing tools for specific technical functions — such as quality control or inventory control, warehouse location or freight-car allocation, machine loading, maintenance scheduling or order handling. . . But there is almost no work, no organized thought, no emphasis on managing an enterprise — on the risk-making, risk-taking, decision-making job. . . The emphasis is on techniques rather than on principles, on mechanics rather than on decisions, on tools rather than on results, and, above all, on efficiency of the part rather than on performance of the whole. . . For management science (substitute 'the computer') to become a gadget bag . . . not only means a missed opportunity; it may also mean loss of its potential to contribute altogether, if not its degeneration into a mischief maker."

Are you as impressed as I with the validity of these statements as they might be applied to computer developments to date?

What is computer power? I'm sure we all agree that the computer does have power — an ability, a potential force capable of exercising control, of acting to produce change or to bring about a new event. This is a definition of power of all kinds. But if we look at this ability in the way the psychologists do, we would divide it into two categories — its **active** powers or **faculties,** and its **passive** powers or **capacities.**

In this light some organizations today are concerning themselves with the faculties or active powers of the computer, while others (and fewer) are concerning themselves primarily with the passive powers or capacities. My thesis is that we **should,** all of us, be concentrating on its capacities — that we should consider computer power almost from the metaphysical veiwpoint of Aristotle — as a state which, while not actually in existence, is awaiting the fitting conditions in order to manifest what it already potentially is.

Potential Computer Ability Available

On this basis, computer power consists of actual ability used and potential ability available.

First, actual ability used — What is it? It is:

- Data manipulation (sort, match, merge, collate, file, etc.).
- Computation.
- Data reporting.
- Applications — individually, singly, compartmentalized, clocked to specific, limiting, governing time periods.

Second, potential ability available — What is it? It is:

- Data manipulation, computation, data reporting — the same as before.
- But it's also speed.
- It's also combinatorial capabilities.
- It's also multiple use, togetherness, simultaneity, integration.

— It's expressed in terms that are beginning to show up a little more extensively in computer thought:

Simultaneous read — write — compute.

Multiple access.

Numbers of simultaneous inputs and outputs of many kinds.

Wide ranges of timing requirements. All sorts of speeds of input, output and processing, functioning automatically together.

What does this say to us in business?

— We're generally handling basic transactions (paperwork) as we've always known it — just a whole lot faster.

— We're using the same old inputs — paper forms, punched cards, punched paper tape, typewriter keystrokes.

— We're asking for the same old outputs — paper forms, reports and punched cards or punched tapes which we can re-introduce as inputs back into the system.

— We're in general applying a high-priced, so-called "office machine" to an old familiar, long-established business system.

— We're **not** determining the real, over-all fundamental needs of our businesses in the light of all that might be done to satisfy them through the capacities of the electronic art.

Those of you whose companies are now operating computers (or planning computers), think over these questions:

— Are you processing all your data through the computer, or only certain specific parts which you consistently call "applications"?

— Is your company only working on the possibilities of adding more pieces or 'applications' to it?

— Is your computer connected to the communications network of your company so that all basic transactions enter and leave it as promptly as you need?

— Is your computer system producing all your engineering computations, some of your essential charts, and even some of your engineering drawings?

— Is it connected to production machinery in the factory, reading gages and meters and feeding back instructions which operate the controls on your machinery?

— Is it providing to your managers, from your chief executive officer down, most of the information they use each time they have to make a risk, take a risk, or make a decision? Are you using it for all the following purposes?

— In determining when to increase or decrease your personnel at all levels and how much?

— For planning capital expansion or retraction?

— Evaluating and adjusting your product line?

— Setting your prices or rates?

— Changing your financing?

— Revising your marketing?

— Programming your advertising?

— Editing and printing your catalogs?

— Mapping out and policing your competitive strategy?

— Naming your products?

— Retrieving information from your reference library?

— Policing the flow, motion and interrelationships of all your facilities and manpower throughout your entire organization?

Functions Within Computer Power

If your answer is "no" to some of these questions, it's possible that you're dealing too much with faculties and too little with capacities. All these individual functions are within the **power** of the computer technology today even though they may not **all** be within the power of your present specific computer system or the present knowledge and experience of your company's personnel. If, however, you are planning and working only on the efficiency of the part and not also on the potential performance of the whole, you are pointed in the direction of "the gadget bag, the missed opportunity."

Military Systems Using Computers

Of course, we must acknowledge that the magnitude and cost of carrying out all the work involved in the whole — its principles and its decisions — is great. It is this magnitude that seems to make the work of the military on computer systems more major than the work of commerce and industry. Whether we like it or not, it is the military that is in general guiding the future of the technology more than industry. While industry is largely concerning itself with the application of already existing tools for specific technical functions, the military is devoting its organized thought and work to the managing of its entire enterprise. The scope of its problems is such that it **must** deal in team efforts, in integration, on such a scale that all the potential capabilities within the electronic art **must** be made to work together in correlation so that they can provide what is needed by the managers (commanders) all over the world in their risk-making, risk-taking decisions. While the military, like industry, is concerned with the processing of the detailed papers of orders, requisitions, paychecks, and the like, they seem to be more deeply concerned with how those details fit into the over-all requirements and concepts of administration. Thus, they speak more of systems than computers. They search for all elements of electronic power that can be fitted together to provide greater power in the ultimate decision-making. Their systems concepts require the inclusion of capabilities which industry in general needs but does not or perhaps cannot yet, for economic and other reasons, include — infra-red, radar, television, telemetering, microwave, tropospheric scatter, automatic switching within communications networks, computers talking to computers, visual displays, multiple control centers, portable computers, real-time controls, sub-systems within systems, etc.

Thus, in designing its systems concept, the military is analyzing the needs of every level and in every branch of its organization to determine the precise nature of those needs in the light of the technological ability to supply them. Out of their analyses are coming specifications — requirements — based not on specific units of equipment available for purchase, but on the engineering together of attainable equipment powers into new and exceedingly powerful systems. The scale of their team activities in conceptual formulation has become so large that the manufacturers to whom they turn have similarly pooled their resources and brainpower in order to satisfy the needs.

I'm sure you've heard of some of such systems — Sage, Bemews, Rapcon, and a recent one, the Field Data System that will bring together into one system from several manufacturers, several different new designs of computer and several different communications facilities.

Systems Too Powerful for Business?

Thus, while individual electronics manufacturers are largely renting to business firms, product lines of computers with varying degrees of power, they are producing for the military total systems of much greater power and scope. They are developing systems of data processing which, in some cases, they believe are too costly and too powerful for you in business to consider at this time.

But these capabilities which are being developed today are the capabilities to be available to you in the future. They are the ones around which you should be formulating your concepts and toward which you should be pointing your future plans. All of your thinking should be in the direction of such new and more potent uses of computer power. I would recommend that you search out, procure and study as many of these comprehensive system projects as you can, both in the military and in industry.

Major Integrated Projects Using Computers

Representative of these is the work of the Army Ordnance Supply System in its project MASS and related efforts to tie together all worldwide elements of supply-demand forecasting, depot storage and distribution and field service operations. Not satisfied with analyses and decisions based on historic supplying of materials to the Army, they have done significant work in determining demands (needs) and in constructing techniques for governing future supply in accordance with forecasted demand. They are considering not only the detailed processing of necessary paperwork at an operating level but also the over-all management correlation of every aspect of supplying a massive, world-wide organization and controlling it quantitatively, qualitatively and fiscally.

Similar significant work is being done in many other branches of the Army, Navy and Air Force, such as the Air Material Command, the Strategic Air Command, the Aviation Supply Office of the Navy, Navy BuPers, the Naval Gun Factory, the Marine Corps, and in various other specific projects connected with battlefield surveillance, sea surveillance, air traffic control and defense. There are untold major projects where the integration of manpower controls, supply and logistic controls, and monetary controls is attaining significant proportions in enterprises of enormous magnitude and scope. And, their problems are very much the same as yours in terms of administrative control needs — in many respects no more demanding of integration, power and economic reality.

Throughout these and many industrial and commercial organizations, there are accompanying programs for relating the computers directly with automatically-switched communications networks. Programs are more and more calling for the interconnection of numerous scattered locations on wire and microwave networks, automatically switching data transmission by a wide variety of techniques, teletypewriters, teleprinters, transceivers, dataphone systems, kineplex systems, transactors. Some of these projects are so increasing in scope, magnitude and speed requirements that the automatic switching controls require the power of the large-scale computer itself. The problems of the switching and the processing are becoming intermingled to an extent needed by the users and consistent with the principles which underly the electronic art. For precursors of the power that is becoming available to you in business, look into these activities in depth within the military, government agencies and firms like Sylvania, Carborundum, DuPont, U. S. Steel, Alcoa, Western Electric, General Electric, etc.

Telemetering and Computers

Telemetering has been quietly receiving its major boost within the aircraft and continuous processing industries. The ideas of closed-loop systems of remote control by means of electronic computers and communications (which general business is still categorizing as "blue sky" and dreams), are concurrently turning into realities through the efforts of technicians in certain organizations.

Strangely, there are some cases where the engineering branch of a company has forged ahead in the development of sophisticated telemetering systems while the general management of the same company has appeared unaware that its administrative data processing was continuing in the old periodic, unresponsive tradition, although both areas involve data processing for control.

Total Systems for Industrial Control

The test-flights of a supersonic aircraft equipped with a couple of thousand metering and measuring devices which are constantly transmitting their readings to computing equipment on the ground for analysis and guidance instructions back to the aircraft are, in a way, a simulation of an industrial system. The same is true for missile systems and fire control systems. Here again, to see the power you in industry need and can be getting, look into the telemetering activities of the military, the aircraft companies, the oil companies and organizations such as General Electric, DuPont, and even down to such relatively small concerns as the Platte Pipe Line Company. Look too, into the process control developments among the manufacturers who specialize in instrumentation and are quietly producing effective analog and digital systems for data logging, data processing and process control. They are contributing elements of electronic power which can conceivably be coupled and integrated into your future total industrial control systems.

There are many other areas of electronic development and application where major work is being done which, although potentially important to the total business system formulation, is not generally thought of as bearing any relationship to cost accounting, order processing, production scheduling or even managerial decision-making. Significant work in the engineering of roads for determinations of cuts and fills, has yet to be correlated with all the other aspects of road construction logistics, labor distribution, planning, scheduling, accounting, etc. The work of the libraries in business organizations, educational institutions such as Western Reserve and Lehigh University and others, toward electronic solutions to the increasingly massive problems of information cataloguing, abstracting, storage and retrieval, is another instance where potential solutions to business problems may be developing. Even among some of the electronic computer manufacturers themselves accomplishments in this area are not yet being clearly correlated into the hardware concepts presented to you as answers to your business problem. Yet, part of your over-all problem contains major elements of voluminous information cataloguing, storage and retrieval.

The traffic and transportation solutions that are being developed by many organizations offer further elements of potential computer power to those in commercial and industrial concerns who have large problems of transportation, routings and traffic control even though transport is definitely not your basic business. Here, again, you should look into the work of the supply and logistics groups in the Department of Defense, the Transportation Center at Northwestern University, a number of the municipal and state governments, the airlines, some of the oil companies and others. They are mustering new and more potent uses of computer power which you need.

Computer Speed

The computer's distinctiveness is speed in multiple, speed in doing many cogitative things at one time. It is made as a composite from the logical thought-process of many, many individuals, put together in relative leisure. It is the extension of a very large number of human minds and is being made increasingly to do what an individual or a growing group of individuals cannot do — perform combinations of human intellectual functions with superhuman timing — prefabricated intellectual functions, as it were. So the computer power we are talking about is its speed, which is awaiting the fitting conditions in order to manifest what it already potentially is.

There is an economic feature in this power that is of very real interest to all of us: The greater the speed we can engineer into the computer, the lower and lower we can drive the unit cost of data processing. As speeds go up, unit costs go down. This fact of itself will force us to graduate from our past and current inclinations to differentiate between two separate categories of computer — those we say require small input/output/storage and large arithmetic capabilities (which we call 'scientific' computers), and those we say require large input/output /storage and small arithmetic capabilities (which we call 'business' computers). From an over-all standpoint, whatever our data processing needs may be, I repeat — the greater the speed or power, the lower the unit cost.

Cost Reduction in Computer Power

"But," you say, "Mr. Speaker; this is all well and good for large organizations who can afford such cost reduction, like the wealthy man who can buy his food wholesale for cash — in quantity — while the poor fellow buys it a little at a time and still has to pay his higher prices. Aren't the smaller companies going to have to continue using lower-priced equipments? Aren't they going to have to go on paying more than the lowest unit costs of data processing, simply because of the utilization problem — all the capacity they have to buy but cannot utilize during more than a small fraction of each day?"

Computer Power as a Public Utility

My answer is, "Maybe so." However, there may be a strange new combination of circumstances developing right under our very noses that could answer this problem of the smaller users sooner and more fully than we realize. Perhaps the computer business is even now changing its original complexion from that of competitive free enterprise into that of a public utility. Perhaps there is developing a situation in the manufacture and use of computers which will force the business into the pattern of maximum use and minimum profit which is the basic characteristic of a public business.

Analogies

It is not without purpose that I chose to speak of 'power' here today. For there are certain analogies which appear to exist between the computer and the electric power business, analogies which might almost lead one to believe that the computer business cannot maintain its present status as a private competitive enterprise. I repeat: the computer business appears to have many of the basic characteristics of a public utility.

What are the bases that prompt me to suggest such a possibility? First, there are legal bases — for whether or not any business is a public utility is determined by the law. Thus, decisions which have been made in the past by the Supreme Court of the U. S. should serve as criteria against which we might evaluate such an idea. Secondly, there are economic bases that can be checked. What are the economic characteristics of the computer business in comparison with those of other businesses? Here, too, are some of the criteria which are used by the Legal in arriving at their decisions. And thirdly, there are the historical bases for checking our idea, on the strength of the fact that history has always had a strange way of repeating itself.

Essence of Public Utility Service

Since the law functions on the basis of historic precedent, and since the question of public utility vs. private enterprise is primarily an economic one, it is difficult to separate any analysis into the three neat, distinctive divisions. So let us just briefly look at the case without regard for classification. Here are some interesting points to think about:

1. It is generally conceded that the essence of public utility service lies in centralized sources of supply. Is not the essence of the computer a centralization of the source of processed data supply?
2. Public utilities tend to be industries in which there is an unusually low rate of capital turnover — generally in the range of once every four or five years as against much faster turnover in the competitive businesses — automobile manufacture, department stores, chain stores and the like. Capital turnover in the computer business is extremely slow.
3. In public utility operations, a large proportion of the total costs is relatively fixed. The same goes for computer operation.
4. In the public utility there are characteristically variable demands for service through the periods of day, week, month . . . And there is a low utilization factor — a low ratio of average load to rated capacity. Yet there is a duty to supply the demands for service when it is wanted. Thus there is a definite need for reserve capacity and a significant effort must be made to improve utilization by filling up the low periods

of load with other kinds of utilization. So it would seem to be with the computer.

5. Also peculiar to the public utility is a high ratio of the maximum demands of the parts of a system to the maximum demand of the whole system. This high maximum coincident demand requires stand-by or reserve capacity. Is this not so in the use of computers?

6. And then a really major point that is almost uniquely a characteristic of the public utilities — the more powerful the units of equipment can be made, the less the unit cost of capacity. This is an aspect of the computer which I have been emphasizing rather strongly here today.

Joint Production of Computer Power

7. Another specific characteristic of the public utility is that some of its services may be jointly produced, with one service or output so arranged that its production will lead to the production of another, to effect economies such as could not be realized if they were separately produced. Here it would seem that the generation of associations for the interchange and sharing of computer programs might fit this criterion. Cases are also coming into existence for standardization of transaction forms and language between business firms to assist each other in processing purchase orders, invoices, receiving notices, etc. Furthermore, the tendency toward the formation of service bureaus, and cooperative groupings such as SPAN, might further come under this category. As a matter of fact, there seems to be an informal trend developing these days, where some quite large business firms rent computers from the manufacturers with the pre-established intent of going into the service bureau business as a means of effecting economies for themselves. They render computer service although that is far from their business charter.

Historic Comparison with Electric Power

8. Which gets us into an historic comparison with the public utility. Many of our present public utilities had their beginnings this way — cooperatives, joint ventures, and even extreme cases like a farmer establishing an electric power plant and gradually beginning to sell power services to others, including non-farmers, as a means of affording the service for himself.

9. Another historically analogous feature seems to be displayed in the growth of the computer business. In past cases where the high cost of the plant and the large scale upon which the business was conducted began to destroy effective competition, the business gradually turned into public utility. It would appear that whenever a business has grown to such vast proportions that such vast sums have become involved in constructing competing systems and few if any have cared to take the risk for fear of failure, it has become a public utility.

10. Current practice in the computer business is becoming increasingly one of equipment rental rather than equipment sale, with accompanying provision of maintenance, spare parts, training and other services included in the rental rates charged. This is another significant historical characteristic of the public utility business.

Coupling of Computers and Communication

11. The rising trend toward the coupling of computers with communications systems is merely acknowledging the fact that a substantial portion of all data processing consists of data communication. It seems to me that this trend will continue at an increasing tempo for the development of comprehensive data processing systems. If so, the common carriers will be used more and more as inherent parts of the systems — and this communications portion of the service is already established as a public utility.

12. Historically, whenever the consumer has developed wants that have begun to extend beyond the services being offered by the supplier, although within the potential capabilities of the supplier, action has been stimulated to provide impetus beyond that of normal competition. Current data processing demands for cheaper and more effective input/output devices, for protection from equipment obsolescence and its excessive reprogramming costs, for microwave links at lower cost, and the like, might fall under this same class of historic impetus toward the public utility concept.

13. In the early history of practically all public utilities there have been growing numbers of mergers and acquisitions by larger companies of competing systems, as a means of attempting to solve some of the competitive problems we have mentioned earlier. Here again, history seems to be repeating itself in the computer business.

Relation with the General Public

14. And last, but by no means of least significance, is the fact that the general public is becoming more and more involved and concerned in the actual operations and costs of the computer system services. The public is being asked increasingly to fill out various output/input forms in exactly the proper places, not to crumple or otherwise damage the cards and otherwise to take upon themselves some basic responsibilities for the effective operation of the system. These portions of the system function are increasingly coming into your homes in the form of bills, subscription renewals, the bank checks you use, automobile license renewals, charge cards with increasing coverage, W2 statements, trust fund statements for your use in preparing your tax declarations, etc. You individual members of the general public are contributing your time and efforts to the data processing work of general business and are, in turn, buying increasing volumes of their data processing services as a means of helping you to live in this age of rising complexity. The outlook is for more of this rather than for less and it seems to me that the increasing involvement of the public in these data processing services may well lead to their eventual classification as a public utility rather than competitive business.

* * * *

So here, this morning, we have shared a few thoughts concerning computer power and its uses in the future. We have suggested that computer capacities are of greater importance than computer faculties — that business in general is not considering or acknowledging this to be the case — that the military is, and business will sooner or later have to follow its lead — and last, that the legal, economic, historic and social factors at work in this computer business may be leading us out of the area of free competition into that of the regulated public utility.

The Forces of Nature

The forces of nature are moving fast and inexorably. Continuation of our world's population growth in its present upward spiral can bring us to over 21 billion people within less than a century from now. And less than a century beyond that, our outlook is for a population of over 1-⅓ trillion human beings. Heaven knows what will happen to the problems of existence by then, or what will happen to halt the upward spiral. But surely, our sons and our grandsons face ferocious problems of communications, computation, and control. Hence, the subject of our electronics conference this year is by no means a spectator's elective. It is, by all odds, a participant's compulsive. We must make better use of computer power.

As one final parting shot might I ask — What will the new and more potent uses of computer power really be if, perchance, this business turns out to be what certain other businesses with similar characteristics have gradually turned out to be — a natural monopoly?

Remember my text? "God hath spoken once; twice have I heard this; that power belongeth unto God." It is his gift to us and we can do no less than use it well.

AUTOMATIC CLASSIFICATION OF PLANT VARIETIES BY COMPUTER

R. M. Wight
International Business Machines Corp.
White Plains, N. Y.

A significant new development in the techniques for classification of plant varieties has been developed by Dr. D. J. Rogers of the New York Botanical Garden and Dr. T. T. Tanimoto of the Mathematics and Applications Department of IBM. The new technique uses a large-scale IBM 704 data processing system to classify varieties of plants automatically according to the variety characteristics. The scheme was announced at the meeting of the American Institute of Biological Sciences, Bloomington, Ind., August, 1958.

The automatic classification technique begins with a very full, exact description of each of the set of plant varieties being studied. Up to 100 characteristics, including many specifications of size, color, and structure, of leaves, roots, stem, flower, fruit, etc., are recorded in punched cards. Decks of these cards are then fed into the computer. The machine digests the vast collection of data and automatically classifies the plants into natural groups or clusters. Each group or cluster is determined by the associated physical similarities of the plants that comprise it.

Because the computer analyzes a very great number of characteristics, it can detect subtle similarities linking plants to certain groups which otherwise might not be apparent even to a skilled botanist.

Dr. Rogers and Dr. Tanimoto described the application of the new computer technique to the classification of 100 varieties of *Manihot esculenta,* a tropical food plant whose edible rootstocks form the basic diet of many tribes of Indians in South America. Punched cards containing data on fifty physical characteristics of each of the 100 varieties of *Manihot* are fed into the IBM 704. The classification arrived at by the computer determines natural groups, and can also be used to identify the various physical characteristics of the *Manihot* closely related to high food yield.

The new automatic classification technique can be applied to other areas, for example, in the medical field, to disease symptoms, to identify diseases.

The principles underlying the new automatic classification technique are not restricted to the IBM 704 but can of course be applied on any large-scale automatic computing system.

COMPUTER WORKS WITH X-RAY FOR QUALITY CONTROL OF STEEL

A new computer system that measures the thicknesses of steel strips and controls their production standards will shortly operate at the Indiana Harbors Division of Inland Steel Company, East Chicago, Ind. A GE 309 gage logging system works with an X-ray thickness gage to measure the rolled steel's thickness, and an electronic tachometer to measure the steel's length.

An electronic unit classifies the thickness of the material, as it is measured by the X-ray gage, into several tolerance bands, such as "on-gage," "bands ABC off-gage high," and "bands ABC off-gage low." While the steel strip is being processed, the system accumulates the required information. Upon completion, a complete record of the length of the strip, the length of "on-gage" material, the length of "off-gage" material and the strip identification data, is transmitted by teletype to another location on the line where it becomes a printed record.

Designed primarily for steel mill operations, the system is fully transistorized and constructed to be reliable in severe industrial environments.

FRONT COVER: OBSERVING AND ANALYZING "SPACE" FLIGHT OF "AIR"-CRAFT

A 400-mile range for testing the mile-a-second X-15 research airplane which will fly at 100 miles altitude, is being prepared in the Nevada desert by the National Aeronautics and Space Administration.

The range has three stations; Edwards Air Force Base, Calif.; Beatty, Nevada, (the station there is shown in the front cover picture); and Ely, Nevada. The new "High Range" testing system was developed and built by Electronic Engineering Co. of Calif., Santa Ana, Calif. It will provide 600,000 answers per second to electronic questions on the condition of the airplane and the pilot when the X-15, a rocket-powered research airplane made by North American Aviation, is launched from a B-52 bomber, soars upwards to 100 miles altitude, and reaches a speed of 1 mile a second, one seventh of escape velocity from the Earth.

In the "High Range" system is a specially designed recording system for radar data which automatically converts the data received into a form used by the automatic data processing system of the Air Force Flight Test Center. This conversion system, named "Datum," and also made by Electronic Engrg. Co. of Calif., cuts analysis time for data from a single flight from 30 days to 30 hours.

BLUEPRINT FOR A LIBRARY

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The Place of Universal Codes

The past ten years have witnessed the development of a bewildering array of makes and models of automatic digital computers. Although, in principle these are all Turing machines, yet these computers incorporate ever-varying combinations of component parts, logical designs, and instruction codes. Today, with the practicability of interpretive and compiling techniques well established, it is inevitable that a demand for a universal code should arise. Consequently, proposals for universal codes are becoming almost as numerous as the machines themselves.

Pseudo-codes serve to simulate either one machine upon another or an imaginary machine upon a real one. Designers of such pseudo-codes are well aware that their applicability, let alone their efficiency, is restricted in each of several respects. Programming, even at the flow-diagram stage, is influenced by the topology of the given computer (that is, the relative size and accessibility of the various storage units), by the structure of the order code in relation to the unit word, and by the numerical system employed during input, storage, calculation and output. Furthermore, the avenue of application, whether in the main scientific, business or industrial, has a bearing upon the facilities to be provided by the pseudo-code.

Finally, the ultimate aim of the pseudo-code must be considered. Is it to unify coding in a large establishment operating two or more different computers? Is it to simplify coding of one-shot problems for an elaborate machine? Is it for educational purposes, to illustrate coding principles on a real machine? Is it to simulate one machine upon another which it is to replace, thus facilitating the change-over? Lastly, is it to provide a separate language for coding one class of problem on one or more machines, a different pseudo-code being necessary for each class? For example, codes are available for the evaluation of algebraic expressions, the solution of mechanical or electrical networks, the analysis of structures, the solution of the equations arising in the study of enzyme dynamics, and so on.

Philosophy for a University Installation

All these aims have already been justified by experience, but obviously do not tend to a universal code. The following discussion is therefore restricted to the design of a library suitable for a medium-to-large computer in a university setting. The requirements of such an establishment are twofold: a sophisticated coding scheme for staff engaged in research projects and a simplified coding scheme for teaching purposes and student applications. Two systems of coding should therefore be available, which, for the moment, will be termed the primary and the secondary.

The primary system would use the natural machine representation for data and instructions. It would be consistent with a basic organization scheme having facilities to be detailed later, and yet admit a maximum amount of flexibility. The secondary scheme would consist of a number of packages of routines. For each package a pseudo-code would be defined, which would permit a relevant set of operations to be performed on data in some special numerical representation. Thus, for example, there would be a package to handle matrices, another for complex arithmetic, another to operate on multiple-precision floating-point numbers, and so on. In the case of each package the data and pseudo-orders would be translated, upon input, into machine language, under the action of a compiler. Translation should be into machine code, observing the rules of the common organization scheme. This means that the sub-routines written for the secondary scheme could also be incorporated by the expert programmer into the primary scheme whenever applicable. Conversely, packages in the secondary scheme could automatically avail themselves of routines embedded in the primary scheme. With such a reciprocity arrangement, much duplication can be avoided and rules for applying individual routines much simplified.

The routines normally required by the two schemes are listed below. and will be referred to as the "library routines." For computers with single-address instructions and indexing registers it is estimated that these routines would contain approximately 8,000 to 10,000 instructions. It is suggested that the library routines be stored permanently inside the computer or in a unit from which selections can readily be made and inserted. During the input of the object program, then, library routines are incorporated into the translated version of the master program. Other library routines are, in turn, used to bring about this translation and the assembly of the final program.

The Common Organization Scheme

This scheme arranges for housekeeping facilities to be planted into the object program during input and assembly. These facilities come into play when the program is executed. They are consistent with the overall plan of organization, and permit the object program to be written with as little regard as possible for computer detail. Such facilities usually include:

1. The reservation of blocks of locations in the working store for specified library routines and data. Arrangements are made that these locations be not over-

written during compilation or execution of the object program.

2. Transfers of blocks of data, with checking, between various sections of the internal stores.

3. Linking sequences to dial in closed sub-routines, routines, that is, which return control to a specified point in the object program.

4. Incorporation of open sub-routines, routines which are to be inserted bodily between two instructions of the object program.

5. Relocation of both open and closed sub-routines, thus enabling them to operate in any specified section of the working store.

6. Looping a specified number of times or until a certain condition is attained.

7. Optimum programming, when necessary to gain access to delay-line or drum type storage.

8. Initializing arrangements for interruption and rescue of production runs.

9. Possibly automatic logging of individual machine runs.

The common organization scheme should also provide some simple means of bringing input procedures to a halt, and of initiating the calculation by sending control to some specified address.

The Primary Scheme

In addition to the facilities just listed, the Primary scheme must be able to draw upon further resources. These include:

1. A system for recognizing and handling symbolic addresses. The use of a mnemonic rather than an actual address simplifies the initial writing of the code as well as the later inclusion of corrections or variations.

2. A set of conversion routines for numbers from one numerical representation to another. These might have to take effect during input, execution or output.

3. It is often convenient to represent the function digits of an instruction by a mnemonic code. Facilities for making the conversion from this code to machine code would then be included in the primary scheme.

All the individual operations which complete the description of the primary scheme are now listed in sets.

SET A: Basic Arithmetic Operations

The computer, through its order code, will generally provide for the execution of the following operations on both fixed and floating-point numbers

Addition
Subtraction
Multiplication
Division
Negation
Standardization
Comparison with modulus.

SET B: Housekeeping Instructions

Similarly the computer will probably provide instructions

To take advantage of any special registers, such as accumulator, indexing registers, multiplier and so on
To do control transfers (unconditional, accumulator conditional or indexing-register conditional)
To do operations in logic (and, or, not-equivalent, and so on)
To halt
To do no operation.

In connection with studies of Turing Machines it has been noted that only three suitably-chosen instructions are necessary in the order code of a universal computer. The operations just mentioned can be programmed in terms of these if they are not supplied by the hardware. Further functions which should be supplied, by library program if necessary, are

SET C: The Mathematical Functions

Exponentials
Natural and base 10 logarithms
Integral roots (including square root)
Trigonometric functions and their inverses (especially sin, cos and arctan)
Higher mathematical functions (Bessel, Lagrange, Tchebyscheff etc.)

of numbers in both fixed and floating-point form.

SET D: Complex Mathematical Operations

The primary system might well also contain routines to perform, possibly only on fixed-point numbers,

Interpolation (of variable order)
Inverse interpolation
Differentiation
Fourier analysis
Search for the roots, real and imaginary, of a polynomial
Search for the real roots of $f(x) = 0$
Minimization of a function of n variables
Integration over a fixed interval of $f(x)$, where $f(x)$ is either tabulated or generated step-by-step
Solution of linear algebraic equations
Stepwise integration of a set of ordinary differential equations of the first order
Generation of a very large set of random numbers, for use in Monte Carlo processes.

SET E: Checking routines

Finally, the primary scheme must provide an extensive set of code-checking, or debugging, routines. The code to be checked and the instructions necessary for the particular application at hand should be supplied as automatically as possible during input. The mode of operation of the checking routines must therefore be consistent with the basic organization scheme. Routines to operate as follows are suggested:

1. During input:

Check sums attached to both data and instructions should be compared with freshly-calculated sums to insure that input takes place without error. Sums could be precalculated and attached by hand, or calculated and attached by machine during output, for re-input. Any one scale of notation may be used, so that this procedure would be common to all numerical systems in use.

2. During the execution of a program:

(a) Checking facilities should be available to trace the path of control. This could be done in one of three ways:

(i) By outputting the function digits of every instruction obeyed between pre-determined points in the program.

(ii) By outputting pertinent information at a set of pre-determined search addresses.

(iii) By outputting pertinent information at jump instructions only, and beyond a certain point in the calculation.

For this set of three routines, it should be possible to select a common output format for all scales of notation. (b) Checking facilities should also be available to check the machine calculation against the results of an independent hand calculation. Arrangements should be made to output pertinent data at check-points preset in the program, with provision for the suppression of such output during certain cycles within loops. At each check-point, it should be possible to output:

(i) The contents of a fixed set of registers (accumulator, indexing registers etc.) each in a standard scale of notation.

(ii) The contents of certain registers only, each in a specific numerical scale. Steering data must be input after the program. It should contain lists of pairs of addresses and code letters to indicate the numerical scale desired, one such list to correspond to each check-point, and the lists being input in the sequence in which the check-points are encountered.

3. In the event of a program fatality:
Checking routines should be available to operate in a post-mortem manner. These could include:

(a) A tally-type routine to check for unscheduled alterations to blocks of data or instructions.

(b) A comparison-type routine to search for and output such alterations.

(c) A routine to operate as a special case of 2 b (ii).

4. During output:
Check sums consistent with those used during input should be generated, attached, and checked by immediate re-input.

The Secondary Scheme

This consists of packages of routines, as indicated above, which takes advantage of the common organization scheme. Set B instructions are still available for use here. Packages included in this scheme will now be listed, and individual components indicated.

1. Double-Length Arithmetic

For some applications it is important to retain a large number of significant figures, although scaling presents no particular problem. A pair of adjacent words can then be used for storing each fixed-point number. A routine must be provided to interpret symbolic addresses, similar to that for the primary scheme, but which allocates two adjacent words per address. There must be conversion routines to take care of input and output of these numbers, and routines to interpret the pseudo-codes for performing the operations listed under Set A above. Sub-routines are also required to evaluate the functions of Set C and possibly to perform some of the operations of Set D. Provision for checking double-length operations can readily be made in the case of Set E, type 2 b (ii). All the other checking routines of Set E are applicable as they stand.

2. Precision Arithmetic

The ideas for double-length arithmetic can be extended to take care of multiple-length numbers. Three or more adjacent words would then store each number. Such applications are rather special, occurring, for example, in the evaluation of irrational numbers such as π and e.

3. Floating-point Arithmetic

For computers which do not supply the hardware to perform operations on floating-point numbers, a package should be provided to do so. One or two words may be used per number. Thus $\pm a \times 10^{\pm b}$ could be represented by one word, part of which stores $\pm$ a, and the remainder $\pm$ b. Alternatively, this number could be represented by two adjacent words, one to store $\pm$ a and the other $\pm$ b. In either case, one of the routines already written for interpreting symbolic addresses is applicable. Input and output conversion routines are required, remembering that the decimal scale is the only one convenient to use for data which must be hand-processed. Routines to perform the operations of Sets A, C and D must be provided. Remarks for checking routines are as for double-length arithmetic.

4. Precision Floating-point Arithmetic

Even for computers which do provide floating-point operations, it may be necessary to supply facilities for retaining high accuracy as well as a large range of magnitude. Two or even three words per stored number are necessary here. Special routines for input and output as well as for the functions listed in Sets A, C and D must be written.

5. Complex Arithmetic

Various possibilities are open for representing the number $N = a \pm ib$. These evolve from the choice of fixed or floating-point, single-or multiple-precision representation. It may therefore be that more than one package is required under this heading. The routine for interpreting symbolic addresses used depends on the number of words required to store each complex number. Input-output conversion routines also depend on the exact representation. Routines must be provided for interpreting pseudo-codes to perform the following operations on complex numbers:

Addition
Subtraction
Multiplication
Division
Square of modulus
Complex conjugate
Principle value of modulus
Conversion between $a + ib$ and $re^{i\theta}$.

The operations of Sets C and D do not apply, but all the checking routines of Set E are applicable when suitable provision is made under 2 b (ii).

6. Matrix Algebra

It is recommended that a compiler to interpret and carry out a sequence of matrix operations be developed. The conventions used in addressing the matrices would depend very much on the internal storage available. Pseudo codes should include:

Input of matrix A, with check sum
Output of matrix B, with check sum
Addition $(A + B)$
Subtraction $(A - B)$
Multiplication $(A \times B)$
Inversion (A^{-1})
Transpose (A^T)
Add transpose $(A + B^T)$
Transpose multiplication $(A\ A^T)$
Transpose multiplication $(A\ B^T)$

Multiplication by a scalar (aA)
Linear combination with scalars (aA + bB)
Row augmentation $|A, B|$
Column augmentation $\begin{vmatrix} A \\ B \end{vmatrix}$
Partitioning $A = | A_1, A_2 |$ or $\begin{vmatrix} A_1 \\ A_2 \end{vmatrix}$
i.e., separating A_1 and A_2, where A is square;
Finding the eigenvalues and eigenvectors of a symmetric matrix.

7. *Statistics*

A package containing quite a large number of routines would be useful here. It should include:

- Least squares
- Autocorrelation
- Chi-squared
- Product-moment correlations
- Variances and co-variances
- Means and standard deviations
- Multiple regression analysis.

Conclusion

This two-level system of coding has been organized so as to be expansible. In particular, special purpose packages could be added, each to cope with one class of problem, without disturbing the framework of the library. The special requirements of logistics, circuit design, linear programming, and so forth and so on, could then be met. Such a two-level system is adaptable to most university establishments, which operate on an open-shop basis. With a nucleus of expert programmers to prepare such a library, a host of student and research workers could then take full advantage of the central computer.

The Philosophy of Computers in Society and the Responsibility of Computer People in Society

[Continued from page 9]

PHILOSOPHY AND RESPONSIBILITY OF COMPUTERS IN SOCIETY

Chairman: R. W. Tyler, Center for Advanced Study in the Behavioral Sciences, Stanford University

The trend toward the use of computing systems for tasks other than accounting and the mathematical sciences has led many of our engineers into the contemplation of the broader philosophical aspects of their responsibilities as scientists. It is suggested that some traditional problems might be exploited more effectively if modern techniques were applied.

SOCIAL RESPONSIBILITY OF ENGINEERS

Speaker: F. Wood, IBM

Some recent papers on the social responsibility of computer scientists and the social problems of automation are reviewed. A classification of the sciences derived from the work of early sociologists is used to develop a simple prospectus for the engineer. This classification table is transformed into a "checking chart," for use by engineers in determining the extent to which the social problems relating to their work are being covered. This leads to a limited concept of social responsibility that is believed to be easier for the average engineer to take on as an obligation. Namely, the social responsibility of the engineer is to be a guide or coordinator to make certain that the social problems related to his physical engineering work are being studied and that there are provisions made by our society to explain the basic principles and significance of science to the voters in our democracy.

EMERGENCY SIMULATION OF THE PRESIDENT OF THE UNITED STATES

Speaker: L. Sutro, Mass. Inst. of Technology

This paper reasons that the time is indeed approaching when there may not be time for the President to respond to a threat to the nation's existence. In fact, there appears to be a trend under way to use automatic devices to respond to an attack. This paper reasons that the firing of a nuclear weapon at some other part of mankind is an act that should be taken only after the greatest possible deliberation. If this deliberation must take place in seconds or even microseconds, then we should start now to plan the computer and its program which will make the most of those seconds or microseconds.

CAN COMPUTERS HELP SOLVE SOCIETY'S PROBLEMS?

Speaker: J. Rothstein, Edgerton, Germeshausen & Grier, Inc.

Development of computer techniques has made it possible in principle to tackle complex problems of social significance which were impractically difficult a few years ago. Of the large number of such possibilities, three classes are briefly examined These are weather forecasts and economic policies, some questions of public health, and the socio-biological nature of man. It is concluded that there is a good chance of achieving computer-based advances which could be revolutionary in their beneficent effects, and that computer scientists and engineers have a responsibility to help bring this about.

MEASURE OF SOCIAL CHANGE

Speaker: R. L. Meier, University of Michigan

There has always been a need for a quick synoptic view of the changes affecting the most complex area of contemporary society — the metropolis — but the demands are becoming much more intense. The present methods such as land use maps, the census, economic activity surveys, the telephone directory, and traffic flow patterns, reflect much more the social processes. There are now quite new devices for handling large quantities of data rapidly at very low unit cost. The equipment has properties, dimensions, and limitations which are already well understood, but they are vastly different from what was possible in the early history of sociology. With the aid of technical equipment that is now in reach, it should be feasible to display the changes on a much finer scale, thus revealing the detail that is desired. Because the unit data may be stored almost at random, the larger picture can be assembled in many different ways. With the new equipment, it seems quite likely that quantitative aggregate measurements can be brought into anthropology and sociology. The statistics should eventually be at least as firm as those presently enjoyed by economists. These ideas were discussed and developed over the years 1957-8 in the Acculturation and Social-Change seminar, conducted by mental health research institutes.

Computer Talks:

International Conference On Information Processing

The United Nations, through UNESCO, is sponsoring the International Conference on Information Processing, in Paris, France, June 13 to 23, 1959. Fourteen nations including the United States are working with UNESCO on the program. For detailed information about the conference, write to USICIP, Box 4999, Washington 8, D.C.

The papers which will be given and discussed at the conference, according to the program released on Feb. 28, 1959, are the following:

1. METHODS OF DIGITAL COMPUTING

Rapporteur: J. Kuntzmann (France)

Error Approximations

Rounding errors in algebraic processes, J. H. Wilkinson (U.K.)

Sur l'estimation des erreurs d'arrondi, Ch. Blanc (Switzerland)

Theoretical and experimental studies on the accumulation of error in the numerical solution of initial value problems for systems of ordinary differential equations, P. Henrici (USA)

Rational approximations for transcendental functions, H. J. Maehly (USA)

The exact determination of the characteristic polynomial of a matrix, D. B. Gillies (USA)

Partial Differential Equations, Applications, and Linear Programming

The use of high-speed digital computers for the solution of partial differential equations, A. A. Dorodnitzin (USSR)

Methods of computation on digital computers for partial differential equations, L. Collatz (Germany)

The solution of elliptic difference equations by stationary iterative processes, D. J. Evans (U.K.)

Overrelaxation applied to implicit alternating direction methods, R. S. Varga (USA)

Resolution sur calculateur electronique d'un probleme d'algebre diophantienne, G. Letellier and R. Lattes (France)

Les programmes logarithmiques — Application aux calculs des programmes convexes specialement lineaires, G. R. Pariso (France)

2. LOGICAL DESIGN OF DIGITAL COMPUTERS

Rapporteur: M. V. Wilkes (U.K.)

Logical Design in General

Zebra, a simple binary computer, W. L. van del Poel (Netherlands)

The specification development of a cost-limited digital computer, M. Lehman (Israel)

Processing data in bits and pieces, F. B. Brooks, G. A. Blaauw and W. Buchholz (USA)

A new computing machine, S. A. Lebedev and K. Sulim (USSR)

Methods of speeding up the operation of digital computers, G. D. Monachov, I. Ia. Akushsky, L. B. Emerjanov-Iaroslavsky, E. I. Kijamko and V. S. Linsky (USSR)

Elimination of carry propagation in digital computers, G. Metze and J. E. Robertson (USA)

Time Sharing

Time sharing in large fast computers, C. Strachey (U.K.)

Input and output in the X-1 computers, B. J. Loopstra (Netherlands)

Sympathetically programmed computers, W. F. Schmitt and A. B. Tonik (USA)

Sur certains aspects de la conception logique du gamma 60, J. Bosset (France)

Design of concurrently operating computer systems, A. L. Leiner, W. A. Notz, J. L. Smith and R. B. Marimont (USA)

High-Speed Computation and Other Subjects

Application of error correction codes to multiway switching, H. Takahasi and E. Goto (Japan)

Logical elements on a majority decision principle and the complexity of their circuit, S. Muroga (Japan)

A three valued system of logic and its application to base three digital circuits, R. Vacca (Italy)

The use of cyclic permuted chain codes for digitizers, G. C. Tootill (U.K.)

The application of the numerical system of residual classes in mathematical machines, A. Svoboda (Czechoslovakia)

3. COMMON SYMBOLIC LANGUAGE FOR DIGITAL COMPUTERS

Rapporteur: S. Gorn (USA)

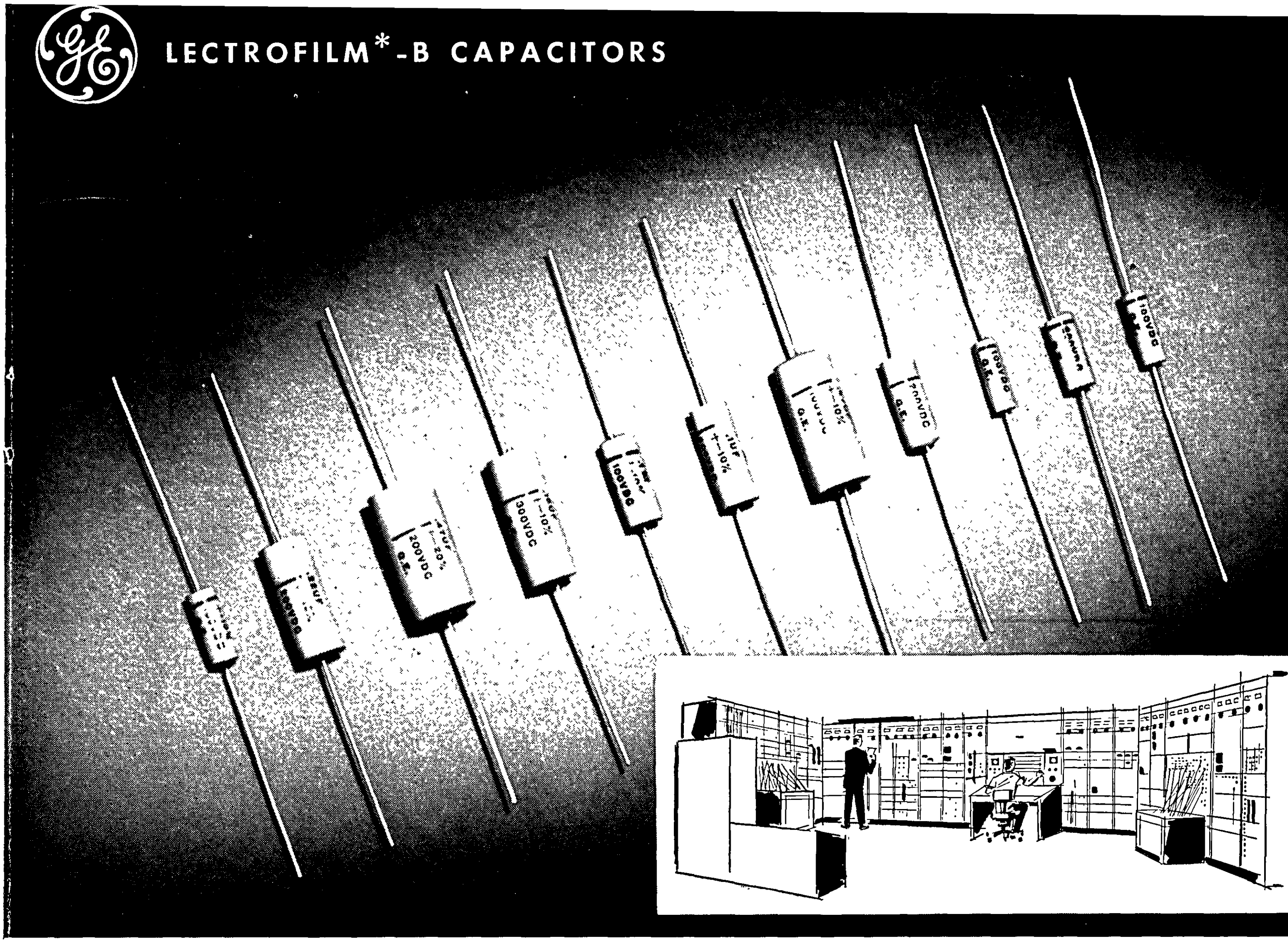
A propos d'un langage universal, J. M. Poyen and B. Vauquois (France)

Methods of logical recursive and operator analysis and synthesis of automata, I. I. Basilevsky, Iu. A. Shreider and I. Ia. Akushsky (USSR)

Pseudo-code translation on multi-level storage machines, F. G. Duncan and E. N. Hawkins (U.K.)

The problem of a common language, especially for scientific numerical work (motives, restrictions, aims and results of the Zurich Conference on Algol), F. L. Bauer (Germany)

Survey on the syntactical construction of the Zurich



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† Registered trade-mark of DuPont Co.

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recommendation of the ACM and GAMM, J. Backus (USA)

4. AUTOMATIC TRANSLATION OF LANGUAGES

Rapporteur: D. Panov (USSR)

Research in automatic translation at the Harvard Computation Laboratory, V. E. Giuliano and A. G. Oettinger (USA)

The COMIT system for mechanical translation, V. H. Yngve (USA)

The use of machines in the construction of a grammar and computer program for structural analysis, K. E. Harper and D. G. Hays (USA)

Machine translation from English to Japanese, S. Takahashi, R. Tadenuma, S. Watanabe and H. Wada (Japan)

Machine translation methods and their application to Anglo-Russian scheme, I. K. Belskaia (USSR)

5. PATTERN RECOGNITION AND MACHINE LEARNING

Rapporteur: K. Steinbuch (Germany)

Pattern Recognition

Electronic reading machine, H. Wada, S. Takahashi, T. Iijima, Y. Okumura and K. Imoto (Japan)

A quasi-topological method for recognition of line patterns, H. Sherman (USA)

Procede analogique de reconnaissance des signes par tracage des contours, W. Sprick (Germany)

Quantitative research on potential methods, Kazmierczeck (Germany)

Information-theoretic aspects of character reading, S. Frankel (USA)

Proving Theorems

On the recognition of speech by machine, G. W. Hughes and M. Halle (USA)

Report on a general problem solving program, A. Newell, J. C. Shaw and H. A. Simon (USA)

A program for the production of proofs for theorems derivable within the first order predicate calculus from axioms, P. C. Gilmore (USA)

Realization of a geometry theorem proving machine, H. Gelernter (USA)

A non-heuristic program for proving elementary logical theorems, B. Dunham, R. Fridshal and G. L. Sward (USA)

A new method for discovering the grammars of phrase structure languages, R. J. Solomonoff (USA)

Machine Learning

Plastic neurons as memory elements, D. G. Willis (USA)

Analysis of the working principles of some self-adjusting systems in engineering and biology, S. N. Braines, A. V. Napalkov and Iu. A. Shreider (USSR)

Experiments in machine learning and thinking, T. Kilburn, R. L. Grimsdale and F. H. Sumner (UK)

A machine model of recall, M. E. Stevens (USA)

Some mathematical fundamentals of the use of symbols in information retrieval, C. N. Mooers (USA)

A reduction method for non-arithmetic data and its application to Thesauric translation, A. F. Parker-Rhodes and R. M. Needham (U.K.)

6. COMPUTER TECHNIQUES OF THE FUTURE

President: I. L. Auerbach (USA)
Vice President: A. Speiser (Switzerland)

Program to be Announced

SYMPOSIA

Thirteen symposia have been set at this time. Registrants have been asked to indicate their preferences on the official UNESCO application form. Additional symposia may be organized on request to officials at the conference. These requests will be handled within the limits of available facilities. Scheduled symposia to date include:

1. Relationship between digital and analogue computing.
2. Collection, storage and retrieval of information.
3. Automatic programming.
4. Numerical analysis on computers.
5. Influence of very large memory designs and capabilities on information retrieval.
6. Logical organization for very high speed computers.
7. Methods for solving linear systems.
8. Linear programming.
9. Logical organization of very small computers.
10. Programming procedures.
11. Switching algebra.
12. Error detection and correction.
13. Machine translation.

AUTO-MATH 1959

An exhibition of information processing equipment, running the entire gamut of computation and peripheral equipment, from small electronic computers to complete data control systems, will be on display from June 13 to June 23. The exhibits will include both commercially manufactured equipment and special products of government laboratories and institutions. It is expected that the main manufacturers of such equipment from France, Germany, Japan, United Kingdom, United States and other countries will have exhibits. Technical expository papers related to equipment are scheduled for June 15-19th.

CALENDAR OF COMING EVENTS

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

May 11-13: Joint Automation Conference, Chicago, Ill.

May 14-15: Fourth Annual Electronic Data Processing Conference, University of Alabama, University, Alabama.

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

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

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

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

Opposition To New Ideas—Controversy

I. From Patrick J. McGovern
Mass. Inst. of Technology
Cambridge 38, Mass.

The article "Opposition to New Ideas" in the February issue by Neil Macdonald, although it provided some entertaining reading for me, created a disturbing aftereffect: the conclusion that much of the argument was fallacious and unsound.

I was initially entertained by the way Mr. Macdonald's candid opinions were so plentifully conveyed. However the sparsity of fact, and the plethora of ambiguities, made Macdonald's opinions seem like gaudy tinsel on an unbalanced mobile. The author has written such intelligent material in the past, that I could not let this article go without comment — if not for the sake of Mr. Macdonald's conscience, then at least for my own.

Intuitive Probability

First, before I pick up my axe and try to cut some of the article's circular reasoning, equity demands a statement of my own position toward the "acceptance of new ideas." It strikes me as reasonable that we accept a newly stated proposal to the degree that our experience confirms the likelihood of that proposal happening, or being "true." This rating system of the plausibility of a new idea, I like to call intuitive probability (although other persons have named similar feelings subjective probability, credence, personal probability, etc.). That mankind possesses such a faculty allows what we now enjoy as civilization to exist, and it protects our emotions and our lives from being overrun by fakers, hoaxers, quacks, charlatans, etc.

The same judging system plays a vital role in the computer field. The computer designer relies on his feeling of intuitive probability to confirm the projected logical systems that he incorporates into the computer. Appeals to the intuitive probability of the investor by the computer salesman provide the orders on which the business of computer manufacturing advances.

Recognizing this evaluation system to exist, it follows that no generalized "opposition to new ideas" exists. A new idea (and by new we must mean new to the perceiver or receiver of the idea, for who can say whether an idea has or has not been contemplated by others previously?) stimulates no opposition on the basis of its newness. Instead, it is accepted or rejected solely on the basis of the thinker's intuitive feeling of the likelihood of the idea's factual foundation. For example, if we were told that someone had discovered a new lake in Western Australia, we would probably accept this new idea. Our experience confirms the existence of numerous lakes elsewhere, and we feel intuitively that there could be another lake in Australia. However, if the same person told us the same lake had purple water, we would undoubtedly not believe him, yet we have evaluated both new ideas by the same principles in either case.

Computer people are naturally quite familiar with this type of reasoning, for data processing systems often give answers based on the ratio of confirming results to denying results. An example of the latter is a relay network instructed to generate a positive voltage if the majority of the switches are triggered by a previous signal, otherwise a negative voltage.

I would therefore challenge Macdonald's thesis that "there is opposition to new ideas," as such. And although there are some defects in almost everyone's feeling for intuitive probability, no three and a half page article will put a dent in an evaluation system that a person has spent his lifetime developing. Only a complete revamping of the social structure and the teaching system of our culture, it seems to me, can hope to significantly alter the judgment and evaluation processes of our people. And even such sweeping changes, started immediately, would be too late to affect existing generations whose minds have been indelibly engraved by the experiences of our world.

Other Logical Pitfalls

There are some other logical pitfalls that have lured Mr. Macdonald and trapped him in his article, and these cannot escape mention. As he has numbered his article into fourteen parts, I will attempt to assay them in order, using corresponding numbers:

(1) Mr. Macdonald criticizes his friend for accepting the opinion of two prominent astronomers that flying saucers do not exist. The friend is accused of accepting ". . . the views of someone else without thinking about them yourself." If we can safely assume that the author has had no personal contact with such "flying saucers," then he himself is accepting the opinions of another by being in sympathy with the unidentified flying object legends. Therefore any feeling of self-righteousness on the author's part is unfounded.

(2) The fact that the conservative British Government, in the early part of the nineteenth century, generated enough sympathy for the embryonic idea of an automatic digital computer that they invested funds in Charles Babbage's project for twenty years, is, in fact, strong evidence against the thesis that new ideas experience a negative reaction.

(3), (5) & (7) These three discussions concern themselves with essentially the same idea. The first states the accusation "Why, who ever heard of a machine with a million parts that is not breaking down every few minutes?"

The second deals with the prediction "It is impossible to plan production for a whole society using computers." The third simply quotes the clichès "That is contrary to human nature" . . . "No computer will ever do that."

Their common element is the argument "I have not seen it done; no one has ever recorded it as being done—therefore it is highly improbable that it will be done in any reasonable time."

This is, in fact, a rather safe argument. For if we were to pick at random one thing out of an entire class of non-existing things, the probability that we would pick one likely to become existing shortly is extremely improbable. And so if the man-in-the-street has *not* been educated to the fact that computers are making rapid advances in reliability and capacity, he is as justified in disclaiming advanced computer properties as he is anything else in Pandora's box.

(4) Here Mr. Macdonald tangles with the perennial argument "computers cannot think." However, since the opponents of the "computers can think" group usually define "thinking" as the reasoning, judging, and decision-making processes that *human beings* do, they form a logically untouchable caste. Nevertheless, the operations of a computer are in reality no different whether the management likes to say the computer is "thinking" or whether the management declares that it is only "calculating."

(6) My only objection here is that Mr. Macdonald, after expounding at length about the need for thoughtful consideration of opinion, indulges in what seems to me a scandalous bit of stereotyping by giving McCarthyism as an example of a definite evil influence in America.

At the time of the Senator's death, a nationwide public opinion poll showed that by percentages, fifteen million Americans thought McCarthy's tactics were something less than evil.

Cannot fifteen million nays arouse any skepticism in a mind that argues consideration of all sides of a question?

(8) & (9) These two sections deal with impractability, and improbability, evaluated in the light of what Mr. Macdonald feels is unwarranted prejudice. However, from the discussion above in my initial paragraphs, it becomes apparent that the opinions cited are justified if they are evaluated on the basis of intuitive probability.

(10) Here the accusation is made that ". . . most people in the United States, including most of Congress, in their everyday behavior, act as if mainland China does not exist." This is logically trivial, for in our everyday behavior we seldom consider anything but our own affairs and those of our close associates, for that is where our personal responsibility lies; and I doubt if it is otherwise in different parts of the world.

(11) The dispute between the "experts" and the "non-experts" resolves again to a manner of definition. If we declare that an expert in a field is one who is able to carry out the operations of that field successfully, we have defeated the confusion. What Mr. Macdonald calls "ordinary people" undoubtedly includes myself and a good many friends. But we do not judge experts; rather the recognition by ordinary people of the works of another ordinary person turns that person into an expert.

In reality then, the deifying of computer people, or of other highly skilled persons, will occur only when such people have exercised their intellectual muscles and mechanical talents enough to woo the "ordinary" man away from his own self-centeredness.

(12) In the problem of "disloyalty" versus intellectual integrity, Mr. Macdonald has at last struck a solid note. His statements deserve endorsement.

All too often attempts to insure economic or social security for a sheltered group of people are hidden falsely behind the pseudo-heroic word, patriotism.

(13) The person who says "outside of my field" is admitting that nothing in his experience confirms, or denies the possibility of an idea having a factual foundation. This is a rational attitude certainly; it does not seem to be an appropriate symptom of "opposition to new ideas." It indicates nothing more than the speaker is honest enough to realize that his intuitive probability has no basis on which to assign weighing functions to the various possibilities, and to come up with a reasonable judgment. No indictment is warranted.

(14) On the plausibility of the enumerated "new ideas" about computers, I leave the reader with his own intuitive probability, to decide. Readers of **Computers and Automation** will probably have enough experience in the computer field to evaluate these ideas accurately.

Summing up then, Mr. Macdonald's article I think contains some gross logical loopholes, and such confused thought that I did not feel it was in keeping with the intellectual and professional standards of **Computers and Automation.**

I am just as positive, however, that Mr. Macdonald will shortly be back in form. He has my full encouragement in effect to retort.

While a dollar shared among men yields each only small change, an idea among men rewards each full principal plus a promise of ready interest.

II. From Neil Macdonald

Assistant Editor

Computers and Automation

First, let me say also that Mr. Patrick J. McGovern's discussion and challenges of the points in my February article "Opposition to New Ideas" have entertained me. I am grateful to him for this, for discussing and arguing, and for the opportunity to take my turn at cutting up and slicing his arguments.

Unfortunately, there is neither space nor time here (we are close to press date) to try to answer in full detail all the remarks and assertions which Mr. McGovern makes. Let me therefore try to answei just three of them.

(1) Mr. McGovern says "It strikes me as reasonable that we accept a newly stated proposal to the degree that our experience confirms the likelihood of that proposal happening or being true. This rating system of plausibility I like to call 'intuitive probability'."

To me this viewpoint is a well-stated expression of the central core of opposition to new ideas: "judge a new idea on the basis of our experience, our estimate of the likelihood of the proposal happening or being true, our intuitive judgment of its probability."

The first objection to this viewpoint is that it is difficult or impossible to apply in society in practice, because experience varies greatly from person to person and intuition varies even more widely. We have therefore a shifting sand which makes objective judgment of a new idea impossible.

Second, this viewpoint rejects many important new ideas at the time they develop, because often the new idea shocks experience and confronts intuition with the feeling of "very improbable." Examples: the idea of the Soviet Union's first Sputnik a month before it was launched in 1957; the idea in 1904 of the Wright Brothers flying a machine heavier than air; the idea in 1950 of an automatic computer performing 10,000 operations a second and running for weeks without machine error.

Third, this viewpoint is utterly unscientific, based as it is on "experience" and "intuition." The scientific criterion for judging a new idea is: (1) deliberate observation and experiment; (2) comparison with carefully stated summaries of many thousands of observations and experiments made by different competent observers; (3) the making of predictions and seeing if they come true; and (4) a permanent attitude of wonder and doubt, curiosity and inquiry.

For example, the physicist P. W. Bridgman in his famous book "The Logic of Modern Physics" published about 1930 inquires how physicists could have avoided being astonished by the new ideas of the relativity and the quantum theories. And he offers as a cure the principle that a concept should be defined by describing the operations behind the concept. For instance, he remarks that the concept "length" may be one kind of thing when measured over short distances with the method of moving rigid rods, and another kind of thing when measured over long distances with methods based on light. And he says that although these two methods of measurement may agree closely in units of "length" where they both can be used, say for example in distances from a mile up to ten miles, yet nevertheless in cases where these two methods of measuring length cannot both be used (for example in measuring the diameter of the moon) we are simply assuming that we are measuring the same thing, and this assumption is not necessarily true.

Many important new ideas are ideas for which our experience up to a given date is likely to be a very poor guide, and our intuitive judgment as to their probability is likely to be "very improbable."

(2) Mr. McGovern says "A new idea stimulates no opposition on the basis of its newness." This is a sweeping statement and is I believe riddled with exceptions. First, a great many new ideas challenge vested interests; for example, a company may have put a big investment into one way of doing something, and a feasible new idea may cause that investment to become far less valuable, and so it stirs opposition. Second, many new ideas when proved require human beings to unlearn one set of beliefs and learn a new set of beliefs; and this is hard work and unpleasant for many people; and they try to avoid it, and therefore oppose the new idea. The newness of an idea is intimately associated with the response that people make to it.

(3) Mr. McGovern says "If we declare that an expert in a field is one who is able to carry out the operations of that field successfully, we have defeated the confusion."

But this is not what happens, if we think of the times involved. At one time a man may build up a reputation for himself in some field, and become acknowledged as an expert. At later times, he may be given more tasks in similar or related fields, perhaps under conditions where objective appraisal of his results is not possible. His reputation remains. And then finally along may come some tasks in which it becomes evident to numbers of people that whatever expertness be may have had, it no longer exists. His reputation departs. It is just a trick of sophistry to declare that after all the man was not an expert.

I appeal for an attitude that is much more rational than judgment based on "intuitive probability." I appeal for the attitude of a scientist who realizes that some things have been proved with almost complete certainty (like Newtonian and Einsteinian mechanics), and that other things have been disproved with almost complete certainty (like the impossibility of a perpetual motion machine), and that still other things have neither been proved or disproved. I appeal for a tentative, thoughtful, exploring, inquiring attitude about important new ideas.

A perennially important example for the computer field is a man's attitude about the proposition "machines can think" or equivalently "machines can display any form of intelligence that human beings can display."

If an investigator, on the ground of "intuitive probability" or on some other ground, considers this proposition impossible, he will behave in one way. If on the contrary, he treats this proposition as possible, he will behave in a different way. This difference affects his behavior as an investigator, and affects what he can accomplish.

SURVEY OF RECENT ARTICLES

Beginning in the last issue, we have started to publish frequently a survey of articles related to computers and data processors, and their applications and implications, occurring in certain magazines. We hope to cover at least the following magazines, beginning with issues dated January 1, 1959, or later:

Automatic Control
Automation
Automation and Automatic Equipment News (British)
Business Week
Control Engineering
Datamation
Electronic Design
Electronics
Harvard Business Review
Industrial Research
Instruments and Automation
ISA Journal
Proceedings of the IRE
Management Science
The Office
Scientific American

It is not easy to look into more than fifteen magazines each month, and make a search; the purpose of this type of reference information is to help anybody interested in computers find articles of particular relation to this field in these magazines.

For each article, we shall publish: the title of the article / the name of the author(s) / the magazine and issue where it appears / the publisher's name and address / two or three sentences telling what the article is about.

Applying the Systems Approach to Warehousing / R. J. Marland, General Electric Co. / Control Engineering, vol. 6, no. 1, Jan., '59, p 65 / McGraw-Hill, 330 West 42 St., New York

The feasibility of automatic warehousing, which is now possible by various means, ranging from a simple manual system, to a "sophisticated computer-controlled layout."

Soviet Trends in Computers for Control of Manufacturing Processes / V. B. Ushakov, Scientist, Moscow University / Instruments and Automation, vol. 32, no. 1, Jan., '59, p 102 / Instruments and Automation, Pittsburgh 12, Pa.

A resume of the state of Soviet computer art, covering process control computers and optimum parameter control.

File Maintenance on Magnetic Tape / D. M. Irwin, Asst Secy, Group Division of Aetna / Machine Accounting and Data Processing, vol. 1, no. 2, Jan.-Feb., 1959, p 24 / Gillc Associates, Inc., 956 Maccabees Bldg., Detroit 2, Mich.

Problems in applying electronics to keep files efficiently. Comparison of manual, punched card and magnetic tape systems.

A Primer on Paper Tape / J. W. O'Connor / Machine Accounting and Data Processing, vol. 1, no. 2, Jan.-Feb., 1959, p 19 / Gille Associates, Inc., 956 Maccabees Building, Detroit 2, Mich.

Advantages and disadvantages of paper tape, and some of its varied uses, as input for electronic computers, to control the operations of automatic machines, etc.

Transistors Provide Computer Clock Signals / S. Schoen, Data Systems, Norden Division, United Aircraft Corp. / Electronics, vol. 32, no. 9, Feb. 27, 1959, p 70 / McGraw-Hill, 330 West 42 St., New York 36, N.Y.

Circuits designed to provide clock signals for large digital computers using germanium transistors. Certain design techniques provide for efficient use of transistor power, allowing the system to achieve a peak load up to 5 amp.

Western Joint Computer Conference / Datamation, vol. 5, no. 1, Jan.-Feb., 1959, pp. 7-15 / Relyea Publishing Corp., 103 Park Ave., New York 17, N.Y.

The conference, March 3-5, 1959; chairmen's messages of welcome; field trips; women's activities; list of exhibitors, their products and services; map of exhibit area; technical sessions with titles of papers and authors.

Man-Machine Relationships / M. Taube, President, Documentation Inc. / Datamation, vol. 5, no. 1, Jan.-Feb., 1959, p 18 / Relyea Publishing Corp., 103 Park Ave., New York 17, N.Y.

The question of whether a machine can simulate a human brain. The author says "No," and defines the relationship between machine and man, as being one of complementation and augmentation, not simulation.

Electronic Switching — A New Concept for Future Telephone Exchanges / R. C. Stiles, Senior Project Engineer, General Telephone Laboratories, Inc. / General Telephone Technical Journal, vol. 6, no. 3, Jan., 1959, pp 62-75 / General Telephone Labs., Inc., Northlake, Illinois.

A broad look at some possible future electronic switching techniques, with a history of research and development, and a concise outline of experimental systems. Any proposed system will demand a great deal from the "memory" of the computer, but in the distant future, computers will operate the telephone.

The Computing Field Will Continue Its Expansion / R. W. Hamming, President, Assn. for Computing Machinery, Bell Telephone Laboratories, Inc. / The Office, vol. 49, no. 1, Jan. '59, p 122 / Office Publications Inc., 232 Madison Ave., New York 16, N.Y.

Due to the growth of computing in America, "many installations do almost double the volume of work that they did the previous year." The Assn. for Computing Machinery helps coordinate and organize matters pertaining to computing, so that individuals can obtain help and guidance from others who are familiar with computers.

A High-Speed Logic System Using Magnetic Elements and Connecting Wire Only / H. D. Crane, Senior Member, IRE / Proceedings of the IRE, vol. 47, no. 1, Jan. '59, pp 63-73 / Institute of Radio Engineers, Inc., 1 East 79 St., New York 21, N.Y.

By the use of geometric variation in the magnetic core toroidal structure, new logic design freedom is achieved. Logic functions may be formed directly within a Multiaperture Device (MAD), and these elements may also be simply interconnected to perform logical functions, such as, one output controlling several inputs.

Computer Increases Employees But Greatly Improves Records / A. R. Bongiovi, Assistant Controller, Phillips-Van Heusen Corp. / The Office, vol. 49, no. 2, Feb., '59, p 116 / Office Publications Inc., 232 Madison Ave., New York 16, N.Y.

The increase in a company's competitive strength more than offsets the need for more employees to process the timelier computer records. The computer produces a variety of valuable reports, such as local, county, state, and federal tax calculations, monthly sales by quantity and dollar value of each item sold, etc.

Survey of Digital Computer and Calculator Users and Orders / D. G. & R. Pedder / Automation and Automatic Equipment News, vol. 4, no. 6, Feb. '59, p 971 / Automation and A. E. News, 9 Gough Square, Fleet Street, London, E. 4.

A survey of digital computer and calculator users in the United Kingdom, including a summary of computers on order and delivered during Feb., 1959, including IBM, Leo, Ferranti, National Cash Register Co., etc.

A Survey of Automatic Tank-Level Gages / Howard S. Andrews, Esso Standard Oil Co. / Control Engineering, vol. 6, no. 2, Feb., '59, p 92 / McGraw-Hill, 330 West 42 St., New York.

A complete automatic gaging system for most refineries and many chemical plants can be installed comparatively cheaply. Through electronically controlled gaging and computing systems, the instrumentation results in lower costs.

Team Approach to Computer Programs for Numerical Control / E. F. Carlberg, Boeing Airplane Co. / Control Engineering, vol. 6, no. 1, Jan., '59, p 77 / McGraw-Hill, 330 West 42 St., New York.

The various approaches to developing a computer program; why there are so many schools of thought; why the team approach, through compromise among its members, overcomes many problems.

How Robot Voices Vector Fighter Pilots / C. W. Poppe, Defense Products Division, Fairchild Camera and Instrument Co., and P. J. Suhr, Marine Division, Sperry Gyroscope Co. / Electronics, vol. 32, no. 2, Jan. 9, 1959, p 47 / McGraw-Hill, 330 West 42 St., New York.

Still in the experimental stage, an automatic voice link converts data describing the position of enemy aircraft into verbal instructions for transmission to interceptor aircraft. Describes the use of a five-bit code, and binary bits to select prerecorded spoken words.

Optimizing Refinery Operations With a Digital Computer / R. Landes, Research Programmer, Champlain Oil and Refinery Co. / ISA Journal, vol. 6, no. 1, Jan., '59, p 67 / Instrument Society of America, 313 Sixth Ave., Pittsburgh 22, Pa.

The digital computer as a useful tool in providing fast answers to complex problems in petroleum blending, pipeline delivery scheduling; plans to use the computer to watch and check refinery processes, and to operate as close to optimum level as possible.

BOOKS and OTHER PUBLICATIONS

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

Murphy, John S. / Basics of Digital Computers / John F. Rider Publisher, Inc., 116 West 14 St., New York 11, N.Y. / 1958, photooffset, vol. 1, 116 pp., $2.50; vol. 2, 133 pp., $2.50; vol. 3, 136 pp., $2.50.

These three volumes contain the "meat" of a four-year course developed to give computer technicians and field engineers a fundamental education in digital computers — concepts of storage, control, timing, arithmetic, programming, etc. The indexes are comprehensive; graphic illustrations abound.

Goldberg, Samuel / Introduction to Difference Equations, with Illustrative Examples from Economics, Psychology and Sociology / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. / 1958, printed, 260 pp., $6.75.

The author of this text, associate professor of mathematics at Oberlin College, introudces the reader to the principles and applications of finite differences and difference equations. As indicated in his title, he includes ample illustrative examples throughout the text discussions; also he includes more than 250 problems for solution. In the beginning, the text requires only a knowledge of standard algebraic techniques and some trigonometry. As the material of the text requires more advanced mathematical backgrounds, topics such as the limiting behavior of real sequences, generating functions, and matrix algebra are developed. A bibliography and index are included.

Vajda, S. / Readings in Linear Programming / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. / 1958, printed, 99 pp., $3.00.

Dr. Vajda presents here a representative selection of linear programming applications, seeking to demonstrate the basic ideas involved when linear programming techniques are applied to the types of problems often met by the operations research analyst. The material is presented so that the reader needs only a background in elementary mathematics in order to grasp the ideas and applications involved. A bibliography of nearly one hundred items is included.

Bendat, Julius S. / Principles and Applications of Random Noise Theory / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16 ,N.Y. / 1958, printed, 431 pp., $11.00.

This book seeks to explain to the student, the research scientist, and the practising engineer the basic ideas of random noise analysis. It presents difficult problems in noise and their solutions, blending probability theory and statistical theory with the basic fundamentals of analysis of random noise. Analog computer techniques, errors in auto-correlation measurements, optimum time-variable filters are among the topics covered in the text. A comprehensive bibliography is included.

Elsasser, Walter M. / The Physical Foundation of Biology, An Analytical Study / Pergamon Press Inc., 122 East 55th St., New York 22, N.Y. / 1958 printed, 219 pp., $4.75.

The author attempts an ambitious project — he proposes to analyze "the difference between an organism and an automaton." The book's early chapters survey the relatively new fields of cybernetics and information theory, then continue into a discussion of physical "Structure and Variability" and "Microscopic Measurement." This last chapter is a somewhat philosophical attempt to "provide a better understructure for biological concepts." The author's subject-matter is interesting; and he has usually succeeded in presenting his material in simple, factual terms.

Hurley, Richard B. / Junction Transistor Electronics / John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. / 1958, printed, 473 pp., $12.50.

This book emphasizes working principles of applied transistor circuits. The author first discusses low-level semiconductor physics, including lattice-structure and conductivity. He then presents such topics as bias stabilization, thermal runaway, switching theory, negative feedback, and saturation currents.

Hohn, Franz E. / Elementary Matrix Algebra / The MacMillan Co., 60 Fifth Ave., New York 11, N.Y. / 1958, printed, 305 pp., $10.00.

This text requires of the reader only a background in elementary college algebra. The author presents matrix algebra simply and clearly enough so that a reader wishing to use the tool of matrices without studying formal mathematical proofs may do so. He treats the Laplace expansion in a way intended to be of especial interest to scientists and engineers working with computers. A bibliography of "Vector Spaces, Matrices, Determinants, and Their Applications" is included.

A Survey of British Digital Computers

(Part 2)

Joseph L. F. De Kerf
Research Laboratories
Gevaert Photo-Producten N.V.
Mortsel, Belgium

(Continued from the March issue, p. 29)

Finally, a large data processing system, Ferranti Perseus, was designed and the first models are completed. The U.S. agency is at New York.

— Pegasus

Operation mode: serial. Number base: binary. Word length: 38 bits plus sign. Instructions: 1 address type (1 half-word).
Immediate access store: nickel delay lines. Capacity: 7 accumulators or B-registers, 2 of which combine to a double length accumulator, and 48 one word registers. Main store: magnetic drum. Capacity: 5,120 words, 4,096 words for general use and 1,024 words for permanent input and test programs. Speed: 3,720 rpm. Mean access time: 8 ms. Up to 4 ElectroData magnetic tape units are optional. They are connected with the computer by a magnetic tape control unit (with a buffer store capacity of 32 words).
Input: two 5 hole paper tape readers (200 char. per sec), with switching by program. Output: 5 hole paper tape (33 char. per sec) or teleprinter (7 char. per sec). A converter, linking the magnetic tape mechanisms to auxiliary equipment, a card reader (200 cards per min), a card punch (100 cards per min) and a line printer (150 lines of 92 alphanumeric char. per min), is optional. Powers-Samas, Hollerith or IBM cards can be used.
Operation speeds (including access time): 0.3 ms for addition and subtraction, 2.0 ms for multiplication and 5.5 ms for division.
Power consumption: 17.5 kVA maximum. Floor area (standard machine): 65 sq. ft. Price: about £ 55,000, magnetic tape units and auxiliary equipment not included.
An improved version, Pegasus 2, has following features: an expanded capacity of the main store (9,216 words), up to 16 optional magnetic tape units, increased speed of the two paper tape readers (300 char. per sec), an high speed paper tape output (Creed: 240 char. per sec) and direct punched card input/output.

— Mercury

Mode: serial in operation and parallel for storage. Number base: binary. Floating point automatic. Word length: 10, 20 and 40 bits. For floating point operation the full word length is split in 30 bits for the argument and 10 bits for the exponent. Instructions: 1 address type (20 bits). Division by subroutine.
Computing store: magnetic cores. Capacity: 1 accumulator of 40 bits with floating point working, 7 B-registers of 10 bits (1 being an accumulator) and 1,024 registers of 40 bits (alternatively 512 or 256 words). Main store: 4 to 8 magnetic drums. Capacity: 4,096 words per drum. Speed: 3,472 rpm. Mean access time: about 8.6 ms. An auxiliary magnetic tape store, with up to 8 ElectroData tape units, is under development.
Input: 5 hole paper tape (200 char. per sec). Output: 5 hole paper tape (33 char. per sec) or teleprinter (7 char. per sec), equipped with a keyboard. The standard paper tape equipment can be replaced by an high speed reader (300 char. per sec) and punch (Creed: 240 char. per sec). Input by punched cards (200 cards per min) and output by punched cards (100 cards per min) or line printer (150 or 300 lines per min), via converter from magnetic tape, are developed. 7 extra input and 7 extra output devices will be optional.
Operation speeds (including access time): 0.180 ms for addition and subtraction (0.06 ms with the B-registers), 0.3 ms for multiplication and 3.5 ms for division (by subroutine).
Power consumption: 40 kVA (plus 15 kVA for refrigeration system). Floor area (standard machine): 180 sq. ft. Price: approximately £ 100,000.

— Perseus

Operation mode: serial. Number base: binary. Word length: 72 bits. Data are represented by 12 6-bit characters. These characters may be alphabetic letters, decimal digits or other symbols. Instructions: 1 address type. Instruction length: 24 bits (3 instructions form 1 word). Radix arithmetic is automatic.
Quick access store: nickel delay lines. Capacity: 1,024 words, arranged in 32 blocks of 32 words. Composition: 1 block of 32 single lines (accumulators, registers and radix registers), 4 blocks of 32 single lines (immediate access) and 27 blocks of 32 words, stored in 16-word lines (average access time: 2 ms). The store may be extended to 64 blocks. Addition of a drum is possible. Up to 16 ElectroData magnetic tape units may be connected in 4 blocks of 4 units. Each block control unit is individually addressed and provided with a 32-word buffer store. Transfer from and to the tapes is done in 32-word blocks (75 ms).
Input: 65 or 80 column cards (Powers-Samas, Hollerith or IBM: up to 300 cards per min) or 5 and/or 7 hole paper tape (200 char. per sec). Output: high speed printer (Samastronic: 300 lines of 140 char. per min), operating from magnetic tape, or teleprinter (7 char. per sec).
Operation times: 0.234 ms for addition and subtraction, 0.780 ms per significant digit of multiplicand for multiplication and 11 ms average for division.
Power consumption: about 10 kVA. Floor area occupied by the basic computer, control desk and power supply unit included, is 180 sq. ft. Price of the system: expected to be in the £ 300,000 range.

LEO COMPUTERS LTD, Elms House, Brook Green, London.

In 1947 J. Lyons & Co., Ltd, proposed to use an electronic computer in their office. As no commercial machine was available at that time, it was decided in 1949 to build one themselves. The computer, based on the Cambridge EDSAC I, was completed in 1953 and named LEO (Lyons' Electronic Office). A LEO Computer Service was organized and used by many organizations for a variety of mathematical and clerical jobs. From this prototype, a more flexible and compact computer, LEO II, was developed. LEO II was completed in 1957 and commercial copies are available from LEO Computers Ltd. Five machines have been installed and two are on order.

— Leo II

Operation mode: serial. Number base: binary. Word length: 18 bits plus sign (short) and 38 bits plus sign (long). Instructions: 1 address type (19 bits). Square root is automatic.
Quick access store: mercury delay lines. Capacity: 14 registers of 39 bits and 2,048 words of 19 bits. Access: respectively immediate and 0.16 ms average.
Auxiliary store: up to 8 Ferranti magnetic drums. Capacity: 8,192 words of 19 bits per drum. Average access time: 6 ms. Up to 8 Decca twin magnetic tape units can be connected.
Input (4 channels): punched cards (Hollerith: 200 cards per min), paper

tape (Ferranti: 200 char. per sec) or magnetic tape. Output (3 channels): punched cards (Hollerith: 100 cards per min), printers (Hollerith: 100 lines per min, Bull: 150 lines per min, Samastronic: 300 lines per min) or magnetic tape. Provision is made for automatic conversion and reconversion between binary, decimal and sterling notations. Buffer stores are provided in each of the input/output channels and also between the auxiliary and main stores, enabling each to work in parallel with the computer. Thus, reading, punching, calculating and printing can be carried out simultaneously with the operating of any 2 of the magnetic tape decks.
Operation speeds: 0.34 for addition and subtraction (0.6 ms including instruction), 0.6 to 3.5 ms for multiplication and 3.5 ms for division.
Power consumption: up to 40 kVA. Room accommodation: about 1,250 sq ft. Price: a complete installation, including ancillary and data preparation equipment but magnetic tape units not included, may cost between £ 80,000 and £ 180,000.

METROPOLITAN-VICKERS ELECTRICAL CO. LTD, Trafford Park, Manchester.

Metropolitan - Vickers commenced work on designing a medium speed digital computer in 1954 and by the end of 1955 the first prototype, using point-contact transistors, was operating. A commercial version, the Metrovick 950 general purpose digital computer, was developed. Junction transistors on printed circuits, plug-in board techniques are used throughout the arithmetical and control units. Three machines of this type are operating. A large scale high speed data processing computer, the Metrovick 1010, a completely transistorized machine, is designed. It is scheduled to be available in 1960.

The company manufactures alsc control systems and general purpose electronic analogue computers with extension facilities (like the Metrovick 952).

— Metrovick 950

Operation mode: serial. Number base binary. Decimal to binary conversion and reconversion automatic. Word length 32 bits. Instructions: 1+1 address type (1 word). Division by subroutine.
Main store: magnetic drum. Capacity 4,096 words. Speed: 3,000 rpm. Acces time: 10 ms average. Arithmetic two-word registers take the form of regenerative tracks on the drum. A B-line consisting of 8 words on a regenerative track enables instructions to be modified after they are from the main store and before they are obeyed.
Input: 5 hole paper tape (Metrovick 960, available as a self-contained unit: 250

char. per sec). Output: 5 hole paper tape (25 char. per sec), teleprinter (7 char. per sec) or both (7 char. per sec). Operation speeds (excluding access time): 3 ms for addition and subtraction, 8 ms for multiplication.

Power consumption: about 6 kVA. Floor area occupied: 50 sq. ft. Price: approximately £ 21,000.

— Metrovick 1010

Operation mode: parallel. Number base: binary. Word length: 13 bits (short) or 44 bits (long). Point working: fixed and floating. Instructions: 1 address type (22 bits). Two or more programmes can be operated concurrently. Facilities are provided for temporary interruptions of one programme in order to execute another of high priority.

Arithmetical registers: three 44 digit accumulators (two of which combine to form a double length accumulator) and eight 13 digit accumulators (B-lines). Working store: magnetic cores. Capacity: 2,048 or 4,096 words of 44 digits. Access time: 3.5 microsec. Backing store: magnetic drum. Capacity: 8,192 words of 44 digits, in blocks of 32 words. Mean access time: 10 ms per block. Random access store: magnetic drum. Capacity: 60,000 words of 44 digits, in blocks of 3 words. Mean access time: 0.1 sec per block. Up to 8 Decca twin magnetic tape units may be connected.

Input: 5 hole paper tape (Metrovick 960: 250 char. per sec), 5 to 8 hole paper tape (Metrovick 961: 1,000 char. per sec), 40 column cards (Powers-Samas: 540 cards per min) or 80 column cards (Hollerith: 600 cards per min). Output: 5 to 8 hole paper tape (Creed: 300 char. per sec) or line printer (Samastronic: 300 lines of 140 char. per min). A buffer store control unit organizes simultaneous operation of ancillary units and computation by sharing use of the working store between them.

Operation speeds (including access time): 0.020 ms for addition and subtraction, 0.200 ms for multiplication and division (maximum).

Power consumption: 2 kVA and up. Floor area occupied by the basic computer, working store and control desk included: 20 sq. ft. Floor space occupied by a large installation: less than 600 sq. ft. Price: not available for the moment.

POWERS-SAMAS ACCOUNTING MACHINES LTD, Whyteleafe, Surrey.

The company, one of the Vickers Group, is one of the oldest manufacturers of punched card equipment. Originally the company imported "Powers" machines. In 1921 a factory was established at Croydon and manufacture commenced (Acc. and Tab.). The "Samas," derived from the name of the French marketing company, was added later. Agency in the U.S. is the Underwood Corporation (Samas Punched Card Division).

The Powers-Samas punched card equipment handles cards with 21, 40, 65 or 80 columns. The capacity of the cards may be doubled (interstage working). Well known electronic calculating punches are the Emp and the P.C.E. A more recent calculator is the P.C.C. (Program Controlled Computer). The control is not internal, but by plugboards. It is however one of the largest of its kind. About 35 have been delivered.

A flexible data processing system (Pluto), with the Ferranti Pegasus as central computer and Powers-Samas ancillary equipment, has been introduced recently.

— PCC

Operation mode: serial parallel. Number base: binary decimal. Word length: 16 decimal digits plus sign. Program storage is contained in 4 pre-set program boards (160 instructions totally). 80 additional instructions form built-in subroutines to perform certain fixed functions such as multiplication and division, as well as for automatic sterling processing. Instructions are of the 2 address type (the result replaces one of the 2 operands in its location).

Main store: magnetic drum. Capacity: 160 words (4 tracks of 40 words). Speed: 3,000 rpm. Access time: 10 ms average. Additional tracks are used as immediate access store (6 words) and as input/output store. Input/output: 65 or 80 column cards. Normal speed is 120 cards per min (60 cards with full normal and interstage working). An high speed stylographic printing tabulator (off-line), the Samastronic, completes the equipment. Printing speed is 300 lines of 140 char. per min.

Operation speeds: 0.5 ms for addition and subtraction (including instruction), 6.5 to 65 ms for multiplication and 25 to 150 ms for division.

Price: about £ 20,000, the Samastronic Tabulator not included.

STANDARD TELEPHONES AND CABLES LTD, Newport Mon.

The company manufactures telecommunication and allied equipment. In cooperation of the Netherlands P.T.T., their information processing division designed and developed a medium sized electronic digital computer, called Stantec-Zebra. About fifteen have been delivered. In U.S. the company is associated with the International Standard Electric Corporation and with the Intelex Systems Incorporated.

[To Be Continued]

NEW PATENTS

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

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

Sept. 30, 1958 (cont'd):

2,854,576 / Peter Palic, Hamburg-Lockstedt, Germany / North American Philips Co., Inc., New York, N.Y. / An electronic memory system.

Oct. 7, 1958: 2,854,854 / Sigmund Rappaport, Port Washington, and William H. Newell, Mt. Vernon, N.Y. / Sperry Rand Corp., Ford Inst. Co. Div., Long Island City, N.Y. / A mathematical function generator.

2,854,856 / Walter R. Oppen, Plandome, N.Y. / Sperry Rand Corp., Ford Inst. Co. Div., Long Island City, N.Y. / A programming device.

2,855,146 / Harley A. Henning, Millington, N.J., and Orlando J. Murphy, New York, and Herbert M. Teager, Brooklyn, N.Y. / Bell Telephone Lab., Inc., New York, N.Y. / A magnetic drum computer.

2,855,148 / George F. Schroeder, West Hempstead and Victor H. Seliger, Forest Hills, N.Y. / Sperry Rand Corp., Ford Inst. Co. Div., Long Island City, N.Y. / An electric multiplier for analog computers.

Oct. 14, 1958: 2,856,126 / Tom Kilburn, Davyhulme, Eng. / National Research Development Corp., London, Eng. / A multiplying arrangement for electronic digital computing machines.

2,856,256 / Justice N. Carmen, Jr. Inglewood, Arthur J. Hannum, Los Angeles, and Edward W. Gould, Reseda, Calif. / Hughes Aircraft Co., a Corp. of Del. / A coded magnetic binary recorder.

2,856,526 / Leslie C. Merrill, Ft. Wayne, Ind. / U.S.A. as represented by the U.S. Atomic Energy Comm. / Gating circuits.

Oct. 21, 1958: 2,857,099 / Gerhard Liebmann, Aldermaston, Eng. / Sunvic Controls Lim., London, Eng. / An electrical analogue-computing apparatus.

2,857,100 / Abraham Franck, Minneapolis, Minn., Robert Simon, Brooklyn, N.Y., and William R. Keye, St. Paul, Minn. / Sperry Rand Corp., a corp. of Del. / An error detection system.

2,857,554 / Thomas Arthur Watson, Montreal, Quebec, Can. / Canadian Marconi Co., Montreal, Quebec, Can. / A pulse code responsive circuit control arrangement.

2,857,586 / Joseph Wylen, Phila., Pa. / Burroughs Corp., Detroit, Mich. / A logical magnetic circuit.

Oct. 28, 1958: 2,858,429 / James E. Heywood, Palo Alto, Calif. / General Electric Co., New York, N.Y. / A gated delay counter.

Nov. 4, 1958: 2,858,979 / Garrett Gruner, Ypsilanti, Mich. / Regents of the Univ. of Mich., Ann Arbor, Mich. / A circuit for vector solution in D.C. analog computers.

2,858,980 / Harold H. Bargmann, Groton, Conn. / Sperry Rand Corp., a corp. of Del. / A mechanical secant multiplier.

2,858,981 / David A. Goldman, Yorktown Heights, N.Y. / —— / A vector summation system.

2,859,359 / Arthur B. Olson, Richfield, Minn. / Sperry Rand Corp., a corp. of Del. / A magnetic binary counting circuit.

2,859,408 / Johann Holzer, Long Branch, N.J. / U.S.A. as represented by the Sec. of the Army / A binary pulse modulator.

2,859,429 / John M. Coombs, St. Paul, Minn. / Sperry Rand Corp., a corp. of Del. / Data storage apparatus controls.

Nov. 11, 1958: 2,860,258 / Arthur D. Hall, Berkeley Heights, N.J. / Bell Telephone Lab., Inc., New York, N.Y. / A transistor decade counter.

2,860,260 / Langthorne Sykes, China Lake, Calif. / U.S.A. as represented by the Sec. of the Navy / A transistor integrator which provides both positive and negative integration.

2,860,287 / Theodore D. Koranye, Vestal, N.Y. / International Business Machines Corp., New York, N.Y. / An information storage unit.

2,860,294 / Floyd G. Steele, La Jolla, Calif. / Digital Control Systems, Inc., La Jolla, Calif. / A digital position servo system.

2,860,327 / Charles A. Campbell, Melbourne, Fla. / —— / A binary-to-binary decimal converter.

Nov. 18, 1958: 2,861,233 / Patrick J. McKeown, Syosset, N.Y. / Sperry Rand Corp., a corp. of Del. / A servomechanism having an unlimited servoing range.

ADVERTISING INDEX

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

Ampex Corp., 934 Charter St., Redwood City, Calif. / Page 40 / McCann Erickson, Inc.

Audio Devices, Inc., 444 Madison Ave., New York 22, N.Y. / Page 33 / Marsteller, Rickard, Gebhardt and Reed, Inc.

Bendix Aviation Corp., Computer Div., 5630 Arbor Vitae St., Los Angeles, Calif. / Page 31 / Shaw Advertising Inc.

Bendix Aviation Corp., Industrial Control Section, Detroit 37, Mich. / Page 28 / McManus, John and Adams, Inc.

CEIR, 1200 Jefferson Davis Highway, Arlington 2, Va. / Page 27 / Ernest S. Johnston.

C. P. Clare & Co., 3101 Pratt Blvd., Chicago 45, Ill. / Page 26 / Reincke, Meyer & Finn.

Computer Control Co., 92 Broad St., Wellesley 57, Mass. / Page 37 / Briant Advertising.

Di-An Controls, 40 Leon St., Boston 15, Mass. / Page 35 /

ElectroData Div. of Burroughs Corp., 460 Sierra Madre Villa, Pasadena, Calif. / Pages 8, 10 / Carson Roberts Inc.

ESC Corp., 534 Bergen Blvd., Palisades Park, N.J. / Page 5 / Keyes, Martin & Co.

General Electric Co., Aircraft Nuclear Propulsion Dept., P.O. Box 132, Cincinnati 15, Ohio / Page 29 / Deutsch & Shea, Inc.

General Electric Co., Schenectady, N.Y. / Page 23 / G. M. Basford Co.

Harvey-Wells Electronics, Inc., Research & Development Div., 5168 Washington St., W. Roxbury 32, Mass. / Page 38 / Industrial Marketing Associates

Minneapolis - Honeywell Regulator Co., DATAmatic Div., Newton Highlands, Mass. / Page 39 / Batten, Barton, Durstine & Osborne.

NJE Corp., 345 Carnegie Ave., Kenilworth, N.J. / Page 36 / Keyes, Martin and Co.

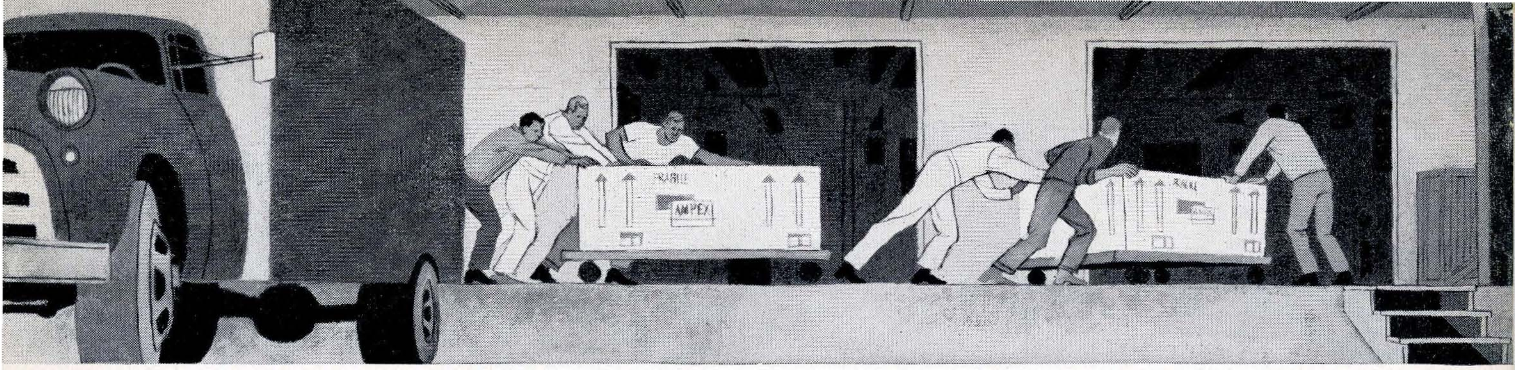
Philco Corp., Government & Industrial Div., 4700 Wissahickon Ave., Philadelphia 44, Pa. / Page 3 / Maxwell Associates, Inc.

Ramo-Wooldridge Corp., Los Angeles 45, Calif. / Page 21 / The McCarty Co.

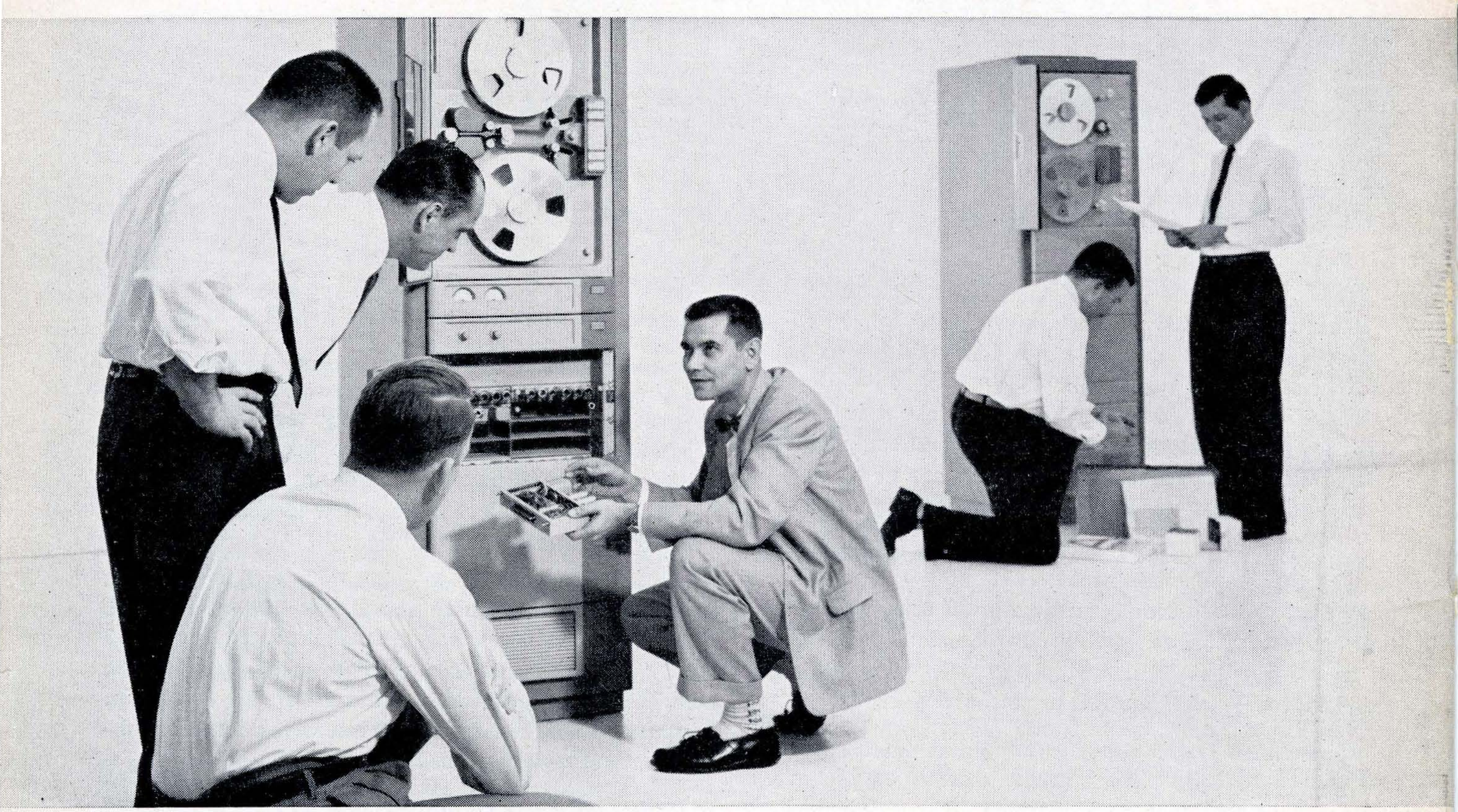
Space Technology Laboratories, Inc., P.O. Box 95004, Los Angeles, Calif. / Page 2 / Gaynor and Ducas, Inc.

System Development Corp., 2406 Colorado Ave., Santa Monica, Calif. / Page 7 / Stromberger, LaVene, McKenzie.

Thompson-Ramo-Wooldridge Products Co., P.O. Box 90067, Airport Station, Los Angeles, Calif. / Page 32 / The McCarty Co.



Perfect complement to your AMPEX system



. . . your AMPEX Field Service Engineer

Ampex service begins the moment your new equipment comes out of the cases. Whether it is a single FR-100A or a complete digital tape handling system, your Ampex Service Engineer is there on installation day.

He sees to the proper installation of your equipment. He tests it with its original factory checkout tape and specially designed calibration units. And he thoroughly instructs your staff in its operation.

Throughout your warranty period—and afterwards—Ampex Field Service is instantly available for modifications or *fast* replacements, avoiding costly down time.

Minutes after your call to the nearest of 12 offices or to the Ampex Home Office, extra parts or components are on their way. And this same close tie between factory and Field Service keeps Ampex Service Engineers constantly up-to-date on the latest techniques and equipment.

Available are Field Service programs ranging from scheduled preventive maintenance calls or time and materials contracts, to the services of a full-time resident Ampex engineer. With your purchase, an Ampex data specialist will discuss a service and spare-parts plan tailor-made to suit your magnetic tape instrumentation needs.

First in magnetic tape instrumentation

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