April, 1969

computers and automation

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Vol. 18, No. 4 — April, 1969

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computers and automation

Vol. 18, No. 4, April, 1969 *The magazine of the design, applications, and implications of information processing systems.*

Special Feature:

Electronic Data Processing and Management

Regular Features

In the front cover picture, the design of a circuit is being converted directly into computer language. As the operator traces the drawing, a MicroMetric digitizing system converts drawing coordinates into digital language. For more information, see page 52.

NOTICE

*D ON YOUR ADDRESS IMPRINT MEANS THAT YOUR SUBSCRIPTION INCLUDES THE COMPUTER DIRECTORY. *N MEANS THAT YOUR PRESENT SUBSCRIPTION DOES NOT INCLUDE THE COMPUTER DIRECTORY. SEE PAGE 58.

Departments

Letters To The Editor

Computers: Wonderful but Dangerous

I missed your fine editorial ("How to Spoil One's Mind as Well as One's Computer") in the August issue of *Computers and Automation* the first time around. I did, however, go back to that issue to read it when I read the letters in your December issue.

I would like very much to have a copy of the memorandum which gave the details on the lies told by our government.

I congratulate you on a very penetrating editorial and followup. It shows a great deal of insight and good citizenship on your part. You are providing a valuable and needed public service with this kind of editorial. Computers, like all other important inventions, are just as dangerous as they are wonderful, and I feel that we all need to be reminded of this frequently.

B. RUDY GFELLER
Systems & Procedures Analyst
Omaha, Nebr. 68102

Ed. Note — *I am glad that you think that* Computers and Automation *should keep covering "information engineering" in a broad sense, not a narrow sense. I fully believe that computer people should be "information engineers" and should take as much trouble with the data coming in, as with the wonderful machines that they supervise.*

City Planning

I have been reading your magazine with increasing interest, but some difficulty (because of my lack of background). As my grasp of data processing and systems design grows, with training, I will enjoy your publication even more. In this regard, I wonder if you could answer a question that probably is not new.

My sphere of experience and training is City Planning. As the computer age continues to be felt in this field, more and more planners will need training in "computerese." My main concern at present is in locating and contacting people who have worked with models of and use simulation programs dealing with these models, and, generally, people who apply data processing and analysis to city planning problems. Do you know of any people who would fit the above description? Do you foresee any inclusion of articles or emphasis on city planning computer applications in your magazine?

P. D. CREER, JR., *City Planner*
Planning Dept.
City of San Antonio
P.O. Box 9066
San Antonio, Tex. 78204

Ed. Note — *In the last year, we have published two articles somewhat related to city planning: "A Linear Geographical Code for Management Information Systems" in the April, 1968 issue; and "Handling Small Area Data with Computers" in the Dec., 1968 issue. In addition, you might wish to contact Doxiadis-System Development Corp. (D-SDC), an organization recently formed jointly by Doxiadis Associates and System Development Corp. The objective of this new organization is to "help solve the problems of the American city by combining expert knowledge in urban affairs with expert knowledge in the field of information sciences", and they may be able to be of some help to you, or direct you to other sources of information. I believe the new company can be addressed at the SDC address, which is 2500 Colorado Ave., Santa Monica, Calif. 90406.*

Games Played by Computers

For a number of years I have been following the listing in your directory issue of Games Played by Computers and have noticed the improvement that seems to be taking place gradually in these programs. I thought you might be interested in hearing that *Behavioral Science* for 1969 has an article by Eliezer Naddor titled, "GOMOKU Played by Computers".

This article indicates that there were two computers, one using a strategy which depends upon board positions and the other using an evaluation of the score of each empty square determined by a mathematical formula. In this particular game the second computer won, but both programs give me the impression of being able to be rated good, or, possibly, excellent. I am sure you will be interested in considering these for inclusion in your next directory issue.

This directory issue has proved extremely valuable in the past in furnishing information about computers which have been under consideration by secondary schools and colleges for use in their educational program.

CARL E. HEILMAN
Coordinator Mathematics & Science
Bureau of General & Academic Educ.
Dept. of Public Instruction
Box 911
Harrisburg, Pa. 17126

NEW PATENTS

Raymond R. Skolnick
Patent Manager
Ford Instrument Co.
Div. of Sperry Rand Corp.
Long Island City, N.Y. 11101

The following is a compilation of patents pertaining to computers and associated equipment from the "Official Gazette of the U. S. 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, D.C. 20231, at a cost of 50 cents each.

January 7, 1969

3,421,148 / George Aneurin Howells and Geoffrey Allen Hunt, Aldwych, London, England / International Standard Electric Corporation, New York, N.Y., a corporation of Delaware / Data Processing equipment.

3,421,149 / Ernest R. Kretzmer, Holmdel, Paul Mecklenburg, Fort Lee, Donald W. Rice, Neptune, and William Ryan, Red Bank, N. J. / Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York / Data processing system having a bidirectional storage medium.

3,421,150 / Ralph A. Quosig, St. Paul, and Norman L. Viss, Savage, Minn. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Multi-processor interrupt directory.

3,421,151 / Howard F. Wong, San Diego, Donald W. Liddell, La Mesa, and William F. Vollmer, Jr., San Diego, Calif. / The United States of America as represented by the Secretary of the Navy / Coded data translation system.

3,421,152 / William J. Mahoney, Darien, Conn. / American Machine & Foundry Company, a corporation of New Jersey / Linear select magnetic memory system and controls therefor.

3,421,153 / William J. Bartik, Jenkintown, Woo Foung Chow, Horsham, and Edward N. Schwartz, Philadelphia, Pa. / Sperry Rand Corporation, New York, N.Y., a corporation of Delaware / Thin film magnetic memory with parametron driver circuits.

3,421,155 / Hans Glock, Germering, Germany / Siemens Aktiengesellschaft, a corporation of Germany / Magnetic store.

January 14, 1969

3,422,283 / Donald E. Murray and Walter C. Seelbach, Scottsdale, Ariz. / Motorola, Inc., Franklin Park, Ill., a corporation of Illinois / Normal and associative read out circuit for logic memory elements.

(Please turn to page 62)

c.a EDITORIAL

The Misdirection of Defense — and the Social Responsibilities of Computer People

Few of the citizens of any nation would I believe disagree with this proposition:

> The main objective of the Defense Department of any nation is to try to guarantee the successful defense of that nation against attack.

For there is no doubt that armed attacks by one nation against another do occur — one of the most recent examples being the military invasion of Czechoslovakia by the Soviet Union and four other nations in August 1968. In Czechoslovakia, the government chose not to resist the overwhelming force, but to try to adjust to the demands, i.e., surrender. This was also the choice made by the commanding officer of the U.S. electronic spy ship *Pueblo* when the ship was taken over by North Korean naval vessels either just inside or outside North Korean waters.

In the case of the Defense Department of the United States, there is now substantial evidence that its main objective has shifted — it is only secondarily "the successful defense of the United States against attack" and is mainly something else. In fact there is good evidence that the something else is the serving of the interests of what President Dwight D. Eisenhower identified in 1960 as the "military industrial complex" and warned Americans against.

What is the military industrial complex? Briefly, it is a portion or segment of the United States, consisting of industries, regions, lobbies, and people (of many kinds), who make a great deal of money (profits, income, salaries, wages, research and development grants, pensions, consulting fees, etc.) from the vast budget of the U.S. Department of Defense, some $80 billion a year. According to tables in a book *The Depleted Society* by Professor Seymour Malman, 73% of this budget has been paid to 100 companies.

From 1965 to 1967, the main reason the people of the United States put up with the enormous, rising costs of "defense" was the pair of arguments: "We have to fulfill our commitments to the government of South Vietnam" (no matter that it was the ninth dictatorship since Ngo Dinh Diem was shot), and "We can't let our boys down in Vietnam — we must give them all they want or need".

But in 1968 it became clear that the war in Vietnam was not being won. By 1969, over 32,000 Americans had been killed there; over 150,000 Americans, wounded; over 4000 planes and helicopters had been lost; over $100 billion, spent; more bombing tonnage had been dropped in Vietnam than the United States dropped in all the theaters of World War II; and still no substantial progress. What is the main trouble? Basically, we cannot tell the difference between Vietnamese on our side and Vietnamese on the other side, and so our fire power produces hatred for Americans on a large scale.

In 1965 it may have seemed true to many people in the United States that "defense of the United States" required winning a land war in Asia more than 9000 miles away from California.

But it looks now as if the people of the United States no longer believe that fighting such a war is necessary to our interests, and they want the war stopped. So the civilian government of the United States is saying to the Defense Department and the Saigon government, "No, with 500,000 American soldiers in Vietnam, you cannot have any more". And a president of the United States has been denied reelection to the presidency because of the war in Vietnam.

As a result, the theory and practice of the U.S. Defense Department and of the U.S. military industrial complex are being questioned by thousands of influential persons, including Senators and Congressmen. Even President Nixon in one of his campaign speeches promised to bring the war in Vietnam to a conclusion within six months of his inauguration.

The way in which the military industrial complex operates is particularly clear in the present pressure from the Defense Department and associated defense industries to obtain public approval for the proposed Sentinel, "thin" Anti-Ballistic Missile System. The proposed system has aroused a great deal of opposition in the U.S. Congress and in Boston, Chicago, and elsewhere in locations which are threatened by the proposed anti-missile sites. Clearly these sites will increase the danger of those areas becoming priority targets in event of a nuclear war. In fact, as soon as the first antimissile has been fired against the first incoming missile, according to a statement by Senator Edward Kennedy, then radio location of the second incoming missile becomes impossible, because of the effects of radiation from the nuclear explosion in the high atmosphere! But does the Defense Department honestly and patriotically admit this flaw? It does not.

Instead, the Pentagon makes use of an Assistant Secretary of Defense for Public Affairs and a Chief of Information Office of the U.S. Army. Both these offices with a total budget of over $6 million a year have been "programmed" into the public affairs plan of Lt. Gen. A. D. Starbird for "promoting" the Sentinel Anti-Ballistic Missile system. He is to provide for "speaking engagements, information kits, exhibits, films, press releases", etc. In other words, the Pentagon is using the taxpayers' money to try to persuade the taxpayers to support a technically illogical project. For example, the Selectmen of Reading, Mass., are being invited by the Army on a sightseeing trip to anti-ballistic missile centers.

The military industrial complex (the MIC) by its very nature, evolution-wise, cannot be considered to be really interested in the defense of the United States. Since a large part of the MIC could not exist competitively in the civilian market, it must continue to seek large funds from the government, using good arguments if they exist, and any arguments at all if good arguments do not exist. What it is really interested in is making money from defense contracts. So the real preferences of the MIC are for billion dollar procurement programs, which sound meaningful and which can be escalated, even if technologically they are unsound, logically they are unreasonable, politically they increase the insecurity of the United States, and financially they threaten the solvency of the United States and the deepening neglect of our domestic needs.

Why should computer people be concerned with the interrelation between the defense of the United States and the military industrial complex?

Computers have been one of the scientific and technological miracles which have enabled the military industrial complex

(Please turn to page 41)

FR-80 is for certain birds

People close to computers think they see the graphic output problems very well. To render an engineering drawing from a digital tape, they might recommend a Stromberg 4060. For charts and graphs from tape, a Calcomp 835 is an excellent choice. 3M's EBR is suggested for forms generation. An E-K KOM-90 qualifies for outputs of personnel records.

But a man somewhat above the action can see that all of these things might be done by one machine. Instead of four trained operators, he'd need only one. Instead of four maintenance contracts, one. Instead of four rooms and four sets of supplies, one.

Instead of four partly idle, special purpose systems, a busy all-purpose one.

If you are that man, congratulations. Here's how you sell your department managers on a centralized film-recording system.

Your chief engineer: Tell him his drawings will be of graphic arts quality — sharper than any method short of re-drawing, sharp enough to stand up through multiple reproductions at E-size.

Your marketing manager: Tell him his charts, graphs and tables can be in any format, with any symbols, any line weights, and of a quality perfectly suitable for use in printed proposals and reports.

Your personnel manager: Tell him he will be able to do selective, computer-processed listings on the same pass with the film recording. Much faster than two-step processing and sharp enough for multiple reproduction.

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FR-80 is the first system to combine a fast computer and the latest developments in precision CRT imaging on 16 or 35 mm film. No other electro-optical system can touch its resolving power (80 line-pairs per millimeter) and none is so versatile.

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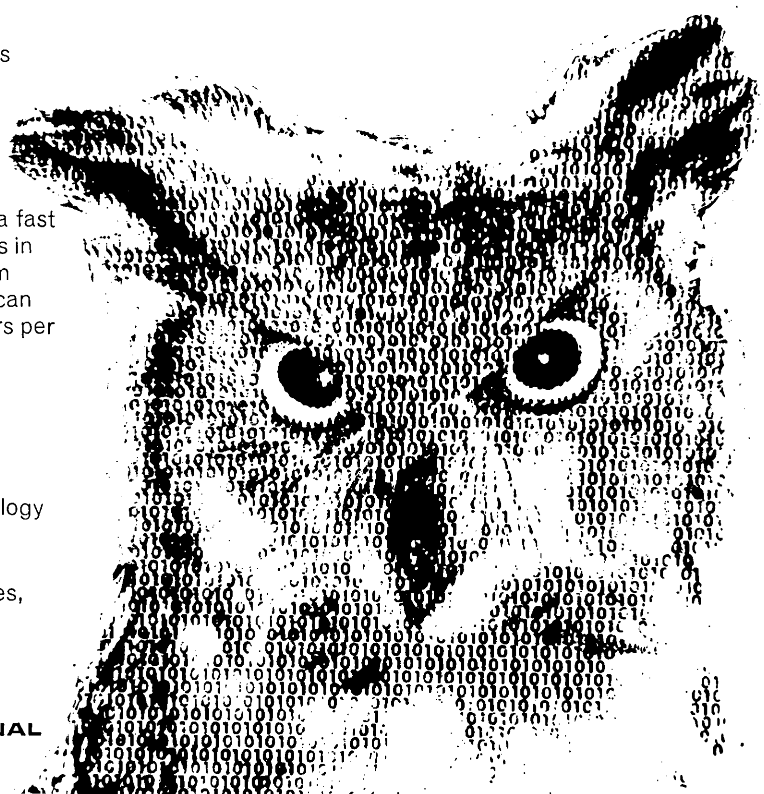

c.a

PROOF GOOFS

Neil Macdonald
Assistant Editor

We print here actual proofreading errors in context as found in actual books; we print them concealed, as puzzles or problems. The correction that we think should have been made will be published in our next issue.

If you wish, send us a postcard stating what you think the correction should be.

We invite our readers to send in actual proofreading errors they find in books, *not* newspapers or magazines (for example, *Computers and Automation*), where the pressure of near-at-hand deadlines interferes with due care. Please send us: (1) the context for at least twenty lines before the error, then the error itself, then the context for at least twenty lines after the error; (2) the full citation of the book including edition and page of the error (for verification); and (3) on a separate sheet the correction that you propose.

We also invite discussion from our readers of how catching of proofreading errors could be practically programmed on a computer.

For more comment on this subject, see the editorial in the September 1968 issue of *Computers and Automation.*

Proof Goof 694

(Find one or more proofreading errors.)

Economic self-sufficiency should be one of the basic aims of education in a democratic society. Gainful employment is a joyful experience. Honest work has moral value. One's self-esteem is firmly established when the world is willing to pay for your services; skilled, semi-skilled or unskilled. Every man must ultimately be inducted into the economic fraternity as a contributing member. In a responsible society there must be no such thing as a total drop-out. When a youngster leaves school he should be able to choose between two exits — one marked TO WORK, and the other TO MORE EDUCATION. There should be no exit leading to NOWHERE, and certainly no unguarded exits. It is not just a living we are responsible for but a life.

What, after all, is education? The dictionary definition is: "To bring up a child physically or mentally; to educate. Also: to develop and cultivate mentally or morally; to expand, strengthen and discipline the mind, or a faculty, etc. To prepare and fit for any calling or business by systematic instruction; to cultivate; train; instruct. Synonym: Develop, teach, inform, enlighten, indoctrinate.

It follows, therefore, that it becomes the duty of *all* who educate to remove the obstacles — psychological, physical, emotional, intellectual or environmental — which might undermine this definition.

I am sure that the story is apocryphal, but it is told that someone asked Michelangelo what method he used for sculpting his Moses. "It is very simple," he is credited as saying. "You just take a chunk of marble and chop away everything that doesn't look like Moses."

The implication is clear: that within any crude piece of stone (or child) lies a work of art, if you know what to chop away in order to reveal it.

It should also be emphasized that the child will have to help with the chopping. Discovering ones self is hard work.

— From *Everything But Money* by Sam Levenson, pp. 229-230, published by Simon and Schuster, Inc., 630 5th Ave., New York, N.Y. 10020, 1966, 285 pp.

Solution to Proof Goof 693:

Paragraph 5, line 7: Replace "hysterical" with "historical". □

c.a IDEAS: SPOTLIGHT

The Power of A Computer Rests in What It Can Become

Machines execute procedures and each machine is the embodiment of the procedure it executes. This is an important relationship that exists for all machines, but people are just not in the habit of speaking about machines in this way. It means, of course, that knowing in detail what a particular machine does — how it works — is enough in theory to know what procedure it is executing. This is true because when we say that a machine is the embodiment of the procedure it executes, we are saying, in effect, that a statement of a procedure describes the machine needed to carry out that procedure. Thus mechanizing means *thinking about procedure,* not about hardware, and once we state a procedure explicitly we should not really be surprised that a machine can be built to execute it.

Now, a computer is a device whose job it is to accept a statement of a procedure and to imitate the behavior of the machine implied by that procedure. This statement of procedure is called a computer program and is usually thought of as a set of instructions for what the machine is to do. But a computer program is more like a blueprint which the computer uses to build itself into the particular machine needed to execute the particular procedure described by the program. It is as though the computer were armed with pliers and screwdriver rebuilding itself to conform step-by-step to the elements of the procedure; and it will then function as that machine.

A computer without a program will do nothing, whether or not it is plugged in, because computers are not like other machines. In a sense the computer is not a machine at all in its own right, and yet it can become many machines, in fact, any one which can be fully described to it. While the power of most machines is in what they do, the power of the computer rests in what it can become, and the essential idea of a computer is that it is an incomplete machine ready to be completed in an infinite number of ways, each way producing a different machine. Thus, a computer program is at the same time an explicit statement of a procedure and the blueprint of a machine needed to carry it out, and whether or not a computer can execute a given procedure depends most heavily upon how well we understand the components of that procedure, and how imaginative we are in conceiving procedures in terms of the basic elements of which they are comprised.

— From *Discussion* by Allan B. Ellis, Harvard University, p. 32, in *Educational Technology: New Myths and Old Realities,* Reprint No. 6, Harvard University Program on Technology and Society, Cambridge, Mass., 1968. □

C.a

MULTI-ACCESS FORUM

THE SPECIAL INTEREST COMMITTEE ON SOCIAL IMPLICATIONS OF COMPUTERS OF THE ASSOCIATION FOR COMPUTING MACHINERY

I. To Mr. M. Stuart Lynn, Editor in Chief
Communications of the ACM, **IBM Scientific Center, 6900 Fannin St., Houston, Tex. 77025**

From: Paul Armer, Robert P. Bigelow, Michael A. Duggan, Roy N. Freed, Herbert R. J. Grosch, Patrick J. McGovern, Anthony G. Oettinger, Donn B. Parker, Stanley E. Rothman

President B. A. Galler has recently dissolved the Special Interest Committee on Social Implications of Computing because of a "lack of interest." We deplore this action, and call upon our fellow members to join us in resurrecting the only group in ACM through which a member can show he cares about the interface of the computer industry with the rest of the world.

At the Spring Joint Computer Conference in 1967, the then SICSIC ran a program on the social problems engendered by computers. Over 100 people came.

And these problems are many. How about Privacy and Data Banks? How about the problems of Computers and Communications? And the regulation of the Computer Industry by various branches of government? What about automation and worker displacement?

Growth projections say that by 1980 the Computer Industry will be bigger than the automobile complex. Will the computer injure the mind of man the way the automobile has beaten his body? The automobile has changed this nation ... its living standards, its housing patterns, its work and recreation habits, and, above all, its transportation. The computer may have a similar effect. If, for example, developments in computers and communications should cause many people to work and to learn at home, there might be no need for huge offices and crowded schools. The implications for society of such a change are enormous.

ACM claims to be a "professional" society. But the great difference between a trade and a profession is that the tradesman is interested in his job — his work — and that alone — while the professional feels that he and his fellow professionals owe a duty to their fellow man to use at least some of their professional training and talent to improve the status of mankind. ACM's image as a professional organization is not helped by shutting down the only open ended group it has which is concerned with how computers affect our citizenry.

Under the By-Laws, SICs and SIGs can include nonmembers of ACM. In the area of social implications this is an asset. The disciplines of sociology, education, business management, law, and medicine, to name a few, all have a function in such a Special Interest Committee. The primary interests of several of the undersigned are in fields other than computing. And we have friends who are equally concerned about the impact of this new technology on the fabric of our nation, but who may not meet the requisites for ACM membership.

To reactivate the Special Interest Committee on Social Implications requires a petition to the ACM Council. We are starting such a petition. If you want to join us and are willing to do some work, please write to Robert Bigelow, 39 Grove Street, Winchester, Massachusetts 01890, or telephone him at 617-742-8300.

II. To: Dr. B. A. Galler, President
Association For Computing Machinery
The Computing Center
1000 North University Bldg.
The University of Michigan
Ann Arbor, Michigan 48104

From: Robert M. Shapiro,
Secretary, SICSIC
Massachusetts Computer Associates Inc.
480 Seventh Ave.
New York, N.Y. 10001

I find it most disturbing that the president of the Association for Computing Machinery has dissolved a committee, the Special Interest Committee on Social Implications of Computation (SIC^2), without informing the secretary of that committee, namely myself.

I also find the article printed in *Computerworld* based on an interview with Jean Sammet distasteful and misleading. In particular:

(1) The article asserts that SIC^2 has no mailing list. I am the secretary and have never been contacted by Jean Sammet or anyone else in ACM in respect to the mailing list. In point of fact, there exists a mailing list of over 100 SIC^2 members.

(2) The article asserts that SIC^2 has done nothing. SIC^2 has in fact organized round table discussions at various meetings. SIC^2 is at this very moment active in the New York area. I enclose a paper written jointly by members of SIC^2 with a resolution based on that paper and unanimously passed at a New York SIC^2 meeting held on February 20, 1969.

I formally request that SIC^2 be reinstated immediately. I also request that the ACM Council make an effort to undo the impression created by the publicity about the dissolution of the group — an impression to the effect that computer people are not concerned with social or political issues. Minimally, the ACM Council should recommend that the enclosed paper, "On the Social Implications of Computers," be published in *Communications Of The ACM*. It deserves at least as much space as has been devoted to the "Code of Ethics" issue.

III. Enclosure in Mr. Robert M. Shapiro's letter: "On the Social Implications of Computers"

The responsibility of interpreting and informing the computer industry of the social implications of computing is the minimum mandate of (SIC)². Also within its scope should fall the responsibility of public education, persuasion, within and without the industry, to further the judicious use of computers in ways that further their social benefit, and to curtail the use of computers in socially undesirable ways. Investigation and analysis without such advocacy is not only futile but potentially dangerous, for it could mean that decisions about the use of computers which have great social impact will be made by those with no knowledge of the values and limitations of the tool.

The scope of this investigation and advocacy of the socially beneficial uses and implications of computers is virtually unlimited. The computer is no more than a tool. Nuclear energy can be used for generating power or for building bombs and warships. A computer can be used for medical research, for guiding spacecraft to the moon or for guiding nuclear warheads to destroy human life. It is a tool used not by individuals according to conscience but by society at large through corporate, educational and governmental institutions.

Having knowledge of the socially destructive potentials and uses of computers and not sharing that knowledge with society is a failure of our professional, civic, and moral responsibilities. A doctor or medical association which did not strongly oppose the improper use of a dangerous drug, by urging the adoption of laws forbidding its use, for example, would not be meeting any of its responsibilities. A scientific association would be meeting its responsibilities to the public by reporting a lack of funds for essential lines of research.

The social implications of computers affect almost every institutional structure and enterprise in the country today and computers are having an increasing effect on the personal lives of every citizen. Because of the decision-making structure in our society, and the newness of the computer industry, few of our decision makers, corporate or governmental, are computer professionals. This all points to a strong need for computer professionals to attempt to educate and influence our social decision makers.

It is in the nature of a democratic free enterprise system that that which is not forbidden will be done if a profit can be derived from it. It is in the nature of state socialism that only those enterprises with governmental support will be undertaken, for only they will receive the financial support required. It is in the nature of bureaucratic institutions that change will be resisted, and it is in the nature of centralized authority and institutions to infringe upon individual liberties and domains without limit unless restrained by the people in their own behalf. Because our society is a mixture of all these things, our approach to analysis of the social implications of computers and advocacy of their beneficial uses should take all of these into account.

To mention some of the social implications of computers in each of these areas, only briefly consider the following: financial corporations have found it profitable to install large data processing systems at the cost of individual customer service; space research and military projects receive astronomical government grants while educational and medical research receive only a fraction of these amounts; banks are very slow to establish computing networks which will ultimately eliminate the need for both money and securities. And finally, the Government, even while the issue is being raised in Congress, is proceeding virtually unchecked in its program to establish mass data banks containing information on every citizen.

To have an educational or persuasive impact on the uses of computers and their social effects, individuals and professional organizations must approach the decision-making structures of the society. These institutions are, in increasing order of social decision-making power, the people, the corporations and educational institutions, and the government.

The people can be influenced through public education campaigns, using the power and facilities of the media. While this education is vital, it will have little direct impact on social decision-making. Public education would, however, help create demand for social decision-making by more powerful institutions, corporations and government.

Corporate decision-making is influenced to some degree by public demand, to a greater degree by government control, to the greatest degree by profit potential. This last and most important factor, independent of the other two, seems little susceptible to education or persuasion.

Government decision-making is clearly the most critical in most social issues, and the use of computers is no exception. The government itself is a great user of computers. It stimulates corporate use of computers by contracts. It is responsible for restrictive legislation and for encouraging subsidies.

It seems then that the most immediate and effective forum for education and advocacy on the implications and uses of computers is the governmental decision-making apparatus. Since our governmental institutions function, and reach and implement decisions, through political dynamics, it is hard to conceive of being concerned with the social implications of computers without acting in the political arena as educator, advocate, lobbyist and, if necessary, even partisan.

It is our contention, therefore, that (SIC)² and ACM must abandon the misguided concept of professional detachment from political issues and be willing to take and advocate stands on political issues involving the use of computers. In fact, (SIC)² may as well dissolve if it does not recognize and accept its responsibility in the political arena, for it will then have no relevance to the social implications of the uses of computers.

There is no such thing as the "professional neutrality" which is always invoked to prevent a professional society from taking public or political stands on social issues. Edward Teller, who favors a defense policy based on nuclear superiority and the threat of their use, is a "neutralist." Linus Pauling, who recognizes the horror he helped create and wants to do away with it, is a "political activist." To advocate a theory of professional neutrality is to exhibit a deep naiveté about the social dynamics of our society and is to take a position supporting the prevailing or establishment position.

Because of the tendency of government to assume any power not specifically reserved or prohibited by the people, taking no position on data banks and invasion of privacy is, in effect, siding with the proponents of mass data banks. They will be created unless defeated by public opposition because they are convenient to the government. Not taking a position allows the continuance of the government-sponsored myth that adequate safeguards can be built into a data bank computer system to prevent improper use. The general public can be confounded by the mystique surrounding a computer: we can see beyond the technical problems and ask if any group of people in a less than perfect world could be trusted with access to such an information system. The decision, when made, will be a political decision, made by elected representatives and probably along partisan or at least ideological lines; so the position of the professional body must be a political position.

Similarly, political positions must be taken on the issue of the programming institutes in the computer industry. We all know that most of them are frauds and damage both the industry and the public. Action must be taken by (SIC)² on all three decision-making levels to meet our responsibility to police our own industry and profession. A campaign of public education must be started to warn against fraudulent practices by these "trade schools." Corporate, governmental and educational users of computers must be convinced to drop all support either as subsidizers or clients of fraudulent schools. Finally, (SIC)[2] must press for legislation establishing licensing and regulative bodies under either government or industry control. This last is a political decision and can be accomplished only through political means. Taking no position aids the continued existence of these fraudulent companies.

On the far greater and more controversial issues of the war in Vietnam and military uses of computers, we can no more easily shirk our personal or professional responsibilities to take a stand, against these enterprises. Arguments to the contrary assume that professional responsibility is somehow totally divorced from personal and moral responsibility. It is properly a subset of personal and moral responsibility and should conform to and follow from it.

Compartmentalizing the personal man from the professional man creates a very schizoid, alienating society, which in fact ours is. The computer is a tool devoid of morality or social responsibility, but the men who use it are not. Denying professional responsibility to affect decisions on how computers are to be used makes the professional indistinguishable from his tool.

The war in Vietnam is immensely destructive in social consequences to our society, as well as to the Vietnamese, in life, resources, moral energy and political cost. The *New York Times* has recently reported that the Nixon Administration has decided that the war must be ended, by compromise if necessary, as soon as possible because it is dividing the country and using too much of our resources — in other words, the social costs are too great. As individuals we clearly have a political interest in whether the war is allowed to continue. As professionals we are obliged to take a stand also, both as a subset of our personal responsibilities and because computers are used so heavily in the war effort.

Again, (SIC)[2] or ACM should act on all three levels of decision-making. It should take a stand on the social implications of the war in the interest of public education. It should urge all computer professionals to take professional stands, including the refusal to use their professional talents to support the war effort. And it should initiate and support political action to end the war. The single voice of a professional organization can be more effective than the independent voices of individual members.

The computer professions and the industry are vital to the war effort and the defense industry in this country. Had war-making and defense been computerized in the 1930's and 1940's, German computer professionals would have had a clear moral and professional responsibility not to cooperate with the Nazis, and would have been justly condemned for not exercising it. Our case today is little different. Once embarked upon a policy, however disastrous, the government has a tendency to continue, especially when so strongly encouraged (in their own interest) by the military-industrial and defense establishments. Silence in this situation is tantamount to approval and acquiescence. The supporters of the war can claim the alleged neutralists as their own.

Defense policy, a clearly political issue, relates very closely to a general question of the society's allocation of resources. This allocation is affected by the executive and legislative areas of government, influenced only by political pressure and action. As professionals engaged in the use of computers we can and should take positions on how computers are to be used, which means how the society will allocate its resources. Our role should not be limited to opposing socially destructive uses of computers but must also include promoting socially beneficial ones. We should be lobbying as a professional organization for increased resource allocation to fields like education, research, medicine, social welfare and urban planning, fields in which computers can play an important and socially beneficial role. Thus we, as computer professionals, can fulfill both our personal and professional responsibilities to society, using ourselves and our tools in its best interest.

A final point relating to the war and the other general subjects covered here. Other professional organizations of doctors, teachers, linguists, scientists, historians, psychiatrists, and lawyers have confronted the question of political stands on the war and other social issues. All have debated professional neutrality. Many have rejected it in whole or in part and taken political stands.

> The *New York Times* of February 9, 1969, reported that "a deep groundswell of discontent is rolling through scientific communities from Moscow to New York and, perhaps, even isolated Peking. It was manifest last week as activists within the American Physical Society tried to enlist the support of their colleagues in helping to fight what they called the 'overwhelming' domination of research by the military. . . . they were united in a desire to shift the emphasis in research from military goals to pressing social needs. . . . The urged that machinery be created to help scientists better educate the public to assess such controversies as those on the A.B.M. and on biological warfare."

Professional organizations have long taken stands on other political issues, within and without the field of their purely technical competence: the A.M.A. on Medicare, abortion, euthanasia, and marijuana; the American Education Association, on decentralization. In the case of the computer industry, there are few social issues not within our competence because the computer has pervaded all functions of society.

It is time (SIC)[2] and ACM fulfilled its professional obligation to society to speak out on how computers are used rather than just how to use them. Only in an organization open to free exchange of ideas and debate can we provide society with truly responsible and professional information and service.

RESOLUTION

As professionals in the computer field and members of (SIC)[2], we have the responsibility, through our professional association, to oppose the use of our skills for destructive and anti-social ends. Therefore, we urge that ACM adopt these proposals as part of its national policy:

1. We oppose the war in Vietnam, U.S. military presence throughout the world, and economic and political subversion of other nations. Since there is widespread involvement of our profession in these endeavors, we urge all computer professionals to review the moral consequences of their involvement in furthering these efforts.
2. We oppose discrimination as practiced in the computer field by direct or indirect means such as educational requirements, arbitrary testing procedures, and restrictive policies.
3. We oppose the establishment of mass data banks which pose a threat to our privacy and concentrate power in the hands of a few.
4. We oppose the economic exploitation of the uninformed by unscrupulous computer schools.
   We support the implementation of accrediting standards for the computer educational field.
5. We support the active encouragement, development, and funding of programs for the constructive application of computers toward the solution of the many problems faced by our society.

IV. From the Editor of "Computers and Automation"

Several questions arise from the foregoing, on which I would like to comment not only in the capacity of the editor of *Computers and Automation* but also as in the capacity of one of the first handful of members of the Association for Computing Machinery when it was founded in 1947, and as its first secretary, 1947-1953.

First: It seems to me unlikely that the President of the Association for Computing Machinery by his sole action has the power under the Constitution to dissolve a Special Interest Committee. (If the Constitution is now worded in such a way that he can, without assent from the Executive Committee or the Council, then it seems to me that this power should be promptly canceled.) Accordingly, SICSIC still exists, because his action is null and void.

Second: If SICSIC has in fact been dissolved, then it seems to be desirable that the President or the Council should forthwith reconstitute it. There is no doubt at all that it is a vigorous and functioning Special Interest Committee.

Third: Of all the facets of computers and their applications, for business, for industry, for science, for the military, etc., it seems strange indeed that applications for the advantage of society and the social implications of computers should be placed beyond the pale of professional concern of ACM members. In fact, such proscription is nonsense. It is at the same level as the action of the Tennessee legislature many years ago in passing a law making it illegal to teach the theory of evolution in schools in Tennessee.

Finally: If any petition is in fact necessary to reestablish the Special Interest Committee on Social Implications of Computers, we invite all interested readers of *Computers and Automation* to write to Mr. Robert Bigelow, 39 Grove St., Winchester, Mass., and enroll on his petition.

CENSUSES OF COMPUTERS INSTALLED

I. From M. L. Melville
Public Relations
NCR (National Cash Register Co.)
Dayton, Ohio 45409

Computers and Automation has compiled an outstanding record of factual and objective reporting on the data processing industry. For this reason it should be pointed out that the "Improved" Computer Census published for the first time in your February issue is grossly erroneous with respect to the installation figures listed for NCR.

We do not know the composition of the data base from which these figures were derived, but we suggest that this be carefully re-examined.

Actually, the census figures previously published by your magazine gave a generally accurate picture of the numbers of systems installed by our company to date, although we are not in a position, of course, to comment on the data listed for other manufacturers.

II. Report of a telephone call from Norman M. Bryden, Honeywell EDP, Wellesley Hills, Mass., to the Editor

Mr. Bryden expressed shock over the figures published in the February issue for Honeywell's computers installed. He said they ranged from 70% to 20% of the correct figures. He was not permitted by company policy to state what were the correct figures, nor could he say for which models the various percents of understatement applied. He regretted that company policy prevented him from giving more information. He was dismayed that *Computers and Automation* referred to the census in the February issue as "an improved" census. He said that figures published in the January and earlier issues of *Computers and Automation* were far closer to the correct figures.

III. From a news report (anonymous) in Computerworld for March 5, 1969, Computerworld, 60 Austin St., Newtonville, Mass. 02160

A new computer census, which *Computers and Automation* states is more accurate than its previous censuses appeared in the February issue last week and indicates that the share of the computer market held by many of the manufacturers previously had been grossly overstated.

A number of the new figures, however, have been disputed by knowledgeable industry sources.

In the new census, the figures for Honeywell, for instance, showed a dramatic change. The population of 120s in the U.S. was down from 650 to 260, a drop of more than half, while the successful Honeywell 200 line had apparently dropped from 800 installations to 448, a 40% drop. Other Honeywell systems were equally adversely affected.

Burroughs was hit in the figures for the B300 series, dropping from 370 installations to 183.

Some of the reduction was understandable because the new figures included only U.S. installations and apparently were five months old, while the original census had dealt with worldwide figures and the situation in the middle of December.

Even so, Honeywell reacted strongly on hearing of the changes and characterized them as being "completely absurd". A Burroughs spokesman also strongly disagreed with the new B300 figures. . . .

IV. From I. Prakash
D. P. Focus
61 Helen Drive
Marlboro, Mass.

We have received several comments on the figures reported in our Computer Census published in the February issue of *Computers and Automation.*

Our Census is based on hard, factual information, including a listing by name and address for each computer enumerated in the Census.

Most of the companies do not release figures, but we would be prepared to change our Census figures on the basis of hard, factual information — from the companies themselves or other sources — which includes the name and address of each computer installation.

We would much appreciate it if other publishers and reporters would state clearly whether or not they have a listing of the name and address of all (not some) of the installations that they include in a census report.

Our Census is published to assist all our readers and executives in the industry who wish to base their plans, marketing strategies, and other actions on accurate information which can be verified.

We will continue to do our best to prepare and publish accurate reports and figures, even if such reports and figures are not highly regarded by some in the industry.

All comments are welcome.

V. From the Editor

We believe it is desirable to publish the best information we can find in regard to the number of computers installed and the number of computers on order, in order to fulfill our efforts in regard to a census of computers.

For a long time we have been dissatisfied with the figures that we have published in the months through January 1969 in the Computer Census. Our dissatisfaction has shown in some of the published notes attached in the January computer census and earlier.

For example, take the note:

(N) — Manufacturer refuses to give any figures on number of orders and installations, and refuses to comment in any way on those numbers listed here.

To publish a figure marked with a note like (N) attached to it gives a superficial impression of accuracy that may be really false, and we do not like to do that. To add such a figure to a really accurate figure furnished by some other manufacturer who is frankly telling the truth, is to us even more of a statistical sin, and has become more and more distasteful to us.

On one occasion we were told by the public relations officer of a computer manufacturer in California: "When IBM publishes their number of computers installed and their number on order, then we will, and in the meantime we will give you no information." What does an editor do?

On another occasion I asked one of the heads of the Institute of Computers and Mechanics in Moscow, U.S.S.R. how many computers were installed in the Soviet Union; he said it was his impression that there were about 8000, but that he knew of no figures available anywhere, and no way of collecting them either. Later, I commented on the 8000 to an American market research specialist and he said that the figure should be one third of the 8000. What does an editor do?

We are glad to change over to a basis whereby we have an agreement with a competent computer market research organization who will furnish us with computer census information based on the names and addresses of locations where they know computers are installed, who take the responsibility for the correctness of the figures.

We wish to have as little as possible to do with information from:

- "knowledgeable" industry sources
- "informed circles"
- an unnamed "spokesman"
- somebody who "reacted strongly"

and similar vague, indefinite and faceless informants.

If anybody can give us the names and addresses of U.S. installations where a total of six hundred Honeywell Type 120 computers are installed, we shall be more than delighted to increase the total reported in our census to 600, instead of 260. And similarly in all other cases. □

"MACHINE LANGUAGE, AND LEARNING IT" — COMMENTS

William F. Sherman
MACRO Systems Associates
333 Bayside Dr.
Newport Beach, Calif. 92660

Your editorial of February, 1969 ("Machine Language, and Learning It") was quite provocative and raised some points to which members of the programming profession should respond.

As a professional programmer, I, too, consider machine language to be more enjoyable and satisfying. There is a definite element of satisfaction in turning out a good, tightly coded, systems-oriented, real-time routine. One who has had the challenging experience of solving a systems problem when closely bound by the constraints of hardware and time will certainly admit that this is a true test of the programming professional. Additionally, the programmer fortunate enough to be intimately associated with the hardware of a processor develops a competence and discipline which the programmer only experienced with higher level languages seems to lack.

There are those who vow never to use anything other than the highest of high-level languages. These people seem to miss the same point that the "diehard" machine-language-only cadres miss, which is that the language selected for a job is a function of:

a) The nature of the problem to be solved.
b) The environment in which the solving program has to exist.
c) The utility of the solving program.

Part of the function of the professional programmer/systems analyst (you will allow me the commonality, I hope) is to specify a language to solve the problem under discussion. A programmer "hung-up" on one type, or genre, of programming language can hardly be expected to perform well in this area.

In similar fashion, data processing shops hung-up on the use of a single language do themselves a corresponding disservice. The disadvantages incurred by the specification of a single language only usually seem to outweigh the advantages obtained.

It is my impression that, for the professional experienced programmer, a machine language or a higher level language is not all that difficult to learn. Hence, the recurring and repetitive discussion on this subject has little merit. The professional programmer should be obligated to choose, and be familiar with, the language necessary to effect the most economical and timely solution to the job at hand.

As a consequence, your discussion of the MOHAC system has embedded in it the seeds of a basic philosophical discussion which, it seems to me, centers around whether or not a programmer should be aware of the operating principles of the equipment he utilizes to solve the problem given to him. I submit that this knowledge cannot hurt and more than likely will help the programmer as a professional. Hence any system or methodology which aids in gaining this end gains my enthusiastic support. □

OPPORTUNITY FOR THE BRITISH AND EUROPEAN COMPUTER INDUSTRY

Gordon Hyde, Scientific Director
Datatrac Ltd.
6 Collingham Place
London, S.W.5, England

I would like to comment on the IBM anti-trust issue with particular reference to the European computer scene.

Areas of technology characterized by rapid advance call for a correspondingly high level of investment in research and development. For this reason commercial success and innovative competitiveness go hand-in-hand in such fields. Nowhere is this thesis better supported than in the computer field. The overwhelming dominance of IBM over the European scene has undoubtedly been one of the major factors in our failure to develop an adequate home-grown capability, in the innovative and marketing sectors — although strategic errors of our own have played a not insignificant role.

The vast dead-weight of punch-card thinking and hardware, also a legacy of IBM's commercial success, is also likely to inhibit commercial exploitation of next generation real-time systems for some time to come, as far as the conventional market is concerned.

For these reasons, any change in the balance of power in the United States computer industry must be reflected in a determination by the British and European industry to take advantage of the situation. This will call not only for a more strategically aware commercial policy, but also a will to get in first with the next generation of machines.

In this context, we should look closely at the field of small-sized and medium-sized, modular, real-time information-handling systems, where not only is there a possibility of real technological advance for relatively low research investment, but also a hitherto inadequately explored market. □

Based on a letter to *The Times,* Printing House Square, London, England, January 24, 1969.

SOLVING NUMBLES AND OTHER PUZZLES

I. From Richard Marsh

1330 Mass. Ave. N.W., #822
Washington, D.C. 20005

A Scot once said that golf is an "humblin' game." Paraphrasing, may I say that "Numblin' is humblin.'"

Let me explain.

Due to change of address and failure of postal authorities (probably assisted by my wife) in forwarding them to me, I missed the September, October, and November issues of C&A — just one of those things. In the December issue's Letters to the Editor I noted references to the Numbles, and further back in that issue found your December Numble. I gave it a try, and a couple hours later, most of it spent in deciding the approach to take, I came up with the solution.

I noted that you invited human or computer programs to solve such puzzles. Now, though a subscriber to C&A, I'm essentially a procedures man and wouldn't know a COBOL statement from one in FORTRAN. But I did think it would be interesting to try to reconstruct precisely the rules and logic I had used in solving the Numble. I spent the next several evenings on this project — somewhere around 16 to 20 hours. (The fact that it takes 10 to 20 times as long to document a problem than to solve it may explain to some degree why the software people in general have such a hard time getting programs documented!)

Anyway, I had a nice set of rules and logic all written out. I would have mailed it in except that I recognized that a different problem might require a rule or two I had not yet included. So, I decided to await the January issue and apply my rules to the January Numble.

But you, you bum . . . well, the January Numble left me numb. All those pretty rules and logic I had developed for the December Numble were useless. I was reduced to a trial-and-error routine based on possible values of H, K, and L which would produce the two T's in the third line. Oh, I finally got values which would work after only the fifth trial out of about twenty possibles, but it took over four hours. Actually it added only one rule to what I had already developed in December, but it was so different in nature that it looked out of context when placed with my earlier rules.

So, in disgust, I decided to await the February Numble. And what have you done? You've thrown in an entirely different kind of problem — a simple addition which in a few minutes can be solved to yield "Bad Luck." But, again, it doesn't follow any of my painstakingly constructed December rules, and would require another 10 or 20 hours to document.

As I said at the outset, "Numblin' is humblin.'" I have learned, *again,* that things are never as simple as they seem. Complex mathematical equations are far easier to express than the logic of the third and fourth grade arithmetic which makes them possible! I think this is an important lesson.

I recognize that in a "conversational" mode a computer would be handy to come up with a list of possible values for given letters in a specific problem. It would have saved me a few minutes of effort in solving particularly the December and January Numbles. But I'm sure the total cost would be considerably greater than if I did it alone without computer assistance. (Is this another lesson to be learned — that conversational-computer operations should be carefully screened to preclude exorbitant costs?)

But back to Numbles.

My alternatives?

- Go to a library or elementary school and study the basic rules of arithmetic again, or
- Swear off Numbles.

Since procedures men are always interested in the least possible effort, I shall choose the latter. Henceforth I will confine myself to such innocuous pastimes as looking for things like chances in the February Proof Goof 692.

II. From Neil Macdonald, Assistant Editor

Thank you for your enjoyable letter. I take pleasure in sending you a copy of our little booklet on Numbles. Don't swear them off — or swear off them! They're fun; and we have a program on our DEC PDP-9 computer that does addition Numbles very well, but not yet multiplication Numbles. We'll try soon to modify it and publish it in C&A.

III. From Morris Myers, Programmer

Dept. of Chemistry
Univ. of Arkansas
Fayetteville, Ark. 72701

I just discovered Numbles, and have solved Numble 6811. However, Numble 812 seems to be very difficult to solve. I am still trying though. Some of my colleagues and I are attempting to write a computer program to solve Numbles. and I am curious as to whether they ever take the form of division problems. If so, I would very much like to have one as an example.

I thoroughly enjoy the relaxation of working Numbles (already), and look forward to the next issue of C&A.

IV. From Neil Macdonald, Assistant Editor

We are glad you are enjoying Numbles. Yes, they can take the form of division problems, which are rather easy on the whole, because of the large amount of information. We take pleasure in sending you a copy of a booklet on Numbles and their solution.

V. From the Editor

One of the reasons we publish Numbles is the fact that one of the biggest incentives in learning is the solving of interesting problems. The instinct of curiosity that lies back of the human desire to solve problems is without doubt one of the elements that has led man as a species of animal to his present dominant position as a form of life on earth.

The instinct of curiosity and the desire to solve problems might well be the main force which has produced over 200,000 computer programmers and systems analysts in a decade or so, without benefit of formal training in colleges and schools.

In the pages of *Computers and Automation,* we hope to emphasize the area of playing with computers in such fashion as to lead to learning about them. We intend to publish soon a description and details of a program for a miniature LISP (LISt Processing programming language), a LISP that has only five atoms and only five functions — and show its entire structure, so that interested readers can play with it.

We invite readers and authors to send us descriptions and details of small and interesting programs, especially programs that may invite persons into a path by which they become "addicted" to computers, computer puzzles, computer games, and computer programming. □

FORECAST OF COMPUTER DEVELOPMENTS, 1968-2000

Carol Andersen
Parsons & Williams
Nyropsgade 43
Copenhagen, Denmark

On November 22-24, 1968, 250 computer experts from 22 different countries attended a congress on the organization of computerized files. The International Federation for Information Processing Societies (IFIPS) was the sponsor, and the Danish society was the host for the congress. The high point of the conference was a forecast of expected computer developments from the present until the year 2000.

The forecast was made using the Delphi technique. Eighty-eight of the delegates from 11 countries gave their opinions on 24 areas of development. Some of the major findings of the forecast summary are:

1. A 50% reduction of the labor force in present industry is expected by the late 1980's. The reduction will be partially compensated by shorter working hours and by absorption of workers by new industries; but the problem of unemployment is expected to be much more serious in the future than it is today.
2. In the year 2000, all major industries will be controlled by computers. Small industries will not be automated to the same extent, since it is not likely that many will exist by then.
3. The influence on the medical profession by EDP is expected to be extensive. By 1975, treatment of patients in major hospitals will be controlled by computers and by 1980's a majority of doctors will have EDP terminals for consultation and will be able to give reliable diagnosis by computer.
4. The future software will, to a large extent, be built into the hardware by late 1990's and computers which learn from their own experience will exist before 1989.
5. In spite of advanced technology, computer prices are expected to decrease by a factor of 100 by the end of the 1980's.

The entire survey is published in a book entitled *Forecast 1968-2000 of Computer Developments and Applications.* Additional information is available from the address above. □

USASI FORTRAN TO BE EXTENDED

X3 Secretary
Business Equipment Manufacturers Assoc.
235 West 42 St.
New York, N.Y. 10017

The USASI X3.4.3 FORTRAN Working Group at its meeting of January 22, 1969 resolved to begin consideration of standardizing FORTRAN programming language extensions. (This Working Group developed the existing FORTRAN Standards — USAS X3.9-1966 FORTRAN and USAS X3.10-1966 Basic FORTRAN). The Group also established the principle that any extensions to the FORTRAN Standards be such as to protect the integrity of existing FORTRAN source programs written in conformity to the present FORTRAN Standards.

Inquiries and suggestions should be made to the X3 Secretary at the address above. □

ACM SYMPOSIUM ON THE APPLICATION OF COMPUTERS TO THE PROBLEMS OF URBAN SOCIETY — CALL FOR PAPERS

Jessica Hellwig
Symposium Chairman
Columbia Univ. Computer Center
New York, N.Y. 10027

The fourth annual one-day Symposium on "The Application of Computers to the Problems of Urban Society" will be held on Friday, October 24, 1969, at the New York Hilton Hotel. Sponsored by the New York metropolitan chapters of the Association for Computing Machinery (ACM), this Symposium brings together interested professionals from the computing field and from the urban problem areas, and provides a forum for the exchange of ideas, experiences, and information.

Papers are invited on computer applications and experiments in: urban information systems; urban planning and operations research; architecture; pollution, housing, transportation and welfare problems; education; and other areas germane to computing and urban problems.

Abstracts of about 500 words in length should be submitted by June 1; final papers will be required by July 1. Abstracts and requests for further information should be directed to the address above. □

NUMBER OF TIME-SHARING VENDORS

Alan G. Hammersmith, Pres.
Time-Sharing Enterprises, Inc.
251 W. DeKalb Pike, Suite C-110
King of Prussia, Pa. 19406

In reference to your desire to find a better estimate of the number of time-sharing vendors (Feb., 1969 issue, page 17), you might be interested in the following information.

Since September, 1968, our firm has been publishing the "Time-Sharing Industry Directory". This publication lists information on the various time-sharing vendors presently offering a commercial remote access service. On Sept. 1 there were 45 vendors; in Nov. there were 105 vendors; and our last update on Jan. 1, 1969 lists 117 time-sharing vendors.

COMPUTER MARKET REPORT — CORRECTION

Two errors in the Computer Market Report ("The Computer Leasing Industry — Some Statistics") beginning on page 39 in our March, 1969 issue need correction. The heading on Table 6, page 40, should read "Geographic Location of Leasing *Companies*", not "Leasing *Customers*" as published. Likewise, the first sentence in paragraph one on page 69 should read "The geographic location of the top 175 computer leasing *companies* is shown in Table 6."

WHO'S WHO IN THE COMPUTER FIELD, 1968-1969 — ENTRIES

Who's Who in the Computer Field 1968-1969 (the Fifth Edition of our Who's Who), will be published by Computers and Automation during 1969. The Fourth Edition, 253 pages, with about 5000 capsule biographies was published in 1963. The Third Edition, 199 pages, was published in 1957.

In the Fifth Edition we hope to include upwards of 10,000 capsule biographies including as many persons as possible who have distinguished themselves in the field of computers and data processing.

If you wish to be considered for inclusion in the Who's Who, please complete the following form or provide us with the equivalent information. (If you have already sent us a form some time during the past eight months, it is not necessary to send us another one unless there is a change in information.)

WHO'S WHO ENTRY FORM
(may be copied on any piece of paper)

1. Name? (Please print)____________
2. Home Address (with Zip)?____________
3. Organization?____________
4. Its Address (with Zip)?____________
5. Your Title?____________
6. Your Main Interests?

Applications	( )	Mathematics	( )
Business	( )	Programming	( )
Construction	( )	Sales	( )
Design	( )	Systems	( )
Logic	( )	Other	( )
Management	( )	(Please specify)	

____
____

7. Year of Birth?____________
8. Education and Degrees?____________
9. Year Entered Computer Field?____________
10. Occupation?____________
11. Publications, Honors, Memberships, and other Distinctions?____________
____
____
(attach paper if needed)
12. Do you have access to a computer? ( )Yes ( )No
  a. If yes, what kind of computer?
  Manufacturer?____________
  Model____________
  b. Where is it installed:
  Manufacturer?____________
  Address?____________
  c. Is your access: Batch? ( ) Time-shared? ( )
  Other? ( ) Please explain:____________
  d. Any remarks?____________
____
13. Associates or friends who should be sent Who's Who entry forms?

Name and Address

____
____
____
____

(attach paper if needed)

When completed, please send to:

Who's Who Editor, Computers and Automation,
815 Washington St., Newtonville, Mass. 02160

NUMBLES

Number Puzzles for Nimble Minds — and Computers

Neil Macdonald
Assistant Editor

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away and a second one in the digit cipher. The problem is to solve for the digits.

Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, which is expressed in numerical digits, is to be translated (using the same key) into letters so that it may be read; but the spelling uses puns or is otherwise irregular, to discourage cryptanalytic methods of deciphering.

We invite our readers to send us solutions, together with human programs or computer programs which will produce the solutions.

Numble 694:

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          The  H A R D   est
             x S T E P
               E R O R E
             T L S A O
           A S D O T          L = P
         O R L S R
       = S O H S R I E E

    02176  58758  62781  93
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Solution to Numble 693

In Numble 693 in our March issue, the digits 0 through 9 are represented by letters as follows:

B = 0	L = 5
G,K,C = 1	M = 6
E,Y = 2	O,U = 7
T = 3	N = 8
S = 4	J = 9

The full message is: Neglect justly entombs most books.

Our thanks to the following individuals for submitting their solutions to recent Numbles we have published: A. Sanford Brown, Dallas, Tex.; Dick Chase, Bloomfield, N.J.; T. P. Finn, Indianapolis, Ind.; Claude Grenier, Quebec, Canada; John Lambrecht, Antioch, Tenn.; Morris Myers, Fayetteville, Ark.; Joseph J. O'Hara, Jr., New Haven, Conn.; L. Rowland, Columbia, Mo.; D. F. Stevens, Berkeley, Calif.; and Bob Weden, Edina, Minn. □

GEOPHYSICAL DATA MANAGEMENT — WHY? AND HOW?

Dr. Robert M. White, Administrator
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"We need to consider the cost to the Nation of not *having an effective geophysical data system — what it costs us when a scientist, engineer, or citizen is unable to get the information he needs to continue his research, to design a building, to plan a dam, to make a business decision — and what the cumulative effect of this lack of information may be."*

Data management seems to be the "in" thing nowadays. Our technical reports are replete with descriptions of advances in data storage and retrieval. Stock market analyses give special emphasis to investment opportunities in companies engaged in the field. Our journals are full of discussions about the data doomsday which is reportedly about to befall us. By any measure, data management — with all its implications for science and technology — is a spectacularly growing field. Presumably, then, the question I raise in my title has been answered, or at least wrestled with, by many people in many ways.

However, over the past several years, my duties as Administrator of a reasonably large geophysical effort have brought me face to face with problems dealing with many kinds of geophysical data management systems. Naturally, I have arrived at some views about where we are and where we may be going in this immensely complex area.

Environmental Data Service

The problems of data management are woven through the fabric of everything we do in ESSA (Environmental Science Services Administration). They are regarded as so vital that we have established as one of our five major components an Environmental Data Service, on a par with the Weather Bureau, the Coast and Geodetic Survey, our Research Laboratories, and the National Environmental Satellite Center. The Environmental Data Service manages our archival and retrieval systems for the geophysical information for which ESSA has direct responsibility. But it deals with only one part of the picture: every other element of ESSA is also involved in one form of data management or another. Indeed, we constitute an organization whose general purpose is the collection, processing, dissemination and storage of geophysical information of all kinds, and for a limitless range of purposes.

Data management is common to every geophysical scientific and technical activity. Every scientist or technologist in our agency is a data manager in one sense or another. But the need is far wider than this: almost every economic effort depends to some extent upon the information from our geophysical data.

It probably was inevitable, then, that data management should give rise to its own cult. There are basic inherent similarities in the processing, archiving and dissemination of data of all kinds. There is a commonality of complaints about the inefficiency of our present systems. New processing, storage, and retrieval technology form a common technological base. All of this, however, has led many people to almost ignore the fact that each system is merely a means for carrying forward a specific program or giving a specific service. There is a tendency to paper over the difference between programs and services, and their ultimate purposes, and to subordinate them to the efficiency of the data management function. It should be remembered that data management is not, and should not be, an end in itself.

A Catchall Term

In addition to this kind of thinking, we have a further complication. Sometimes one feels that data management has come to mean all things to all people. It is becoming one of those convenient catchall terms like "the environment". I recently attended a joint colloquium sponsored by the House and

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(Based on an address before the Marine Technology Society, Washington, D.C., October, 1968)

Senate on a national policy for the environment. I discovered there are an amazing number of environments. Each of the Secretarial officers spoke to his concerns. The Secretary of the Department of Urban Affairs was concerned about the environment, principally social, of the cities. The representative of the Department of Transportation talked of the environment of the highways and automobile safety. The Secretary of the Interior spoke about the conservation of the natural environment. And so it went; everybody was talking about a different environment.

Nowadays, I see the same tendency when we think about data management. In ESSA, the Director of the Weather Bureau is concerned with the real-time acquisition, communication, processing and dissemination of weather information and the management of data systems to accomplish that purpose. The Director of the Coast Survey is concerned with the acquisition of oceanographic data and their processing into the form of maps and charts and the management of data systems to accomplish that purpose. The Director of the Environmental Satellite Center is concerned with the acquisition and processing of satellite data and the management of data systems to accomplish that purpose.

Primary Systems

The differences between the purposes, the organization and management of these systems are far greater than the common needs that bind all data systems. So I think it is logical to draw a distinction between primary and secondary systems. In primary systems such as those I have mentioned, there exists relatively good control over input, communication and processing. There are clear, specific requirements and customers. The fact that data collected by such primary systems as our weather forecast and warning, or marine mapping and charting systems may later have wide use for other purposes is of only peripheral concern to the primary system manager, is secondary. This, as we shall see, leads to difficult problems for managers of secondary systems.

Secondary Systems

Geophysical data archival and retrieval systems are secondary systems. Let me emphasize that I use the word "secondary" not to indicate lesser importance: I find many problems both in design and management in the development of such systems. Our Environmental Data Service, which is concerned principally with systems for the storage, archival, retrieval and dissemination of historical information — gathered for a multitude of primary purposes — is a good example of a set of secondary systems.

In addition to the National Weather Records Center, this organization operates several geophysical data centers, (geomagnetism, seismology and geodesy), and our Aeronomy and Space Data Center. It is our representative on the advisory board of the National Oceanographic Data Center, and it funds for ESSA's share of that operation.

Lack of Control Over Input and Output

The problems of operating such a set of systems are formidable. By and large, managers have little input control over the amount, character, accuracy, or format of the information they must archive and process. On the output side, their mixture of customers and requirements is continually changing and often indeterminate. By way of example, a decision to build a second canal across Panama, a decision to operate a new vehicle in air or water — all such decisions can generate unanticipated demands for data. This condition is in the very nature of the task, and it will not change.

The principal control which the manager of secondary data systems has is in the archival and data processing segments of the system for which he is responsible. The inherent lack of control and uncertainty at both the input and output ends of such secondary systems makes them very difficult to plan, design and development.

The distinction between primary and secondary kinds of data systems is far more than semantic. It is a source of confusion. The common threads that bind all data management activities are without question weaker than the bonds that tie together a total program or a total data system. The problems of operating a real-time system for observing and forecasting ocean data are so fundamentally different from those of operating a system for the archival and retrieving of ocean data, for example, that lumping them under the general umbrella of data management serves only to becloud the problems of both.

The Real Problems

The real problems in this area do not lie in our ability to deal with what is popularly known as the data explosion. Modern information and data processing technology can cope with almost any flood of geophysical material we can anticipate, if adequate resources are provided for it. Our thorniest problems are not those of building bigger and better boxes into which to feed our information — although these are needed. Our most difficult problems stem from the lack of ability to exercise enough influence over the types and formats of data flowing into the system and arranging quick, responsive retrieval and dissemination to serve our customers.

In designing a storage and retrieval system, we must weigh three major considerations: (1) the impact on those primary systems which supply the data; (2) the responsiveness we will provide the user; and (3) the efficiency of the system itself. It is clear to me that we have focused too sharply on the last consideration to the neglect of the first two. This fact may be leading us toward systems designed primarily to serve their own ends, and it is certain that such systems will never be more than a wasted exercise — a burden to those supplying the data, and a frustration to those who try to use it.

Weaknesses in Present Systems

Most of our current secondary systems take as their task the absorption of the masses of data collected by routine observational or experimental programs, as well as response to the retrieval requirements of subsequent users. Our present systems do not meet the needs. Experience has shown us that primary data are useful for many purposes after they have satisfied the first need — purposes whose values may outweigh in some cases that of the original program.

Measurements of sea-air parameters such as winds, tides, currents, and temperatures made for environmental prediction purposes, for example, become valuable to engineers working in the marine environment, but only after the data have been systematically identified, summarized, and archived to form a large enough data base.

Geophysical data collected for research activities such as continental drift studies have great economic potential — if the basic information is made available to those concerned with assessing and developing the oceans' mineral wealth.

Data collected during surveys associated with the production of navigational charts are also useful in engineering and exploration activities, if it can be made available in appropriate forms.

We ought to face up to the fact that at present we have no satisfactory means in our secondary geophysical data systems for radically influencing the form, timing, and accuracy of input material gathered by primary systems. Even in an organization as integrated as ESSA, in which both primary and secondary data systems are under single management, we have not solved the problem to my satisfaction. There are many reasons, it seems to me. They range all the way from questions of finance, to utility, to international agreements. We are perhaps in best shape in the weather data area. But it has taken a half century to arrive at the present relation between primary and secondary weather data systems, and even here there is much to be done.

The Weather Data System

Let me illustrate. The primary weather data system must respond to real immediate needs for weather forecasts and warnings. New equipment must continuously be obtained and installed, new observational locations found. Old ones must be changed to meet pressing demands; data rates and formats are designed to serve the needs of the primary system. Priorities are established without significant reference to the needs of the secondary weather data system. All of these changes affect the input to the secondary data system, and the cost and workload in that system. Ideally, if we had as many resources as we needed, we could accommodate such impacts. But we never do have all we require. We are forced to decide whether we will allow the primary system to move forward and generate adverse impacts on our secondary system. Frequently the answer is yes, when we are confronted with a pressing requirement of the primary system. The suggestion has been made that secondary systems should be funded as an overhead on the primary system. This is only part of the answer, since it places the secondary system completely at the mercy of the changes in the primary.

We must begin to develop mechanisms whereby the assessment of changes in the primary systems and the secondary system can be made, and where the drawbacks and costs can be compared with the benefits to the primary system.

Determining User Needs

A major problem facing us in the development of secondary geophysical data centers deals with responsiveness of the system in the face of an inherent uncertainty in the nature of the user market.

Determining user needs and assessing the degree to which the data system should be responsive to them is a very difficult question. Again, ideally we should like a system which would be sufficiently responsive to the needs of the user to make him willing to pay for it. I think you are all too familiar with the difficulties of user requirements and user need studies. Sometimes they take on the aspects of Alice-in-Wonderland adventures.

The cost of satisfying user needs must be related in some way to benefits. And the question of the cost-to-whom has to be dealt with. I am convinced that there is a Parkinsonian law of some kind which says that user needs expand in direct proportion to the costs somebody else is willing to bear.

The fact that the problem is a difficult one does not mean we should not tackle it. On the contrary, unless we find some rationale for confronting and solving it, we are going to have unresponsive data systems.

It is clear that many user requirements are not known and cannot in principle be known — because the potential users may not themselves be able to specify what they will need next year or ten years from now. More often than not, current demand reflects only our current response capability — not what the user really needs or wants. We need to know who our users are — and what they are trying to do, since they may be unsure of their own exact needs. We need to identify potential users, customers who are unaware of the data's availability.

Value of Data

Because data have varying degrees of value, ranging from limited or short-term through indefinite or permanent, we need user guidelines or priorities to tell us what to process for high speed, flexible retrieval and what simply to store in the cheapest way possible. Data essential for defense, intelligence, and other activities which require a rapid response or frequent analysis must be stored in sophisticated forms capable of rapid retrieval. Other types, particularly raw data for which there are published results or summaries but which still have potential future value, could be stored in a low-cost medium such as microfilm.

The Cost of Lack of Information

Finally, and most important of all, we need to consider the cost to the Nation of *not* having an effective geophysical data system — what it costs us when a scientist, engineer, or citizen is unable to get the information he needs to continue his research, to design a building, to plan a dam, to make a business decision — and what the cumulative effect of this lack of information may be. I am convinced that any reasonable investment in an effective user-oriented geophysical data system would easily be recouped in the "downstream savings" of the following few decades.

Let's look at our marine data situation today. John Fry, of the staff of the National Council on Marine Resources and Engineering Development, has summarized it as follows:

> . . . There is a wide diversity of collectors, processors, and users of marine sciences data employing a wide variety of techniques, many of which are incompatible; there are numerous uncorrelated data banks in agency files and data centers, which exhibit varying degrees of backlogs and user demands. Marine data acquired at characteristically high cost are not moving expeditiously from acquisition to an end-product stage in the agencies, or to data centers with the capabilities to make them rapidly accessible to industry, universities, and State and local governments; to regulatory agencies responsible for monitoring the environment; or to Federal agencies for use in planning new marine programs.

Marine Data: An Example

To illustrate just one aspect, consider the current dispersal of facilities and arragements for the archival, retrieval, and dissemination of marine data. The charter of the National Oceanographic Data Center charges the agency with archival and retrieval of only those oceanographic data which *were* not already provided for in existing centers. Data from the ocean's surface up — sea surface temperature, waves, swell, and the physical measurement of the atmosphere above the sea — are handled by ESSA's National Weather Records Center in Asheville, N.C. Our organization has also begun a very limited service concentrating on magnetic, gravity, seismic reflection, and bathymetric data, but this involves mainly ESSA-generated observations. There is no single focus for geomagnetic, gravity, bathymetric, or other ocean survey data.

Not only is there no one place to go to obtain marine data, there is not even one mechanism which will tell you what exists. But more important is the problem of collating the information. In too many areas — of which air-sea interaction is an outstanding example — scientists and engineers must deal with simultaneously processed data from different environments, with computers which are in separate centers, with differing formats, programs, procedures and goals. The ultimate consequences of this situation are apparent. This problem must be faced now. And this is by no means isolated; many of the marine problems plaguing us are only too familiar across the whole spectrum of the geophysical environment.

It is clear that as we move to probe, understand, explore and develop our geophysical environment as a whole, we will increasingly come to require a more comprehensive and better systematized network of centers capable of providing a wide range of data. We are going to have to move in the direction of what I call a national Geo Data System. Such a system need not be monolithic; it need not be highly centralized; but it must be an integrated system. It might consist of geophysical "data banks" where collected observations can be centrally processed and archived, and whose data, analyses, studies, publications, and services are available to all scientific disciplines. But these "banks" should be integrated into a common system.

We should seek in designing such a Geo Data System to set some standards. I would advocate some of these:

1. **Provide a "one-stop", rapid-response data-support system for geophysical operations and research** capable of answering most user queries on the availability of geophysical data, facts, figures, and sources. Response time should be measured in minutes or hours, rather than the current days or weeks. This service should be accessible on a national basis, via electronic data links.

2. **Provide international geophysical data files of the highest possible quality,** through appropriate quality control procedures, while developing a full capability for providing data evaluation when needed.

3. **Provide the techniques and procedures which allow the best estimates of environmental parameters** not specifically recorded in the observational or experimental record, through the development of "environmental models".

4. **Provide a capability for computer-based data support to remote operations and research activities,** at less cost and with greater speed and efficiency than is currently associated with just the acquisition of copies of raw data.

5. **Provide for (a) the inexpensive publication of those geophysical data most frequently requested** by the casual or unsophisticated user, in a form that discourages misinterpretation; and **(b) provide an attractive publication series to inform the public** of the potential of geophysical data application for long-range planning purposes.

A Changing System

In planning such a system, we must recognize that it will have to change continually to meet shifting and uncertain demands. A rigid system designed to give data support today will surely be obsolete tomorrow, as new areas of interest and new requirements evolve. Look at our past:

In *data collection* we have extended our reach from the immediate environment of man and direct sensing, to the environment of space and the measurement of solar activity and the earth's cloud cover from a satellite altitude of several thousand miles.

In *data processing* we have gone from the accounting machine era to third generation computers in a dozen years; from the "chunk chunk" of the indestructible IBM 407 Tabulator to electronic speeds in the same length of time.

In *data application* we have progressed from the problems of kites and Kitty Hawk to those of satellites and supersonic transports in less than a lifetime. Users now demand global, as well as local data, and sometimes both, as in problems such as the pollution of the air and estuaries. This is because of man's growing desire to understand and predict environmental change on a geological time scale.

The changes and challenges that will confront us in the next several decades will surely make these problems pale by comparison. This fact makes it even more imperative that we move forward as quickly as possible, making large plans. The time to eliminate tomorrow's bottleneck in data is now. □

UNLOCKING THE COMPUTER'S PROFIT POTENTIAL

*McKinsey & Company, Inc.**
245 Park Ave.
New York, N.Y. 10017

Profile of the study sample

Classified by industry, the distribution of the 36 companies is as follows:

Airlines	2
Apparel	1
Chemicals	8
Food	3
Forest products	1
Insurance	3
Machinery	6
Paper	1
Petroleum	3
Primary metals	2
Railroads	1
Textiles	1
Transportation equipment	4

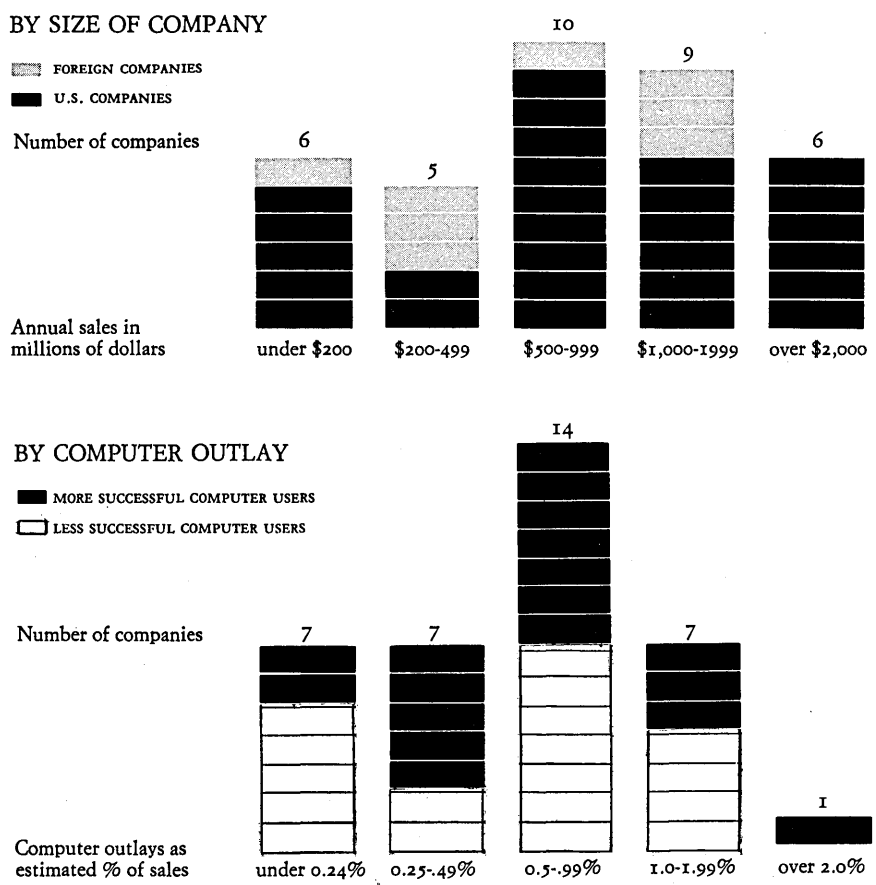

Exhibit 1

"Many otherwise effective top managements are in trouble with their computer efforts because they have abdicated control to staff specialists. Only managers can manage the computer in the best interests of the business. The companies that take this lesson to heart today will be the computer profit leaders of tomorrow."

In terms of technical achievement, the computer revolution in U.S. business is outrunning expectations. In terms of economic payoff on new applications, it is rapidly losing momentum. Such is the evidence presented by a recent study by McKinsey & Company of computer systems management in 36 major companies. The companies studied represented all levels of achievement and experience with computers in 13 different industries. Their distribution by industry, sales volume, and relative level of computer expenditure is shown in Exhibit 1.[1]

Diminishing Returns

From a profit standpoint, our findings indicate, computer efforts in all but a few exceptional companies are in real, if often unacknowledged, trouble. Faster, costlier, more sophisticated hardware; larger and increasingly costly computer staffs; increasingly complex and ingenious applications: these are in evidence everywhere. Less and less in evidence, as these new applications proliferate, are profitable results. This is the familiar phenomenon of diminishing returns. But there is one crucial difference: As yet, the real profit potential of the computer has barely begun to be tapped.

Almost 20 years ago the first computers for business use made their debut. Five years ago, when we published our first research report on the computer,[2] business was well on the way to exploiting the awesome clerical and arithmetical talents of its new tool. Today the early goals have for all practical purposes been attained. Most large companies have successfully mechanized the bulk of their routine clerical and accounting procedures, and many have moved out into operating applications.

[1]The distinction between "more successful" and "less successful" computer users, which is explicit in several exhibits and implicit in much of the text, requires a word of explanation. Because of the many variables involved, any absolute standard of computer success must necessarily be arbitrary. Instead of setting such a standard, we decided to let "success" be defined by the range of performance observed in the survey sample itself. Thus companies identified as "more successful computer users" are simply those falling in the upper half of this order-of-performance ranking, and the "less successful" companies are those in the lower half.

[2]*Getting the Most Out of Your Computer,* McKinsey & Company, Inc., 1963.

As a super-clerk, the computer has more than paid its way. For most large organizations, going back to punch cards and keyboard machines would be as unthinkable as giving up the typewriter for the quill pen. Yet in these same companies — including many that pioneered in the mechanization of paperwork operations — mounting computer expenditures are no longer matched by rising economic returns.

Failure to Adapt

What has gone wrong? The answer, our findings suggest, lies in a failure to adapt to new conditions. The rules of the game have been changing, but management's strategies have not.

There was a time, less than a decade ago, when management could afford to leave the direction of the corporate computer effort largely in the hands of technical staff people. That time is past. Yet the identification and selection of new computer applications are still predominantly in the hands of computer specialists, who — despite their professional expertise — are poorly qualified to set the course of the corporate computer effort.

It is not hard to understand how this situation has come about. Historically, profit-oriented companies have undertaken computer development work for the sake of a single ultimate objective: improved financial results. There are just three ways such results can be reflected in the income statement, and three general categories of computer applications by which this can be accomplished directly:

Purpose	Application
1. To reduce general and administrative expenses	Administrative and accounting uses
2. To reduce cost of goods sold	Operations control systems
3. To increase revenues	Product innovation and improved customer service

Improved financial results, of course, can also be achieved indirectly, through better management information and control. This gives rise to a final purpose and application category:

4. To improve staff work and management decisions	Information systems and simulation models

Mainly because of rising clerical costs and the desire to cut clerical staffs, the practical history of computers in U.S.

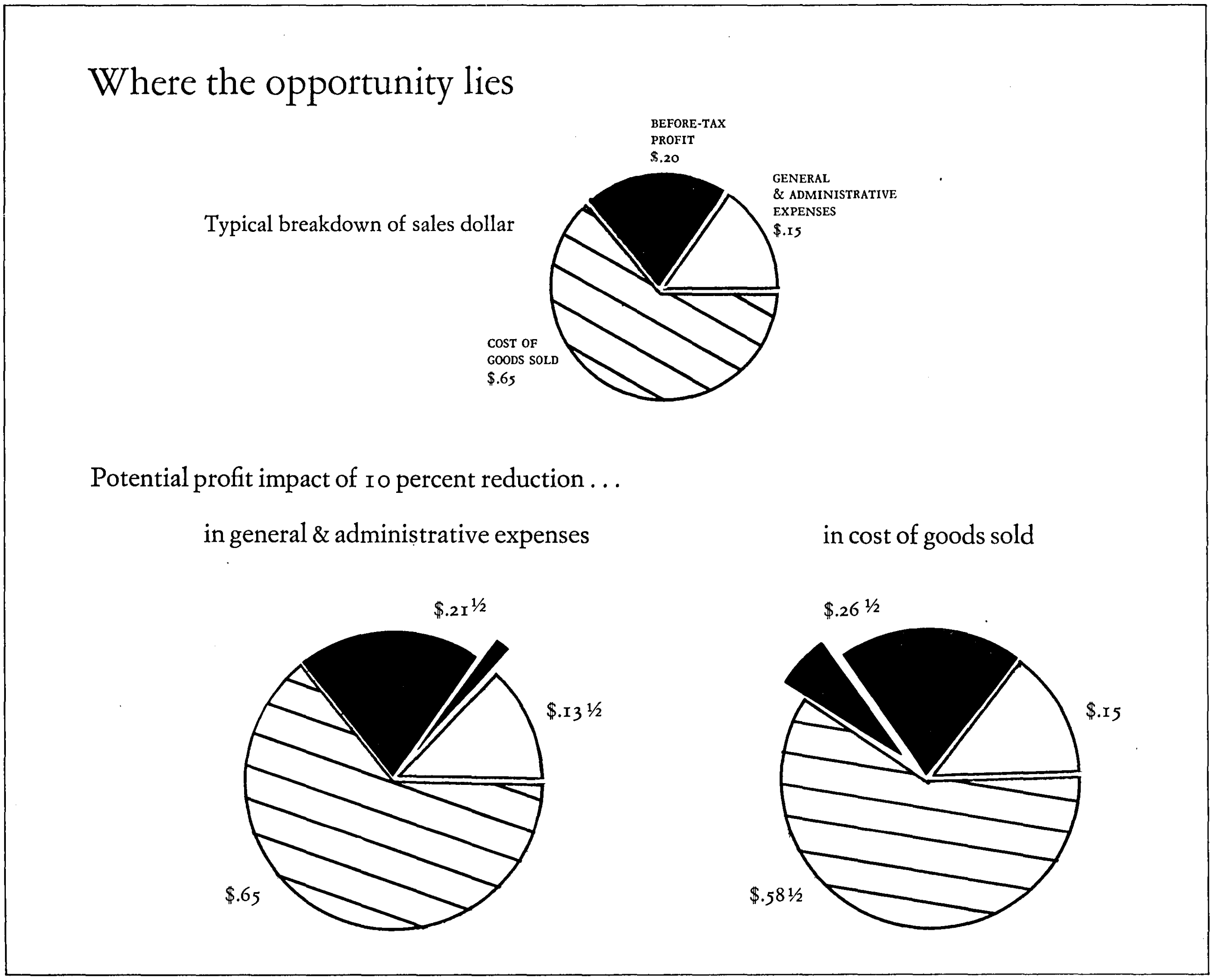

Exhibit 2

business to date has been dominated by the first of these four purposes. A look at current computer development projects shows that the prime objective in many computer departments is still the refinement of administrative systems and the reduction of G&A expenses. But this, our study indicates, is an area where the cream (and some of the milk) has already been skimmed. It is high time for a change in emphasis, if not a change of course, in the computer development effort. And the next move is up to management.

Many senior executives are already beginning to recognize their dilemma. "How can I keep on justifying major computer expenditures when I can't show a dollar saved to date from our last three applications?" asks the president of a large consumer goods company. "Maybe I'm a fool to let it worry me — after all, who tries to find a dollar justification for telephones and typewriters? But I do worry. After all, we know that what we're doing with telephones and typewriters makes sense. But that's more than I can say for some of the things we're doing with the computer, at many times the cost."

The ill-justified expenditures, however, are insignificant compared to the opportunity costs. Though it has transformed the administrative and accounting operations of U.S. business, the computer has had little impact on most companies' key operating and management problems. Yet, as Exhibit 2 suggests, this is where its greatest potential lies.

In our 1963 report, we noted that no company had yet come anywhere near exhausting the computer's potential. Today the gap between technical capability and practical achievement is still wider, and the stakes have risen sharply. Until the computer is put to work where the leverage on profits is high, the penalty of lost opportunities and lost profits will continue to mount.

Subsequent sections of this report will set forth the dimensions and implications of the issue. We shall outline the developments that have shaped it, explore the current problems to which it has given rise, and indicate some of the future opportunities open to companies that take timely action to resolve it. Finally, we shall offer a few practical guidelines for the chief executive who recognizes his own vital personal responsibility for the success and profitability of his company's computer effort.

The Stakes and the Problem

In 1963, computer manufacturers shipped hardware worth $1.3 billion to their U.S. customers. By 1967, the value of computer shipments had risen to $3.9 billion, an increase of no less than 200 percent in four years.[3] Of every $1 million that business laid out on new plant and equipment in 1963, $33,000 went for computers and computer-associated hardware. By 1967, the computer's share had risen to $63,000, and each dollar was buying at least half as much again in capacity. Computer spending, both absolutely and as a proportion of all plant and equipment outlays, is still rising.

Another index to the growth of computers as a factor in the national economy from 1963 to 1966 can be found in the published accounts of the largest computer manufacturer, the International Business Machines Corporation. IBM's gross investment in "factory and office equipment, rental machines and parts" grew from just under $2 billion in 1963 (double the 1957 figure) to just over $5 billion in 1966. In its annual report for 1966, IBM chose for the first time to report separately the value of its investment in machines on rental. Valued at cost, that investment had grown from $3.3 billion to $4.4 billion during the previous 12 months, a one-year growth of 33 percent.

Cost of People and Supplies

Massive as it looks and rapidly as it is growing, the investment in computer hardware is far from an adequate measure of business's stake in the computer. For every dollar spent on equipment, the typical company in our current study spent close to $2.00 on people and supplies in 1967, as Exhibit 3 indicates; and the payroll component of the total outlay is clearly rising more rapidly than the rental bills. Thus, a company that is paying as little as $125,000 a year to rent equipment of very modest capacity is probably spending upwards of a third of a million dollars on its total effort. It is a fair estimate that well over a hundred industrial companies have rental bills running into seven figures, and there are a handful whose total computer outlays approach $100 million a year.

Because so much of the total cost is payroll, and because staffs are dispersed and personnel classifications and accounting conventions differ from company to company, attempts to formulate "yardsticks" for corporate computer outlays (e.g., as a percentage of assets, capital expenditures, administrative expenses, or sales volume) are likely to end in confusion. Even if precision in such figures were possible, what a particular company "ought" to be spending on computers will not be discovered by studying industry averages or the outlays of individual competitors. At best, such yardsticks will provide a bench mark from which to start; but the final answer can only be determined in the light of the company's own situation, strategy, and resources (including the depth and sophistication of its computer experience).

The distribution of costs which go to make up total computer expenditures is, however, fairly consistent among the companies participating in our study. Exhibit 3 indicates this distribution. Of every $100,000 of total computer expenditures about $35,000 goes for hardware; $30,000 for computer operations staff payroll; $15,000 for maintenance programming

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[3]*EDP Industry and Market Report,* January 26, 1968.

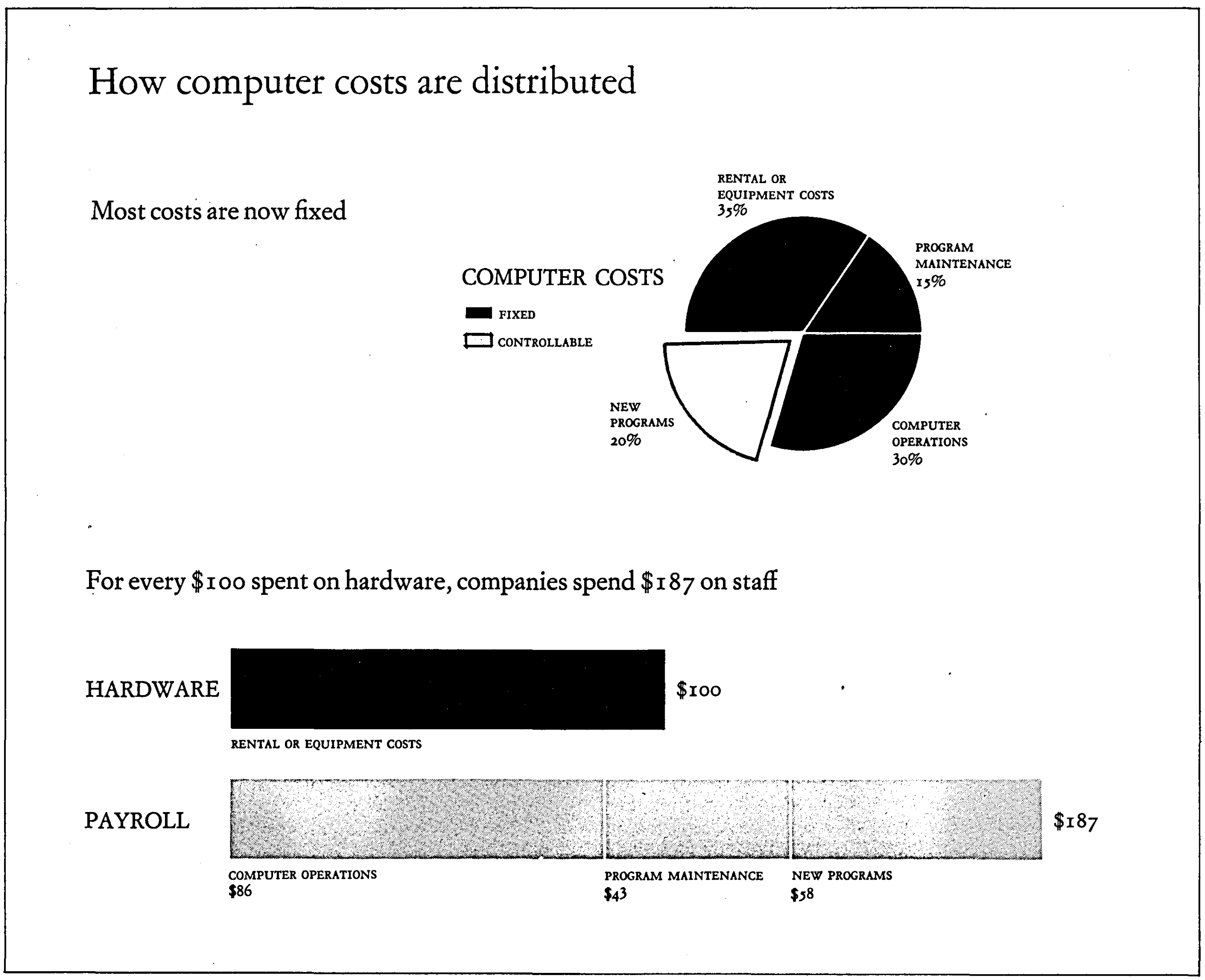

Exhibit 3

(i.e., keeping current systems updated); and the remaining $20,000 for development programming and other staff time devoted to new applications.

Development Dollars

These development dollars, the only computer outlays subject to significant short-term management control, are typically a smaller fraction of the total than the company's annual bill for hardware rentals. Yet their leverage on future costs and benefits is enormous; in fact, they hold the key to the company's long-range success or failure with its computer effort. For unless management segregates these costs and understands the nature of the resources they buy, the direction of future computer developments will be in doubt, and the whole activity will be vulnerable to precipitate, perhaps emotional, review.

The computer management problem as it confronts corporate executives today, then, is a matter of future direction rather than current effectiveness. The key question is not "How are we doing?" but "Where are we heading, and why?"

Five years ago this was a less critical issue at the top-management level. As long as computer developments were largely confined to accounting departments there was less reason for corporate executives to concern themselves with direction setting: If the controller carried out his function and kept his costs in line, no one outside his department worried very much about *how* he did it. The situation is very different today. Now that the conversion of accounting work to computer processing is virtually complete — as it is in 30 of the 36 companies in our study — the question "What next?" comes into urgent focus. Many of the alternatives currently being proposed are complex and costly enough to require executive approval, but their justification is obscure at best. When top management, reviewing a proposal, looks in vain for the promise of profit, it is right to hesitate.

For example, the following three proposals, submitted for approval during 1967 in one company we studied, would have consumed 80 percent of the computer staff time available for development:

1. *Design a computer-based "strategic management information system."* This was candidly described by its sponsor, the manager of the Systems & Procedures Department, as "a basic research project," as indeed it would have been. Management's information needs had not been determined; the cost of making information available was uncertain; and the proposed techniques for putting the manager (assuming he was interested) in a position to manipulate the information (if it could be provided) had never really been tried out.

2. *Design a model of the corporate distribution system, to be used in both long-range planning and daily management of operations.* Cost data on the present distribution system were scanty and out of date. Moreover, responsibility for distribution lay with the marketing vice president, a man who had made no major changes in distribution policy or practice for 15 years, and had a well-earned reputation for being hostile to innovation. Perhaps understandably, he had not been consulted on the proposal. Yet his support would obviously be indispensable to its success.

3. *Design a revised system of sales call reporting.* As this project was envisioned, the computer would analyze salesmen's routes and product and customer profitability; it would then print out detailed instructions to salesmen each week, specifying customers to be called on, sequence of calls, target sales by product, and weekly sales quotas. This project looked promising, but it had not been evaluated by the very sales people for whom it was intended. And its assumptions were based on present account volume, not future potential.

All these proposals were listed, without specific cost or benefit estimates, in the annual request for budget approval submitted by the Systems & Procedures Department. The president, when they were presented to him for review, reacted with irritation. Were they the best opportunities available for the application of the computer resources? What economic results could realistically be expected? No good answers were available.

Essentially the same questions are raised by any computer development proposal. They are basically questions of *feasibility* — a concept often misunderstood and even more often misapplied where computer projects are concerned. It is this concept, crucial to soundly based computer development efforts, that we will now briefly consider.

Three Tests of Feasibility

Recently the president of a German chemical company was asked to examine and approve a proposal for an exciting new management information system. Featuring a desk-side cathode-ray tube inquiry terminal that would display on demand any data in the computer files, the system would enable the president to compare current production figures, by product and/or by plant, against plan; it would break down current sales figures in half a dozen different ways; it would display inventory levels, current labor costs and trends, material costs — in short, just about any kind of operating data he might care to request. A few years earlier such a project would have looked like science fiction; in 1967, its technical feasibility was assured.

Nevertheless, the president turned the proposal down. As he explained his decision to a McKinsey interviewer, "I care more about what will happen five years from now than what happened yesterday. Anyway, I already get all the routine data I can handle. What would I do with more?'

Proof of a Payoff

The incident is significant because it typifies a trend. Computer technology has made great strides in just the past few years. Fewer and fewer applications are excluded from consideration because of limits on computer file capacity, internal speed, or input/output ability; more and more technically exciting projects are being proposed for management approval.

Particularly when corporate management is unaccustomed to dealing with the computer department, it takes a certain amount of hard-boiled skepticism to insist on proof of a payoff. Yet the fact is that technical virtuosity is no guarantee of problem-solving potential. The most ingenious new proposal may be merely a fancy new wrapping for an outmoded product. Instant access to data generated by an outmoded cost accounting system, for example, is at best a dubious blessing.

Back in the days when the computer's full potential, and hence its full impact on operating systems, was not foreseen, the overall feasibility of a proposed computer application was generally equated with its technical feasibility. That being the case, it made sense to let the computer professionals decide how to use the computer. Today, judging from the findings of our study, this same policy of delegation is being followed in most companies. But it no longer makes the same kind of sense. Technical feasibility is only one aspect of overall feasibility. For the great majority of business applications, it is no longer an important stumbling block.

The concept of "feasibility" really takes in three separate questions. There is the test of *technical feasibility:* "Is this application possible within the limits of available technology and our own resources?" There is the test of *economic feasibility:* "Will this application return more dollar value in benefits than it will cost to develop?" And there is the test of *operational feasibility:* "If the system is successfully developed, will it be successfully used? Will managers adapt to the system, or will they resist or ignore it?"

Continuous Reassessment

Particularly on complex and ambitious computer development projects, these key questions of feasibility can seldom be answered once and for all at the time the project is proposed. Continuous reassessment of the technical and economic risks and payoff probabilities may be vital to keeping such a project on the right track. But a careful initial assessment can go far to avert costly misapplication of scarce computer resources.

It is dangerously easy, however, to avoid confronting the full implications of feasibility until a project is well under way. Technical feasibility, though less often a question mark today, is still the test most commonly considered at the start. The issue of operational feasibility is far too often neglected until the new application is actually tried out in practice and perhaps found wanting — the costliest kind of feasibility test. And economic feasibility — the measure of how much expected dollar returns will exceed expected costs — is frequently given only superficial examination.

Since a company's computer resources are seldom equal to its computer opportunities, economic feasibility should almost always be a key criterion in weighing the merits of technically feasible projects. Yet it is frequently assessed rather casually, on the grounds that the important benefits are intangible, and intangible benefits can't really be evaluated. Actually, of course, the very difficulty of measuring intangible payoffs is the best argument for imposing on managers the discipline of explicit evaluation.

In assessing the cost-benefit balance of a proposed application, computer personnel can, of course, provide the needed input on costs. The assessment of benefits, however, requires a full understanding of the operations affected and the policies that govern them — an understanding that only operating executives can really bring to bear.

To achieve its economic potential, a computer project may also require substantial operational changes — changes in corporate policies, staff reorganizations, the construction of new facilities and the phasing out of the old. It will certainly require the support of operating managers and their staffs, and it may also depend on the cooperation of dealers, suppliers, and even customers. Consider the case of a hardware distributor who requires his customers to submit orders on coded forms designed for the computer. All his customers may want the faster service promised by the system, but some may balk if it entails a messy problem of staff retraining.

Corporate computer staffs cannot really judge the necessity of such changes, much less implement them. At most, they can advise the operating managers who must make the final assessment of operational feasibility.

Against this background, let us look more closely at the problems and opportunities confronting the companies in our study.

Past Successes and Present Problems

Ironically, the basic problems currently besetting the management of the computer effort in most of the companies we studied have their origin in the successes of the past. In 30 of the 36 companies, conversions of routine administrative and accounting operations to computer systems are already complete, or so close to completion that only minor incremental savings are expected from the mechanization of remaining manual procedures. Typically, most of the people who accomplished these conversions are still operating and maintaining the systems they helped to install. But others who participated in the early installations now enjoy a different organizational status. They constitute the nucleus of a corporate computer staff. Instead of reporting to the controller, in some cases they now report directly to top management.

For obvious reasons, these computer department staffs are under pressure to show results in the form of new computer systems. Technically speaking, they may be superbly equipped to respond to management's expectations. Typically, they are highly skilled in computer systems design, and their status as professionals is unchallengeable. But they are seldom strategically placed (or managerially trained) to assess the economics of operations fully or to judge operational feasibility. These limitations, although they reflect no discredit on the corporate computer staff, are raising ever more serious obstacles to the success of new corporate computer efforts, our findings indicate.

Another obstacle to future success, also stemming from past experience, is management's lack of exposure to the feasibility problem. Back in the days when corporate computer efforts centered on the conversion of accounting and administrative systems, management seldom had to concern itself with the issue of feasibility. With a relatively orderly manual system, the feasibility question centered on the technical problems of programming the computer. Economic benefits could be determined with relative ease in terms of clerical payroll reductions: Once a company had learned how to estimate conversion costs realistically, assessing economic feasibility was relatively simple. And operational feasibility was assured when a single executive, such as the controller, had charge of both the development and operating phases of the new system.

Today the situation is very different. Applications are not only more complex, but also more far-reaching in their impact on different operating departments. Feasibility is no longer an issue that operating managers can ignore, for it is affected by complex economic and operational questions that the staff specialists are unequipped to answer. Yet many managers — far too many — are still leaving the whole question of feasibility to the computer professionals. At the same time, they are neglecting their own responsibility for setting the direction of the company development efforts.

The background sketched above, then, typically affects the computer effort today in two ways.

Attitudes of Management

First, today's management practices and attitudes, inherited from a time when the full scope of the computer's potential was not foreseen in most companies, are falling short of the demands of today's task. Over the past five years, computer staffs have typically doubled. The department that had 40 people in 1962 has 80 or 85 now, and expects to double again by 1975. Yet no overhaul of the management practices of earlier years has taken place. In 14 of the 36 companies we studied, nothing deserving the name of an overall plan for a full range of computer applications is yet in evidence, and the economic and operational feasibility of individual projects is seldom fully explored. Ten companies, including a number that do have a computer plan, are providing few if any short-term objectives against which the progress of individual computer projects can be measured.

Range of Computer Projects

Second, the range of computer projects now open to the company is circumscribed by the limited background of its computer personnel and the limited initiative of its managers. Consider a list of four proposed applications recently submitted to the president of a midwestern electric machinery manufacturer:

1. Put labor records on random-access files, so that production department or machine group efficiency (now the subject of a weekly report) can be measured daily.

2. Mechanize the follow-up of delinquent accounts receivable. (At present the computer lists delinquent accounts and

shows the age of outstanding debits, but clerks review the list and handle the follow-up.)

3. Install a data-transmission terminal at the warehouse receiving dock so that receipts can be recorded immediately on the computer file when shipments are unloaded. (At present good pieces are counted and the count punched into cards only after a quality control inspection.)

4. Double the core memory of the computer to permit multiprocessing of data processing jobs instead of running them one at a time as at present. (The computer is currently loaded less than two shifts, five days a week.)

None of these proposals had much relevance to the well-being of the corporation. Individual machine shop efficiencies, for example, had long been appallingly low, and the vice president for production was convinced that efficient production runs would be impossible until the design department learned to reduce the catalog of parts used in assemblies. But no attempt had ever been made to put bills of material on computer files, and an overall analysis of the catalog of parts would have to be done manually, an excessively time-consuming job. Accordingly, the president decided to postpone Proposal No. 1, making his reasons quite clear to both the computer department manager and the production head. Later, these two men came up jointly with a project, which was promptly approved, to transfer bill-of-material descriptions from a manual file to computer files. With this application "on stream," production managers are beginning to show real interest in making more extensive use of the computer, and the computer staff is gaining a valuable understanding of the practical problems of production. At least in this area of the business, the prospects for profitable future computer applications look good.

Operational feasibility was the Achilles heel of Proposal No. 2. The sales vice president firmly opposes automatic dunning of delinquent accounts. The clerks who now analyze the delinquent listing are pensioned salesmen who make collections by phone and call personally on seriously delinquent customers. This system of debt collection will not be changed until there is a change at the top — and that is unlikely to happen until 1971 at the earliest.

As for Proposal No. 3, the quality control inspection is essential since high-value components make up 40 percent of all receipts at the dock, and typically between 3 and 5 percent of all items received are returned to the manufacturer or held pending billing adjustments. Thus, although a data-transmission terminal would put data on the computer file two to three days earlier and might avoid some of the interruptions in work flow that now result from reported stock-outs, the data would be faulty and would require detailed subsequent correction and audit.

The Unbridged Gap

Such examples, symptomatic of the unbridged gap between computer staff and operating management, could probably be duplicated in most corporations. They are as discouraging to computer professionals as they are to operating management, and they doubtless account for the tendency, observable in many of the companies we studied, for computer staffs to take refuge in refining the internal operating efficiency of the computer department itself (as in Proposal No. 4).

If computer systems design must be so closely linked to operating procedures even in apparently simple applications, it should not be surprising that the more ambitious projects conceived by computer staffs so seldom meet the tests of economic and operational feasibility. To make better use of computers in the future will require expanding the scope and capabilities of computer professionals and bringing managers to a fuller awareness of the computer's vast potential. The history of computer developments to date has limited both.

The Opportunities: Near and Far-Out

The computer's credentials as a cutter of clerical payrolls are now beyond dispute. On the evidence of its achievements in a few exceptional corporations, we believe that the computer can make an equal or greater contribution to corporate profits by reducing the cost of goods sold.

The more successful companies in our study have recognized this potential and are already beginning to exploit it. The dominant lesson of their experience so far is that this second stage of the computer revolution, unlike the first, entails real operational changes — new, and at first uncomfortable, ways of doing business that will quite possibly encounter resistance within the company.

For the companies moving into operating system applications, moreover, the issue of feasibility has emerged on a new level of importance. They have found that technical feasibility is often a problem because marketing, production, and distribution systems are subject to outside influence and therefore less orderly than accounting systems. Since the benefits do not derive from reductions in payroll dollars, they have often found it harder to determine economic feasibility. Most significantly, they have found that the operational feasibility of a project is vitally dependent on the attitude of operating managers.

Teamwork

Teamwork, then, is the key. Where top management provides leadership, and operating managers actively and enthusiastically cooperate with professional computer staffs, major economic achievements can result. Even a fairly commonplace computer application such as inventory control requires such cooperation. Design engineers must give adequate notice of design changes; sales planners must furnish detailed product sales forecasts; and management must give guidance on spares requirements and desired customer service levels. But once developed on the early projects, cooperation between managers and professional computer staffs becomes an important stimulus to the development of profitable further applications.

Consider the case of one manufacturer of heavy construction equipment. In this company, whose first computer-based inventory control system went into operation well over a decade ago, computers now play such an integral role in production planning and control that it is difficult to picture the company without them. These are some of the jobs now being done by computer:

1. *Consolidating sales forecasts from 31 countries.* Forecast data are first consolidated by region, product, and model; then they are correlated with figures for seven previous years. Trends are established for each product group, and forecasts that seem not to "fit" are pulled out for further staff review. The president and the vice president for sales use these staff analyses in their annual budgeting discussions with division heads at corporate headquarters.

2. *Establishing a quarterly manufacturing plan for each of 13 plants.* These plans are updated monthly by reconciling revised sales forecasts with records of finished goods inventory and work in process in final assembly. The revised manufacturing program is then exploded into component requirements, and a "net component requirement" analysis is prepared. Extensive manual analysis by production planners is still required to supplement these computer analyses, but lead time between customer order and delivery has been reduced, and the cost of shipping finished goods from depots in surplus to those with shortages has been cut drastically.

3. *Maintaining cost schedules in all plants showing the economics of make-or-buy decisions.* In conjunction with the "net component requirement" report, these cost schedules

make possible intelligent work-load leveling and allocation among plants. Where there is an option to contract work out, managers can make their decisions with full knowledge of both the costs and the effect on specific work centers within each plant where bottlenecks are predicted.

4. *Central recording of all engineering changes.* Before an engineering change is put into effect, components in stock are exhausted first wherever possible. With changes occurring at a rate of about 2,000 a month, the costs of writing off obsolete stock used to run as high as $1.5 million annually before the advent of the computer. In the past three years, these costs have been reduced to approximately $500,000 a year.

5. *Maintaining cumulative records on labor efficiency.* In addition to detailed information on direct labor costs and trends, this system provides production planners with data on the work content of each component by work center. These data have been invaluable for scheduling manpower requirements to meet a varying production schedule, and particularly in planning the start-up of two new plants, which required the transfer of hundreds of skilled manufacturing workers.

The complex network of systems which produces such results has been evolving for 12 years now, and its net benefits to date have been outstanding. Overall, management credits computers with reducing lead time between order receipt and delivery by three to five months for U.S. customers, and with cutting direct labor requirements by 2 percent through improved materials availability and better control of work flow. Since direct labor costs are approximately $100 million per year, this fractional saving is significant both in absolute terms ($2 million) and as a percentage of before-tax profits (5 percent).

Evolutionary Development

Another example of evolutionary development is offered by a major consumer goods corporation. This company gives its product managers and marketing staffs access to a comprehensive, detailed sales history file, in which total U.S. sales over three years are cross-referenced to show product sales data by geographic region, type of outlet, timing with relation to promotions, and packaging. This system evolved from an order entry and billing system that recorded sales solely by customer number.

The direction of this company's development effort was set early in 1959 by a product manager who foresaw the potential value of a comprehensive marketing information system. Today, in addition to recording orders centrally, the system he envisioned is used to schedule production at nine plants and to coordinate shipments from 13 warehouses. One gauge of its usefulness is the willingness of marketing men to pay the salaries of the programmers who prepare on demand whatever analyses may be needed by marketing managers.

Evolutionary development is typical of systems requiring audited data bases, since these cannot be built up overnight. But other systems, equally ambitious, can sometimes be developed quite rapidly where management recognizes that the data-base approach is not the only, nor necessarily the best, way to develop advanced computer applications.

A manufacturer of high-style clothing, with national outlets and multiple plants, decided two years ago that computers, hitherto used only for accounting purposes, could furnish major help in forecasting sales and establishing preliminary cutting schedules at the beginning of each season. The resulting computer forecasting model has already proved so successful in matching production to demand that a project is now under way to put computer forecasting methods to work in planning purchasing decisions.

Similarly, a number of oil companies have moved quickly into new fields unrelated to previous computer development work. Several have successfully undertaken crash programs to develop computer-based seismic analysis techniques to assist in the planning of exploratory drilling, and more than one has developed a computer model of the crude oil distribution system in order to improve the scheduling of its tanker fleet, at potentially vast savings.

In a matter of months, one oil company moved to transfer the production and maintenance records of thousands of domestic oil wells to computer files where they can be correlated and analyzed. This system enables production decline curves of wells and fields to be plotted and future production forecast under various alternative secondary recovery programs. It also calls management's attention to wells that are no longer producing enough to cover marginal costs. The principal task in developing this computer system was one of data reduction and file design, and here there was ideal matching of the talents of the computer systems men and petroleum engineers. With the engineers' enthusiastic support, the computer staff is now exploring the feasibility of making the same data accessible to engineers in the field through graphic display units. The obstacles are great, but the potential payoff from improving the effectiveness of operating engineers, who control expenditures in the hundreds of millions of dollars per year, is greater still.

Communications

Finally, in industry after industry where such data are critical, the science of communications is being wedded to the science of computing to centralize record keeping, planning, and control in an ever more complex economic environment. Railroads have "control centers" where up-to-the-minute central records are maintained on the movement of freight and rolling stock. Retail chains are using teleprinters and central computer-based dispatch systems to reduce branch-store inventories by cutting the stock-replenishment cycle. A wood-products company is coordinating production at its nine mills to match sales orders transmitted by branch offices throughout the United States directly to a central computer. Banks are handling branch accounting centrally; it is interesting to note that one of the main reasons cited for the recent merger of three large British banks was the opportunity to consolidate the banks' computers and computer know-how. And virtually all the major airlines now have their own versions of the seat reservation system that first proved computers able to control large communications networks on a commercially feasible basis.

It is often extremely difficult to assess the overall economic effects of these advanced computer applications, for the simple reason that where the corporation would be now *without* its computers is well-nigh impossible to determine. But many of these companies are convinced that they have the computer to thank for the fact that they are beginning to outdistance their competitors.

Leadership

The resources — computers, professional computer systems men and programmers, management scientists, and communications experts — are available to all. But the team needs leadership. Advanced computer application concepts, with potential impact on the central activities of a corporation, must have sponsors high in the management pyramid to plead their case. The leadership of enthusiastic managers will gain the commitment of operating men — and teamwork between operating men and computer professionals will turn concepts into practical reality.

If the situation prevailing in the companies we studied is typical of U.S. industry as a whole, it is a fair guess that more than half of the proposed computer applications currently awaiting management approval were not originated by operating managers in consultation with computer staffs but proposed independently by systems and programming professionals. Yet the experience of the more successful computer users leaves little doubt that operating managers, well motivated and equipped with some knowledge of computer capabilities, are likely to be a better source of ideas for profitable changes in operations than are computer professionals. The most profitable applications uncovered in our study had originated with operating executives pondering such ideas as these:

- If only we had a way to test the reliability of the sales forecasts made by these regional managers of ours, we might not find ourselves out of manufacturing capacity in Italy at the same time that we're laying off valuable skilled labor in Brazil.
- If only we had a way of recording and analyzing all our customer orders in one place, we ought to be able to allocate our production better — improve mill efficiencies and raise the yield from our raw materials.
- If only we could easily check out our historical sales performance by product, package, and so on, maybe we could interpret our test marketing results faster and more reliably.
- If only we could play with alternatives on our tanker deployment, we might use our capacity better — charter in less and charter out more.
- If only we could project our needs for skilled labor three months out, we could save the expense of these crash recruiting and training programs.

Two lessons emerge from all the varieties of successful computer experience that we have studied. First, there is a unique set of *feasible and profitable* computer applications for each company. Second, most of these applications are closely related to the key strategic opportunities that the top executives are really concerned about: marketing and distribution operations in the package goods company; production operations in the capital equipment concern; facilities planning operations in the chemicals maker; exploration and producing operations in the petroleum company; financial planning in the conglomerate; and so on. Such applications may be designed to reduce costs of goods sold, or to increase revenues by changing operating methods directly. Or, as already noted, they may seek to improve the staff work and analyses available to decision makers.

Implications for Top Management

These lessons, in turn, have important implications for the top manager. Since each corporation has its own unique pattern of problems and opportunities, there is danger in trying to duplicate the successes of others: The computer development strategy that has worked well for one company may not work at all for its competitor. For the same reason, a company would be unwise to pin all its hopes on vendor-produced "applications packages" where major development projects are at stake. Nor can the answers be left to the professionals. No top executive is going to turn over the operation of his key departments to specialists with little or no operational experience.

In almost every industry, at least one company can now be found that is pioneering in profitable new uses of computers. In such companies, our findings suggest, the key to success has been a strong thrust of constructive interest from corporate operating executives who have put their own staffs to work on computer development projects.

We believe that other companies will follow their lead. Indeed, it may soon be a nearly universal practice to transfer operating staff to computer development projects, either by making them members of a project team or by attaching them for a year or two to the corporate computer staff.

Simulation

Another much-discussed area of computer use is management information and control. A few companies have already succeeded, by means of computer systems that sort out and speed routine data to the user, in notably improving the quality and quantity of specific information available to operating managers. Others, as noted earlier, have made profitable use of the computer in decision making through simulation models designed to improve decision making by predicting the impact of alternative actions on economic and operating realities. Skills in the construction of such models are widespread and growing, and their results have frequently been noteworthy.

A fertilizer manufacturer has used computer-based simulation to help top management answer such questions as these:

- How much should we plan to manufacture, ship, and store at the plant location in order to minimize total accumulated costs of production, distribution, and storage over a one-year period?
- How much, if at all, could we reduce total costs by renting additional storage in outlying locations? What would be the effect on our present production, shipping, and storage program?
- How large a market area should be served from each of our warehouse locations?
- Where should new plants be located with respect to warehousing locations and market areas?

A well-known food products company has constructed and used a computer-based simulation model enabling it to assess, under various possible 1970 and 1975 environments: (1) the relative profitability of different product markets; (2) the desirability of investing in new-market development; (3) the impact of investment in added plant capacity; and (4) detailed income statements based on these projections.

Again, computer-based risk analysis techniques have demonstrated their value in a wide range of capital investment situations. The industrial chemicals industry is known for the magnitude of both its investment and its risks. Since industry capacity directly affects market price, these risks are aggravated by the uncertainty of industry intelligence regarding competitors' plans for adding new capacity. Risk analysis, made practical by computers, has proven invaluable for evaluating alternative strategic plans with the help of simulation models, sometimes even including simulation of alternative competitive responses by the application of game theory. To exploit the potential of these and related techniques, an increasing number of corporations are finding it necessary to supplement the professional skills of computer men by recruiting specialists in the management sciences.

What is true of simulation models, however, is hardly true of the so-called total management information systems that have beguiled some computer theorists in recent years. Much effort and ingenuity have been devoted to the design and promotion of such systems, and many businessmen are understandably intrigued by their possibilities. Yet in terms of economic payoff and operational feasibility they are as yet ill-defined, and certainly they are a long way from practical realization in business.

Doubtless the computer's information processing capabilities will one day eliminate the need for large staffs occupied with collecting and interpreting information from various sources for the use of decision makers. But whether the computer will ever be able to evaluate strategic opportunities or indicate the proper timing for corporate actions is by no means assured. Nor are man-machine dialogs via desk-side consoles likely to become a feature of life in the executive suite any time in the foreseeable future; top management's "interface" with the computer is unlikely to be anything more exotic than a telephone, with a human information specialist at the other end of the line. What counts, of course, is not the sophistication of the interface but the responsiveness of computer-based systems to management's information needs, and the quality and timeliness of the information they can provide. Here, without doubt, the potential of the computer is only beginning to be realized. But "integrated total management information systems" drawing on a single data base, which have so often been touted as the wave of the future, are another matter. They have not yet come to pass — and it is far from clear that they ever will.

In short, the potential of comprehensive computer-based information systems and the role of the computer in decision making are still surrounded by question marks. Research in these areas may be a sound investment for some companies, even though the costs of experimentation are high. But no company should embark on a program to develop a major management information system except to meet a specific, well-defined need. Even then it should carefully weigh its options — including the option of applying its scarce computer resources to areas where operating success and economic payoff can be predicted with greater confidence.

Keys to the Future

In embarking on the present study, McKinsey & Company analysts were not seeking fresh evidence of a gap between potential and performance with respect to the management of the computer effort. The existence of such a gap has been obvious for some time to most informed observers. We were concerned, rather, with determining the present dimensions of the gap, analyzing its background and causes, and synthesizing from the practices of the top performers a few succinct management guidelines for maximizing the computer's effectiveness and unlocking its profit potential.

Evidence on the first two points — the performance gap and its underlying causes — has been reviewed in the earlier pages, and the general nature of the remedies has been indicated. Against this background, certain lessons emerge for the senior executive who is dissatisfied with the performance gap he sees in his own company and is determined to do what he can to close it.

In the computer field, as in other areas of management, the usefulness of generalizations from successful experience is rather sharply limited. It is possible to state *some* of the principles a company must follow to have a reasonable chance of success with the computer. But there will always be other factors — constraints, needs, or opportunities — which are peculiar to each company and can only be determined in the light of the individual situation. Hence it is useful to state general precepts only if their neglect is rather widespread and the consequences of that neglect are costly. This is the case in the management of the computer effort today.

The common denominators of successful computer practice, as seen in the companies we have examined, may be expressed in terms of three principles: the rule of high expectations, the rule of diversified staffing, and the rule of top-management involvement.

The rule of high expectations. In all of the companies that are realizing outstanding *economic* results from computer applications, top management is simply unwilling to settle for anything less. In the less successful companies, many managers exhibit a tendency to keep the computer at arm's length for fear of exposing their technical inadequacies. This tendency is conspicuously absent among the top computer users. Departmental and divisional managers in these companies know that top management will insist on economic results — and that they will be held personally responsible for achieving those results.

The new president of a capital equipment manufacturer, who has succeeded in getting a badly stalled computer program in his company moving again, typifies the prevailing tone of management expectations in the better-performing companies. Said he: "I ask my department heads to give me regular formal reports on their current successes and failures with computers and their future objectives. Right now they're a bunch of sheep with computers. I aim to convert them into enthusiasts, so that later I can be jockey, not herdsman."

The rule of diversified staffing. A computer staff whose experience is limited to successful conversion of accounting and administrative operations is seldom really qualified to design and install new systems in major operating functions such as manufacturing and marketing. Computer professionals alone seldom constitute an adequate corporate support staff.

To make the most of their opportunities for profitable corporation-wide use of the computer, therefore, the top-performing companies take one of two organizational approaches. Some assign to the corporate computer staff — along with the usual operations research specialists and other professionals — at least one talented individual with experience in each of the major functions of the business. Others, relying on the project approach to computer development, use project teams staffed by temporary transfers from operating departments. This arrangement, too, encourages good support from all levels of management.

To head up the computer staff and assume responsibility for the implementation of development plans, the outstanding companies have in all cases been careful to pick a manager who commands, or can quickly learn to command, respect and confidence throughout the organization. The appointment of the right man to this position is seen as a key contribution that top management can make to the success of the computer effort. It is also recognized that this individual's effectiveness depends more on his personal stature and professional skills than on the precise location of his unit in the corporate hierarchy. We found no evidence, statistical or otherwise, to suggest that high organizational status assures effective performance on the part of the corporate computer staff.

The rule of top-management involvement. If any one man can be said to hold the key to the computer's profit potential, it is probably the chief executive. He has a very definite responsibility for the success of the computer development effort, and it is not a responsibility that he can safely delegate.

At a minimum, the chief executive who wants maximum results from his company's computer effort must do five things. *First,* he must approve objectives, criteria, and priorities for the corporate computer effort, with special attention to the development program. *Second,* he must decide on the organizational arrangements to carry out these policies and achieve these objectives. *Third,* he must assign responsibility for results to the line and functional executives served by the computer systems — and see to it that they exercise this responsibility. *Fourth,* he must insist that detailed and thorough computer systems plans are made an integral part of operating plans and budgets. *Fifth,* he must follow through to see that planned results are achieved.

There is nothing novel in any of these recommendations; they are standard operating practice for most chief executives in most of their traditional areas of responsibility. Many otherwise effective top managements, however, are in trouble with their computer efforts because they have abdicated control to staff specialists — good technicians who have neither the operational experience to know the jobs that need doing nor the authority to get them done right.

Only managers can manage the computer in the best interests of the business. The companies that take this lesson to heart today will be the computer profit leaders of tomorrow. □

The Implications of the Information Sciences for INTERGOVERNMENTAL COOPERATION IN COMMUNICATIONS AND EXCHANGE OF INFORMATION

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One morning, not too far in the future, a City Manager or a Cabinet Officer or a Lieutenant Governor will enter his office, draw his chair up to the desk, activate his computer terminal, and proceed to have a conversation with his data base. That, in the current jargon of computerized information processing, is how he will "get the basic facts".

In this way, a few executives in a few large organizations *today* are beginning to secure the information they need for planning, organization, or control. If we look ahead two or three years, the executive is unlikely to be the only one in his organization working in this fashion. The technology is too ready, the advantages of on-line computer use too compelling, the implementation of interactive data management systems too easy and too economical for an effective organization to withhold direct computer access from its star technical and management performers.

Before going further, let us review some of the history and current happenings in the area of intergovernmental cooperation in the exchange of information among the various levels of government.

Exchange of Information in Government: Review

Federal legislation in the 1930's and later to improve the conditions in our society have led to significant changes in the pattern of intergovernmental action. Increasingly, federal, state, and local governments are being brought together to act as partners in carrying out programs that are designed to meet public needs. This places a high premium on close cooperation and a steady flow of information. But all levels of government have been slow to change their habits and develop new methods of working together. This is particularly true with respect to the development and use of information systems.

The requirements imposed by the federal grant-in-aid programs beginning in the 1930's inevitably led to an increased exchange of information flowing through the supervisory and reporting processes. Prior to this time there had been considerable exchange of information of a census nature, but very little of this exchange bore directly upon the operating of programs. The one important exception was in the field of tax information.

(Based on an address at the Eighth Management Conference, Hawaii, 1968)

Tax Information

States have had access to federal tax returns since the beginning of federal taxation. In the early years, states were able to send agents to Washington to examine returns under formal agreement. The procedure was formalized by the Revenue Act of 1926 which opened the federal returns to state officials at the request of the governors. By the end of 1965, the District of Columbia, and 29 of the 34 states with broad-based personal income taxes, had agreements with the Internal Revenue Service for the cooperative exchange of tax records. In general, the agreements provide for the establishment of mutually acceptable programs, the cooperative exchange of information allowing the federal and state governments to obtain each other's returns, and exchange of other necessary information to insure effective compliance. The Advisory Commission on Intergovernmental Relations has been particularly influential in this entire area of cooperative exchange of information.

The development and use of information systems among the three levels of government is the subject of the recent report by the Intergovernmental Task Force on Information Systems, dated April 1, 1968. This report contains recommendations to improve the flow of information within and among federal, local, and state governments. The Task Force was arranged by the Bureau of the Budget, Council of State Governments, National Association of Counties, National League of Cities, U.S. Conference of Mayors, International City Managers' Association, and the Advisory Commission on Intergovernmental Relations. The purpose of the study was to:

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"The technology resources currently available far exceed any needs. But computers and storage devices, in and of themselves, are of little value. What counts is how we define our requirements, specify our system, and implement it. The people in the system are all-important; they are fundamental from the point of view of design, decision making, and control."

(1) Identify impediments to attaining an effective flow of information within and among governments, and
(2) Recommend actions that could be taken at the federal, state, and local levels of government.

The Flow of Reliable Information

The Task Force concluded that intergovernmental approaches to the solution of public problems require that reliable information flow readily among those who share responsibility so that concerted action may be taken. In general, information systems now in use and current efforts to improve them are not adapted to satisfy this requirement. A number of factors impede efficient flow of information. These factors include: the lack of strong, central coordination at all levels of government over the development and operation of internal information systems; and the fragmentation of federal grant-in-aid programs available to assist state and local governments in this development.

The Task Force made twenty specific recommendations under the following headings:

1. Improving information systems within governments.
2. Improving the exchange of information among governments. An example is *Recommendation 5* which reads:
   "Develop, under the leadership of the U.S. Bureau of the Budget, a standard 'package' of socioeconomic data to be used as a base by Federal agencies in obtaining information from state and local governments."
3. Strengthening information systems at the local level.
4. Sharing systems knowledge.
5. Achieving compatibility among systems.
6. Improving information about federal assistance programs.
7. Guidelines for action.

Federal Grant-in-Aid Programs

A number of the federal grant-in-aid programs contain authorizations designed to help state and local governments improve their information systems. Let me cite a few examples:

1. The National Defense Education Act (PL 85-864, Title X, Section 1009) provides grants to states to improve the statistical services of their educational agencies. The Office of Education is authorized to provide grants to cover half the cost of such improvement programs, but no state may be paid more than $50,000 in any one fiscal year.
2. The State Technical Services Act of 1965 (PL 89-182) provides grants to establish State Technical Information Centers as a means for stimulating industrial and economic growth.
3. The Housing Act of 1954, as amended, provides grants to assist urban development planning programs in small communities, states, and metropolitan areas.
4. The Law Enforcement Assistance Act of 1965 (PL 89-197) provides grants to states, counties, and cities to develop new and better methods of crime prevention, law enforcement, and criminal law administration.

Also in many instances expenses for the establishment and operation of information systems needed to manage grant programs are recognized as allowable charges to the grant.

Another way in which the Federal Government helps to improve information systems is by providing direct technical assistance. For example, the Office of Economic Opportunity sends teams of systems analysts to states to assist in the development of information systems patterned after a similar system operated by the OEO.

A third way in which the Government assists state and local governments is by providing federal facilities in the administration of the grant program. To illustrate, the Bureau of Census has prepared data files on population and housing in the form of punched cards and computer tapes that can be processed to provide a user with almost any kind of statistical summary or small-area tabulation he may desire.

Also, state and local governments are now authorized to use the federal ADP Service Centers of the General Services Administration.

Complex System Leads to Fragmentation

In spite of these resources, the present system of grant-in-aid is much too complex to lead to anything except fragmentation. There are more than 400 separate grant authorizations; each is devoted to specific purposes; and the grants are administered by more than 20 federal agencies, a fact that creates major problems of information flow. This leads to further complexity when state and localities seek help in unified information systems. Such proposals not only cross program lines but (obviously) agency lines.

Varied proposals are currently before Congress for improving the situation and I am sure progress will be made, but it is quite evident that we shall be working on these problems against great odds for a long time to come and progress will undoubtedly be slow.

Several documents are useful in trying to achieve a better understanding of available federal resources. One is entitled *Catalog of Federal Assistance Programs,* produced by the Office of Economic Opportunity. This catalog identifies all the domestic assistance programs of the Federal Government — — 459 of them — and provides a brief description of their purposes, etc. Another document, issued by the Vice President's office, entitled *Handbook for Local Officials,* serves as a guide to federal assistance primarily for local governments.

State and Local Activity

In addition to the extensive activities at the federal level, developments emerging at the state and local level are stimulating an improvement in the flow of information. For example, efforts are underway for state and local governments to establish joint service bureaus and/or cooperative agreements among various units of government. In Los Angeles County a number of small cities are planning the establishment of their own processing center. For some time, there have been efforts in the state of Iowa to establish a data processing center to serve all levels of government in that state. In fact, this particular proposal has been endorsed by the Council of State Government's Committee on Information Systems.

A Statewide System

Another type of activity is exemplified by the so-called "California Study," which was undertaken in California under the administration of Governor Brown. This study, entitled *The California Statewide Information Systems Study,* was undertaken by the Lockheed Missiles and Space Company, a division of Lockheed Aircraft Corporation in Sunnyvale, California; it is one of the studies demonstrating the applicability of aerospace technology skills to government problems. This study resulted in an extensive report which recommended the establishment of a statewide information system concept. Simply stated, the basic purpose of the concept is to augment the information resources of California's public jurisdictions into a single, integrated system serving the information requirements of individual state and local organizations as well as the needs of the entire state.

It was proposed that the State-Wide Information System be developed as a federation of organizational computer centers (state and local) tied together by an Information Central and operating within a framework of compatibility rules. The state of the art in information sciences and technology would permit the implementation of the Lockheed proposal; but the state of the art of politics has impeded the implementation considerably, particularly the intergovernmental relationship aspects. But there has been some progress.

An Area-Wide System

Another type of study, of which the following is only typical, is one made by the firm of Touche, Ross, Bailey and Smart, proposing an area-wide automated data processing system for the city of Memphis and other local government organizations in that area. This particular study recommended a five-year plan for implementation and ultimate automation of the entire information processes of the city and of its interactions with county and other local governmental units. Probably in hundreds of similar cases progress is being made. Within two or three years, according to today's best estimates, it is entirely possible that any well-managed organization will have 50 to 100 terminals at its headquarters building and branch locations through the country. Through these terminals and by means of complex computer programming, managers in every functional department will put daily information into, and will receive timely output from, one large central computer.

A Simple Medium: Terminal and Data System

The medium through which these man/computer conversations are to take place is deceptively simple. It consists essentially of two parts: one is a computer terminal (the component physically present to the user), which may take the form either of a teletypewriter or a video screen and keyboard (voice analyzers are not yet perfected); the other is a general purpose data system which, stored in the computer, enables the machine to understand and carry out English-expressed commands.

If this medium is to be widespread in the near future, certain prior conditions need to be met:

1. That the enabling software exists — as a self-consistent system — in packaged, off-the-shelf form. (Otherwise the claim is pure speculation.)
2. That the medium is easy to learn and use (because no company is likely to invest in a massive programmer training course for its management personnel).
3. That the software system is truly generalized — or able to handle a wide variety of data for a wide variety of applications. (Otherwise extension of this on-line data management capability to all functional areas of the company would require much more than two or three years' time.)
4. That it operates under a time-sharing system (for no company could afford a large private computer for every user).
5. That a management information system based on the framework of an interactive generalized data management system offers significant advantages over standard management reporting systems (or managers would not bother to use the new medium).

Now, the medium does exist in at least some examples. And the medium opens up a whole new way of thinking and working with information. When the data are organized in one central location, anyone who has a terminal and authorized access to the files can find out the information he needs. With the data "alive" and residing in the computer, the manager who bases a decision on the facts he obtains can review, manipulate, summarize, and recall facts at will.

Technology Resources Available

The technology includes not only computers, which are "front and center", but also many other devices, such as microform applications, memory storage devices, etc. The technology resources currently available far exceed any needs. They are quite sufficient to meet any requirements for computation, documentation, or communication. A single illustration may help: We now have "micro images", microphotostatic storage devices. One chip, about one inch square, contains the entire Holy Bible. That can indeed be called "storage of information." It is certainly a *"small testament"* to what is possible.

By far the more important problem, as I view it, is not the technology, but how we organize to use the resources in terms of systems and people. Computers and storage devices, in and of themselves, are of little value. What counts is how we define our requirements, specify our system, and implement it. The people in the system are all-important; they are fundamental from the point of view of design, decision making, and control.

In the information business the word "systems" is a very common one. To illustrate the information systems concept, let's consider the short-order restaurant.

A Simple Information System: A Coffee Shop

As you will notice the next time you are in a coffee shop, there is a spindle somewhere between the kitchen where the cook performs his duties and the counter where the waitress performs her duties. This spindle is a simple example of an effective information system. The order blank that the waitress fills out provides the *input*. The placement of this input on the spindle puts the information in *memory*. The spindle itself serves as a *buffer* between the waitress and the cook. It also provides a *queuing device* — that is, it lines up the various orders in sequence. It provides a *random access display* whereby the cook and the waitress can both look down the row of orders and see what comes next and what can be combined, etc. The spindle provides *control* and settles arguments as to priorities, and it clearly provides a *record*. These are all "operations research" terms that are used in the discussion of much more complex and difficult systems.

A Complex Information System: SAGE

A very complex information system involving the use of immense communications devices and computers is SAGE (Semi-Automatic Ground Environment) System. In the SAGE System the computer is used as a device for many of the same functions that the spindle performs in the short-order restaurant. Information about geography, weather, known plane flights, etc., is stored in the memory of the computer. Radar data converted to digital form and fed directly into the computer, are computed and sent to the operators. Operators then have the opportunity to react, to ask for more information, to take appropriate action to investigate unidentified objects in the air, to guide interceptors to these objects if advisable, etc. The computer operates in what is known as "real" time. It deals with current information; it enables men and machines to react as the information is being handled and displayed. SAGE has been a very important and significant development in the history of computer systems; it has led to many subsequent developments in both space exploration and satellites. Now it is being extended to many commercial applications.

Time Sharing

The operation of information systems in real time was a significant development of the late 1950's. Another most important further development was the advent of time sharing in the early 1960's. In time sharing many users share the computer almost simultaneously. Each user has the illusion of undivided use, although the high-speed computer itself may be serving many while appearing to serve only one. The implications for cost sharing are obvious.

Real time and time sharing have led to both new problems and opportunities in computer software. One concern is to develop effective "executive" programs — programs that manage the difficult sharing process. A number of such systems have been developed that are working effectively. A second concern, stemming from the potential for direct interaction that time sharing makes feasible, is to develop conversational programming languages for the user. Here, too, progress has been made and a number of useful languages have been developed.

Data Management Systems

Another interesting recent development is data management systems. Several general-purpose programs are currently available for handling simple, tabular files of limited size. These systems permit a non-programmer manager to select categories of data for a report, a non-programmer statistician to perform various analyses, and a non-programmer documentalist to generate a variety of indexes and bibliographies.

A number of data management programs have been developed and are being marketed by manufacturers of computing equipment, as well as by programming firms. These programs all have limitations as to file size, format, types of data that may be manipulated, and computers on which they may be operated. But new developments as to manageability and speed will be possible within the next few years.

For example, at SDC in Santa Monica we have in current operation what we call a "Skills Inventory System." Data about more than two thousand professional personnel of the company have been placed in the memory of a large computer. This data base is updated monthly; it contains all of the basic employee information in regard to: current assignment; status; background experience; and education. The purposes of the Skills Inventory System are two-fold: to identify and describe individuals for possible transfer to proposed assignments; and to summarize technical capabilities — for instance, the numbers of persons who have performed various kinds of technical work.

This data base was assembled from two sources: questionnaires sent to employees, and already existing data in our automated personnel system. We are now able to query this data base in much the same manner as described in my introduction. We type a request on the teletypewriter (the input device to the computer), which asks the computer a question; the reply can either be a videoscope display or a response on the teletypewriter.

For example, we recently needed to know whether we had any programmers with a certain number of years' experience who were single and were possibly available for consideration for assignment in Vietnam. Within two minutes we had a list of six such programmers. This enabled us to proceed with interviews and screening to meet an urgent request. Without this kind of help, such a simple request would become a tedious, difficult project.

Implications

What are the implications of the information sciences for intergovernmental cooperation in communication and exchange of information? Clearly the technology itself offers great possibilities for improvements. The federal grant-in-aid program will be a great resource for both financial aid and technical help. The state and local governments are making great strides towards improvement; however, it must be remembered always that the man in the system must stay in charge.

We will do well to remember a comment made by Norbert Wiener in 1964:

> No, the future offers very little hope for those who expect that our new mechanical slaves will offer us a world in which we may rest from thinking. Help us they may, but at the cost of supreme demands upon our honesty and our intelligence. The world of the future will be an even more demanding struggle against the limitations of our intelligence, not a comfortable hammock in which we can lie down to be waited upon by our robot slaves.

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COMPUTER MARKET REPORT

The Computer Leasing Industry — The Prospects

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The first part of our report on the computer leasing industry (published in the March issue) discussed the background which gave growth to this industry, and presented a statistical analysis of the industry to date. Part two, presented here, discusses some of the problems of computer leasing companies, and estimates the future prospects of this industry.

Leasing Company Personnel

As is well known, many of the computer leasing companies were started by those previously in the employment of computer manufacturers. Almost all the companies have drawn heavily upon previous employees of computer manufacturers to staff their executive, marketing, and systems activities. A recent tabulation shows that a large percentage of such people previously worked for IBM's various divisions. Naturally, most of the previous IBM'ers were drawn from IBM's data processing division and the field engineering division. It is estimated that over one thousand persons who were previously employed by all the computer manufacturers, including IBM, are currently employed by firms in the computer leasing industry. Since few, if any, computer leasing companies have a training program of their own, future personnel requirements by firms in this industry will naturally draw upon the pool of trained and experienced personnel employed by all the computer manufacturers, particularly IBM.

Bank Activity in Computer Leasing

Some of the commercial banks have, individually and on a joint basis, extended large lines of credit and other financing to some of the computer leasing companies. However, except for some of the large banks like Bank of America, Crocker Citizens, and the First National Bank of Boston, most banks have not engaged in computer leasing activities. There have been fragmentary reports from computer users that some banks have entered the computer leasing activity in cases where a full payout lease is involved.

In general, however, participation of the banking industry in the computer leasing industry is unlikely in the future, so long as users refuse to sign up for full payout (eight- to ten-year) leases. However, it is not unlikely that those banks, large or small, who have engaged in computer leasing activities (without full payout leases) or extended large lines of credit and other financing to computer leasing firms will face the moment of truth in the coming few years.

Merger and Acquisition Activity

The merger and acquisition fever gripping a large number of computer leasing companies during the 1967 and 1968 period continues unabated at this time. Most of these acquisition activities have been in fields unrelated to data processing and computers. The primary aim of these nonrelated acquisitions, it seems to us, is directed towards solving the financial problems created by debt service requirements. Thus companies rich in assets with a strong cash flow are the primary targets of computer leasing firms.

Acquisition activities have been assisted by the rich multiples accorded leasing company stocks in the marketplace. It should be noted that these rich multiples are often based on misleading income statements and profit growth figures, more an illusion to some reputable analysts of accounting and financial statements than evidences of concrete progress of these businesses.

Tie-ups with Computer Peripheral Manufacturers

Several tie-ups of computer leasing firms with peripheral equipment manufacturers were reported in 1967 and 1968. Some of the major firms involved were Boothe Leasing, Computer Leasing (subsidiary of University Computer), Computer Sciences Leasing (subsidiary of Computer Sciences Corp.), Data Processing Financial & General, Granite Equipment Leasing, Management Assistance Inc., and Transamerica Computer (subsidiary of Transamerica Corp.).

Since leasing companies rarely purchase complete systems and have primarily acquired the computer main frame (CPU) machines, these tie-ups could develop, in time, into making the computer leasing companies full-scale competitors of the major computer manufacturers.

In addition to IBM, whose equipment has been mainly involved in the leasing company acquisitions to date, it seems to us that companies such as Burroughs, Control Data, General Electric, Honeywell, NCR, RCA, Scientific Data, and Sperry Rand would watch these developments with the greatest interest. It may well be that the effects of tie-ups between peripheral equipment manufacturers and leasing companies could lead all these firms into difficulties as well as leading them into direct competition with the main computer manufacturing companies.

Future Competition

Computer leasing companies face increasing competition from several sources during 1969 and future years. The one source of competition most frequently mentioned in the various publications is computer manufacturers. However, there are others who are likely to be tougher competitors of computer leasing companies and who are playing the same game of discounted prices which these companies may not be able to match.

Computer users have purchased increasing amounts of data processing equipment from IBM and some of the other manufacturers. An estimate in a research study made by DP Data Corporation shows that almost one half billion dollars were spent by IBM's regular customers during 1968 in such purchases. In most cases, purchased equipment will be offered for sale by their present owners when they obtain new equipment in the future. This is indicated by a sample survey of users conducted in the third quarter of 1968. Since most of these users depreciate equipment on a more conservative basis than the computer leasing companies, it is likely that all this equipment will be offered in the future at prices below those of the leasing companies.

Thus, the potential for serious competition with the offerings of leasing companies is present. Some of these computer users expect to sell their equipment (in four to six years from the year of purchase) at less than 25% of its original value. Marketplace reports indicate that five-year-old, second generation IBM equipment is currently being offered by computer users at 20 to 25% of the original price. Due to the low book values of this equipment in the hands of users, anything over 10 to 15% of the original value is considered reasonable by these users. This gives us some guide regarding the future course of events for third-generation equipment.

Intra-industry competition between the leasing companies increased during 1968. Marketplace reports indicate this will further increase in 1969. Severe price cutting and other extraordinary concessions can be expected starting with the re-leasing activities later in 1969 and 1970.

The financial houses (such as CIT) and some of the banks are likely to be drawn into the computer leasing industry. Some of these financial institutions will be forced to come to the aid of their large customers in the computer leasing field. They will, we believe, add to the competition in the marketplace.

There is little doubt that a continuing attack from computer manufacturers, other than IBM, (some of whom are reported losing money at this time) will bring about some consolidation in the computer leasing industry. After all, these are the companies most affected by the low rental IBM systems offered to their potential customers by the independent computer-leasing firms. A similar consolidation of the computer manufacturers is also likely due to the severe competition from independent computer lessors.

Increasing Government Business

Reports from various parts of the United States indicate an increasing level of activity by computer leasing companies in the acquisition of computers currently rented directly from the manufacturers by federal, state, and local governments. States reporting the largest amount of such activity include California in the west and Pennsylvania in the east. The General Services Administration (GSA), the arm of the Federal Government which talks the loudest, has apparently frightened many data processing managers. Fragmentary reports indicate that some of these managers recommend that the government use independent leasing companies to purchase systems currently rented from the manufacturers, and sign up initially for a two-year term.

Although the exact reasons behind some of these recommendations remain a mystery, a few of those contacted expressed fears that GSA's emphatic talk of consolidations "could have led to undesirable personnel cut backs". Increasing activity by computer leasing companies in the large pool of rented computer equipment installed with government agencies can be expected in 1969 and in the future.

Litigation in the Industry

As reported in the national press, one of the top ten computer leasing companies, Data Processing Financial & General Corporation (DP F & G) of New York has filed an anti-trust action against the IBM Corporation. Many of the other leasing companies also maintain an active interest in obtaining their business goals through litigation — although of a different variety than that of DP F & G. With intensifying competition in the computer leasing industry, many of the small companies are likely to feel competitive pressures from the major companies. These small firms could easily band together to bring anti-trust and other legal actions against these major companies. Although no comments for publication are available, more than one executive of these large computer leasing companies feels that almost all these large companies have used the same tactics as DP F & G complains about IBM. It may well be that "those who live by the sword shall perish by the sword".

Investor Interest in the Industry

As in any new industry, investors were slow to recognize the short term potentials of the new companies which leased computers for rates lower than the rates of computer manufacturers. Then the great wave of investor enthusiasm came to life during 1967 and 1968.

At this time, some of the institutional investors seem to feel that despite the high risks in computer leasing issues, the payoff in capital gains would be worth the investment. Few individual investors are in a position to analyze accurately the future of the computer leasing companies and their common stock, convertible bonds, and other investment issues. But, based on interviews with some knowledgeable individual investors, we believe that at least a respectable minority of them consider the risks much too high compared to the possibilities of gains.

Some of the leading stock brokers doubt whether investor interest in computer leasing issues would remain as high during the 1969-1970 period as it has been in the past two years. A small minority fear the burst of a bubble in the not-too-distant future and feel some real bargains would become available, if one was interested in short-term gains.

We believe most analysts of computer leasing companies and the leasing industry have not looked carefully at one of the most important facts: All of the computer leasing companies, including the large ones, are too small at present to be able to withstand the adversities that they may face in the computer marketplace in the next few years. None of them is even a fraction of the size of the computer manufacturers with whom they are in competition. Their marketing and other business activities do not compare with those of Honeywell, Burroughs, RCA, General Electric, and National Cash Register, and we simply cannot compare them with Sperry Rand, Control Data, or Scientific Data Systems, to say nothing of IBM. As more thought is devoted to this topic, we believe some of the current recommendations and enthusiasm for the common stocks, convertible bonds and other issues (like warrants)of the computer leasing companies, will seem like footprints on a sandy ocean beach — here now but gone before one can document them. □

TOTAL COMPUTER SERVICE

Clayton C. Lisle, Vice Pres.
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If company managers could delegate their computer operations entirely to independent businessmen who would provide complete data processing services, the managers could again become free to devote all their energies to improving the efficiency of their own business. They could make use of the information provided by the data processing service . . . without having to be in the data processing business themselves.

The possibilities of the computer as a tool for management have inspired businessmen with visions of vastly improved efficiency in operations. Unfortunately, for many businessmen these visions remain largely illusory.

Instead, they have experienced — or have hesitated to pursue their visions because they know of others who have experienced — the all-too-common problems of computerization:

- Overbought hardware,
- Uncontrollably skyrocketing costs,
- Postponements and delays,
- Barely useful results presented at wrong times,
- Continual personnel problems.

One solution offered is for top management to learn more about data processing, so that they will be able to understand the problems and better communicate with their company's data processing people.

Is this really a good way to solve these problems? If the computer is to be as useful as it should be to the businessman, shouldn't the data processing industry be more responsive to his needs, rather than vice versa?

Another solution offered has been external computer service organizations. They have proliferated as a response to the needs for software assistance caused by the shortage of experienced systems analysts and programmers.

Yet the availability of software services hasn't eliminated the common problems enumerated above. The problems continue. And, as more and more computers are sold, they become more widespread.

The Over-Sold Computer

Few top executives are qualified to make a truly rational decision as to the best computer for their application. As a result they are susceptible to hard selling by hardware manufacturers. And let's not deceive ourselves. The hard sell exists. A computer is a big ticket item. Commissions are high, and salesmen are well motivated. The result is predictable.

Many businessmen fail to take into account the capital costs of a computer installation beyond the equipment itself. The cost of special electrical, communication and environmental systems required for a computer facility is significant. So is the cost of the time required to install them.

Delays and Disappointments

The startup of data processing systems behind schedule is considered normal. Delays are common, in equipment delivery, in installation of utilities, and in the completion of software.

Finally, when the system does operate, it often fails to measure up to expectations. The information wanted isn't presented so it can be used, or when it is needed.

Staff Problems

Perhaps the most difficult problem for management is that of staffing the data processing operation. Experienced personnel are in short supply. They command high salaries, usually out of line with other positions of comparable responsibility. Because they are in short supply, good data processing personnel are nomadic and turnover is high.

The experienced systems analysts and programmers needed to put a system into operation are often largely superfluous once the system is running. Parkinson's Law, that work expands to fill the time available, takes effect. When that happens, the data processing empire grows and expands, often well beyond actual needs.

Extreme?

Perhaps this recitation of problems takes an extreme point of view, for not every business has experienced all of these headaches. But, it is reasonable to believe that every business which has installed a computer has experienced at least one of them.

In the most extreme case management begins to realize that they are now operating two businesses: their own business and a separate data processing business, which had been originally intended as merely a management tool.

At this point many executives may wonder what they are doing in the data processing business. It's a good question.

Partial Solutions

Conventional software services, time-sharing and service bu-

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reaus offer partial solutions to the problems of computerization, but fall short of a complete answer.

Software firms provide a pool of experienced systems analysts and programmers to meet the purely temporary needs of getting a system up and operational. But they still leave the businessman with the responsibility of owning and operating a sophisticated and complex piece of equipment which, more often than not, is not being fully utilized.

Time sharing, service bureaus, and software packages offer limited answers to the problems. Time sharing is often a useful scientific tool, and permits users to share a computer for the solution of mathematical problems; but often it is not well suited for business systems. Service bureaus and software packages are appropriate for simple applications common to many businesses, such as payroll, billing and accounts receivable. However, the user must adapt his operations to the capabilities and procedures of the software system he is going to use.

Business systems can be generalized, but the cost in terms of operating efficiency is high. For maximum efficiency, a system should be specific to the business in question. Up to now such systems have required the user to own and operate his own computer. Yet, in many companies it is not essential to day-to-day operations that the computer be an integral part of the organization.

A Total Solution

This article advocates what may be called a "total" solution.

Data processing is a business service — a management tool. But only a few companies in the data processing business offer the total service. Hardware manufacturers offer equipment and some standard software. Contracts with software companies usually expire once the system is operating properly. But the "total" solution to management's problems is a complete service; in addition to providing system design and programming, will manage and operate the system, and may even house the computer.

This is a reasonable approach. Outside organizations already provide a variety of business services, including legal advertising, transportation, accounting, sometimes even janitorial services. By letting other businessmen manage these necessary services, company management is free to concentrate on activities which contribute to profitability.

The advantages of this total service approach, compared to the partial approach, are clear. Being responsible for every aspect of the system, the computer service center must provide satisfactory and efficient service in order to stay in business.

The customer avoids the problems of selecting a computer and of staffing to operate it. In the center, his system is applied to the most appropriate computer. Experienced data processing personnel are available as needed. Expensive specialists are shared with other clients. Operations are under the direction of highly qualified data processing managers.

Additional advantages are possible if the computer is housed by the service organization. The facility is already prepared, minimizing installation costs and lead times. Overhead is reduced because the facility is shared with other computers and other systems.

The computer itself may also be shared, cutting operating costs. All customer systems can be truly independent of one another, yet have appropriate access to the central processing unit. Programs remain proprietary. Mass storage capacity is available, but proprietary information is protected.

Through sharing at the center, the customer's data processing system can be built in reasonable and economical stages, without wasting computer capacity in the meantime. If, as new systems are added, the operation becomes large enough to justify a dedicated computer, then system programs and stored data can be transferred intact.

EDITORIAL

(Continued from page 8)

to spin its fascinating arguments of scientific and technological magic, and sell portions as proposals to the Defense Department. The computer industry has been one of the beneficiaries of the flow of funds from the Defense Department to the MIC and has been part of the MIC. In this field, the technological development has frankly been so marvelous that now more than eighty percent of the computer industry and its applications are civilian and not military. Here society as a whole has received back a major (though incidental) benefit from the operation of the military industrial complex.

Computer people, having been beneficiaries, should now seek to fulfill their social responsibilities. They should help reorient the Defense Department toward its primary objectives; they should help to increase the defense and security of the United States in rational, logical, and honest ways. Pandora's box of new scientific weapons (chemical, bacteriological, radiation, nuclear, missiles, nuclear-powered submarines, etc.), is now wide open; and we should help to close it. This will make the U.S. and the world more safe, not less safe.

One direction is the development of strong international agreements and controls (possibly computerized) over weapons systems, in the interests of all the people of the world. One such example is the Nuclear Nonproliferation Treaty. Many proposals of this nature have been made, and should be studied, talked about, and advocated, by computer people and other people. Illogical, unsound proposals should be opposed by computer people and by other people. Thus we help change the climate of public opinion away from the usual rubber-stamp "yes" for expensive proposals from the MIC.

The military industrial complex will then make less money. But the people of the United States and the world will then make more money, and they will live more instead of dying more. Even American boys, instead of dying in Vietnam, will stay alive in the United States.

Edmund C. Berkeley

Editor

Total Service Systems

Examples of this type of total computer service were described in "Dedicated Systems Share One Computer", *Computers and Automation,* October, 1968. At Aries Data Centers, Inc., Fairfield, New Jersey, seven completely independent, dedicated systems share two computers. Each remote terminal of these systems has instantaneous access to a computer, yet each system is completely separate from the other. Each system was put into service in a fraction of the time which would be normally expected and is operated at a fraction of the cost required if each were operated separately.

Total computer service provides business management with:

- Freedom from the headaches of computerization.
- Predictable and controllable costs every step of the way.
- Flexible staffing without internal personnel problems.
- Professional management, operation and maintenance of the system.

Even more importantly, by delegating computer operations entirely to independent businessmen dedicated to providing a useful and profitable data processing service, the managers of the business become free again to devote all their energies to improving the efficiency of their own business, making use of the information provided by the data processing service. □

THE SYSTEM FOR DECISION OF PRINCE HENRY THE NAVIGATOR

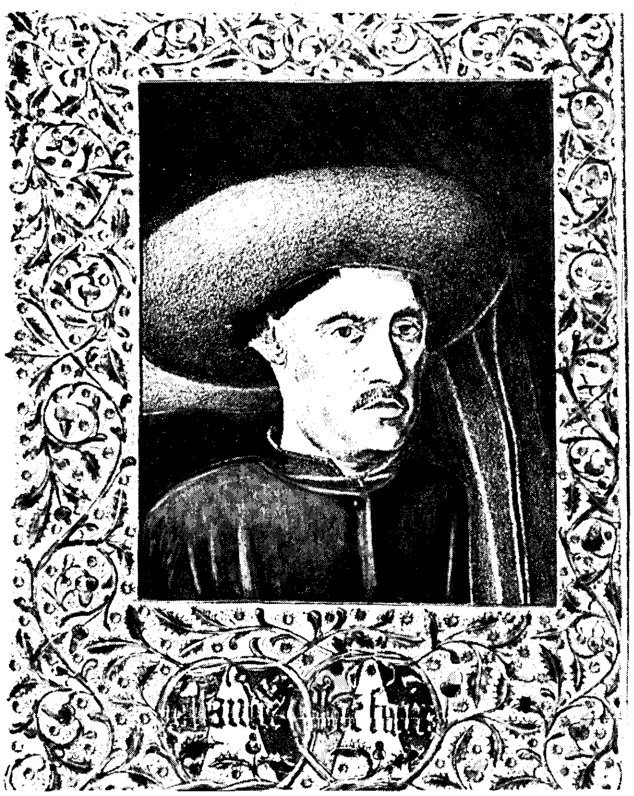
Anonymous

The apparatus of decision built by the Prince was incredible. Its input: the accumulated geographical knowledge of all history. Its output: not only the riches of the earth . . . but half the earth itself as a possession for Portugal.

If asked to choose a time in history that seemed most like today, we would do well to choose the 15th Century. Strangely, of all that has gone before us, this period is the fragment of the past most like our own times . . . perhaps because it marked the beginning, the Renaissance, of the modern world; perhaps because it saw the outpouring of some of man's most sublime achievements, such as the works of da Vinci and Michelangelo, the genius of Gutenberg. The 15th Century was, like today, a time of vigor and reform and discovery . . . and of disturbance.

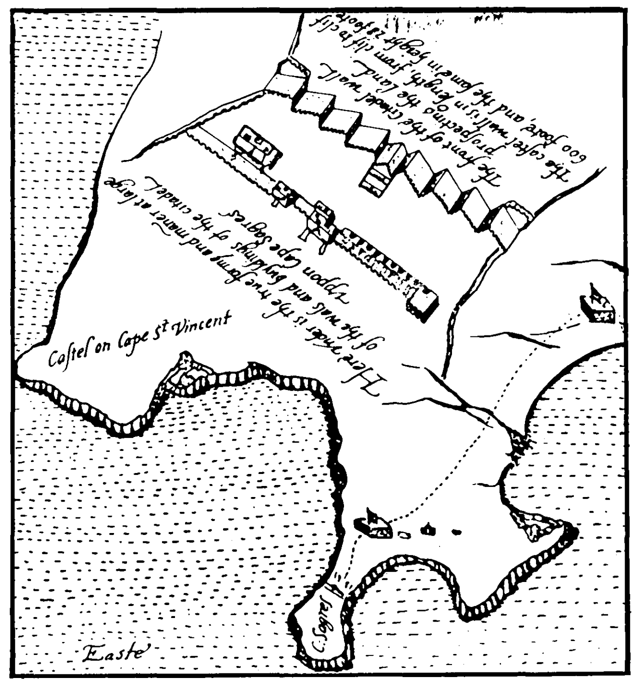
But there was one enormous difference between that world and the world of today. Then, "the world" was an island . . . adrift in the vast and forbidding Sea of Shadows . . . and the arc of the horizon marked the threshold of the Unknown.

On the very edge of this island-world, in Portugal, was born the man whose genius lifted forever the shadows, the creator of a system to manage the total knowledge of the Western World, the guide responsible for the discovery of more new land than man had known since time began. His name was Dom Henrique d'Avis, Prince of Portugal—Henry the Navigator.



Portrait of Prince Henry, drawn during his lifetime. From a manuscript in the Bibliotheque Nationale in Paris.

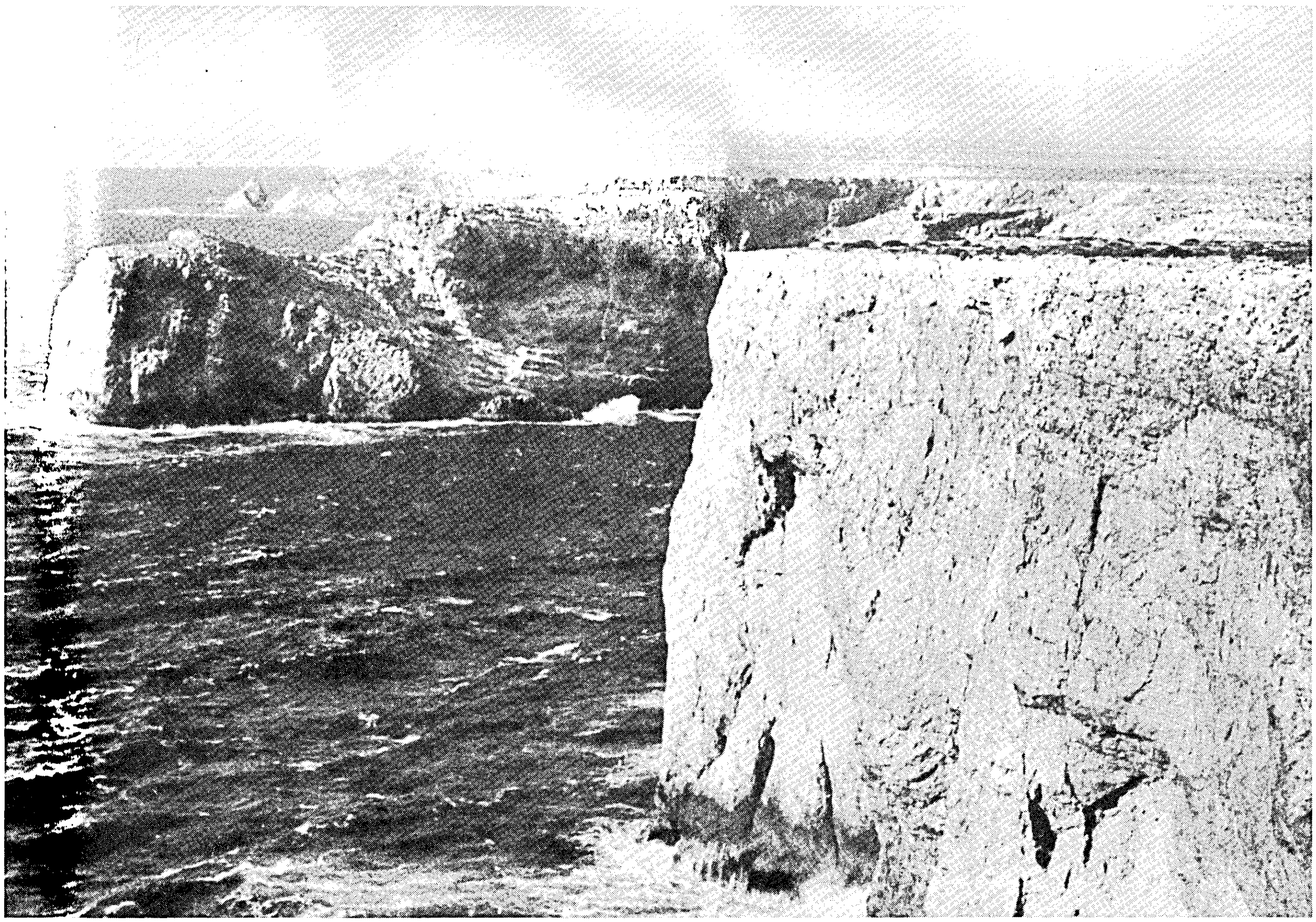
(Reprinted with permission from *Input for Modern Management*, Fourth Quarter 1968, published by Sperry Rand Corp., Univac Div., 1290 Ave. of the Americas, New York, N.Y. 10019)



A map of the Citadel drawn from the original.

At about the time that Henry, third son of the King of Portugal, was born, the tiny nation was mired in the frustration of confined freedom. A century earlier, the Portuguese had shaken loose from the Moorish yoke that had stifled them for hundreds of years. Although the air was clean at last, the walls were still evident; Spain sprawled smugly along the entire land border of little Portugal, a nation of less than a million people. And the rest of Portugal brinked upon the fearful waters of the Mare Tenebrosum—the Sea of Shadows. Everyone *knew* that monsters peopled its seething depths . . . everyone *knew* a man's blood would boil if he dared to venture south across the Equator. And everyone *knew* there was nothing out there, anyway.

But to Henry of Portugal, the dark sea offered the only path to true freedom: "You cannot meet there a peril so great that the reward shall not be even greater." He spent his life dispelling the perils, and reaping the reward.



Sagres today. The Citadel was located on the promontory in the foreground.

When he had reached his 24th year, Henry renounced the worldly life of his father's court, and set out to pursue another sort of worldliness. He chose the very edge of the earth-island, the bleached bones of the peninsula of Sagres, as the place to animate his vision of freedom. Here, in 1415, he began work on a vast Citadel to house the world's knowledge of the world. He gathered here all the maps and charts and diagrams, all the instruments and all the techniques, everything that the past could offer. And he brought to this bleak place the learned mathematicians from the East, the map-makers of five nations, the instrument-makers from all of Europe. Weather experts and navigators, cosmographers and mercantile savants, ship designers and astronomers, all came to Sagres. All that was known of the world came to Sagres, and all that would be known of the world would come from Sagres—from the incredible apparatus of decision conceived by Prince Henry.

The Master Chart

Once the accumulated knowledge of the past was thus within his grasp, Prince Henry ordered his supreme creation: the great Master Chart.

Filling an entire wall in the heart of the Citadel, this vast cartographical masterpiece contained, in incredible detail, the distillation of man's knowledge of the earth. Writhing over its enormous face were the painstakingly drawn coastlines, rivers, islands, and harbors of every inch of the known world. But this was merely the skeletal framework which supported the flesh of additional information to guide the decisions of the Prince. The roads of trade crossing the land were shown for the first time on any map. Cities, with indications of size and importance, were added. Winds, tides, and currents were charted, and a staggering amount of commercial information completed the input. When it appeared complete, the life and usefulness of the Master Chart had only begun: "I charge you, go as far as is possible!", instructed Prince Henry as his mariners gathered in the looming presence of the Master Chart. "Make use of the Chart, you shall derive therefrom only honor and profit."

The captains hoisted sail to snare the rinsed winds off Sagres. In Henry's ships, with Henry's maps, and Henry's instruments, they followed the courses he had set and they conducted his business. They brought back "honor and profit," and an avalanche of information. The first success was the discovery of the island of Porto Santo in 1418 by two of the captains of the Prince. Jubilant, they returned to Sagres, and Henry entered their findings on the Master Chart, and promptly sent them out again. This time they discovered Madeira, and Prince Henry dispatched colonists and livestock to sustain the holding, and to produce revenue for his kingdom. From the start, the Madeira Colony flourished and was soon engaged in lively trade in the sugar and excellent wines produced from its rich, black soil and benign climate.

The Exhilaration of Discovery

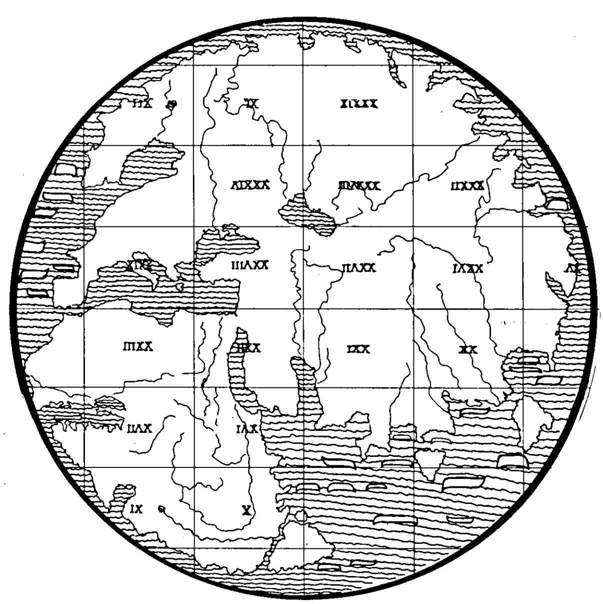
Voyage by voyage, man's millenia-old chains of superstition and inertia were struck loose, and the heady exhilaration of discovery gained momentum—and wealth—for Portugal. By 1434, Cape Bojadur, high on the shoulder of Africa, had been passed. Then came Cape Blanco, followed by the discovery of the Cape Verde Islands. In 1471, the Equator was crossed for the first time in recorded history.

With each venture, the input to the Master Chart grew more complete. Constant updating modified the writhing coastlines and wind-grids that laced across its surface. The Prince's staff attached the ever-changing mosaic of appended notations that fluttered like proud banners of victory: "These waters yield up pearls, the most beautiful that you can find anywhere" . . . "The islands abound in rare spices" . . . the commercial gazetteer was staggering. The marvellous decision machine was always ready to prepare the discoverers for new triumphs.

Diaz' Incredible Voyage

The classic disciplines that Prince Henry's genius had established at Sagres did not end with his death at age 66. His remarkable vision endured to guide Bartholomeu Diaz south along the coast of Africa, on one of seafaring's most astonishing adventures. Caught beyond the sight of land in a furious month-long storm which totally obscured the sky, Diaz survived to see the violent seas grow calm and the heavens clear . . . and the sun apparently *rising* in the *West!* Immediately, the skilled navigator realized the stunning meaning of the seeming miracle: his ship had rounded the tip of Africa. He—and not the Sun—had changed direction.

News of Diaz' incredible voyage swept through Portugal and inspired Admiral Vasco da Gama to duplicate the accidental triumph. His success is one of history's brightest pages, and one of Portugal's most profitable. Da Gama's 28,000-mile voyage acquired far more than the cargo of spices worth sixty times the cost of the expedition: he had found the elusive trade route to India . . . *for Portugal,* and



A section of the Master Chart. The Roman numerals appear here upside down because the original map showed South at the top, which was standard on 15th century Portuguese maps.

Another section of Prince Henry's Master Chart in which part of India is shown. Bombay is at the extreme left center. The number of towers on each walled city indicated its size. The thin lines edged with trees are trade routes.

had destroyed the trade monopoly enjoyed for centuries by Venice.

The Ultimate Adventure

Now there was no holding Portugal. Flushed with triumph and wealth from the new trade with India (and stung by Columbus' Spanish-sponsored discovery of "a new route to the Indies"), Portugal prepared for the ultimate adventure: the circumnavigation of the earth. Captained by courageous and brilliantly trained Ferdinand Magellan, the expedition suffered indescribable hardships, but proved that Columbus hadn't found India at all. In the process, Portugal became master of half the earth.

A Highly Successful Information Management System

Fittingly, when Magellan's ship at last sighted its final landfall, the grey shape looming on the horizon was Sagres . . . site of the Citadel of Henry the Navigator . . . birthplace of the apparatus of decision that had made it all possible.

The study of history will reveal many epoch-making achievements, and behind each one there is invariably a man of decision and a system to manage the information he needed to make his decisions. But history will reveal few men with the genius of Prince Henry of Portugal, and few information management systems as fantastically successful as the great Master Chart he created in the Citadel at Sagres.

From the vantage point of today . . . and from our knowledge of the ultra-sophisticated equipment available to solve today's information management problems . . . we might be tempted to look upon Prince Henry's apparatus of decision with tolerant superiority. But primitive or not, the triumphs it achieved will stand forever as a challenge to men of adventure and vision.

C·A WORLDWIDE

REPORT FROM GREAT BRITAIN

Official figures for EDP Trading during 1968 show — if one believes in an independent British computer industry — how timely Government intervention to streamline and sustain this industry has been. If, on the other hand, one thinks, as do many Tory politicians, that U.S. computer manufacturers should have the unfettered run of all areas of the British market, then the figures show that the UK builders just are not up to big-time competition and that they should be left to find their own salvation.

Adverse Balance of Trading

Briefly put, Britain's adverse balance of trading in computer systems and parts shot up to $65m in 1968 from $45m a year earlier. True exports improved a great deal by $24m to $108m, but imports were a heavy burden on a country striving desperately to achieve a balance and convince its many creditors that it can and will attain solvency in three years. The import bill was $180m against $135m.

I have mixed feelings on the matter, in common with most of the EDP journalists in Britain. This attitude stems quite simply from the many pronouncements by people like John Diebold and Dick H. Brandon deploring what has happened during the first mad years of computer fever in the U.S. Nothing has escaped their strictures — hardware, software and people — and the estimates they have given of economic failure in as many as 70 percent of installations in the U.S. lead inevitably to the conclusion that so far as applications go, British users have nothing to learn from the U.S. — and that with few exceptions they might just as well buy domestic-built equipment. I wonder whether Diebold and Brandon would disagree.

ICL Labour Cutback

Now this single UK industry, personified in International Computers Limited, recently held its first annual general meeting since the great mergers. It came in an atmosphere of job cutbacks in the group's 32,000 labour force, officially put at 500 but privately expected to reach more than 1,500. "Over-capacity in some manufacturing units" is the reason given by the new chairman, Sir John Wall. This is polite English for the aftermath of the mad expansion spree by English Electric Computers, undertaken at a time two to three years ago when order books just did not justify such optimism. In fact, ICL has had to write off some $20m of losses from that side of the house.

On the Bright Side

But let us not be gloomy all the time. The shareholders at the sometimes stormy meeting were told that while it had taken the company 32 months to make its first £100m ($240m) from 1900 series machines, the second magic £100m figure was reached in only 19 months.

Deliveries of these sound, workmanlike machines had reached nearly 1000 and orders on hand for them and for System-4 units now were above the $240m mark.

Clearly to allay suspicion that ICL was planning to kill off the two remaining models in the System-4 series (and this would certainly be cold commercial logic), the medium to large-scale '50' and '70' comparable to the IBM 40 to 65 coverage, managing director Arthur Humphries disclosed that about $20m of orders were in the pipeline for these RCA-type machines. This included an order for $6m from Soviet Russia. Some 75 System-4 installations had been delivered and total sales in 3 years had been 120 machines worth £35m.

For the moment, more effort was being put into software on this System-4 side than for 1900, it was asserted, and it was again stated that the company was working towards a new design of machine compatible with both ranges.

Anyone with a knowledge of what successful implementation of a single machine to take in new technology and yet preserve the work of users of older machines means in terms of blood, sweat and tears will not envy Arthur Humphries his hair shirt.

Another CDC 6600 Arrives

Just to rub it in; a second CDC 6600 has arrived in Britain. It will go alongside the Atlas at London University and by the time it is officially inaugurated in April, a lot of meaningless words on how much more powerful the former is than the latter will have been written. Which brings me back to where I started and the despairing statement that the control of a country's technological development is much too vital to be left to politicians impervious to new ideas.

Ted Schoeters

Ted Schoeters
Stanmore, Middlesex
England

CALENDAR OF COMING EVENTS

April 15-18, 1969: The Institution of Electrical Engineers and the Institution of Electronic and Radio Engineers Computer Aided Design Conference, Southampton University, So 9, 5 NH., Hampshire, England; contact Conference Dept., IEE, Savoy Place, London, W.C.2

April 23-25, 1969: Honeywell "200" Users Association Spring 1969 Conference, Chatham Center, Pittsburgh, Pa.; contact W. Gretzler, Anderson and Gilbert Assoc., Inc., Box 2144 Downtown Station, Uniontown, Pa. 15201

April 23-25, 1969: 21st Annual Southwestern IEEE Conference and Exhibition, San Antonio Convention and Exhibition Center, San Antonio, Texas; contact William E. Cory, Southwest Research Institute, Box 2296, San Antonio, Texas 78206

April 23-25, 1969: CUBE (Cooperating Users of Burroughs Equipment) Spring Meeting, Statler-Hilton Hotel, Cleveland, Ohio; contact Thomas S. Grier, Burroughs Corp., 6071 Second Ave., Detroit, Mich. 48232.

April 28-30, 1969: Conference on Statistical Computation, Univ. of Wis., Madison; contact Dr. Roy C. Milton, Univ. of Wis. Computing Center, 1210 W. Dayton St., Madison, Wis. 53706

May 5-6, 1969: Association For Computing Machinery (ACM) Symposium on Theory of Computing, Marina del Rey Hotel, Marina del Rey, Calif.; contact Prof. Michael A. Harrison, Dept. of Computer Science, Univ. of California, Berkeley, Calif. 94720

May 5-7, 1969: UNIVAC Users Association/Europe, Sixth International Conference, Paris Orly Hilton Hotel, Paris, France; contact UNIVAC, 24 Piazzale dell'Agricoltura, Rome, Italy

May 6-9, 1969: The Association of Educational Data Systems (AEDS) Annual Convention, Portland Hilton Hotel, Portland, Ore.; contact Wayne J. Smith, Convention Contractor, 201 Massachusetts Ave., N.E., Washington, D.C. 20002

May 7-9, 1969: International Joint Conference on Artificial Intelligence, Statler-Hilton Hotel, Washington, D.C.; contact Dr. Donald E. Walker, IJCAI Program Chairman, The MITRE Corp., Bedford, Mass. 01730

May 8-9, 1969: Sixth Annual National Information Retrieval Colloquium, Warwick Hotel, Philadelphia, Pa.; contact Margaret M. Isselmann, E. I. duPont deNemours & Co., Wilmington, Del. 19898.

May 13, 1969: Symposium on Extensible Languages sponsored by the ACM Special Interest Group on Programming Languages, Boston, Mass.; contact Carlos Christensen, Chairman, Massachusetts Computer Assoc., Inc., Lakeside Office Park, Wakefield, Mass. 01880

May 14-16, 1969: Spring Joint Computer Conference, War Memorial Auditorium, Boston, Mass.; contact American Federation for Information Processing (AFIPS), 210 Summit Ave., Montvale, N.J. 07645

May 14-28, 1969: International Exhibition, Automation-69 (Modern Equipment for Automation of Production), Moscow, USSR; contact Mikhail Nesterov, USSR Chamber of Commerce, Moscow, USSR.

May 18-21, 1969: Power Industry Computer Application Conference, Brown Palace Hotel, Denver, Colorado; contact W. D. Trudgen, General Electric Co., 2255 W. Desert Cove Rd., P.O. Box 2918, Phoenix, Ariz. 85002

May 19-21, 1969: National Automation Conference of the Automation Dept. of The American Bankers Assoc., Conrad Hilton Hotel, Chicago, Ill.; contact William P. Rust, American Bankers Assoc., 90 Park Ave., New York, N. Y. 10016

May 21-22, 1969: ACUTE (Accountants Computer Users Technical Exchange), Palmer House, Chicago, Ill.; contact ACUTE, 947 Old York Rd., Abington, Pa. 19001

May 21-23, 1969: Seventh Annual Workshop Conference of the Interagency Data Exchange Program (IDEP), Sheraton-Belvedere Hotel, Baltimore, Md.; contact E. T. Maguire, Avco/MSD IDEP Center, 201 Lowell St., Wilmington, Mass. 01887

May 27, 1969: Systems and Procedures Association 5th Annual Systems Seminar, Holiday Inn Town, Harrisburg, Pa.; contact Stan Kross, Publicity, 710 Elkwood Drive, New Cumberland, Pa. 17070

June 8-12, 1969: Sixth Annual Design Automation Workshop, Hotel Carillon, Miami Beach, Fla.; contact Dr. H. Freitag, IBM Watson Research Ctre., P.O. Box 218, Yorktown Heights, N.Y. 10598

June 9-11, 1969: IEEE International Communications Conference, University of Colorado, Boulder, Colo.; Dr. Martin Nesenbergs, Environmental Science Services Administration, Institute for Telecommunication Sciences, R614, Boulder, Colo. 80302

June 16-19, 1969: Data Processing Management Association (DPMA) 1969 Internat'l Data Processing Conference and Business Exposition, Montreal, Quebec, Canada; contact Mrs. Margaret Rafferty, DPMA, 505 Busse Hwy., Park Ridge, Ill. 60068

June 16-21, 1969: Fourth Congress of the International Federation of Automatic Control (IFAC), Warsaw, Poland; contact Organizing Comm. of the 4th IFAC Congress, P.O. Box 903, Czackiego 3/5, Warsaw 1, Poland.

June 17-19, 1969: IEEE Computer Group Conference, Leamington Hotel, Minneapolis, Minn.; contact Scott Foster, The Sheffield Group, Inc., 1104 Currie Ave., Minneapolis, Minn. 55403

June 17-20, 1969: American Astronautic Society and the Operations Research Society of America, Brown Palace Hotel, Denver, Colo.; contact Dr. George W. Morgenthaler, General Program Chairman, Martin Marietta Corp., P.O. Box 179, Denver, Colo. 80201

June 19-20, 1969: Assoc. of Data Processing Service Organizations Management Conference, Sheraton Ritz Hotel, Minneapolis, Minn.; contact Jerome L. Dreyer, Assoc. of Data Processing Service Organizations, Inc., 420 Lexington Ave., New York, N.Y. 10017.

June 19-20, 1969: Seventh Annual Conference of the Special Interest Group, Computer Personnel Research of the Association of Computing Machinery, Univ. of Chicago, Chicago, Ill.; contact A. W. Stalmaker, School of Industrial Management, Georgia Tech., Atlanta, Ga. 30332

June 21-28, 1969: Second Conference on Management Science for Transportation, Transportation Center at Northwestern University, 1818 Hinman Ave., Evanston, Ill. 60204; contact Page Townsley, Asst. Dir., Management Programs, 1818 Hinman Ave., Evanston, Ill.

June 23-24, 1969: National Gaming Council Eighth Symposium, Sheraton-Elms Hotel, Excelsior Springs, Mo.; contact Dr. Richard L. Crawford, Booz, Allen Applied Research Inc., 911 Walnut St., Kansas City, Mo. 64114

June 30-July 1, 1969: ACM/IEEE/SHARE/SCi Conference on Applications of Continuous System Simulation Languages, Sheraton-Palace Hotel, San Francisco, Calif.; contact Robert Brennan, IBM Scientific Center, 2670 Hanover St., Palo Alto, Calif.

June 30-July 3, 1969: Institution of Electrical Engineers Conference on Computer Science and Technology, Univ. of Manchester Institute of Science and Technology, Manchester, England; contact Conference Secretariat, Institution of Electrical Engineers, Savoy Place, London, W.C.2, England.

July 8-11, 1969: IEEE Annual Conference on Nuclear and Space Radiation Effects, Penn State University, University Park, Pa.; contact D. K. Wilson, Bell Telephone Laboratories, Whippany, N.J. 07981.

July 19-22, 1969: 30th Annual Convention of the National Audio-Visual Association, Conrad Hilton Hotel, Chicago, Ill.; contact Harry R. McGee, National Audio-Visual Association, Inc., 3150 Spring St., Fairfax, Va. 22030

Aug. 6-8, 1969: Joint Automatic Control Conference, Univ. of Colorado, Boulder, Colorado; contact unknown at this time.

Aug. 11-15, 1969: Australian Computer Society, Fourth Australian Computer Conference, Adelaide Univ., Adelaide, South Australia; contact Dr. G. W. Hill, Prog. Comm. Chrmn., A.C.C.69, C/-C.S.I.R.O., Computing Science Bldg., Univ. of Adelaide, Adelaide, S. Australia 5000.

Aug. 25-29, 1969: Datafair 69 Symposium, Manchester, England; contact the British Computer Society, 23 Dorset Sq., London, N.W. 1, England

Sept. 8-12, 1969: International Symposium on Man-Machine Systems, St. John's College, Cambridge, England; contact Robert C. McLane, G-MMS Meetings Chairman, Honeywell Inc., 2345 Walnut St., St. Paul, Minn. 55113

Sept. 28-Oct. 1, 1969: Association for Systems Management International (formerly Systems and Procedures Association) International Systems Meeting, New York Hilton Hotel, New York City, N.Y.; contact Richard L. Irwin, Association for Systems Management, 24587 Bagley Rd., Cleveland, Ohio 44138.

Oct. 1-5, 1969: American Society for Information Science, 32nd Annual Meeting, San Francisco Hilton Hotel, San Francisco, Calif.; contact Charles P. Bourne, Programming Services, Inc., 999 Commercial St., Palo Alto, Calif. 94303.

Oct. 6-10, 1969: Second International Congress on Project Planning by Network Analysis, INTERNET 1969, International Congress Centre RAI, Amsterdam, the Netherlands; contact Local Secretariat, c/o Holland Organizing Centre, 16 Lange Voorhout, The Hague, the Netherlands

Oct. 13-16, 1969: Association for Computing Machinery (ACM) Symposium on Data Communications, Calloway Gardens, Pine Mountain, Ga.; contact Edward Fuchs, Room 2C-518, Bell Telephone Laboratories, Inc., Holmdel, N. J. 07735; Walter J. Kosinski, Interactive Computing Corp., P.O. Box 447, Santa Ana, Calif. 92702

Oct. 15-17, 1969: IEEE Tenth Annual Symposium on Switching and Automata Theory, University of Waterloo, Waterloo, Ontario, Canada; contact Prof. J. A. Brzozowski, Dept. of Applied Analysis and Computer Science, University of Waterloo, Waterloo, Ontario, Canada

Oct. 22-24, 1969: IEEE 1969 Systems Science and Cybernetics Conference, Philadelphia, Pa.; contact C. Nelson Dorny, Moore School of Electrical Engineering, Univ. of Pa., Philadelphia, Pa. 19104.

Oct. 26-30, 1969: ACM/SIAM/IEEE Joint Conference on Mathematics and Computer Aided Design, Disneyland Hotel, Anaheim, Calif.; contact J. F. Traub, Program Chairman, Computing Science Research Center, Bell Telephone Laboratories, Inc., Murray Hill, N.J. 07974.

Oct. 27-31, 1969: Business Equipment Manufacturers Assoc. (BEMA) Annual Business Equipment Exposition and Management Conference, New York Coliseum, Columbus Circle, New York, N.Y. 10023; contact Laurance C. Messick, Business Equipment Manufacturers Assoc., 235 East 42nd St., New York, N.Y. 10017

Oct. 30-31, 1969: Assoc. of Data Processing Service Organizations Management Conference, Regency Hyatt Hotel, Atlanta, Ga.; contact Jerome L. Dreyer, Assoc. of Data Processing Service Organizations, Inc., 420 Lexington Ave., New York, N.Y. 10017.

November 15-16, 1969: ACUTE (Accountants Computer Users Technical Exchange), Jack Tar, San Francisco, Calif.; contact ACUTE, 947 Old York Rd., Abington, Pa. 19001

Nov. 18-20, 1969: Fall Joint Computer Conference, Convention Hall, Las Vegas, Nev.; contact American Federation for Information Processing (AFIPS), 345 E. 47th St., New York, N.Y. 10017

March 17-20, 1970: Symposium on Management and Economics in the Electronics Industry, Edinburgh, Scotland; contact The Conference Department, The Institution of Electrical Engineers, Savoy Place, London W. C. 2 England □

C.a

PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 694: BITS AND PIECES

"You're not practicing writing bits, are you?," Al asked, looking at the sheet full of 1's and 0's Bob was working on.

"No. I thought I could solve this problem by working out a few small cases to see what was going on and then extrapolating. But it's proving to be a bigger job than I expected."

"Is that the same Majority Function part of that control program you were working on last week?"

"Yes. The boss wants the input stream broken up into segments, and to smooth things out, every three bits is to be replaced by the bit that's in the majority, thus ending up with pieces two bits shorter." Bob added as an afterthought, "But he doesn't want to get all 0's. That apparently makes things difficult."

"Well, if these bits come in at random he's going to get some all-zero cases whether he wants them or not."

"That's true, but the longer you make the stretch you take at a time the less likely the smoothed stream is to be all zero. He wants to have less than a 1% chance of getting all 0's."

"What do you get for those cases you've worked out by hand?," Al asked.

"Well, with three bits you're equally likely to get 0 or 1 in the majority. With four bits the chance of getting two 0's is 3/8 and with five bits, only 9 of the 32 possible combinations yield three 0's. I don't feel like going beyond that with pencil and paper."

"Why not make the segments very long, say 100 bits long. I'll bet that would do the trick."

"Yes, but for our purposes the pieces should be as short as possible. In other words we want the smallest N so that when this majority function is applied to all N bit long combinations of 1's and 0's, less than 1% of the resulting N − 2 long segments will be all zero. Any bright ideas?"

Solution to Problem 693: Homework on the Range

The required 'range' is in two parts, from N equal to the cube root of 2 to N equal to the square root of 2, and from N equal to the cube root of 3 to N equal to the cube root of 4. The values in between the square root of 2 and the cube root of 3 are not part of the solution. □

Readers are invited to submit problems (and their solutions) for publication in this column to: Problem Editor, Computers and Automation, 815 Washington St., Newtonville, Mass. 02160.

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

CONTINENTAL ASSURANCE CO. USING COMPUTER TO TAILOR INSURANCE POLICIES TO THE BUYER'S NEEDS

Continental Assurance Co., Chicago, Ill., is using a computer to create insurance policies to fit the buyer rather than have the buyer fit the limits of 'packaged' policies. The new concept, called Comp-U-Term, permits each prospective life insurance buyer to design his own, one-of-a-kind policy.

The tailored insurance concept, introduced last fall, runs on an IBM System/360 Model 50. Herbert DePrenger, Executive vice president and originator of the concept, said the company devoted six and a half man years of actuarial and programming effort to develop Comp-U-Term.

Under the plan, agents can specify for each prospective buyer such factors as length of term, premium and benefit structure, convertibility, renewability, waiver of premium and accidental death options. The data is sent to the computer center on a special proposal request form. It includes some 25 variable factors which the agent may adjust in designing a customized policy. There is virtually no limit to the number of proposals which can be generated by the IBM computer. Each change in request data triggers a new proposal which can be produced in about 15 seconds.

Comp-U-Term breaks all the traditions of the life insurance business by doing away with the standard rate book and replacing it with a fluid structure that can be different in each instance.

DOCTORS APPLY TECHNIQUES OF NUCLEAR MEDICINE AND COMPUTERS TO DETECT GROWTH OF CANCER IN HUMAN BODY

Doctors at Long Island Jewish Hospital in Hyde Park, N.Y., are using a Honeywell Series 16 computer with a device called a scintiscanner to find thyroid and brain tumors directly in patients and to pinpoint the location and size of the growth. Until recently, clinical examinations and the x-ray machine were relied upon almost exclusively to locate tumors. While still useful, the technique does not pick up all tumors. Dr. Lester M. Levy, head of Long Island Jewish Hospital's nuclear medicine division, explained that while many patients have enlargements of the thyroid glands, the problem is that of selecting those that really need surgery.

The thyroid gland is made up of two lobes connected by a thin bridge of tissue called the isthmus. A tumor normally causes an enlargement of one of the lobes. To check out these enlargements, Dr. Levy's patients are given a derivative of an atomic metal and examined with a scintiscanner. The scintiscanner presents an image of the distribution of radioactive isotopes. The results are digitized and fed to the Honeywell computer which draws a picture of the area being studied.

"Nodules caused by cancer do not function or pick up the chemical and do not transmit rays to the scintiscanner," Dr. Levy said. A "cold" area in the midst of a thyroid enlargement is a suspicious sign indicating a patient may need surgery. (The situation is reversed in scanning for brain tumors since the normal brain excludes most foreign substances. Large amounts of concentrated isotope in the brain would usually indicate a problem area.)

Dr. Levy's work already has resulted in the detection and location of cancerous growths in both the thyroid and brain regions. He said that one of the greatest advantages of the system is determining the exact location of very small tumors. "While the work is still young," he said, "computer-processing appears very promising."

KNX NEWSRADIO BROADCASTS COMPUTERIZED TRAFFIC SERVICE TO HOLLYWOOD FREEWAY COMPUTERS

KNX Newsradio, a CBS-owned station in Los Angeles, Calif., is providing freeway commuters with a computerized traffic service. The service, which began in late September of 1968, evaluates the time delays and computes total travel time, allowing the motorist, using his knowledge of alternate routes, to bypass congested portions of the freeway.

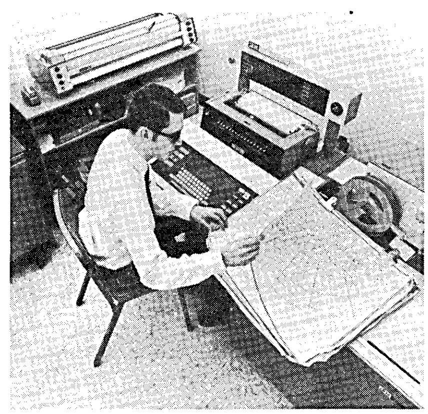
KNX uses an SDS Model 940 Time-Sharing Computer System located at Scientific Data Systems' Time-Sharing Service Center in El Segundo, Calif., to provide its computerized traffic service to the freeway commuters. An actual print-out of a traffic report from the computer follows: "For the Hollywood Freeway, northbound, between Silver Lake and Hollywood Boulevard at 4:00 p.m., with one lane blocked and no adverse weather conditions, the average delay is 30 seconds for a distance of 2.48 miles. Total time of travel is 3.25 minutes."

By using SDS Time-Sharing Services, KNX can immediately access the 940 computer from any location via a standard telephone and typewriter terminal. George Martin, KNX traffic reporter, has a terminal in the same room with his radio monitor equipment. When he learns of a traffic slow-down on the freeway, Martin types the information into the computer located 15 miles away from the KNX studios. Answers start coming back in milliseconds.

Predictions take into account such factors as weather, time of day, accidents or incidents blocking one or more lanes — even the reactions of rubber-necking motorists who often slow down to view an accident on the roadway. Traffic reports are broadcast seven days a week during heavy driving periods.

OCEAN WEATHER ANALYSIS AND COMPUTING SYSTEM HELP SHIPS CROSS HIGH SEAS

To help merchant ships cross the oceans through areas of best weather, Pacific Weather Analysis Corporation (Menlo Park, Calif.) uses an IBM computing system which keeps track of the rapidly changing ocean weather and as many as 300 moving ships at a time. By studying ocean weather maps and the location of



each ship, the firm's meteorologists can advise captains of the most favorable courses to steer. Each ship receives advice periodically by radio.

An IBM 1130 computing system constantly monitors the progress of each ship and can pinpoint a ship's location at any given moment. Weather information from teletype machines is fed into the IBM 1130, along with periodically teletyped position and course reports radioed from ships served by Pacific Weather Analysis. A plotting device attached to the computer automatically prepares maps every six hours showing the position and course of each ship and the prevailing weather at numerous locations across the seas. The maps also show "sea and swell" — the prevailing disposition and currents of the waters.

By studying these maps, weather experts can advise ships by radio of changes in course that will result in the best weather and most favorable crossing time. These advisories can save ships an average of 12 to 24 hours time in crossing an ocean. Course changes have been offered that saved up to six days' crossing time.

Pacific Weather Analysis Corporation constantly receives weather data from every legitimate source, including domestic and foreign weather bureaus, satellites and ships. The firm serves 70 American and foreign shipping lines and has helped guide ships through more than 25,000 ocean crossings.

INDIANA LEGISLATORS USE COMPUTER-BASED SYSTEM TO AID IN FISCAL CONTROL

Indiana legislators are using a new computer-based system to monitor the financial impact and trace the whereabouts of some 2,000 bills expected to come out of the 96th General Assembly presently in session. Computer terminals, IBM 2260 visual display stations, have been installed in chambers of both the House of Representatives and the Senate. Requests for information on any bill are keyed into the terminal by legislators. Lawmakers also may use the terminals to update legislative records.

Information is stored in an IBM System/360 Model 50 in use at the State Building computer center to support the work of 30 different agencies of state government, including the legislature. When a bill is introduced in either house, all pertinent information, including a brief description of its contents, are filed in the computer. As the bill is acted on and moves through committees, these actions are recorded in the computer. A request can be made into the system at any time to find out where a bill is. Information displayed on the terminal includes a brief description of the bill, every action taken on it since its introduction, where it now rests and its fiscal impact.

Authors of new legislation are required to specify how much their bill will cost or how much revenue it will generate for the state. This fiscal information is entered into the computer and becomes a valuable aid in fiscal control. At the end of each day, a printout is produced by the Model 50 computer, summarizing legislative activity and providing totals on all proposed expenditures and anticipated revenue represented by legislation. This daily log is used by the Legislative Council's Fiscal Management Division in counseling with legislators and other elected state officials on the advisability of legislation under consideration.

EDUCATION NEWS

COMPUTER COURSE ESTABLISHED BY HONEYWELL EDP FOR GEORGIA CORRECTIONS DEPARTMENT

A pilot program to teach computer fundamentals and operation to teenage boys at the Georgia State Board of Correction's Alto juvenile home has been announced recently by Georgia Gov. Lester Maddox. Gov. Maddox said that Honeywell's Electronic Data Processing Division has offered the program to the state without cost as a means of helping in the rehabilitation of the teenage boys.

Eleven volunteer teachers from Honeywell's Southeast region and Atlanta branch offices will conduct the training class at the detention home in northeast Georgia. The instructors will take a model of a computer operator's console and a working model of Keytape, a data preparation device, to the juvenile home so that the students may have "hands-on" experience with computer hardware. The pilot program will include 15 to 20 boys in the 16 to 19 year old bracket. (There are about 800 inmates at the Alto juvenile home.)

The training course will begin with a series of aptitude tests. Instruction will last approximately six weeks and then will be evaluated before being continued. If there is sufficient interest and aptitude among the boys, Honeywell will continue the course.

THE NATIONAL LAW CENTER OF THE GEORGE WASHINGTON UNIV. ANNOUNCES COMPUTERS-IN-LAW GRADUATE RESEARCH FELLOWSHIP

The National Law Center of The George Washington University, Washington, D.C., has announced the offering, under its Computers-In-Law Institute, of the Computers-In-Law Graduate Research Fellowship. This fellowship is for the nine month academic year and will be awarded for research and related study in the combined computer and law disciplines. The stipend is in the amount of approximately $7,800 (which includes $1,800 for tuition).

The research fellow must hold an LL.B. (or equivalent degree) and will be expected to be competent in some aspect of computer technology, including sufficient ability in at least one programming language to code his own programs. University courses in software or hardware will be available, if needed, as part of his Master of Laws degree program.

The fellow will undertake an approved program of research and study under the direction of a faculty member associated with the Computers-In-Law Institute. This program will lead to an LL.M. degree after two semesters of residence. For fellows successfully completing the first year, a follow-up J.S.D. fellowship for the succeeding year of approximately $8,800 may be available.

NEW PRODUCTS

Digital

L2000 BILLING COMPUTER / Burroughs Corp.

A desk-size electronic billing computer, designated the L2000, has been developed by Burroughs Corp., Detroit, Mich. The L2000 utilizes integrated circuitry, disk memory, and fourth generation software techniques called "firmware," or strings of micro-instructions stored in disk memory.

— L2000 Billing Computer

Firmware provides complete internal control of computation, print formatting, printer positioning, forms movement, and console and peripheral data input and output. Every application program automatically resets these controls for the operator.

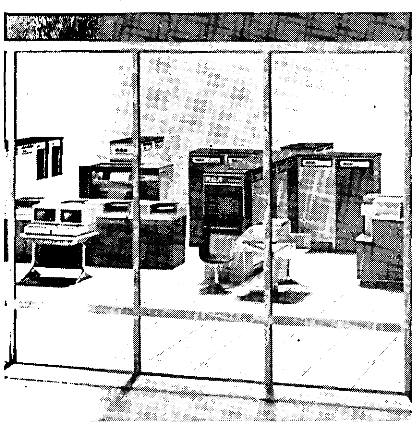
The L2000's five major components of the main operator console include: memory, logic, in and out controls, keyboard, and a high speed printer and forms handler. These are controlled entirely by the micro-instructions of the firmware.

Concurrent with introduction of the L2000, Burroughs' President Ray W. Macdonald announced that application programming for the system will be priced separately from the computer hardware and basic firmware. A series of standard application packages is available with the L2000, such as general billing; completion billing with automated order writing; automatic sales report preparation, and others.

The L2000 billing computer and the previously announced TC500 terminal computer are part of the new Burroughs family of systems which can be used either as independent off-line computers or as on-line terminal computers that can perform remote processing and data communications with large scale computer systems.
(For more information, designate #41 on the Reader Service Card.)

SPECTRA 70/60 COMPUTER / RCA

Introduction of RCA's Spectra 70/60 computer marks the company's entry into the $1.8 billion domestic market for large-scale computers. The 70/60 is intended primarily for volume input-output jobs. Principal applications for the new computer include retail credit card systems, automated production control, transportation systems and business and governmental data networks.



— RCA Spectra 70/60 system. The processor, center rear, is shaped like a large plus sign.

The Spectra 70/60 is more than three times faster than the medium scale 70/45. Memory modules may be added according to user needs, up to a maximum of 1,048,576 bytes (computer words). Input-output rate for transferring data is up to four million bytes per second. Any combination of a large array of data storage and input-output devices can be used with the new system.

The Spectra 70/60 provides full language compatibility with the IBM 360, with all instructions, character codes and non-privileged features functionally the same in both systems. Various memory sizes and system configurations are available. Shipments of the new computer — seventh in the Spectra 70 line — will begin in the second half of 1970.
(For more information, designate #42 on the Reader Service Card.)

GE-410 TIME SHARING SYSTEM / General Electric Co.

General Electric's new member of the GE-400 family of time-sharing systems, the GE-410, is designed for large industrial businesses, government agencies, service bureaus and commercial banks. The GE-410 will serve up to 10 scattered user keyboard terminals simultaneously. As many as 40 terminals may be accommodated by a single system. When not operating in a time-sharing mode, the GE-410 may be used for batch processing.

The basic configuration of the GE-410 includes a central processor with console typewriter; two DSU160 removable disc storage units (providing over 15-million characters of on-line storage); one card reader; and a DATANET®-30 data communications processor. The system uses a 32,000-word core memory, with a memory speed of 6.3 microseconds.

Computer software available for the large GE-430 and GE-440 time-sharing configurations also may be used with the GE-410. The new system may be upgraded to a GE-430 or GE-440 system by addition of a few options and without reprogramming or re-training of operators.
(For more information, designate #43 on the Reader Service Card.)

UNIVAC 9200 II and 9300 II SYSTEMS / Univac Division, Sperry Rand Corp.

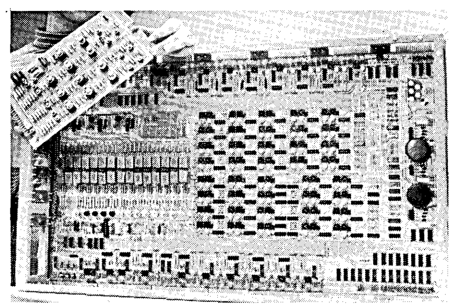
The two new additions to Sperry Rand's 9000 series, UNIVAC 9200 II and UNIVAC 9300 II, offer increased capabilities and versatility over the earlier models. The new systems, compatible in hardware and software with the 9200 and 9300, offer five print speeds varying from 250 to 1600 lines per minute; two disc subsystems with from 3.2 to 58 million bytes of direct access storage; card readers ranging from 400 cards per minute in single file operation to over 1000 cards per minute with a multi-file unit; and three card punches producing 75 to 25 cards per minute.

Maximum main storage capacity of the 9200 II is doubled over that of the 9200 from 16,384 to 32,768 bytes of plated-wire memory. Memory cycle time is 1.2 microseconds per byte for the 9200 II and 600 nanoseconds for the 9300 II. Software for the two new computers includes Basic Card, Tape and Disc Operating Systems.

The new tape systems are scheduled for deliveries beginning in six months time; disc system deliveries are planned for March of 1970.
(For more information, designate #44 on the Reader Service Card.)

PRODAC 2000 COMPUTER SERIES / Westinghouse Electric Corp.

The new Prodac 2000 series, being produced by Westinghouse Electric Corp., Pittsburgh, Pa., is an integrated circuit, 16-bit, high-speed, random-access digital computer designed for real-time, on-line process control applications. The system offers modular hardware and software.



— The big "macro-sized" circuit board replaces the familiar small circuit board (top, left) in the new Prodac 2000 series. Expansion is accomplished merely by adding of additional circuit cards or portions of cards.

Downtime is essentially eliminated because the basic computer — input/output, memory, and arithmetic function circuits — is contained on just four 16-by-25-inch microcircuit plug-in boards. A malfunction can be corrected by simply replacing one of the four integrated circuit boards. Spares of the cards will be available on a lease basis, and faulty cards can be returned to Westinghouse for repair.

The P-2000 can use the Westinghouse integrated software package called Progen, thus giving the small computer an on-line real-time compiling capability. With Progen,

computer time can be shared with the process being controlled to translate Fortran program statements into new control programs — or to debug existing programs — without interfering with the computer's control of the ongoing process.
(For more information, designate #45 on the Reader Service Card.)

Teaching Devices

CARDIAC (CARDboard Illustrative Aid to Computation) / Bell Telephone Laboratories

CARDIAC is a hand-operated, cardboard model computer which serves as an aid to understanding computer operations and computer programming. The cardboard model has most of the parts found in a large digital computer. The power supply, or energy source is supplied by the student. The student operates the slides and transfers the data from one section of CARDIAC to another as he learns how a computer operates. A supplementary manual relates the device to larger computers and leads the student through ten problems.

David Hagelbarger of Bell Telephone Laboratories (shown with the cardboard device) developed CARDIAC for "Understanding Computers" — the fifth in a series of Bell System Aids-To-High-School-Science programs.
(For more information, designate #46 on the Reader Service Card.)

Software

CODED-CAP / Com-Share, Inc., Ann Arbor, Mich. / A conversational Circuit Analysis Program, CODED-CAP offers AC or DC circuit analysis, parameter variation, gain-phase response and more. Circuits may contain up to 25 nodes and 75 elements. The engineer or designer simply describes a circuit in his own language, specifying the basic elements, component values, and tolerances. Editing features allow correction of errors immediately.
(For more information, designate #47 on the Reader Service Card.)

DATATRAP / Arista, Winston-Salem, N.C. / Specifically developed to reduce program debugging time by 30% to 50%, the software package works with COBOL, PL-1, RPG and Assembler language programs, in System 360/30 and 40 installations, operating under either DOS or TOS. DATATRAP's function is to recognize and note all data exception and other "housekeeping" errors in a program under test, and allow the test to run to completion. A programmer can find and correct virtually all housekeeping errors in the first test run. DATATRAP is delivered complete with installation and operating instructions at a cost of $950, with a 15-day money-back guarantee.
(For more information, designate #48 on the Reader Service Card.)

MACROBIT / Programmatics, Inc., Los Angeles, Calif. / The industry's first patent-protected software package, this mini-computer assembly program is easily adapted to any 8 or 16-bit computer and occupies less than 4K bytes of memory. MACROBIT is described as a full fledged assembler providing relocation, literals, external symbols and even macros. MACROBIT sells for $10,000.
(For more information, designate #49 on the Reader Service Card.)

OS/360 RELEASE 17 / IBM Corporation, White Plains, N.Y. / Improvements in IBM's Release 17 for users of Operating System/360 include: advanced checkpoint/restart capability; more powerful use of auxiliary bulk storage; and the use of Remote Job Entry (RJE) with MFT (Multiprogramming with a Fixed number of Tasks). Schedules call for shipments of the programming package to begin by March 31.
(For more information, designate #50 on the Reader Service Card.)

UPGRADE / Information Management Inc., San Francisco, Calif. / Translation of 1401 production programs to 360 DOS COBOL is performed from machine language object code or an IBM 1401 SPS or AUTOCODER source deck. UPGRADE is available on a service basis (turnaround time averaging three weeks from anywhere in the U.S.) or it may be leased.
(For more information, designate #52 on the Reader Service Card.)

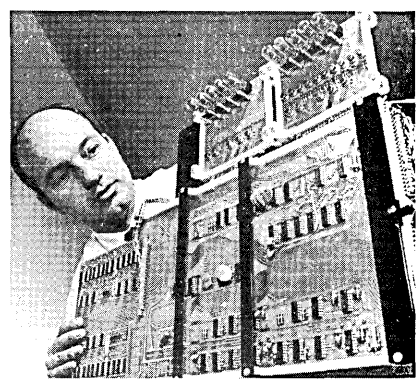
Peripheral Equipment

THREE-AXIS REVERSIBLE SCALER / The MicroMetric Corporation

A new computer accessory, a three-axis reversible scaler, helps machine shops, construction companies and others to more easily convert blueprints, photos and other graphics into computer language. The "digitizer", as the scaler and its plotting table are called, was developed by The MicroMetric Corp., Berkeley, Calif.

As the operator of the scaler traces a blueprint or photo on the system's plotting table, 264 integrated circuits within the instrument translate straight, curved and even three-dimensional tracings to computerized codes. The numbers are displayed as illuminated digits on the control console and are transmitted to a computer card punch or an incremental tape deck.

Personnel with no formal programming experience quickly learn to operate the scaler, freeing trained programmers from routine graphics conversion for more profitable assignments.



— Victor Elisher, MicroMetric engineer, examines integrated circuitry of new scaler system

The use of integrated circuits (from Texas Instruments Inc., Dallas, Texas) has resulted in a scaler which is 25% less expensive, less than a third as heavy, and less than a fourth as large as the more complex scaling equipment formerly available.
(For more information, designate #58 on the Reader Service Card.)

CRT TERMINAL / Bunker-Ramo Corporation

A compact cathode ray tube computer terminal, for processing short messages between non-typist operators and computers, is available from The Bunker-Ramo Corp., Stamford, Conn. Known as Model 2212, it is designed for locations where operators work on their feet or on stools, rather than seated in normal typing position. The block-

type keyboard enables entries and interrogations by operators with no typing skill. The simple operating procedure requires very little training.

The Model 2212 has an integral 6" cathode ray tube for data display, block alpha and block numeric key clusters and a cluster of 24 editing and programmable function keys. The screen can display up to 444 characters on 12 lines. It has a repertoire of all numeric, alphabetic and punctuation characters.

The control unit, containing buffer storage, character generator and communication interface, will handle up to 36 terminals, and will also drive hard copy devices.
(For more information, designate #53 on the Reader Service Card.)

KEY-TO-TAPE INPUT SYSTEM / Cybercom Corp.

Cybercom Corporation of Sunnyvale, Calif., has announced its first product, a key-to-tape input system that its designers say "will enable key-punch operators to up efficiency 30 to 50 percent." The system, known as the Cybercom Mark I key encoder, is compatible with any computer now being produced by a major manufacturer.

The encoder permits the key-punch operator to determine exactly what data is being programmed. Errors are indicated automatically, and the nature of the error is pointed out, allowing instant correction. Cybercom Mark I includes a typewriter-size encoder which records on cassette tape, and a translator, which pools the cassette's information on computer tape. The system can be operated in any part of the plant, independent of the computer room.
(For more information, designate #59 on the Reader Service Card.)

PAGE READING OCR SYSTEM / Scan-Data Corp.

An expandable page reading OCR system, called the 200, has been announced by Scan-Data Corp., Norristown, Pa. This system gives the user a choice of type fonts to match his present requirements. Capabilities for reading up to five fonts can be added as the needs grow.

The 200 reads upper and lower case alphabetics, numerics, punctuation, and symbols. Reading rate is 400 characters per second. There are no mechanical scanning components. Rather, the 200's scan system consists only of a flying spot scanner that reads the document while it is held in position by vacuum
(For more information, designate #57 on the Reader Service Card.)

DATA ACQUISITION INSTRUMENT / Astrodata, Inc.

A data acquisition instrument, called ASTROVERTER, has been announced by Astrodata, Inc., Anaheim, Calif. The device is designed for maximum versatility within a minimum size package.

The ASTROVERTER, designated the Model 3900, consists of a built-in power supply, 16 card slots, and a family of 5" x 5" plug-in cards. It is housed in a compact 7-inch high rack.

The Model 3900 performs as a multiplexer, an analog-to-digital converter, a digital-to-analog converter, a sample-and-hold amplifier and a buffer amplifier depending upon a selection of inserted circuit cards. Any combination of cards can be inserted into the 16 card slots. Two cards provide all circuitry for the 12-bit analog-to-digital converter, while only one additional card is required for sample-and-hold or differential buffering. System configurations are almost unlimited since all cards are identical in size, and can be powered from the built-in supply.
(For more information, designate #67 on the Reader Service Card.)

PROGRAMMABLE SYSTEM CONTROLLERS / Scientific Data Systems

Scientific Data Systems, Los Angeles, Calif., will market two, 16-bit word length, programmable system controllers. The desk-top/rack-mounted units, Models CE16 and CF16 System Controllers, are small, controlling/computing devices, designed for general-purpose application in industrial, aerospace, and educational projects.

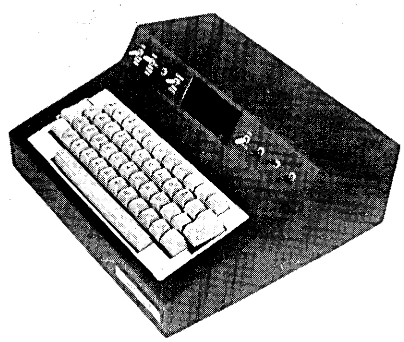
Although identical in appearance, both controllers use the same software, and operate on the same 126 user-oriented instructions. The Model CF16 is approximately three times faster than the Model CE16. Execution time for a fully signed software multiply is 42 microseconds for the CF16 and 126 microseconds for the CE16.

The controllers' instructions and interrupt structure permit automatic multiplexing among a large number of peripheral devices, without ongoing program interference. Special instructions permit data to be transferred directly between the input/output bus and memory in a single cycle time. Deliveries of the Model CE16 began in March; deliveries of the CF16 are expected in September, 1969.
(For more information, designate #68 on the Reader Service Card.)

R1 SYSTEMS FOR KEYBOARD DATA ENTRY / Realtronics Inc.

Realtronics Inc., New York, N.Y., a subsidiary of the Struthers Wells Corp., has announced new data entry systems, designed for keyboard data entry, either to an IBM-compatible magnetic tape or directly to a computer. The basic difference between the new product line, the R1 Systems, and any unit device (punched card, magnetic tape or cartridge) is electronic central control of data keyboards.

Data is entered on the keyboard exactly as in keypunching. The data is transmitted from the keyboard to the central controller where it is



stored. The stored data is transferred to magnetic tape or transmitted directly to a computer on demand. Each of up to 32 keyboards can simultaneously perform data entry, verification, search and error correction.

At any time during a job, status reports on any work in progress can be obtained. The R1 System can produce, on demand, up-to-the-minute performance reports on any operator. These reports include rate of keystroking, number of errors, time distribution and other performance measures.
(For more information, designate #69 on the Reader Service Card.)

ANALOG TO DIGITAL INTERFACE SYSTEM / Datawest Corp.

The DATAWEST Model 380 analog to digital interface system has been announced by Datawest Corp., Scottsdale, Ariz. The system consists of a high level (single ended or differential) multiplexer, a sample and hold amplifier and a 15 bit binary A/D converter. The DATAWEST Model 301 A/D Converter, heart of the 380 system, is capable of digitizing an analog signal to a resolution of 15 bits binary, at a speed of 250 KHz.
(For more information, designate #71 on the Reader Service Card.)

TWO NEW MODEL 18 TAPE READERS / Computer Mechanisms Corp.

Computer Mechanisms Corp., South Hackensack, N.J., has introduced two new models of its Model 18 Tape Reader for special applications. The new models, 18-C and 18-G Tape Readers, as with CMC Model 18 Tape Reader, have Starwheel sensing at 30 characters per second or more. Output is in the form of contact closures. Tape is read uni-directionally without complex circuitry or timing required.

Model 18-C, an eight channel unit, is designed for direct mechanical coupling of the Tape Reader with other equipment. It has particular application in the high speed printer field. The Model 18-G is specially engineered for use in the graphic arts field, and can effectively handle a six channel paper tape with advanced feed hole.
(For more information, designate #70 on the Reader Service Card.)

MULTI-CHANNEL A-D CONVERTER / Electronic Engineering Co.

A high speed combination Multiplexer and Analog-to-Digital Converter is now available from Electronic Engineering Company of California, Santa Ana, Calif. The new device — called the EECO Model 1202 — is capable of 200,000 complete conversions per second with a resolution of 15 binary bits, and will accept up to 128 single-ended input channels.

The EECO 1202 will operate in automatic mode — external command mode, random or sequential channel select — or manual mode. The conversion method is a combination parallel decision, serial approximation technique in which 4 bits are generated in parallel at each decision, with a one bit overlap for possible correction of the previous decision. A sequence of 5 decisions is performed in less than 5 useconds.

Analog input range of ±10V is standard, with optional ranges from ±5V to ±100V. The output code is 2's complement. The output and the channel address are displayed on the front panel. Front panel thumbwheel switches enable any channel to be displayed while operating at any sampling rate. An optional serial output with a 10MHz bit rate is available as well as the standard parallel output.
(For more information, designate #72 on the Reader Service Card.)

OSCILLOSCOPE PATIENT MONITORING STATION / Spacelabs, Inc.

A 17" oscilloscope display, for coronary, intensive care, and surgical monitoring, has been announced by Spacelabs, Inc., Van Nuys, Calif. The new scope has complete interchangeability of up to six plug-in modules for display of various physiological measurements. By plugging in the appropriate modules, any combination of measurements may be selected for an individual patient or surgical procedure. (Several modules are presently available; others soon will be released.)

The scope has been designed for computer compatibility. It is available in either a self-contained cabinet or in a rack mountable configuration. The display is capable of displaying up to twelve traces simultaneously with sweep speeds of 25, 50, and 100 mm/sec. Also included is an audible alarm and QRS beep tone.
(For more information, designate #54 on the Reader Service Card.)

TYPEWRITER-TO-COMPUTER TAPE SYSTEM / RJ Communication Products, Inc.

The typewriter-to-computer tape system, DS-10, announced by RJ Communication Products, Inc., Phoenix, Ariz., uses an IBM Selectric or Model 8 typewriter plugged directly into one of three digital incremental recorders manufactured by Delta-Corders, Inc., a subsidiary of RJ Communication Products. The system eliminates key punching and other data conversion steps. No special operator training is required. It has data densities of 800, 556 or 200 bpi, can store over 180 hours of typing on a six inch reel and is completely portable.
(For more information, designate #55 on the Reader Service Card.)

OPTICAL PAGE READER / Farrington Manufacturing Co.

A low-cost Optical Page Reader announced by Farrington Mfg. Co., Springfield, Va., reads typed or printed alphanumeric information from documents up to 8½ x 14" with either Farrington 12L or USASCSOCR type fonts — at speeds up to 400 characters per second. Designated the 3050, it is designed specifically for input applications involving ten or more keypunch operators. The 3050 includes on-line character insertion, rescan, document counting and marking capabilities.
(For more information, designate #56 on the Reader Service Card.)

Data Processing Accessories

DATA PROCESSING SAFE / Wright Line

Wright Line, a division of the Barry Wright Corp., Worcester, Mass., recently announced that their Data Bank Safe (manufactured exclusively for Wright Line by Schwab Safe Co., Inc.) successfully completed Underwriters' Laboratories testing standards for four-hour electronic data processing media safes. Prior to the establishment of a four-hour standard, the highest rating accorded any EDP media safe was for a two-hour test during which outside temperatures reached 1850°F in two hours.

The four-hour test subjects the safe to temperatures reaching 2000°F in four hours. Temperatures inside the safe may not exceed 150°F at any time during heating and cooling, and relative humidity may not exceed 85%. Magnetic computer media are highly susceptible to both heat and moisture; temperatures and/or humidity in excess of these limits can result in loss of information or read-out errors.

The Data Bank Safe is offered by Wright Line for sale or under a variety of rental or leasing plans.
(For more information, designate #60 on the Reader Service Card.)

COMPUTER ROOM AIR CONDITIONER / Westinghouse Electric Corp.

A down-flow air conditioner, specifically designed for computer rooms, is the joint development of the Westinghouse architectural Systems Department, the Westinghouse Air Conditioning Division, and the Westinghouse Product Transition Laboratory. The new air conditioner uses plug-in modular humidity and temperature controls; they are automatic and solid state for greater accuracy. Air temperature is controlled to 72°F plus or minus 2 degrees and relative humidity to 45 plus or minus 5 percent.

To provide for assured continuity of service, all major components are doubled. In the event that a unit should fail, the air conditioner will continue to operate at half capacity indefinitely or until the defective unit is repaired or replaced.

The new air conditioner is fully insulated and can be serviced from the front for component changes and from the top for filter changes. An integral main disconnect switch mounted on the unit eliminates the need for a separate disconnect installation. For added safety, a latch mechanism locks the control box door so that it cannot be opened when the power is on. Indicating lights on the front panel provide instant checking of all functions of the dual component systems, even if only one is operating at a time.

Models UK90, UK120, and UK180 are rated at 7½, 10, and 15 tons, respectively. Lengths of the three units are 57, 75, and 99 inches; all units are 34.5 inches wide by 77.5 inches high.
(For more information, designate #61 on the Reader Service Card.)

POCKET REGISTER FOR SOURCE DATA WRITING / Moore Business Forms, Inc.

The Pocket Register from Moore Business Forms, Inc., Niagara Falls, N.Y. speeds collection of original source data for ultimate computer or other uses. The Register is light, compact and portable, and goes wherever a record must be written — at receiving docks, switchboards, desks, counters, etc.

It is used in connection with Flatpakit forms and can accommodate 100 two-part forms in numerical sequence. A file compartment is provided to store completed forms. (Three and four part forms also can be used in the Register.)
(For more information, designate #62 on the Reader Service Card.)

COMPUTING/TIME-SHARING CENTERS

"PACKAGED" DATA SERVICE FOR SMALL STORES ANNOUNCED BY NCR

The smaller retailers now may have the advantages of the computer through a "packaged" data processing service designed and developed by the National Cash Register Co., Dayton, Ohio. The major provision of the new automation program is monthly accounts-receivable processing; sales analysis and clerk-activity reports also are included.

Available through NCR data processing centers, the retailer may, if he chooses, simply send sales slips to the data center nearest him. In this case, the data center personnel encode the sales data for entry into the computer.

The retailer, if he prefers, may prepare his own computer "input" by using a low-cost NCR adding machine especially designed for use with the package. (The adding machine comes in two models offering either 10 or 14 rows of keys; it may be purchased or rented.) If the store prepares its own input by the adding machine method, the result is paper tape printed in machine-readable figures. The tape is run through an optical scanner at the data center, and the data thus entered into the computer.

For those who prepare their input by adding machine, the data processing fee ranges upward from $60 a month depending on volume. This covers not only computer time, but the assigning of account numbers, preparation of credit cards for the retailer's customers, and other services associated with accounts-receivable processing.
(For more information, designate #63 on the Reader Service Card.)

TELE-COMPUTER SERVICE CENTER OPENED BY WESTINGHOUSE IN CHICAGO

Westinghouse Electric Corporation has opened its first Tele-Computer Service Center in Chicago, Ill. The new center will provide manufacturers with a wide variety of services especially useful to users of numerically controlled (N/C) machine tools.

The Center offers computer-aided machine programming assistance to parts programmers (those that prepare the punched tapes for N/C machine tools); computer time; and in-plant terminal hardware (remote terminals, with tie lines to computers at the service center and in Pittsburgh).

The Chicago service center has an IBM 1130 computer with tie lines to an IBM 360/75 ASP computer system and an RCA 70/46 computer system, both located in Pittsburgh. Peripheral equipment, including high-speed printers, tape punchers, card readers, and two-axis plotters, also is available at the center. Westinghouse plans to place other Tele-Computer Service Centers in operation soon in most of the business centers in the country.
(For more information, designate #64 on the Reader Service Card.)

MIDWESTERN COMPUTER CENTER OPENED IN SUBURBAN CHICAGO BY SPERRY RAND UNIVAC

Newest in the nationwide chain of data processing centers being established by Sperry Rand's Univac Information Services Division is the Univac Midwestern Computer Center located in Oak Brook, 17 miles southwest of downtown Chicago, Ill. The Center, including offices and conference rooms, has 13,000 square feet of space.

The facility utilizes a UNIVAC 1108 Computer System as the keystone of its data processing services. Remote data processing will be one of the major functions of the UNIVAC 1108 complex. To more economically facilitate remote batch processing ISD now offers a new service known as RPS (Remote Processing Service).

In addition to the UNIVAC 1108 System, other computing equipment at the Center includes a UNIVAC 418 Computer System, 10 high-speed memory drums, 20 magnetic tape units, two FASTRAND mass memory storage units, three UNIVAC 1004 Systems, up to 35 communication lines, a high-speed printer, and a variety of other equipment.

The Center's capabilities will enable it to process programs originating anywhere in the country. Communication lines will connect the Midwestern Computer Center to all of the ISD Centers in the United States.

COMPUTER-RELATED SERVICES

DUN & BRADSTREET MARKETING DATA BANK NOW COVERS MORE THAN THREE MILLION COMPANIES

Market profiles on more than three million commercial business establishments in the United States and Canada are now available from a computerized data bank set up by Dun & Bradstreet, Inc., New York, N.Y. Last November, when the marketing service was announced, it covered business establishments only in New York, New Jersey, Pennsylvania, and Delaware. Expansion of the data bank — Dun's Market Identifiers — makes vital marketing information available to any size business.

Dun's Market Identifiers provides current market, sales, advertising, and research data which D&B has gathered in the course of its nationwide business reporting operations. Subscribers can use it to find new prospects, define markets, maintain current mailing lists, determine market potential, measure market penetration, and obtain the information needed to plan advertising, perform market research, and manage sales.

Eugene V. Reichstetter, executive vice president and general manager of the Dun & Bradstreet Business Information Division, said, "Our experience in the industrial marketing field leads us to believe that many companies are only scratching the surface when it comes to locating and reaching their entire prospect population."
(For more information, designate #65 on the Reader Service Card.)

COMPUTER ORIENTED BOOKKEEPING AND ACCOUNTING SYSTEM FOR PHYSICIANS

Computer Management Consultants, Inc., Skokie, Ill., has developed a computer-oriented system of recording, billing and information retrieval to help the busy practicing physician minimize the time that need be spent on bookkeeping and accounting chores.

The CMC system, termed COMPUDOC, is based upon the purchase or lease by the physician of: a data transmission unit, which looks like an ordinary telephone touch-tone dial instrument with areas for card insertions and a print-out receipt tape; a set of plastic cards imprinted with account numbers representing the practice, the patient, and their respective addresses; and another set of plastic cards imprinted with account numbers which represent professional services performed.

The data transmission device in the physician's office is linked via ordinary telephone lines to a new CMC development, a data acquisition and storage device which will accept information from thousands of medical practices. The device stores the information, then sends it at the appropriate time each month to the central computer at CMC's Skokie headquarters, and later retrieves the information following billing for future use by the physicians.

COMPUDOC transfers the bookkeeping and billing responsibilities of a physician's office to the computer. The physician saves valuable time, reduces overhead, increases efficiency of billing and collection procedures, and receives periodic billing and cost analysis statements. It is estimated that all of COMPUDOC's services are available for approximately 21 cents a transaction, including the computer services, billing preparation, and other necessary components.
(For more information, designate #66 on the Reader Service Card.)

MEETING NEWS

FULL DAY SESSION ON "HUMAN USES OF COMPUTERS FOR EDUCATION" AT SJCC

As part of the 1969 Spring Joint Computer Conference, May 14-16 in Boston, Mass., many of the nation's educators will learn how computers can help teach math and science and improve skills in logical thinking and expression. The instruction will be given at a one-day (May 16) session "Human Uses of Computers for Education".

Lesson plans for the educators include two theses: 1) computer use in schools will become economically feasible much faster than believed; and 2) computers will help education along lines not yet familiar to most educators.

The Spring Joint Computer Conference is sponsored by the American Federation of Information Processing Societies (AFIPS), a non-profit society of more than 40,000 computer specialists in the United States who represent seven computer-related organizations.

NEW LITERATURE

INDEX OF OPPORTUNITY IN THE COMPUTER SCIENCES PUBLISHED BY RESOURCE PUBLICATIONS INC.

Career opportunities in the computer field are the subject of a new directory, THE INDEX OF OPPORTUNITY IN THE COMPUTER SCIENCES. This paperbound guide, published by Resource Publications Inc., Princeton, N.J., gives information on specific jobs with nationwide companies. The guide contains geographic and occupational indexes plus full-page profiles of each company.

The profiles contain a company description, a breakdown of areas of endeavor, listing of each firm's job opportunities, special features, benefits, and the personnel contact. The organizations include very large companies, such as Aerojet General and Calcomp, as well as smaller firms, such as Applied Data Research and University Microfilms.

Employment opportunities outlined in the directory include the entire spectrum of computer design and application — from integrated circuit fabrication and systems programming to computer service sales and customer support.
(For more information, designate #73 on the Reader Service Card.)

A SURVEY AND ANALYSIS OF THE U.S. COMPUTER TIME-SHARING INDUSTRY

A Time-Sharing Industry Directory has been published by Time-Sharing Enterprises, Inc., King of Prussia, Pa. The 200-page volume includes: data sheets on each time-sharing vendor describing the kind of service provided, equipment used, cost of service, etc.; a chart showing the geographic location of vendors; a chart listing vendors by the type of equipment used; and a section on how to select a vendor with forms for rating vendors.

The Directory is prepared in single sheets put in a ring binder, and is updated six times per year. (For more information, designate #74 on the Reader Service Card.)

ORGANIZATION NEWS

CONTROL DATA CHARGED WITH PATENT VIOLATION BY POTTER INSTRUMENT

Potter Instrument Co., Plainview, L.I., N.Y., has filed a suit charging Control Data Corporation with patent infringement. Potter charges that the Control Data line of magnetic disk and magnetic tape drives utilizes apparatus covered under Potter patents. "It is interesting and a little ironic to note," said John T. Potter, president, "that CDC is suing IBM for unfair competition, yet IBM has paid for the use of one of the very patents being violated by CDC."

The two patents specifically cited in the suit against Control Data Corporation are U.S. Patent No. 2,674,728 issued in the name of John T. Potter, and U.S. Patent No. 3,263,223 issued in the name of George E. Zenzefilis. Both are assigned to Potter Instrument Company. The Potter suit was filed in the U.S. District Court, Southern District of Indiana.

XEROX ACQUISITION OF SDS APPROVED BY BOTH BOARDS

The tentative agreement of Xerox Corp. and Scientific Data Systems to merge (as reported in the March issue of Computers & Automation) has been approved by both firms' Boards of Directors. Shareholders of both companies will be asked to approve the merger agreement at their respective annual meetings on May 15.

The agreement approved by the Boards provides that, effective upon the merger, four officers of SDS will become Directors of Xerox. They are: Arthur Rock, Chairman; Max Palevsky, President; Sanford Kaplan, Sr. Vice President, Finance and Administration; and Dan L. McGurk, Executive Vice President.

DATA COMMUNICATIONS COMPLETES ACQUISITION OF CARTERFONE

Carterfone Communications Corp. has been acquired by Data Communications Systems, Inc. for an undisclosed amount of common stock.

Data Communications Systems manufactures an accoustical coupler which permits the transmission of data over ordinary telephone lines between various terminal devices and computers. Carterfone Communications manufactures the Carterfone device which links the private 2-way radio system to the public telephone system.

Such a link was heretofor illegal because of tariffs filed by AT&T with the Federal Communications Commission. Those tariffs were ruled unreasonable and unlawful in an antitrust suit filed against AT&T by Carterfone.

NEW COMPANIES

COMPTERM CORP., Phoenix, Ariz. / Manufacture and market computer peripheral equipment.

D/P COMPUTER SERVICES, INC., Evansville, Ind. / Provides management consulting in the fields of data processing and modern information technology, with special concentration on commercial or business use of EDP.

MACRO SYSTEMS ASSOCIATES, Newport Beach, Calif. / A systems technology and computer applications organization; primarily concerned with system analysis and software development on the total systems level.

SCHOLARSHIP SEARCH CORP., New York N.Y. / Specializing in computerized financial aid search service for students seeking to further their education; the service does not secure or offer financial aid, but helps the student locate existing items for which he qualifies.

TRAVCOM, INC., Hartford, Conn. / A wholly-owned subsidiary of The Travelers Corporation / Develop, market and operate computerized "total information systems" for hospitals and other medical and health care institutions, governmental-municipal services, education, business and industry.

FINANCIAL AND BUSINESS NEWS

Box Score of Sales & Income for Computer Field Firms

C&A presents below comparative operating results
for firms of interest to computer people, as distilled from the latest group of news releases.

COMPANY	PERIOD	SALES Current Period / Previous Period	(%)	NET INCOME Current Period / Previous Period	(%)	NOTES
Applied Data Research, Inc., Princeton, N.J.	Year ended December 31, 1968	$4,188,309 $2,870,380	(+46%)	$528,515 $234,245	(13%)	Proprietary software sales, almost 1/2 of '68 operating revenues
Control Data Corp., Minneapolis, Minn.	Year ended December 31, 1968	$289,012,438 $200,605,874	(+44%)	$45,508,983 $41,742,205	(90%)	
Computer Leasing Co., Washington, D.C.	Year ended 1968	$30,428,000 $21,109,000	(+44%)	$3,276,000 $1,625,000	(102%)	
Diebold Computer Leasing Inc., New York, N.Y.	Year ended December 31, 1968	$12,813,000		$1,098,000		First full year earnings report (operations began Oct. '67)
Dynamics Research Corp., Stoneham Mass.	Year ended 1968	$4,929,023 $3,936,673	(+25%)	$7,631 $53,429 (Loss)		
Greyhound Computer Corp., Chicago, Ill.	Year ended December 31, 1968	$39,372,447 $24,431,821	(+61%)	$5,434,116 $4,098,632	(+32%)	
Information Displays, Inc., Mt. Kisco, N.Y.	Year ended December 31, 1968	$1,803,157 $1,132,644	(+59%)	$89,519 $51,551	(+74%)	
The National Cash Register Co.,	Year ended 1968	$1,102,178,000 $1,004,843,000	(+10%)	$35,860,000 $36,520,000	(-2%)	Domestic orders for computer eqpm exceeded those for cash registers or accounting machines for first time

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Sperry Rand Corp., Univac Federal Systems Div.	Federal Aviation Administration	Automated Radar Terminal Systems (ARTS-III) for installations at airport terminals (64 systems over next 4 years). Systems display aircraft identity, altitude, other pertinent flight information adjacent to existing display of aircraft position on flight controller consoles at the terminals. Univac is prime contractor; two major subcontractors, Burroughs and Texas Instruments, will also supply hardware	$35 million
Sanders Associates, Inc., Nashua, N.H.	U.S. Navy	Production of DIFAR sonobuoys; DIFAR is Navy's latest anti-submarine warfare system	$8.4 million
	U.S. Army	Continued volume production of Forward Area Alerting Radar system (FAAR) designed to detect and identify aircraft flying at extremely low levels	$7.1 million
Sprague Electric Co., North Adams, Mass.	unnamed 'major computer manufacturer'	Electronic components; large quantity of monolithic and hybrid integrated circuits account of over $3 million of order; components to be used in memory and arithmetic sections of the computers	$5 million
Mohawk Data Sciences Corp., New York, N.Y.	Digital Equipment Corp., Maynard, Mass.	Page printers and card handling equipment to be used in PDP-9, PDP-10 computer lines	$2+ million
Sylvania Electric Products Inc., a GT&E subsidiary, Needham, Mass.	U.S. Air Force	Continued work on Minuteman II intercontinental ballistic missile (IBM) system; will study launch facility data procg requirements and design equipment for Minuteman ground electronics system	$1.4 million
Astrodata, Inc., Anaheim, Calif.	Lockhead-California Co., Burbank, Calif.	High-speed acquisition system to be used to acquire, record, and reduce test data at Lockheed's Rye Canyon facility	$1,225,000
Computer Sciences Corp., Los Angeles, Calif.	Atomic Energy Commission	First year of 3-year contract to operate a large-scale remote computing center at Las Vegas, Nev., for the AEC; CSC will support AEC in acquiring, installing new 3rd generation computer equipment, and in developing, implementing and maintaining system software	$890,000
Digital Equipment Corp., Maynard, Mass.	Strategic Time-Sharing, Inc., New York, N.Y.	Computer equipment; bulk of order is for 7 of DEC's TSS-8 computer systems	$700,000+
Decade Computer Corp., a subsidiary of REDCOR Corp., Canoga Park, Calif.	Datacap Systems, a division of Datacap Int'l. Inc., Salt Lake City, Utah	Delivery of 30 compact, high-speed computers	$500,000+
Ampex Corp., Redwood City, Calif.	Westinghouse Hagan Computer Systems Div., Pittsburgh, Pa.	Core memories to be used in the new Westinghouse P2000 series computer system	$500,000
Data Products Corp., Woodland Hills, Calif.	Raytheon Computer, Santa Ana, Calif.	A 900 nanosecond memory, the STORE/33, to be used with new 706 Computer System	$400,000+
Scientific Control Corp., Dallas, Texas	U.S. Navy	An additional six Model 660 computers for use in the Poseidon Fleet Ballistics project; delivery will be to General Electric in Pittsfield, Mass. and Raytheon in Waltham, Mass. for on-line factory checkout of Poseidon equipment	$400,000+
Ampex Corp., Redwood City, Calif.	Digi, Inc., Salt Lake City, Utah	One hundred TMZ digital tape memory systems for use in Digi's new, small computer	$350,000
Mauchly-Wood Systems Corp., Newport Beach, Calif.	NASA's Jet Propulsion Laboratory, Pasadena, Calif.	Continuation of software maintenance covering SFOF (Space Flight Operations Facility) systems of Surveyor and Mariner space flights	$243,000
Computer Applications, Inc., Information Sciences Div., New York, N.Y.	NASA's Kennedy Space Center, Florida	Study contract to investigate facilities and equipment used at Cape Kennedy in preparing Saturn IB Space Vehicle for launch	$200,000+
Association for Computing Machinery, New York, N.Y.	National Science Foundation	A twenty-seven month study to develop recommendations for courses, course content and curricula concerned with application of computers to management information systems and develop instructional materials needed to implement these recommendations	$96,900
Iowa State Univ., Ames, Iowa	National Science Foundation	Research on thin magnetic film for use in computer memory systems; studies include switching, dispersion, creep, etc.	$52,000
The Rand Corporation, Santa Monica, Calif.	The Carnegie Commission on the	A comprehensive study of instructional uses of computers in higher education; findings will be distributed to college and university leaders, legislators and the public	—
Programming Methods Inc., New York, N.Y.	Eastern States Bankcard Association	Designing and installing a computerized sales authorization program for the Master Charge credit card; will permit merchants in eastern half of U.S. to phone toll-free to a Master Charge sales authorization center and get an immediate credit authorization for transactions which exceed normal credit card limits	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B500 system	Livingstone-Graham, Inc., El Monte, Calif.	Payroll, accounts receivable and payable, general and sub-ledgers, and accounts analysis applications (system valued at almost $290,000)
Burroughs B2500 system	Kuhn Brothers Co., Inc., Nashville, Tenn.	Sales analysis, payroll, inventory, general accounting, budgeting, and forecasting applications (system valued at over $380,000)
Burroughs B3500 systems	U.S. Air Force Bases (150) throughout the world	Use by the bases to automate management systems and procedures (systems valued at over $60 million)
Control Data 6600 system	Chalk River Nuclear Laboratories of Atomic Energy of Canada, Ltd., Ottawa, Ontario, Canada	Many applications in AECL's research and development programs
Digital Equipment PDP-10 system	Chalk River Nuclear Laboratories, Physics Division, Chalk River, Ontario, Canada	On-line acquisition and manipulation of data from a Model MP Tandem Van de Graaff accelerator; accelerator is used for studies of nuclear structure
	National Institute of Health, Division of Computer Research and Technology, Bethesda, Md.	Biomedical research activities; system used for interactive time-sharing by NIH researchers, for research in artificial intelligence, and for developing models for biological and biomedical research applications
	Pennsylvania State University, Hybrid Computer Laboratory, University Park, Pa.	Use as a logic controller, to conduct simulation studies under a time-shared monitor, and for time-shared digital computation in time-sharing for program development; will be interfaced with EAI 680 analog computer
GE-115 system	Ripley Industries, St. Louis, Mo.	Production scheduling, inventory control, routine accounting functions, and market research
GE-415 system	Financial Computer Center of Eastern New York, Inc., Schenectady, N.Y.	Processing some 300,000 items daily for its 12 member banks in nine area cities (system valued at $1 1/2 million)
Honeywell Model 110 system	Superior Coach Corp., Kosciusko, Miss.	Keeping track of some 19,000 parts used in manufacture of 42 bus models and other vehicles; being linked via telephone line to larger central processing system at Superior's Lima, Ohio headquarters (system valued at $100,000)
IBM System/360 Model 20	National Headquarters, Civil Air Patrol, Maxwell Air Force Base, Ala.	Keeping track of 67,000+ members in 50 states, Washington, D.C. and Puerto Rico; educational development of 34,000 cadets from 13 to 17 years old; and availability of qualified pilots and locations of some 5,100 aircraft used in CAP search and rescue missions
IBM System/360 Model 30	United Data Processing, Portland, Oregon	Data processing services including: medical clinic accounting; automotive parts inventories; accounting systems for manufacturing and distributing concerns
IBM System/360 Model 40	Randolph Data Services, Inc. Cincinnati, Ohio	Replacing an IBM 360/30 computer that had a smaller memory capacity; Columbus and Louisville data centers will each install an IBM 360/30 computer
	Orange and Rockland Utilities, Inc., Nyack, N.Y.	A Customer Service System which will handle customer service problems as well as dispatch gas and electric crews and appliance repair crews
NCR Century 100 system	Campanella Corp., Warwick, R.I.	Payroll, job-cost, labor-distribution and equipment distribution accounting, fringe benefit reporting for use of unions, and payroll tax analysis
	Gay Togs Inc., New York, N.Y.	Coordinate "cutting room" activities with demands of marketplace
	Knox Gelatin, Inc., Johnstown, N.Y.	Billing, sales analysis, inventory control and payroll; eventually will join five plants in data network
	McKnight and Frampton, Charleston, N.C.	Data processing for local medical institutions and retail establishments
	Schleeter, Monsen and Debacker, Charleston, N.C.	Accounting services to a wide variety of local business including retailers, auto dealers, etc.
UNIVAC 490 system	Ultronic Systems Corp., a subsidiary of Sylvania Electric Products, Inc., Mount Laurel, N.J.	Serving as master systems of Ultronic quotation service to stockbrokers (an international network) reporting information from all principal stock-markets and commodity services (systems valued at approximately $1.5 million)
UNIVAC 1108 system	New York University, University Heights, Bronx, N.Y.	Serving combined needs of two colleges at the Bronx campus and of the NYU Medical Center in Manhattan
	Sanyo Electric Company Ltd., Osaka, Japan	Production control and sales management (system valued at $3.4 million)
UNIVAC 9200 system	Family Security Insurance Company of America, Fort Worth, Texas	Payroll, field accounting, life registers, insurance statistics, and other applications
	Southwest Forest Industries, Inc., Phoenix, Ariz.	Applications include payroll processing, inventory control, accounts receivable, accounts payable, and other general accounting chores
UNIVAC 9300 system	Treasury Department of the State of Texas	Processing and balancing all new issue and paid warrants, reconciliation, and bond and property inventory
UNIVAC 9400 system	Villa St. Rose, Portland, Ore.	Use as basic equipment in a data processing course being introduced in this high school for teenage girls
	Helena Rubinstein Inc., East Hills, Long Island, N.Y.	Initial applications include billing and sales statistics; will become integral part of a management information system as other applications are programmed
	Lord Baltimore Press, Baltimore, Md.	Estimating and product control

COMPUTER CENSUS

I. and U. Prakash
DP Data Corp.
61 Helen Drive
Marlboro, Mass. 01752

This Computer Census is based on files which identify be each user, installation sites and information regarding digital computers, other data processing equipment, and software.

Part 1, information on the ten largest manufacturers in the U.S. market, was published in February. Part 2, information on other manufacturers in the U.S. market was published in March. Part 3, information on non U.S. controlled companies in the world market is presented here. Any company whose data is not included in our censuses is invited to send us the applicable figures for us to publish. Also, we invite any corrections or additions from informed readers.

PART 3A-NON U.S. CONTROLLED COMPANIES IN THE WORLD MARKET (excluding U.S.)
Data as of December 30, 1968 (except as noted)
*1 Data not available at press time
*2 For sale only

MANUFACTURER	COMPUTER TYPE	DATE OF INITIAL CUSTOMER INSTALLATION	AVERAGE MONTHLY RENTAL $ (000)	NUMBER OF COMPUTERS INSTALLED LEASED & PURCHASED
Elbit Computers	100	10/67	*2	45
English Electric	4-30	10/67	*1	3
	4-40	-	*1	None
	4-50	5/67	*1	9
	4-70	1/68	*1	2
	4-75	-	*1	None
	ELLIOTT 903	1/66	*1	52
	ELLIOTT 4120	10/65	*1	82
	ELLIOTT 4130	6/66	*1	23
GEC-AEI Automation	CON/PAC 4020	-	*1	None
	CON/PAC 4040	5/66	*1	9
	CON/PAC 4060	12/66	*1	5
ICL	1901	9/66	4.0	328
	1901A	3/68	3.7	1
	1902	7/65	4.8	189
	1902A	-	6.3	None
	1903	7/65	6.5	99
	1903A	9/67	10.6	2
	1904	5/65	12.2	58
	1904A	-	18.6	None
	1904E	1/68	16.0	8
	1904F	-	17.0	None
	1905	12/64	13.0	31
	1905E	1/68	16.5	4
	1905F	-	17.5	None
	1906	12/66	28.0	4
	1906A	-	54.0	None
	1906E	-	29.3	None
	1906F	-	31.2	None
	1907	12/66	29.0	9
	1907E	3/68	30.3	1
	1907F	-	32.5	None
	1909	8/65	5.5	17
Marconi Co.	MYRIAD I	3/66	*1	26
	MYRIAD II	10/67	*1	8
Norsk Data-Elektronikk	NORD 1	8/68	1.0	5
	NORD 2	-	0.2	None
Regnecentralen	GIER	12/60	*2	37
	RC 4000	6/67	*2	1
Saab	DATASAAB D21	12/62	*2	32
	DATASAAB D22	5/68	*2	4
Siemens	301	*1	0.5	1
	302	9/67	1.0	16
	303	4/65	2.5	67
	304	*1	3.0	17
	305	11/67	3.5	27
	2002	6/59	13.5	42
	3003	12/63	13.0	34
	4004/15/16	10/65	4.8	75
	4004/25/26	1/66	8.0	32
	4004/35	2/67	11.5	79
	4004/45	7/66	18.8	69
	4004/55	12/66	25.8	4

NEW PATENTS

(Continued from page 7)

3,422,401 / James Robert Lucking, Kidsgrove, Stoke-on-Trent, England / English Electric Computers Limited, London, England, a British company / Electric data handling apparatus.

3,422,402 / Fred E. Sakalay, Poughkeepsie, N. Y. / International Business Machines Corporation, Armonk, N. Y., a corporation of New York / Memory systems for using storage devices containing defective bits.

3,422,403 / James E. Webb, Administrator of the National Aeronautics and Space Administration with respect to an invention of Irwin M. Jacobs, La Jolla, Leonard Kleinrock and Warren A. Lushbaugh, Los Angeles, and Willy Tveitan, Tujunga, Calif. / Data compression system.

3,422,404 / David E. Ferguson, 101 Ocean Ave., Apt. B-7, Santa Monica, Calif. 90402 / — — — / Apparatus and method for decoding operation codes in digital computers.

3,422,405 / Roger E. Packard, Glendora, and Donald E. Knuth, Sierra Madre, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Digital computer having an indirect field length operation.

3,422,408 / Alexander Turczyn, Philadelphia, Pa. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Thin film memory device employing unipolar bilevel write-read pulses to minimize creep.

3,422,409 / William J. Bartik, Jenkintown, Pa. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Magnetic switch for reading and writing in an ndro memory.

3,422,410 / William J. Bartik, Jenkintown, Pa. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Plated wire memory employing a magnetically saturable shield.

January 21, 1969

3,423, 528 / Robert D. Bradshaw, Wappingers Falls, and Hans H. Jensen, Poughkeepsie, N. Y. / International Business Machines Corporation, New York, N. Y., a corporation of New York / Electrographic data sensing system.

3,423,577 / Marius Cohn, Minneapolis, Minn. / Sperry Rand Corporation, New York, N. Y., a corporation of Delaware / Full adder stage utilizing dual-threshold logic.

3,423,602 / John R. Louis, 5 Chestnut Square, Foxboro, Mass. 02035 / — — — / Logic circuit.

3,423,603 / Joseph Reese Brown, Jr., Pasadena, Calif. / Burroughs Corporation, Detroit, Mich., a corporation of Michigan / Address selection switch for coincidence memory.

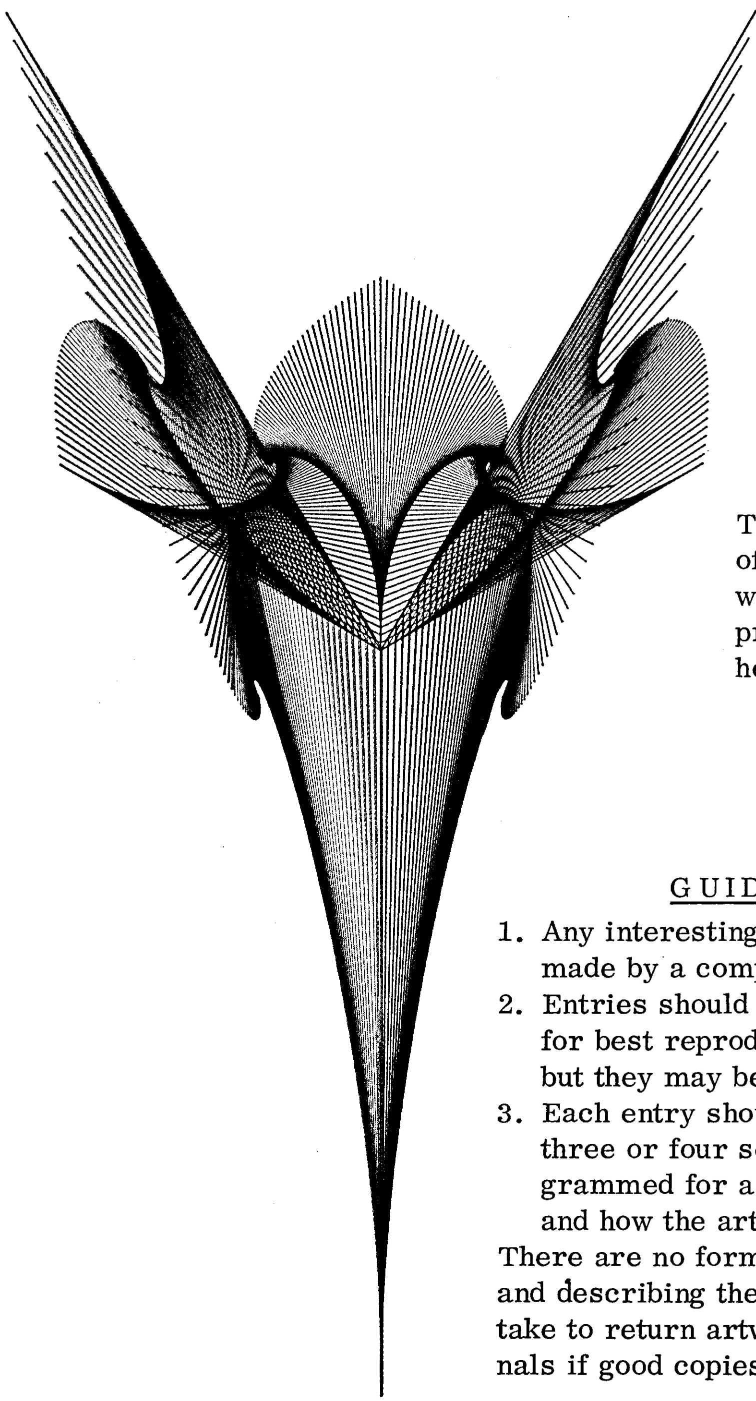
3,423,734 / Wyman L. Deeg, Glenview, Ill. / C. P. Clare & Company, Chicago, Ill., a corporation of Delaware / Data handling system.

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.

YOU ARE INVITED TO ENTER OUR

7th annual COMPUTER ART CONTEST



the special feature of the August, 1969 issue of

computers and automation

The winning entry will appear on the cover of our August issue — more than 25 entries will be published inside. The 1968 first prize winner, "Hummingbird", is shown here at the left.

GUIDELINES FOR ENTRY

1. Any interesting and artistic drawing, design or sketch made by a computer (analog or digital) may be entered.
2. Entries should be submitted on white paper in black ink for best reproduction. Color entries are acceptable, but they may be published in black and white.
3. Each entry should be accompanied by an explanation in three or four sentences of how the drawing was programmed for a computer, the type of computer used, and how the art was produced by the computer.

There are no formal entry blanks; any letter submitting and describing the entry is acceptable. We cannot undertake to return artwork, and we ask that you not send orignals if good copies are available.

Deadline for receipt of entries in our office is July 3, 1969.

For information on how to obtain color reproductions of this and other computer art from our 1968 contest, designate No. 2 on the Reader Service Card.

Someday it may be possible to store the medical records of every American in the space of a cold capsule.

Or the tax records of the nation may fit in one file cabinet.

All this, and even more extraordinary things may become possible, because Univac is experimenting with a process called photochromism, a molecular phenomenon involving color changes with light.

Univac has developed a non-fatiguing photochromic material (so unique we've applied for patents on it) that can be used as a reservoir for computer information. Exposure of this material to ultraviolet light records the information.

The information can then be read with a low-intensity light beam and, when desired, erased with a high-intensity beam.

The advantages of photochromism for computer systems are multiple. Theoretically, present computer information storage space can be reduced enormously.

Some of Univac's plans for the application of photochromism may lead to color information displays that will retain images for hours, and interchangeable information cartridges that could give one computer the information diversity of fifty.

Photochromism is just one of many advanced ideas in Univac research and development laboratories.

Other advanced ideas can be found in today's UNIVAC® computer systems.

UNIVAC

Univac is saving a lot of people a lot of time.

SPERRY RAND

Designate No. 17 on Reader Service Card

The white ones are the men and the yellow ones are the women.