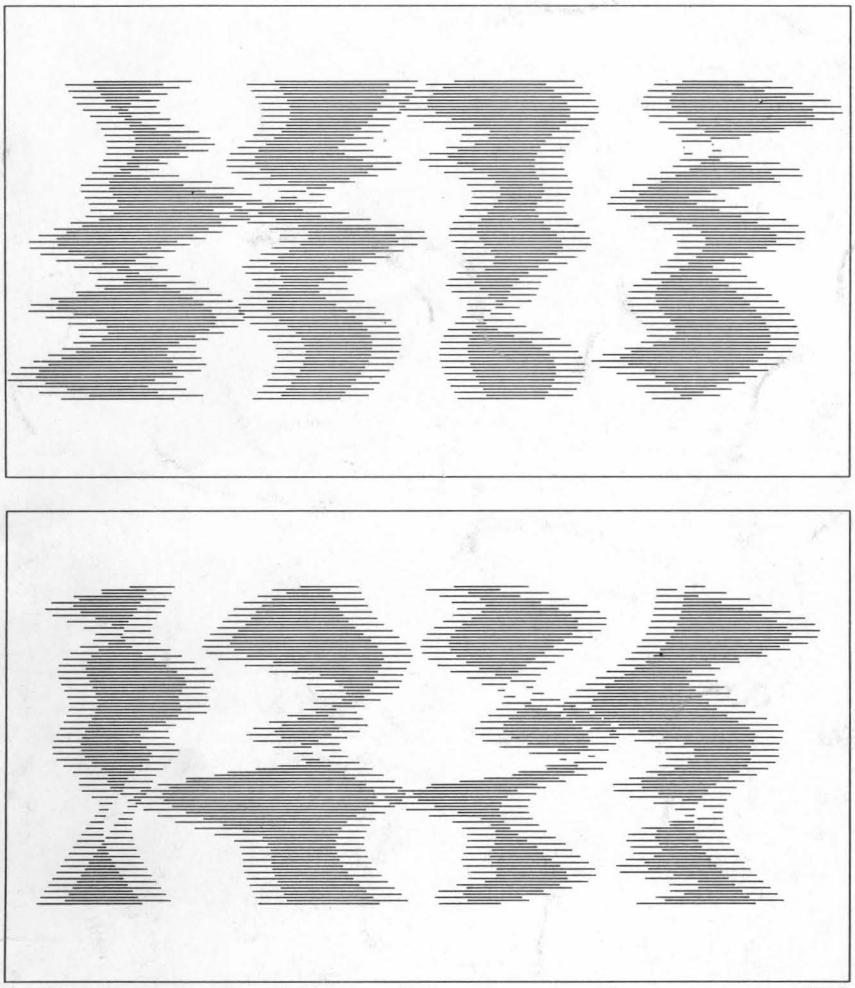
SCIENCE & TECHNOLOGY
December, 1971
Vol. 20, No. 12

computers and automation



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"VIBRATIONS"

Data Processing Can Be Cost Controlled — *R. E. Hirsch*
Rethinking the Use of the Computer in Industry — *F. H. George*
Air Cargo and the Computer — *A. L. Jacobs*
Building Your Own Computer — *S. B. Gray*
The Assassination of President John F. Kennedy: A Model for Explanation — *V. J. Salandria*

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Editor: Edmund C. Berkeley, author, businessman, actuary, scientist, computer professional, first secretary of the Association for Computing Machinery 1947-53, editor of *Computers and Automation*.

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The Most Important of All Branches of Knowledge

(Based on the editorial in the April 1971 issue of *Computers and Automation*)

It may be that there is a branch of knowledge which is the most important of all.

If so, I would maintain that it is a subject which used to have the name "wisdom" but nowadays does not have a recognized scientific name, or in any college a recognized department or faculty to teach it. This subject currently is a compound of common sense, wisdom, good judgment, maturity, the scientific method, the trained capacity to solve problems, systems analysis, operations research, and some more besides. Its earmark is that it is a general subject, not a special one like chemistry or psychology or astronautics. Useful names for this subject at this time are "generalogy" or "science in general" or "common sense, elementary and advanced".

Many editorials published in "Computers and Automation" have in one way or another discussed or alluded to this subject:

- Examples, Understanding, and Computers / December 1964
- The Barrels and the Elephant: Crackpot vs. Pioneer / May 1965
- Some Questions of Semantics / August 1965
- Perspective / April 1966
- Computers and Scientific Models / May 1967
- New Ideas that Organize Information / December 1967
- How to Spoil One's Mind – As Well as One's Computer / August 1968
- The Catching of Errors by Inspection / September 1968
- Tunnel Vision / January 1969
- The Cult of the Expert / May 1969
- Computers, Language, and Reality / March 1970
- Computers and Truth / August 1970
- The Number of Answers to a Question/March 1971

In the editorial "The Cult of the Expert" we offered a leaflet that belongs in this subject, "Right Answers – A Short Guide for Obtaining Them". More than 600 readers asked for a copy; so clearly this subject is interesting to the readers of C&A.

This subject is related to computers and the computer field in at least two ways:

First, many of the general principles which this subject contains can be investigated in experimental or real situations by means of a computer. In fact, far more can be investigated by computer than can possibly be investigated by ordinary analytical mathematics.

Second, since computer professionals are in charge of computing machines, many people consider these professionals responsible for the worthwhileness of the results of computers. Because of "garbage in, garbage out", computer professionals have a responsibility to apply common sense and wisdom in at least three ways:

- *Input* – in the selection and acceptance of the data with which they begin;
- *Processing* – in the processing through a system;
- *Output* – in the interpretation and use of the answers.

Then the computerized systems will produce strong structures that human beings can use and rely on, and not weak structures which will crash with false information or ridiculous results.

"Computers and Automation" for April 1971 contains an article, "Common Sense, Wisdom, General Science, and Computers", which deals with this subject. For more than a dozen years I have been studying this subject – ever since I searched in a very large and good public library for a textbook on common sense or wisdom and found none at all. There is, however, a great deal of information to be gathered on this subject because a large number of great men, ancient, medieval, and modern, have made remarks and comments (usually while talking or writing about something else) that belong in this subject.

The subject of wisdom is particularly important in these modern days. The subject has been neglected, while special sciences have been cultivated. Investigators have pursued the special sciences with the enthusiasm of a child with a new toy. Specialized science and specialized technology have rendered our earthly world almost unrecognizable:

- All major cities on the planet are only a few hours apart by jet plane.
- Millions upon millions of people who otherwise would be dead are alive because of miracle drugs, – thus creating a population explosion;
- Nuclear weapons if used can destroy mankind and civilization in a few hours; etc.

To deal with so many diverse, vast problems we need wisdom. To use wisdom we should study it.

The staff of "Computers and Automation" have decided that it is desirable to make the drawers full of information we have been collecting on this subject more accessible and more widely distributed. We have decided to publish twice a month a publication of newsletter type called "The C&A Notebook on Common Sense, Elementary and Advanced". For more details, see the announcement on page 2. (The first few issues of the Notebook are free.)

We invite you, our readers, to join us in the pursuit of this subject, as readers of the Notebook, and as participators with us in the research and study.

Wisdom is a joint enterprise – and truth is not shaped so that it can fit into the palm of any one person's hand.

Edmund C. Berkeley

EDITOR

Vol. 20, No. 12
December, 1971

computers and automation

The magazine of the design, applications, and implications of information processing systems.

Editorial Offices — **Berkeley Enterprises, Inc.**
815 Washington St.,
Newtonville, Mass. 02160
617-332-5453

Advertising Contact — **THE PUBLISHER**
Berkeley Enterprises, Inc.
815 Washington St.,
Newtonville, Mass. 02160
617-332-5453

Computers and Automation is published monthly (except two issues in June) at 815 Washington St., Newtonville, Mass. 02160, by Berkeley Enterprises, Inc. Printed in U.S.A.

Subscription rates: United States, 11 monthly issues and two issues in June (one of which is a directory issue) — $18.50 for 1 year, $36.00 for 2 years; 12 monthly issues (without directory issue in June) — $9.50 for 1 year; $18.00 for 2 years. Canada, add 50¢ a year for postage; foreign, add $3.50 a year for postage. Address all U.S. subscription mail to: Berkeley Enterprises, Inc., 815 Washington St., Newtonville, Mass. 02160. Second Class Postage paid at Boston, Mass.

Postmaster: Please send all forms 3579 to Berkeley Enterprises Inc., 815 Washington St., Newtonville, Mass. 02160.

Change of address: If your address changes, please send us both your new address and your old address (as it appears on the magazine address imprint), and allow three weeks for the change to be made.

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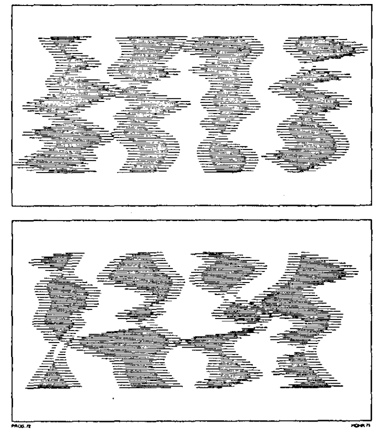

Front Cover Picture

"Vibrations", was produced by Manfred Mohr of Paris, France — The design is Program 72 — eight different curves built out of random points and interpolated with a 3rd degree spline function are calculated. A special routine connects always two curves with straight y-lines, incrementing continuously by 2mm in the positive x-direction. Twice the same drawing is superimposed in between the first one with a displacement of the (0,0) point. — We think the drawing conveys the happy action and good "vibes" of the holiday season.

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c.a

EDITORIAL

THE STRATEGY OF TRUTH-TELLING

In general there are three ways of telling unpleasant truth.

The first way is the direct way. Something unpleasant happens; you tell the whole truth; the situation responds as if you had burst a balloon, and often you get smacked across the face, or worse. When Adolf Hitler's dictatorial rule over Germany was coming to an end in 1945, few indeed were the German leaders who dared to tell him the truth.

The second way is the indirect way. Something unpleasant happens; you tell little bits of the truth slowly over a long time; the situation responds slowly bit by bit, as if you had pushed a pin into a tire, which gradually goes flat; and you may or may not get smacked across the face.

The third way is not telling the truth at all, but signaling it. Something unpleasant happens; you give an untrue but acceptable explanation that hangs together for a time, even if you know it is false (the "cover story"). Only signals from the real world indicate what is the real truth. The situation again responds slowly, but this time irregularly, as different classes of people at different times finally realize they have been lied to — and been played for suckers. Before "the people" can smack you across the face, the different classes of people must organize together on the basis of their direct knowledge of the truth and their indignation over the lies they have been told. Furthermore, if you are in a position of power, you may very well be able to continue to keep your opposition disorganized, by control over the information reaching the various divisions of your opposition. You can use the old Roman principle of empire, "Divide et impera — divide and rule". I was once told of a steel plant where 40 years ago the different shifts at different locations recruited different groups of European immigrant workers, so that the Polish, the Italian, the Swedish, the German shifts, etc., would have almost no opportunity to talk across shift divisions, or get to know each other.

The third way of telling unpleasant truth is the method of choice for many governments and all secret intelligence services, such as the KGB of the Soviet Union and the CIA of the United States. For if you never make any official statements, there is a good chance people will forget about you; in addition you never have to deny or contradict anything previously said. You obtain the largest amount of advantage certainly in the long run and often in the short run, because what people don't see or notice, they have a hard time remembering, even thinking about. When evolution helped to make the tiger inconspicuous in the bamboo thickets, the tiger acquired light and dark stripes so that he would resemble his surroundings.

As we have asserted often in the past and will assert often in the future, computer professionals must eventually become information engineers. An information engineer is an engineer who deals with information, a professional person who accepts responsibility for the truth of the input, the correctness of the processing, and the truth of the output, so that the bridges of information that he builds support people and do not crash.

It is not hard for a computer professional to live up to this responsibility when all he has to deal with is conflict of interests between different groups within a business, and there is a group of top executives which is arbiter. However, it is much harder to live up to this responsibility when there is divergence between the interests of parts of government and parts of society.

In this issue of "Computers and Automation" we print an article by Vincent J. Salandria, an attorney in Philadelphia, entitled "The Assassination of President Kennedy: A Model for Explanation". In this article the author develops a rational argument that:

- the conspiracy to cover up the assassination;
- the declaration of the "cover story" ("The lone assassin is Oswald") by the White House Situation Room, $5\frac{1}{2}$ hours after the shooting of President Kennedy (before anybody could really have known);
- the "denial" of Newton's Laws of conservation of momentum by the backward motion of Kennedy's head at the time of the fatal shot; and much more;

are all compatible with the following explanation:

> An alliance between topmost parts of the Central Intelligence Agency and of the Pentagon took place, which assassinated President Kennedy and proceeded vigorously to expand the war in

South East Asia; and the evidence of a coup d'etat was deliberately signaled for all those, but only those, who could read the signals.

And Salandria says this is an example of the third way of telling the truth, not telling it but signaling it.

This explanation, like a good scientific hypothesis, works. It explains why in spite of great and widespread domestic opposition to the war in South East Asia, the war still continues, the airwar increases, and Cambodia and Laos have been involved. It explains why the peace movement in this country is very ineffective. It explains why $7\frac{1}{2}$ ton bombs that make explosions the size of football fields have begun to fall in South Vietnam, Cambodia, and Laos. It explains why the presidency never says a single word criticizing the corrupt, single-candidate "re-election" of Thieu. It explains why the Vietnam war is the longest in American history. It explains why the presidency nominates nonentities for the U. S. Supreme Court. It explains why the presidency via the Dept. of Justice is pursuing with great vindictiveness the persons associated with releasing the Pentagon Papers. Finally, it explains why the commander-in-chief of United States forces (the President) says (illegally) that he does not need the rescinded Tonkin Gulf Resolution in order to pursue the war. Etc.

This hypothesis leads to the thesis that the presidency has become the leading instrument of an alliance between the Pentagon and the Central Intelligence Agency, and is on its way to being a dictatorship.

What do we do?

Obviously, sending humanitarian appeals to stop the war to the presidency is a waste of effort. Demonstrations in New York and San Francisco, even Washington, are a waste of effort.

Perhaps cutting off funds from the waging of the war might have an effect. Perhaps for Congress to require the Central Intelligence Agency to account for the funds it receives might have an effect. But funding refusals like those imply that the presidency, the CIA, and the Pentagon would permit their present powers to be curtailed and limited. But why should they? They are in the driver's seat. By dangling plums and deals in front of congressmen, for example, the presidency can get the votes changed. Etc.

"What we do depends in large measure on what we think."

Thinking based on explanations that work is likely to be far more effective and fruitful than thinking based on explanations that do not work.

Edmund C. Berkeley
Editor

NUMBLES

Neil Macdonald
Assistant Editor
Computers and Automation

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. This month's Numble was contributed by:

Stuart Freudberg
Rensselaer Polytechnic Institute
Troy, N.Y.

NUMBLE 7112

```
          I M P R E S
        × S I O N S
        L U I N M T N
      I P M U L M I
    D R D T E I O
  D E R R T L D
H O I N M T N
= L M S E D U E M S S N
```

H = P = L
O = U

85204 206391

Solution to Numble 7111

In Numble 7111 in the November issue, the digits 0 through 9 are represented by letters as follows:

V = 0	S = N = 5
R = 1	H = F = 6
E = 2	X = 7
O = I = 3	C = 8
P = 4	B = 9

The message is: Proverbs are the echoes of experience.

Our thanks to the following individuals for submitting their solutions – **to Numble 7110**: T. P. Finn, Indianapolis, Ind.; James Godderz, Edison, N.J.; and Harold L. Smith, Thomson, Ga. – **to Numble 719**: David P. Zerbe, Reading, Pa.

DATA PROCESSING CAN BE COST CONTROLLED

Rudolph E. Hirsch
Manager, Management Advisory Services
Price Waterhouse & Co.
New York, N. Y.

"Much computer-produced information is requested for 'political' reasons or because 'it would be nice to have' as distinct from being needed . . . and data processing expense is becoming an ever-larger proportion of total corporate and government budgets. Meanwhile, back in their sales offices, the computer manufacturers rub their hands in glee."

(Reprinted with permission from the "Price Waterhouse Review," Summer, 1970)

Planning had seemed perfect for the new computerized production scheduling system. The system analysis staff had documented its designs exceptionally well, with inputs, outputs and computer file contents precisely organized. Approval by each of the plants to be affected was quickly obtained. Completion dates had been forecast by means of PERT techniques and included generous safety factors. The Data Processing Director had analyzed the specifications in detail and concluded that their complexity was such that his three best programmers would have to be assigned. On the basis of their past performance, he estimated that they would complete the required number of programs in approximately four months.

The new system became operational on August 15 instead of on the forecast date of the preceding January 2, due mainly to substantial programming time overruns. The plant managers expressed disappointment (some with considerable vigor, colorfully expressed), but were able to continue their conventional production scheduling procedures until the computerized system was finally able to take over. However, the Controller could not be supplied with the cost figures on the overrun that he had requested, since the Systems and Programming Department did not keep records on project costs.

Rudolph E. Hirsch is manager of Price Waterhouse & Co.'s Management Advisory Services departments in New York, Stamford and Bridgeport, where he assists his clients' companies with their data processing problems. After earning a B.A. in economics from Swarthmore College and an M.A. from George Washington University in the same subject, he served as financial analyst with Ford Motor Company. He joined IBM in 1957 and rose through various programming and systems analysis positions. He has been with his present company since 1964.

This very typical incident illustrates a remaining deficiency in dealing with the difficulties of making predictions. By definition, predicting involves uncertainty, and refining of prediction techniques thus means reducing uncertainty to the lowest possible value. In the case of data processing costs and performance, the prediction techniques used are not yet as refined as possible under experience already on hand.

Present management practice in controlling data processing costs does not seem to have kept pace with progress in the other aspects of data processing. Thinking, in regard to cost control generally appears more appropriate to the beginning days of computer use for commercial data processing in the early 1950's, than to current requirements. Most computer-using organizations still seem to consider data processing largely as an overhead item; consequently, departments using data processing services are as a rule not charged for them. When data processing expense is charged out at all, charge-outs are usually limited to computer time required to produce output, while no charge is made for the more costly items of system analysis, programming, computing time for program testing, and the invariable subsequent program changes. Present cost collection methods seem to be used primarily for accounting purposes and not for planning and control.

Further, in many enterprises, little or no justification seems to be required when a department requests data processing service. Even when justification is required, cost estimates are seldom developed and even more infrequently monitored. This casual approach may be a result of habit rather than oversight: after almost two decades of experience in commercial data processing, systems analysis and programming are still viewed by management as somewhat akin to research and hence allegedly beyond the scope of conventional cost administration techniques. This attitude was not without some justification initially, but a large body of experience has been gathered by now about commercial applications. Based on this experience, it is at present feasible to predict and control data processing costs just as effectively as, for example, manufacturing costs. Feasible, but seldom done.

As a result of this absence of effective data processing cost control, Parkinsonism has appeared in data processing as it has elsewhere. Data processing expense is steadily rising in proportion to total expense, and data processing headcounts in proportion to total employment. As I discussed in greater detail in an earlier article,[1] computer output volume rises most rapidly in the absence of initial *and continuing* information justification and data processing cost charge-out. Much computer-produced information is requested for "political" reasons or because "it would be nice to have" as distinct from being needed; the discontinuance of a computer-produced report is seldom requested by its recipients once the report loses its importance, which all reports sooner or later do. Hence the importance of *continuing* information justification. However, in the usual absence of—and partially as a result of the lack of—justification requirements and cost charge-out procedures, an ever-increasing volume of computer-produced information is generated, and data processing expense is becoming an ever-larger proportion of total corporate and government budgets. Meanwhile, back in their sales offices, the computer manufacturers rub their hands in glee.

It would of course be inaccurate to say that cost control procedures and proper computer information do not exist. There are many excellent systems of this kind, particularly in some larger enterprises. Their procedures, however, are applicable at least in large part to all computer users. For example, the following costs charge-out method has worked well for a large corporate computer-user:

When a department requests computer service, the data processing department estimates the costs of that service and quotes a standard cost to the requesting department. If the latter accepts that cost, it will be charged that amount and none other, regardless of the costs actually incurred. This method has a double advantage: it not only permits "customer" departments to use data processing services with (budgetary) confidence, but also enables top management to monitor the efficiency of the data processing department simply by analyzing its "profitability." Under this method, highly technical data processing operations are being controlled effectively by nontechnical executives in the terms with which these executives are most familiar.

The components of computing costs

The total cost of electronic data processing includes far more than the actual cost of the "hardware" itself. At least all the following types of costs must be included:

a. Computer rental or other lease payments, or acquisition price amortization if the equipment was purchased. In the latter case, maintenance engineering costs are paid separately and must be included in this category.

b. Similar expenses for input data preparation equipment such as keypunches and verifiers, and output-handling devices such as form bursters and decollators.

c. Punched cards, printer forms and other kinds of expendable data processing supplies, including electricity attributable to the data processing equipment (and to its air conditioning!).

d. Data processing premises, including amortization of costs of special improvements, such as double flooring and air conditioning. (Virtually all computers require their own heavy-duty air conditioning or at least extensive modifications to existing central air-conditioning systems.) Office space for data processing management, programmers, systems analysts, control clerks, and the like must be included in these costs.

[1] "The Value of Information," from the *Price Waterhouse Review*, Spring 1968.

e. Salaries, including fringe benefits, for at least the following personnel:

1. Data processing management
2. Systems analysts
3. Programmers
4. Computer operators and other machine-room personnel
5. Control clerks and tape/disk librarians
6. Key punch operators and other data-preparation personnel
7. Custodians, guards and other maintenance personnel.

An obvious but often overlooked prerequisite for a cost control system is an appropriate provision in the chart of accounts for accumulation of each of the cost categories involved to facilitate subsequent charge-out. Assuming appropriate accounting facilities for the cost control system to have been established and "sold," the following points become relevant:

An effective data processing cost control system must account for *all* time spent by programmers and systems analysts, computer power-on time, expendable supplies and nonexpendable data storage such as magnetic tapes in use and disk space tied up. In a well-run computer installation, *all* time spent by programmers and systems analysts and computers, *all* supplies used and *all* data storage facilities preempted are attributable to particular projects or other legitimate uses. Thus if the reported sum of time, material, and data storage use amounts to less than the total available, the difference is a signal of inefficient or unauthorized usage of data processing resources.

"Overhead" items such as management salaries, premise charge-off and similar items are, of course, difficult to allocate directly to particular projects. However, since such items typically account for a substantial proportion of total data processing expense, it is important that these overhead items also be reflected in allocating data processing costs to particular projects. One useful and equitable method of assigning these fixed data processing expenses to particular projects is to assign to each project the same percentage of total fixed data processing costs as that project takes up of total variable data processing costs.

The computer itself can, and should be, used to collect, allocate and report on fixed and variable data processing expense. The description below of a data processing cost control system assumes that the computer will be used to do this.

Areas of Cost Control Attention

Programming. The control and monitoring of programming effort and expense is a particularly critical item in a cost control system, since the methods (if any) of controlling this item have until now frequently been found spectacularly inadequate. An experienced data processing professional can estimate to within about 10 percent the number of statements or instructions a program will contain when finished. Despite this, the programming *time* (and thus programming expense) of a finished and properly functioning program frequently amounts to two or three times the initial estimate. I have been involved in cases of even larger overruns too painful to detail here; my experience has been that well over 90 percent of all programming projects ultimately exceed their original time and cost estimates. In part this discouraging experience is due to the absence of a generally available and acceptable rational programming time estimating system. Another common reason for programming time overruns is a frequent tendency by data processing management and programmers to begin the programming phase of a project before the program specifications have been completely defined; the resulting shortcomings become apparent quite late and then require time-consuming reprogramming and possible enlargement of scope. About as discouraging, however, is the general but unnecessary absence of a system for even reporting, let alone controlling or predicting, programming effort as a project proceeds.

At any one time, a programmer typically works on several different programs. As he completes writing a program or a major segment of it, he will send it to another department for keypunching and then to the computer for compiling or assembling (i.e. translating into computer code), followed by computer-testing to determine whether the program is in fact functioning correctly. Since at least several hours, and often days, elapse before the results of keypunching, compiling and testing are returned, programmers use this turnaround time lag to work on other programs. Therefore, a typical programmer may (and should) work on two or more programs simultaneously, and an essential feature of programming cost control is that each programmer will report the number of hours he has spent on *each* program.

It is always difficult to get people to describe accurately what they do, especially over any length of time. To overcome this problem, time-reporting must be formalized. Exhibit I represents a programmer time reporting form for use in a time and cost reporting system. Each system analyst or programmer may, despite his title, do work other than system analysis or programming; in fact, many computer users do not maintain a formal distinction between system analysts and programmers since their functions frequently overlap, especially at senior levels. Exhibit I therefore exemplifies a time reporting form covering all types of work each individual may be called upon to perform. An

DAILY TIME SHEET — EXHIBIT I

NAME A. E. Neumann EMPLOYEE NO. 34070 DATE 5/22/70

TIME CHARGED TO		TYPE OF WORK										
PROJECT	PROGRAM	SYSTEM ANALYSIS	SYSTEM DESIGN	DETAIL DIAGRAMMING	PROGRAMMING	TESTING AND DEBUGGING	CONVERSION AND PARALLEL	DOCUMENTATION	TRAVEL	TRAINING	MEETINGS	OTHER*
1260	007				2							
8971	012			1								
6407	023			1								
6407	024				2							
0705	101					1		1				
TOTALS				2	4	1		1				

*For "Other" categories use the project code indicated below

90001 Vacation
90002 Holiday
90003 Personal Time
90004 Illness
90005 Professional or Technical Societies

DAILY COMPUTER LOG — EXHIBIT II

SYSTEM TYPE AND NUMBER S70/50-1 DATE 5/22/70

PROJECT PROGRAM IDENTIFICATION	PROGRAMMER CODE	OPERATION CODE	ELAPSED TIME START	ELAPSED TIME STOP	ELAPSED TIME TOTAL	COMPUTER TIME START	COMPUTER TIME STOP	COMPUTER TIME TOTAL	LOST TIME CODE	Trouble Report Number	OPERATOR	COMMENTS
0001/000		30	0801	0857	56	4625	4718	93			J.C	
1214/004		10	0858	1004	66	4718	4828	110			J.C	
0705/101	13	11	1005	1100	55	4828	4920	92			J.C	
0041/012		10	1102	1240	98	4920	5083	163			J.C	
1600/008		10	1241	1243	2	5083	5056	3	42	2-14	J.B.B	
0705/101	13	12	1245	1314	29	5086	5134	48			J.BB	

OPERATION CODES:

10 – PRODUCTION
11 – DEBUGGING
12 – ASSEMBLY
20 – IDLE
21 – SPECIAL
22 – POWER OFF
30 – PREVENTIVE MAINTENANCE
31 – UNSCHEDULED MAINTENANCE

LOST TIME CODES:

40 – LOST TIME-COMPUTER
41 – LOST TIME-OPERATOR
42 – LOST TIME-INPUT DATA
43 – LOST TIME-PROGRAM
49 – LOST TIME-OTHER

effective time reporting system must require that these time reports be turned in *daily*. If the reporting interval is weekly or longer, there will be a tendency to delay completion of time reports to the last possible moment, with a consequent reduction of recollections and hence of the accuracy of the information turned in.

The supervisor to whom these time reports are submitted should accumulate them and submit them on a weekly or other short interval basis for keypunching and computer processing, since the time information constitutes the basic data for all other control reports.

Time for Data Preparation and Computer Use

Exhibit II represents a computer time log, which should be produced daily for each computer used. Entries on such a report should be made manually by the computer operator or, if possible, automatically by the computer itself under control of its operating system or control program. The program identification, project or program type, chronological and actual computer running time, lost-time indication and operator identification must be entered for each program run. (If this log is completed manually, the information on it will be keypunched to produce by computer the Project Cost Analysis (Exhibit III) and Programmer Performance Analysis (Exhibit IV).) It is obviously important that all computer time be accounted for on a computer log. Most computers are now equipped with elapsed-time meters and various programmable internal clocks; making sure that all time is actually being reported has become a relatively simple matter for management.

Once the information discussed has become available, it is possible to monitor and report on programmer and operator performance and project development, progress, and expense. For this purpose, a Project Time and Cost Analysis such as Exhibit III should be produced at least semimonthly. Note that with the information collected from the time reports and computer logs (Exhibits I and II), plus the use of the time and cost estimates made at the beginning of each project and stored on computer files, producing the Project Control Report is a relatively simple matter. The Time and Cost Analysis will give management a clear picture of the development progress and expense of each project underway, and identify time and cost overruns for corrective action.

The information collected from the time reports and computer logs also enables management to analyze programmer performance, since this information also makes it possible to produce a Programmer Performance Analysis (Exhibit IV). This management report will be used to analyze programmer performance rather than project progress. Note that no attempt is being made to monitor systems analyst performance as closely, since overruns are far more frequent (and expensive) in programming than in system analysis.

This report, which will be produced for each programmer, will list on a cumulative basis all previous programs completed by him, in addition to those he is now developing. The report will make possible an accurate evaluation of each programmer's "growth rate" and present ability, since a programmer's ability is measured in terms of programming time and computer testing time required in relation to the length of his programs. Programming time and cost forecasts, not to mention the programmers' periodic counseling interviews, can thus become far more meaningful than is possible under conventional procedures. At present, few computer-using organizations collect or evaluate this information and therefore rely on more or less subjective factors.

Availability of this information is important because programmers must be controlled more carefully than is possible on the present subjective basis. Programming talent remains in short supply and accordingly is highly paid. The most costly resources should be the best-controlled. Until now programming has been an unfortunate exception to that rule.

Supplies

In most cases it is worthwhile to account for expendable data processing supplies. An exception might be made when no single application requires a disproportionate amount of supplies, or where total supplies expense is negligible, say less than 2 per cent of total data processing expense. These conditions are rare, however, and therefore supplies expense must usually be controlled and allocated.

To do so it will be useful to distinguish between general-purpose and special-purpose supplies. General-purpose supplies are used by several applications; an example is blank or general-purpose forms, i.e. not prepared for a special installation but sold as a standard market item. General-purpose punched cards also fall into this category. It is usually not worthwhile to keep records on an application-by-application basis about the consumption of these general-purpose supplies. The total cost of such items is easy to ascertain and should be distributed to all applications using these supplies, in proportion to the total other costs of each application. Cases exist, of course, of all or most of a standard item being needed for a single application, such as large supply of continuous-form gummed labels for computer-printing of mailing labels. In such cases the total cost of these supplies must be posted to the particular application, despite the fact that the supplies are general-purpose.

PROJECT AND PROGRAM TIME AND COST ANALYSIS

EXHIBIT III

PROJECT IDENTIFICATION 0702, CUSTOMER FILE PROCESSING

STATUS AS OF 7/31/70

PROGRAM	DESCRIPTION	TARGET DATE	SYSTEM ANALYSIS	SYSTEM DESIGN	DETAIL DIA-GRAMMING	PRO-GRAMMING	TESTING AND DEBUGGING	CONVERSION AND PARALLEL	DOCUMEN-TATION	TRAVEL	TRAINING	MEETINGS	COMPUTER TIME	KEYPUNCH AND DATA PREP.	COST
0000	GEN. PROJECT									8	1	4			$ 177
0001	INPUT EDIT	6/2/0						7	5			2	2		330
0003	CREATE FILE	7/9/0					4	6	8				4	1	541
0004	SELECT 01	8/4/0	1	2		30	13	4	9				3	1	962
0007	SELECT 02	8/6/0			2	15	11	1	6				1	2	510
0009	UPDATE	9/1/0				10	13	9	7				2	2	638
0015	RESTARTS	9/1/0	1	2	7	12	4		2			1	1	3	453
	TOTAL THIS PERIOD		2	4	9	67	45	27	37	8	1	7	13	9	$3,611
	TOTAL TO DATE		46	35	42	128	105	44	69	16	16	21	39	15	$9,771
	ESTIMATE		50	30	40	135	120	40	70	18	10	5	25	20	$8,607
	VARIANCE		-4	+5	+2	-7	-15	+4	-1	-2	+6	+16	+14	-5	+$1,164

PROGRAMMER PERFORMANCE ANALYSIS

EXHIBIT IV

NAME NEUMAN, A. E.

REPORTING PERIOD 7/16-31/70

PROJECT AND PROGRAM	*IF COM-PLETE	DESCRIPTION	LANGUAGE	NO. OF INSTRUC-TIONS	PROGRAMMING HOURS				COMPUTER TEST HOURS			
					PERIOD	TO DATE ACTUAL	TO DATE ESTIMATED	VARIANCE	PERIOD	TO DATE ACTUAL	TO DATE ESTIMATE	VARIANCE
0041/012	*	TRAVEL EXPENSE DISTB	COBOL	425	-	13	15	-2	-	2	2	0
0702/009	*	UPDATE CUSTOMER FILE	COBOL	650	-	64	50	+14	-	19	7	+12
0705/101	*	PRINT MAIL LABELS	COBOL	40	2	6	5	+1	1	2	1	1
1260/007		TIME CARD EDIT	COBOL	512	2	24	20	+4	-	4	5	1
6407/023		STORES ISSUE REGISTER	COBOL	375	1	9	7	+2	-	-	-	-
6407/024		STORES ISSUE TOTALS	COBOL	185	2	5	5	0	-	-	-	-
8971/012		OPTIMIZE MAINTENC.	COBOL	94	1	12	10	+2	-	2	2	0
		TOTALS		2,281	8	133	112	+ 21	1	29	17	+12

Special-purpose supplies are prepared for use exclusively by one or a few applications. Such supplies usually consist of preprinted punched cards or printer forms. The cost of such items should be charged to the application or applications making use of them, and should not be absorbed by all applications.

Data Storage

In any computer installation it is necessary to preserve information on computer-legible media from one processing cycle to the next. Such information will be kept on punched cards and/or magnetic storage media such as tapes, disks, drums and data strips. Of these, only punched cards are expendable, and their cost should be allocated as already described for supplies. Magnetic media, however, are reusable and their costs on a "rental" basis should be allocated among the applications using them. Allocation methods differ slightly between magnetic tapes and the other magnetic media.

In the case of magnetic tapes, rental for each reel of tape should be charged to the computer application using it for the period of the usage. Since the number of reels reserved by an application often increases with time, especially in the case of those applications that update transaction registers, it is useful for management periodically to audit the total number of tape reels reserved. Management should then make sure that the number of tape reels on rental is not growing unreasonably, and that the pool of unused reels, i.e. those not on rental, likewise is not too large.

Magnetic disks, drums and data strips should be charged to the respective applications using them, the charge to each application being calculated by the amount of data stored on those media by that application. The resulting rental will be charged to the application for as long as it preempts such data storage space.

Some of the magnetic storage facilities available will not be chargeable to individual applications. Control programs and other "utility" programs to facilitate such general functions as sorting must be stored for use by all programs. The actual data storage rate charged to individual applications should thus include an "overhead" amount for "amortization" of the storage required for these general-purpose programs.

Awaiting Completion: A Programming Estimating Procedure

As mentioned earlier, it is possible to estimate the number of instructions or statements of a program to be written with a fair degree of accuracy, but far less easily estimated are the number of programmer-days required to produce that program. It is of course simple enough to count the number of program instructions or statements written by any particular programmer in a day, but such a count would be meaningless since shortcomings in any programmer's meticulousness, understanding of specifications or general competence almost invariably causes the programs he writes to function improperly, if at all, when first computer-tested. All program errors are eventually found through repeated computer-testing—a process inelegantly known as debugging—but the productivity in terms of *properly functioning* instructions or statements completed per day varies greatly between programmers. For this reason alone, programming time overruns of two to three times the original estimate are common, while accurate predictions are as rare as unicorns.

Programming cost estimates have therefore remained spectacularly less reliable than manufacturing cost predictions, for example. In part this is because objective programming time and cost estimates are not often attempted, and in part because some high-level management may still think of computers and programming as something vaguely occult. And although the occult cannot be time- or cost-controlled, programming, after two decades of experience, certainly can be.

There may be another general fallacy in management's thinking: substantially overestimating its programmers. Since management is usually unfamiliar with data processing, it perhaps in some cases considers programmers as being unusual and invariably highly gifted individuals. Accordingly, so goes the reasoning, programmers cannot be put under conventional forms of supervision. This view too is fallacious. Some highly gifted people can indeed be found among programmers, as they can among accountants, engineers, etc., but most programmers are persons of average ability turning out average-quality work. Virtually any reasonably intelligent person can learn programming, and many do. Accordingly, programmers can and should be supervised as are other kinds of employees, and should be directed to work toward explicit output targets, and be measured by results produced, as is everyone else.

Programming, then, can be managed like any other production or administration activity. It is therefore possible and desirable to develop generally applicable programming time and cost forecasting techniques that will greatly improve the accuracy of cost and time forecasts.

The time required to write and fully test a program is determined by the following factors:

1. Size of program, i.e. the approximate number of statements or instructions it will contain
2. Program complexity
3. Efficiency of programmer to be assigned
4. Computer test time requirements

Of these factors, all but the first can be determined quantitatively, and the first, as pointed out, can be estimated to within about 10 percent. To discuss the other three:

Program Complexity in general varies as does the length of the program (which can be estimated), concurrency (the number of separate tasks to be done simultaneously, a known factor), and the number and types of input/output devices to be used (also known). Although long but straightforward programs exist as do short but complex ones, experience shows that program complexity usually varies with length. As an illustration of the point that program complexity increases with each additional input/output device used, consider that each such device adds an area of computer memory to be reserved and released, errors in transmission to be checked and corrected and counted, data fields to be referenced and compared and updated, disk addresses to be calculated and indexed, control totals to be updated and checked, etc.

It should therefore not be difficult to calculate a program complexity factor for use in a programming time prediction formula, since all factors determining complexity are known or capable of being estimated.

Programmer Efficiency. Given program length and complexity, the time required to program it will obviously depend on the efficiency of the programmer to be assigned. While the subjective element can probably never be entirely eliminated in evaluating individual performance, it is possible to minimize subjective factors by the development (and continuous updating) for each programmer of a productivity or efficiency factor, taking into account the following:

a. Length of time as programmer
b. Score on programming aptitude or similar tests
c. Length of time as a programmer of the current machine type and general configuration, and length of use of the particular programming language
d. Length of time in employer's industry
e. Length of time employed by this organization
f. Length of time employed as a programmer by this organization
g. Performance factor. Initially, this factor should be set to 1.0. It should be kept updated, within stated limits, in order to counteract personality influences. Updatings should result from periodic evaluations of the Programmer Performance Analysis (Exhibit IV). The average factor of all programmers in the organization should be 1.0.

In the work remaining to be done to develop a generalized programming time and cost prediction formula, much of the effort must be devoted to defining these factors and assigning the proper weight to each. Of these factors, the first six will be precisely known. The last, based on performance, is subject to less and less subjective influence after each new estimate for a programmer: to forecast a programmer's performance, the prediction formula will be used for him on the basis of his past record of actual-to-estimated performance.

Computer Test Time Requirements can be developed by determining, from the Programmer Performance Analysis (Exhibit IV), this programmer's past average test time *rate* per statement or instruction, and then multiplying this rate by the number of statements or instructions estimated for this program. The result will in turn be multiplied by the dollar cost rate for the computer involved. The resulting dollar figure is added to the total dollar cost estimated so far for producing this program. The result is the total probable cost of this program.

Efforts at developing a prediction formula have of course been going on for some time. As far as I have been able to determine, only one such formula has been used commercially to date.[2] This formula takes some but not all of the above prediction factors into account and is currently being further refined. Work therefore remains to be done to develop a prediction formula for general use.

Even in its final form, any prediction formula will in some measure be based on subjective evaluations, since it deals with future events, and hence a margin for error must be included. Two solutions of the prediction formula should therefore be used, respectively representing the upper and lower limits of the time that will be required to produce this program. These time limits will then be multiplied by the hourly cost of the programmer to be assigned. The estimated systems analysis and computer test-time cost will be added to each of the two values. The result will be the range within which the total dollar costs of this program are likely to fall.

The details of specifying and weighting the respective factors mentioned above will require a good deal of evaluation and study before the proposed prediction technique can become a truly useful tool, but its successful development now seems distinctly feasible. The proposed programming cost system described in this article can provide the data base necessary for its productive use. The wherewithal for management control of the perennially large and ever-growing item of data processing expense will then (at long last) have been provided, as it could have been 15 years ago. □

[2] A component of the SCERT simulation system developed and marketed by Comress, Inc. of Rockville, Maryland.

AIR CARGO AND THE COMPUTER

A. L. Jacobs
Chief Controller of Computer Development
BOAC
London, England

"In the cargo control system of British Overseas Airways Corporation at London Airport the computer is used to record and direct progress of consignments through the warehouse in real time, i.e., as the events are happening."

(Reprinted with permission from Freight News Weekly, London, England, June 18, 1971.)

For many years BOAC has been using computers for routine cargo accounting and statistics jobs.

Indeed a penalty of being early in this field is the need to convert early work from one generation of computers to another; and we in BOAC are at this moment in the process of transferring our basic cargo accounting and statistics work from our second generation IBM 1410/1401 equipment to the central nucleus of very powerful IBM 360 computers which provide the heart of the BOAC system known as BOADICEA.

Of course we have taken the opportunity to review and revise this basic work; and we are, in particular, now developing a cargo data bank, which is designed to allow our users ad hoc access to the millions of characters of BOAC cargo information and records on file. But the work we are doing in this field is relatively orthodox, and whilst by no means straightforward and simple, is paralleled by similar achievements in many other airlines.

I would like to take the opportunity of talking about a very new development in the application of computers to cargo, namely the BOAC cargo control system at London Airport. This is a unique system in which the computer is used to record and direct the progress of consignments through the warehouse in realtime, i.e., as the events are happening.

There is nothing very complex or awe inspiring in the warehouse tasks undertaken by the computer; in principle the tasks are rather very simple and straightforward.

The application is unique in the airline field, and I might add that a number of other airlines have sadly failed with their pioneer attempts of a similar kind.

I believe that this cargo control system is very relevant to the discussion today for three reasons. Firstly, because it is a good example of what can now be achieved by computers working in realtime, and the airlines are leaders in this field; secondly, because many of the people here today have a direct interest in the operation of the BOAC warehouse at London Airport; and thirdly, because the BOAC cargo control system is in many ways the operational precursor of LACES (the London Airport Cargo Electronic Data Processing system) which is scheduled to go into operation in the Autumn 1971, will affect all cargo users of London Airport, and will undoubtedly create a world-wide interest in developments of this kind.

As for the background in which the system was conceived and operates, the detail design study for the BOAC warehouse was completed in 1967, in collaboration with BEA. It was determined that the quantity of goods to be handled merited the incorporation of a very advanced mechanical system; and an extensive building was specified, providing separate but closely linked warehouse facilities for BOAC and BEA, to meet the requirements of the two airlines until 1980. For BOAC the warehouse area covers some 150,000 square feet and there is in addition another 36,000 square feet of office accommodation.

Effective

It was at once clear that a computer system might be a most effective support in this large warehouse environment, particularly on the export side where commercial timescale is generally more demanding and there is a vital operational need to match an individual aircraft capacity with the maximum load. This can be appreciated more readily by a review of the export mechanised handling system.

Goods arrive by road at eight reception points arranged in pairs.

At the reception point there are the usual checks on acceptability and a decision is then made on how to handle the goods. This can be in one of three ways:

- As unconveyables. They are then handled by conventional means through the warehouse to the load assembly area.
- As a boxable consignment. The so-called boxes are really wire cages with dimensions, base 42 inches by 54 inches and height 42 inches. If a consignment constitutes a worthwhile box load it is placed immediately in a box and is dispatched to one of the two storage areas, rack store or live store, which are described below.
- As a "consolidation". If a consignment does not constitute a worthwhile box load it is sent on a separate smaller parcels conveyor to an area which is devoted to the grouping of consignments for the same flight or destination together into a box. Once a box has been filled with such consignments it leaves the consolidation area and proceeds to rack store or to live store.

Consolidation

The consolidation area is composed of 14 lanes of roller conveyor on to which parcels are discharged according to flight and destination. The parcels are then placed manually into the correct box. When the box is full, it is placed on an outgoing box conveyor and proceeds via the exit control point to rack or live store.

The rack store consists of double lanes of cells, each lane served by an automatic picker/stacker crane.

This area serves as storage for boxes which are not required immediately for flights assembly.

Storage

From this area a box is retrieved when it is required and sent to the live storage area. The live storage area consists of lanes of powered rollered conveyors, each lane taking eight boxes.

Boxes reach it from rack store, from export consolidation area or direct from reception according to circumstances.

It is in this area that boxes for the same flight and destination actually come together for the first time.

The load assembly supervisor is able to release boxes a lane at a time into the load assembly area for making up into pallets in the case of freighter aircraft which are parked in stands adjacent to the warehouse, or for transporting to combination aircraft parked nearer the passenger area.

The physical arrangement of the warehouse is calculated to activate the optimum storage of goods, which can be widely dispersed but also dynamically and rapidly drawn together for flight assembly by the extensive mechanized handling equipment. So in order to take full advantage of this organization of the warehouse a control centre must have a comprehensive knowledge of the nature and whereabouts of all the goods entering and in the warehouse, and the ability to direct their movements. In particular, a capacity controller in this centre and in charge of a flight needs to know.

Consignments

- What booked consignments have arrived for the flight, and where they are.
- What booked load is outstanding.
- What unbooked consignments are to hand, for destinations served by the flight, when did they arrive, and where they are.
- What is the remaining capacity for the aircraft serving that flight, and needs to be able to direct warehouse staff in the reception and other areas as to the appropriate handling of a consignment at any given moment in relation to the state of the flight.

Since the load for a flight is affected simultaneously by what is taking place at several reception points, and in consolidation, not to mention the variations which can occur in capacity because of passenger and mail loadings, there is evident need for a central file of information which will give an up-to-date picture of the flight as well as the state of the warehouse.

To achieve all this, it is evident that the system for the control centre basically requires:

1. Flight and destination inventories which can be updated rapidly as a result of allocation to a flight.
2. Inventories of goods which have arrived and are still waiting allocation to a flight.
3. The ability to send instructions to reception quickly on whether to allocate or not and where in the warehouse to send the goods.
4. The means of sending instructions to sections of the warehouse to pass goods forward to the next stage of assembly.
5. The ability to store information regarding each consignment and to use that information to print load lists and manifests quickly when they are required.

To meet this control centre need we studied a considerable number of different approaches; they ranged in sophistication from a system not using computers at all but relying on clerical activity backed up by punched card equipment and electronic accounting machines, to a fully comprehensive real time computer system with records for each consignment held on large backing stores of magnetic discs.

After some hesitation, because of the inherent ambition and consequent risk, a decision was made in favor of a comprehensive, real time computer system, to provide both an export and a rather simpler import control facility.

Satisfactory

This was seen to be the most satisfactory solution, both from the financial and operational point of view.

And here it cannot be too heavily stressed that the choice of this computer solution was fundamentally determined by the 27 percent direct return which could be achieved in the shape of staff savings and displaced equipment over a period of ten years. Of course this simple financial emphasis was not intended to discount the indirect return arising from the operational benefits of a computer system; but in BOAC we are very cautious about proceeding with computer applications which cannot be simply justified in terms of a substantial direct return.

The principal units of equipment chosen were: 2 x Ferranti Argus computers, 2 x Burroughs discs, 4 x Ampex magnetic tapes, 2 x Bull card readers, 4 x IBM

545 card punches, 29 x Ferranti display terminals, 7 x Kleinschmidt printers.

The equipment was delivered to site in August 1969 and the total cost of the installed configuration was just over Ł330,000. To this must be added the detailed design and programming cost. Progress of the design and programming development was not always altogether smooth; the technical problems proved even more demanding than anticipated, and the effort finally expended was some 50 man years, representing a cost of approximately Ł2,000,000, 20 percent greater than budgeted.

Effort

But through a determined effort the system was brought into operation exactly on target, i.e., in line with the opening of the different facilities of the new warehouse, the import system in November 1969, and the export system in June 1970.

With over 12 months experience of the system in operation I am very pleased to be able to report that it has been a real success.

After some inevitable teething troubles during the first few weeks, the equipment quickly settled down and has sustained a very high level of reliability, averaging over 99 percent uptime on a virtually continuous 24-hour day, seven day a week usage.

The programs too have been proved sound, amply justifying the months and months of saturation testing which was undertaken before cutover. And the most important of all the system has been enthusiastically accepted by the cargo users, who have quite simply come to take the system for granted as a natural tool and an inherent feature of their work.

In this context, it is perhaps worth mentioning the operating context of the cargo control system. In an ordinary computer environment, operating the system is the responsibility of specialist computer operators; but with the cargo control system, unusually, responsibility has been given to the capacity control staff who operate the equipment as they use it for cargo business.

With this in mind the computer system has been designed to minimize the amount of operator intervention required. Inevitably there was some initial stumbling as the capacity control staff were still learning their way around the system; but within less than three months they had become altogether efficient, and now, like all the other users of the system, they regard their contribution to the operation of the computer as no more than a minor part of their duties.

But throughout that difficult period the computer system functioned entirely satisfactorily; and not only did the system sustain the confidence of the BOAC cargo management and work staff, but gratifyingly, there was only the most occasional implicit press criticism of the "computerized" element of the warehouse.

Now with the mechanized handling equipment properly bedded down and the whole warehouse operating in a smooth rhythm, we feel that we can talk more freely of the success of the computer cargo control system in the background — performing a vital job.

Handling

The cargo control system has been a success, and it is typical of the new role which computers are beginning to play in the airline cargo field. We have begun to graduate from machine accounting, and with a real time system such as cargo control we are beginning to feel our way into the day to day cargo operation, as a natural user tool and support. And soon with LACES at London (and subsequently SOFIA at Paris) the BOAC cargo control system will be complemented in Europe with a total airport operation; and if BOAC experience can be regarded as a foretaste and a first guide, to a wholly beneficial effect. □

---

c.a PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROBLEM 7112: CARDS ANYONE?

When Al entered the Computer Center he saw Joe poring over a print-out. On his desk was a deck of cards – playing cards. "What's Joe doing?" he asked. "Trying to figure out why he lost to those sharp operators who fleeced him with that thirteen spade game?"

"No", replied Bob. "He saw where he went wrong there. Now he's trying to work out another game to get even. He's got the results of 10,000 random trials there."

"What game is this?"

"He takes the Ace to 10 of spades out of the pack and has his opponent shuffle them and turn them up one at a time. He offers to pay a dollar every time a card shows up that's larger than any previous one."

"Is the first card turned up considered one of these largest cards?"

"Yes, even if it's an Ace. Thus the player is always sure of getting one dollar back."

"How much is Joe going to charge to play this?" Al was beginning to get interested.

"Three dollars per game", Bob answered.

"That doesn't seem like very much, especially if the player is going to get at least one dollar back and may get as much as ten dollars. I don't think he'll make a profit on that basis."

"Well, he's studying that print-out and smiling with what looks like satisfaction."

Will Joe come out ahead or not?

Solution to Problem 7111: Too Few or Too Many?

Bill is wrong. There will be approximately 4, 39, 391, 3913 and 39131 numbers containing 2 to 6 digits respectively. Thus roughly 256,040 digits will have to be stored and at four bits per digit this is more than the million bits in the original data.

THE URGENT NEED TO RETHINK THE USE OF THE COMPUTER IN INDUSTRY

Prof. F. H. George
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"Most people think of computers as always doing exactly what they are told to do by the programmer, and so think of them as completely automatic and completely slave-like machines. ... This conviction has blinded senior management and data processing people to the tremendous flexibility that is possible, which leads to a huge step forward in decision making and planning."

The first major point which we shall assert bluntly is that our use of computers in the western world in general, and Britain in particular, has been grossly inefficient. There are, of course, some computer installations which have carried out an extremely efficient and worthwhile job, but we ought to be quite frank in our opinion and say that there are all too many computer installations set up without sufficient thought given to their potential usefulness, or cost efficiency, and the result has been enormous expense and inefficiency. This has certainly been recognized by the computer manufacturers, but their efforts to "educate" their customers have been unsuccessful, and this seems to be a true assessment of the position, regardless of where the fault lies.

Difficulties in Setting Up Computer Units

There are, of course, basic difficulties in setting up computer units in an industrial setting. Highly experienced and qualified staff are difficult to come by, and when they are eventually acquired there are many different companies in competition for their services, and the problem of retaining efficient staff, once they have been acquired, remains with the computer user all the time.

Management Not Knowledgeable About Computers

Another problem is that the organizing and running of a digital computer in the industrial scene requires a great deal of specialist knowledge of many kinds, and this involves the sort of information which has not yet, in a very general sense, got through to management. This means that senior management are often forced to make decisions about the computer, without sufficient knowledge of the facts. In ignorance of many of the basic facts, they have to rely either on their own data processing department, using the advice of the data processing manager, or upon some outside consultant. Both of these approaches to the problem present difficulties; either party could be less than well informed on how the computer should be used in that particular industry, and both parties have an element of vested interest in the advice they give. Both parties must discuss the problem with management, in computer terms, and the chances are that the decision maker will have to make his decisions without fully understanding their implications. Computers do not perform magic, neither are computer men magicians; the onus is on computer men to simplify the jargon of their trade, or on management to at least make an effort to understand.

Software Designs Bad or Out-of-Date

The position that exists in many companies is exacerbated by the fact that a data processing manager cannot admit that his system is inefficient without risking being dismissed for inefficiency. This applies even if he were not responsible for the design of the system. The fact is that most money is spent in most data processing units on maintaining software, and the patching up of inefficient systems is preferred to the redesign; no one can afford to admit that most of our software designs are bad or out-of-date.

New Uses of Computers

One way of solving this problem is clearly to employ senior management who have a broader education in the field of computer science and specialist skills. However that may be, in this article we will try to set out some of the uses to which computers could be put, which are not readily known and are so far only very slightly practiced by industry, particularly in Britain.

Heuristic Programming

Most people think of computers as always doing exactly what they are told to do by the programmer, and so think of them as completely automatic and completely slave-like machines. To some extent this is true, certainly in the sense that this is the way they have so far been used. This conviction, that computers can only do slave-like things, has blinded both senior management and data processing people themselves to the tremendous flexibility it is possible to introduce into their use. We shall talk about this flexibility, which leads to a huge step forward in decision making and planning in industry, in terms of its central ingredient which is heuristic programming.

Classical Programming

To explain what we mean by heuristic programming we must contrast it with classical programming, or what is sometimes called algorithmic programming. In general terms we think of a program, which deals with payroll or ledger analysis or some such straightforward activity, as something which requires the prior organization of precise instructions, which are used on a step-by-step basis allowing the necessary analysis to be carried through at very high speed, and certainly many times the speed of the equivalent manual worker. This is because it is assumed that everything is wholly specified in advance, and the job done is merely that of a high-speed clerk or arithmetician. Certainly the algorithmic, or classical, program can be extended to do all manner of things, including controlling production lines and the like, but it always requires — or so it seems, judging by what is actually practiced in the British computer industry — a precise and detailed a priori set of instructions.

Contingent Programs

But heuristic programs are contingent programs. They are composed of what are sometimes called "rough and ready rules", hypotheses, ad hoc rules of thumb, approximations, or successive approximations leading to solutions. It is not necessary that a computer be applied only to precise systems wholly definable in advance. Programs are written which modify themselves in the light of experience, and deal with situations which are imprecisely or incompletely defined. Let us give some examples. The first example refers to a commonsense sort of situation, and the next an industrial situation which is also very much commonsensical.

Precise Information

If we say that black clouds entail rain and then ask the computer to collect information on this assertion, the information collected will be absolutely precise. It will say how many times black clouds have occurred and how many times black clouds have been accompanied by, or have immediately preceded, rain. The counting operation which is basic to answering this particular question of whether or not black clouds are connected with rain, is an example of the precise or classical type of programming. However, the deductive statement, or hypothesis, that black clouds nearly always mean rain or are a sign of rain, is a probabilistic statement, and certainly may be wrong. It does not always happen that way and this is something with which the computer, properly programmed, can cope. The model at one level suggests a precise counting procedure, the model at a higher level, the level which is both probabilistic and relatively abstract, is the statement "Yes, black clouds more often than not (a numerical figure in the form of a precise score can be given here if necessary) mean rain".

Dealing With Imprecise Situations

The point to grasp here is that heuristic programming can deal with the imprecise situations which are normally thought to require human judgment and human judgment only. Thus it is that the decision to change the set-up of a production line, to cease production on one product and transfer immediately all effort to another, or to move the store from one factory site to another, is usually an ad hoc human judgment. This is so, even though it may be supported by PERT diagrams and any other sort of aids to decision making available to the human operator.

The very fact that PERT diagrams and the like may be used is a reminder that there can be higher level models (many of them we would call heuristic) that can be programmed onto the computer itself. The result is that decisions over relatively abstract things can be made as precise as is necessary, or as is possible in the light of available information. The great advantage this method has over unaided human judgment is that it can take into account all the relevant evidence, and at least makes the maximum use of this evidence at great speed and with great efficiency.

Consider for example the problem of scheduling a production line; programs have been written by, for instance, the Bureau of Information Science in conjunction with the Department of Trade and Industry, which will allow the scheduling of a production line on a heuristic basis. There may be a very large number of components that must be injected into a production line and these have to be fed in very carefully to maximize the throughput and to make sure that there is no loss of down-time. Such a schedule must also ensure that there is no lack of relevant store components or relevant materials; in short, a workable schedule is required. A classical type schedule for this type of operation may cost a vast sum of money and entail a great deal of time in its preparation. The result is that the appropriate computer program cannot be manufactured in time, or if it can, it would be at such enormous cost it would be hopelessly uneconomic. There is, after all, no point (there is a real lesson for computer users here) in spending a million pounds to save half-a-million.

The Importance of Heuristic Programming

The heuristic scheduling programs already written can supply a very good approximation to the ideal or optimal schedule, and can actually save a vast amount of money. It is not necessary to be wholly precise, as human beings have always realized, about something which is intricate and vast with respect to detail, and where the extra one percent of accuracy costs far too much to achieve. Because heuristic programs are adaptive and capable of collecting information about past results and modifying themselves in the light of these past results, the heuristic can, with experience, be improved. This is just the same as with a human being; he too can gain in his decision-making capacity through experience, so that in the end he may be very near optimal, or even optimal in the schedule he devises. The ability needed, though, in such a human is very rarely found, and cannot be as easily improved as in a computer program. This is the reason for the enormous importance of heuristic programming.

The point about heuristic programming is that it involves a learning process where experience plays a vital part, and experience can be accumulated automatically. Most of classical programming is of an on-off character, non-cumulative, where the acquisition of experience is left to the human user, either in management or in the form of the systems analyst or the programmer. Heuristic programming incorporates this experience into the system, or can do so if necessary, so that the adaptation and improvement of the heuristics used improves automatically.

Non-Numerical Computing

Much of what we have said about heuristics is different from classical computing, not only because it deals with approximations, but also more often than not it tends to be of a non-numerical kind.

It is a clear misunderstanding about digital computing to believe that it is entirely committed to mathematical processes. What is mathematical is the final program fed into the computer; this must be numerical in form. However, although numerical in form when it goes into the computer, it does not require that the model it refers to is itself numerical, and this can easily be seen when we recognize that we can code any ordinary language into numerical form without any difficulty. Thus a can be represented by 1, b can be represented by 2, c can be represented by 3, and so on. Clearly a numerical representation of any English statement can easily be made.

Non-numerical computing has taken large strides in the last few years, and nowhere more so than in the heuristic domain. This is so because many of the judgments made by human decision makers in ad hoc situations are formed on, what are called in scientific parlance, hypotheses. We form these hypotheses in the light of the available evidence to the best of our ability, and with regard to a particular situation, either directly or by deducing certain consequences which follow from the hypotheses, and applying these consequences. The process is akin to scientific method, but is not usually carried out by the average human being with great efficiency or with suitable accumulation of experience.

Heuristics Can Take a Numerical Form

The point that most development in heuristic programming has been non-numerical should not blind us to the fact that heuristics can take a numerical form. There are numerical heuristics used as models for all sorts of activities already. These activities include forms of prediction such as sales estimation, demand estimation, market analysis in terms of projections, etc.

Natural Language Computing

The very fact that we are talking primarily in terms of non-numerical computing is a reminder that we would expect to deal, to a great extent, in natural language. It is natural indeed to put hypotheses in the form of ordinary English statements, and one other large step taken the past few years is the development of natural-language computing facilities.

It is possible to program a computer to answer questions from a data base or a text base, and this can happen even where the information is not immediately available in the data base (that is, it is not immediately stored there). Such data can be retrieved though as a result of inference making.

Drawing Logical Inferences

Inference making on computers has a very special status; it is the process of drawing logical inferences, and the programs so far written can take various forms. Many of the early programs on logical inference making were designed to show how mathematics could be computerized, or "mechanized" as it has sometimes been put. The same movement now has spread to management information systems where it is not only the retrieval of information which is so important to senior management for making decisions, it is the ability to draw inferences from the data.

Natural language programming is a vital adjunct to heuristic programming. This is not to say that heuristic programming depends entirely on natural language programming, nor is it to say that natural language programming depends on heuristics. What is being asserted is that the two things marry themselves together very well, to simulate in the computer the sort of processes that human beings do themselves when they make decisions or make plans.

Management Information Systems

All the above arguments about heuristics and natural language computing in a non-numerical vein provide the clue that what we are really looking for here is a Management Information System. What we need is relevant information to be made readily available to senior management to enable them to make the best available decisions. Although it may one day be possible for computers to make the total decision for human beings, this will almost certainly be thought undesirable by human beings themselves. Whether or not this situation will some time change need not be a source of discussion here.

The human being as a decision maker must, even in the short term, have all the relevant information displayed to him in the most easy-to-understand form, so that he can make the best available decisions in the light of all the circumstances. The only way to decide whether or not he has made the best available decision is to have all the relevant information put to him in a suitable form, and to see, before he takes his risks, what the consequences of those decisions are. It is the consequences of the decision that are so important and depend upon the simulation.

A Management Information System Develops a Simulation Technique

We have already talked about learning programs and about situations in which learning and accumulation of experience can take place, but we must assert that wherever learning is impossible the use of a simulation technique is absolutely necessary. A management information system therefore develops inevitably a simulation technique which allows it to show what will happn, with high probability, like black clouds and rain being associated, in the light of certain environmental changes. If the bank rate should go up by one percent or two percent, or if we should join the Common Market, or if we should make some other economic change in the country or in some other way change the status quo, what would be the effect on our plans?

We may formulate one-year, two-year, five-year or n-year plans, and we want to know if they are robust and will be successful if projected independent of circumstances, or whether they are sensitive to change. If they are sensitive to change, we want to know if they are sensitive to our advantage or to our disadvantage; the only kind of plans in which we will be interested are, of course, the former.

(Please turn to page 24)

ROLE OF THE MINICOMPUTER — TODAY AND TOMORROW

Julian Kindred
Victor Comptometer Corp., Computer Div.
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Chicago, Ill. 60618

"I would maintain that anyone in business who wants to keep up with or surpass his competition needs a minicomputer — particularly if he cannot afford a large-scale computer. . . . The mini will do a maxi job for some time to come."

(Based on a talk at the Second Annual Cleveland Business Show, April, 1971)

When it comes to staggering the imagination of man, no segment of technology can compete with computerization. Within this exploding, glamorous volcano of industry and business, a whole new secondary technology has been developing rapidly to change our lives at home, at work and at play — we call it the minicomputer.

Minicomputers Do Everything

Today, this amazing instrument is employed to do everything from controlling passenger elevators or heating systems or production lines, to processing billing and accounting or carrying on conversations with larger computers. The minicomputer even speeds up race track betting.

Dedicated and Non-Dedicated Minis

Minicomputers come in different shapes and sizes. Most of them either resemble little black boxes or large accounting machines. Dedicated minis perform one specific function. Non-dedicated minis are flexible enough to perform a few or all of the tasks performed by large general-purpose computers but on a smaller scale and at slower speeds.

Potential of Flexible Minicomputers

The dedicated minicomputer was first on the scene and consequently makes up the largest population. But the more flexible minis for business and industry are currently coming into prominence. We see the flexible mini as the computer for today and tomorrow with almost unlimited growth potential. In addition to considering dedicated and non-dedicated minis, we shall take a look at the market for minis today and tomorrow; and we shall determine what a mini is, where it is used and where it will be used. We'll consider mini peripheral equipment, and discuss shopping tips and problems for mini purchasers.

Anyone in Business Needs a Computer

First of all, "Who needs a computer?"

I would maintain that anyone in business who wants to keep up with or surpass his competition needs a minicomputer — particularly if he cannot afford a large-scale computer.

Relatively Low Price of Minicomputers

One of the chief appeals of the minicomputers is its relatively low price, which permits almost any businessman to own or lease a computer and allows the mini to enter fields which were formerly untouched by computers.

20 Manufacturers of Minicomputers Expected to Survive

The minimarket is a maximarket in terms of units, dollars, and numbers of manufacturers. While the number of units and dollars continues to grow, the number of manufacturers is diminishing. A shakeout of weaker companies has begun with an estimated 40 out of 70 companies surviving so far and with further liquidations and mergers, this number is expected to drop to 20 in five years. Long-established companies as well as some of the more successful new companies will be among the survivors.

Expected Sales of Minicomputers

Minicomputer sales this year should reach about $300 million and anywhere from one to one and a half billion dollars in minis and miniperipherals in five years, according to several industry predictions. Estimates and predictions are difficult in the computer industry because of continually changing factors in technology and marketing.

Price Range of Minicomputers

The term minicomputer, like much of the nomenclature associated with it, holds different meanings for both users and manufacturers. At Victor, we refer to our line of products as small-scale computers; however, by most industry standards, several of our models should be called minis. It is safe to say that minicomputers fall in the price range between $5,000 and $25,000 basic purchase price, although there are some that go higher than $50,000.

Capacities of Minis

Minis have input and output devices, a central processor, and memory of at least 4,096 words for information storage. They generally operate in much the same fashion as their large-scale counterparts but the speed of input and output devices is not as fast. The number of programming languages and operating systems are greater in large computers. Mini-memories have less capacity and slower speeds. An operating speed in a typical memory would be between 0.5 and 1 microseconds per cycle. Of course, there are some minis available with speeds up to .01 microseconds per cycle. Word lengths are generally from 8 bits to 64 bits.

Some industry sources insist that minis are little black boxes that have wired-in programs and only one job to perform. Others say they can be flexible, with a wide range of software and the capability to be programmed at the user's place of business. Most sources agree that both types of equipment can be classed as mini. Most manufacturers do not make both types.

Differences of Minicomputers

Although minicomputers have many characteristics in common, there are differences in each one of them. Most of them have some type of magnetic memory core. Some are equipped with a read-only memory. The read-only memory is wired in, and has the advantages of low-cost, high speed and exceptional reliability. These same devices are used as input-output media to speed up processing and communication with other systems. Another common ground is the factor that permits them to be minis — integrated circuits.

Lower speed outputs and direct keyboard input generally characterize the flexible minis designed for general business applications.

Magnetic Stripe Ledger Card

Some of the minis use the magnetic ledger card. This is becoming one of the most popular items in computer accounting systems. A small businessman can keep using his familiar hard copy ledger card with the addition of a magnetic stripe. The card stores alphanumeric information that can be seen and read by both computer and the businessman. You might say that the magnetic stripe ledger card surmounts the communication gap between man and computer. The stripe can be re-read and updated at anytime.

Practical Applications of Minis

There is a seemingly endless list of practical applications to keep minis busy. You can find them working at billing, accounting, payrolls, inventory, process controls and other controls, sales statistics, management information, estimating, municipal tax accounting, interests and yields, driver's route inventory, tax reports, production planning, depreciation schedules, data communication, data collection, laboratory automation, peripheral control, education, and recently time-sharing and remote-batch processing systems.

Remote-Batch Processing Systems

Remote-batch processing can provide large-scale computing facilities to the user who cannot afford to keep a large computer busy enough to justify its cost. In this operation, input is fed into the local terminal and transmitted over telephone lines to a central computer. Once processed, it is sent back as output to the local terminal where it is fed into a line printer. If desired, the central computer can place the output on tape for later transmission. In some cases, the cost of all the local peripherals with the terminal can approach the cost of a medium scale computer. This makes the operation somewhat questionable as a cost saver. The intelligent terminal can offer a way out of this dilemma. A minicomputer within the terminal can utilize the peripheral off-line, by performing processing tasks while the terminal is not communicating with the large scale computer. Peripherals normally used in remote-batch include, line printer, card reader, magnetic tape transport and of course transmission and communication equipment. A good reason for using remote-batch systems is the central data bank, which can be tapped and updated by any number of terminals, eliminating the need for duplicate files at each location. Inventory control systems, payroll, management information systems, accounting and other functions are tailor-made for a remote-batch system.

Minicomputers Overcome Remote-Batch Processing Delays

The system is subject to occasional hang-ups due to transmission line failures. Minicomputers can overcome this problem by continuing to process data while the lines are out of use. Taped data can be transmitted or sent by air mail at a later date. Another disadvantage of the non-intelligent terminals is loss of local control offered by the stand-alone computer. In its favor, it provides an electronic data processing system with large scale computing capabilities at reasonable prices for the small company and a practical system for companies with several divisions or locations using identical inventory, payroll, information, accounting or other systems.

Compatibility

You must consider several things before purchasing or leasing any equipment. First, know the central computer you will use so you will be sure to shop for terminals and peripherals that are compatible. Some terminal equipment is compatible with all large main-frame equipment, but this compatibility is not the rule in the industry.

Alternative to Remote-Batch Processing: Time Sharing

Time sharing is a related alternative to remote-batch processing. In time sharing, a simple device such as a teletyprinter may be used, eliminating the cost of local terminal data processing with its accompanying peripherals. All processing can be accomplished by the central computer. A conversational mode of communication exists with the simple terminal feeding in information over the leased or standard telephone lines and receiving processed information in return. This system utilizes a great deal of expensive central computer and transmission hours.

About 250 companies in the country offer this service. It is generally offered in two forms: the central computer with one central data bank to accept data from each of the user's locations, or through regional central computers which may utilize local telephone lines to cut costs while necessitating duplication of files. Both time-sharing and remote-batch processing offer lower investments in hardware for large scale computer benefits. The minicomputer whether limited or flexible is the key to better use of both systems.

Data Communications

Whether used in remote-batch, time sharing, or other in-house telecommunications between computers, these systems are generally categorized as having the facilities for handling data communications. The minicomputers or intelligent terminals in data communications can interface many different inputs to a single communications facility. They can assemble and disassemble messages, detect errors, convert codes, and coordinate communication inputs for larger computers. About 15 percent of minicomputers are being used in communications today but this percentage is expected to increase to 60 percent by 1975. During the 1970's, telecommunications revenues from machines talking to machines should exceed revenues from people talking to people.

Typical Users of Minicomputers

Chemical plants and automated oil refineries are typical users for process-control minicomputers. These minis each have a dedicated function to manipulate a process. Aerospace industries are also big users of dedicated minicomputer systems.

Minicomputers Used to Speed Up Horse Track Betting

Mincomputers have been used to speed up horse track betting by backing up ticket-issuing machines. Before a seller gets a ticket, the computers check his input against stored information. Verification enables the machine to produce the ticket. An arithmetical function updates parimutuel data when each bet is placed and calculates odds and payoff prices.

Considerations in Shopping for a Mini

Many things need to be considered if you decide to shop for a mini. Some of the minis include only a few standard features; so by the time you get through adding in the optionals, your system may cost more than a basic system which includes the required features as standard equipment.

Peripheral Equipment

Peripherals can add to the capabilities of both minicomputers and intelligent terminals. The need for low cost peripheral equipment to get the most from minicomputers has prompted increased activities by both old and new computer manufacturers. One of the newest categories of peripherals is the tape cassette. When large quantity storage of data is needed only infrequently in large systems, a magnetic tape transport is used. In smaller systems, the tape cassette serves the same purpose on a smaller scale. Paper tape systems are less expensive; but in some applications, low storage density bulky handling and non-erasable memory disqualify them.

Shopping for a Minicomputer

You should determine just what tasks you want your mini to perform, then shop for the one that best measures up to your needs with little or no modification. Next, investigate the manufacturer's ability to supply the proper backup and service for your computer.

Software

Another factor to consider is the software offered by the manufacturer. Software is becoming a primary factor in the purchase of minicomputers. Find out if you are buying hardware only or if software is available. If it is available, find out how flexible and extensive it will be. You must remember that a minicomputer's versatility lies in its ability to be programmed. Programming concepts for a minicomputer are really similar to those for large ones. You have a wealth of systems to choose from and you will have more powerful, faster and cheaper systems to choose from in the future.

Summary

The mini, like any computer, is only as good as the systems analysts and programmers who put it through its paces.

It is no longer an innovation. The mini is an established product and as necessary as the large main frame equipment.

The mini will do a maxi job for some time to come. □

George — *Continued from page 21*

Getting Maximum Utilization Out of the Computer

All that has been written in this short note is an attempt to persuade British industry, particularly in the form of senior management, to wake up to the fact that they have in their possession a vastly more efficient tool than they have seen so far in the form of the modern large-scale digital computer. But if they are to get the best out of that tool, they must come to know the sort of research and development work carried out in the last few years and know how to utilize it to maximize the efficient use of the computer. They cannot in every case depend upon the knowledge of their data processing manager who, with a regular job to perform, can hardly hope to keep abreast of all current research activities, or understand fully their implications. It is not their fault that this is the case. In the first place, research is moving very quickly. Second, if you are performing a practical job, it is difficult to keep up with research and development and its implications at the same time. Furthermore, as we have already said, all too many data processing managers are too busy patching up badly designed systems to worry about developing anything new.

It is therefore absolutely essential that senior management in this country address themselves to the role the computer can and should play in their organization, and make sure, however slowly they develop it, that they make use of modern facilities which would streamline their organization and make their whole job a great deal easier in the future, and perhaps make their computer departments pay their way. A failure to recognize these advantages will be disastrous for all concerned. □

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 the agency, if any.

COMPUTERS AND AUTOMATION, 815 Washington St., Newtonville, Mass. 02160 / Pages 2, 3, 27, 28, 51

TEACHING DEVICES INC., P.O. Box 169, Carlisle, Mass. 01741 / Page 52

BUILDING YOUR OWN COMPUTER — Part One

Stephen B. Gray
Amateur Computer Society
260 Noroton Ave.
Darien, Conn. 06820

"A number of people, especially those working in data processing, sooner or later get the idea of building a digital computer. ...probably no more than 200 in the United States are actively trying."

The following letter appeared in five electronics and computer trade magazines in 1966:

> Invitation to computer builders. This is an invitation to those readers who are building their own computers to join the Amateur Computer Society, a nonprofit group open to anyone interested in building and operating a digital computer that will at least perform automatic multiplication and division, or is of a comparable complexity.
>
> The society publishes a bimonthly newsletter containing problems and answers, information about where to get parts and schematics and cheap ICs, and articles on subjects such as Teletype equipment and checking out magnetic cores.
>
> Will interested readers please write to me, giving details on their proposed or in-the-works computers, such as word length, number of instructions, sources of parts and schematics, clever solutions to previous problems, etc.?

The same letter appeared in several other publications, and enough of a response was generated to permit continuing the Amateur Computer Society, about which more will be said later. But first something should be said about why this group was organized.

THE IDEA — AND THE PROBLEMS INVOLVED

A number of people, especially those working in data processing, sooner or later get the idea of building a digital computer. Most of them, after a brief look at the problems involved, never do anything further about it. Very few, probably no more than 200 in the United States, are actively trying to build a computer, which is defined here as a machine that will perform automatic multiplication and division, or is of comparable complexity. A modest definition, perhaps, but translating it into hardware has taken some hobbyists many months and hundreds of dollars.

A Parallel

A hobbyist with an interest in radio can assemble a simple crystal set from a diode, earphones, antenna and ground, and receive broadcasts for an outlay of several dollars. From there on it is rather simple to add components that increase sensitivity and selectivity. At any stage, programs are received, which provides a sense of accomplishment, right from the beginning.

There are countless books and magazines, plus several amateur organizations, that supply a wealth of radio circuit information and construction details. Components are widely available; kits and assembled receivers and transmitters sell at a wide range of prices.

To build a simple computer accumulator, which can do no more than add successive inputs, using toggle switches for input and lamps for output, will cost several dollars per bit. To build an extremely simple "computer," with four-bit words and without memory, and which divides the easy way (by repeated subtraction without shifting), can cost two or three hundred dollars. As one "ham" put it, "I've been in amateur radio for over 40 years and find computers are much more complex than any amateur equipment I've seen."

No Computer "Cookbooks"

Although there are dozens of books on computer circuits, none are "cookbooks" that tell how to build a computer. Very few overall schematics for computers are available. Components such as transistors and integrated circuits are readily available, but there is great difficulty in obtaining, for example, usable magnetic drums at what would be a reasonable price to an amateur. There are no digital computer kits; commercial computers cost thousands of dollars.

All these facts present a rather bleak picture, but no more so than for the hobbyist who wants to build a jet airplane in his barn.

A Long Island member of the Amateur Computer Society wrote:

> It should be emphasized that the popular analogy between the amateur computer builder and a radio ham is simply not valid. The complexity of even a small computer outweighs by at least an order of magnitude the design effort necessary to construct an amateur transmitter. This is doubly compounded by the fact that: the nature of basic building blocks is changing at a rapid rate; many commercial designs are proprietary; there does not exist 40 years of computer design history to draw upon.

How About a Used Computer?

Used vacuum-tube computers are occasionally available, but they involve big problems of size, power requirements, air conditioning, and tube-replacement costs.

Used transistor computers are seldom available at a price that a hobbyist can afford; a Recomp III, even at five percent of its original price, would still cost $4,750. The cheapest second-generation computer available from one New York broker is the IBM 1620, at about 25 percent of its purchase price, or $30,000. The cheapest third-generation computer is still expensive; a PDP-8/E, made by Digital Equipment Corp., costs five thousand dollars without a Teletype.

Why Not Build One?

Building one's own computer is such a complicated undertaking that very few have been completed, and nearly all of these have been built by electronic engineers who are in the data-processing industry.

The main problem in building a computer is that many technologies are involved. Computer companies have specialists in logic, input/output, core memory, mass memory, peripherals and other areas. To build one's own computer requires learning a great deal about each of these fields. If the computer hobbyist is an electronics engineer working for a computer manufacturer, he can drop in on a friend down the hall or in the next building and ask, "Say George, just what kind of drivers do I need for a core memory with these specs?" Most hobbyists, of course, do not have these resources, and must spend many hours in study, not only in the electronic fields mentioned, but also in mechanical areas such as packaging, back-plane wiring, metal-working, plastics, and many others.

Computer Schematics

Although many computer hobbyists are engineers who design their own circuits, there are just as many non-engineers who cannot do this, and who must copy from existing schematics. Several dozen books and manuals contain computer schematics, but each has some serious limitations.

"Digital Computer and Control Engineering" is a fine technical book[1] for learning all about computers as of 1960, from basic principles through hardware and software, to applications of matrix equations. Three chapters are devoted to Pedagac, a computer with 19-bit words, 17 instructions, a magnetic-drum memory, serial arithmetic and a single-address scheme. There is a full set of schematics, plus partial wiring tables. However, according to an associate of the author, Pedagac was never built; its purpose was pedagogical, and the plans "were not checked out as thoroughly as if construction had been the goal." Furthermore, Pedagac has no real provision for input or output.

A manual containing the plans for the Digiac 3050 can be obtained for $6.50 from the manufacturer, Digiac Corp., perhaps better known by its previous name, Digital Electronics, Inc. The 3050 is a semi-automatic desk-top "computer" trainer, with four-bit words, three registers, input pushbuttons and output lamps, and seven instructions. It has no memory, however, and thus cannot store programs, which must be executed manually.

For $18, manuals are available from Fabri-Tek Inc. on the operation and maintenance of the Bi-Tran Six, a 98-pound computer trainer with 128 words of six-bit core memory, 30 instructions, and a single-address scheme. Input/output is by switches and lamps; peripherals are available for punched paper tape I/O; the latest peripheral to be added is a Teletype. The schematics for individual circuits include complete parts descriptions, except for transformers and the core memory; to copy this machine would be no real hang-up for a computer engineer, but it is indeed for the neophyte.

The Clearinghouse for Federal Scientific and Technical Information has, among its many translations from the Russian, a 168-page book[2] on an "Educational Numerical Computer." The ENC has 19-bit words, a single-address system, 11 instructions, and a 1024-word magnetic-drum memory "from a machine of the series Urals-1." Complete plans are included for this vacuum-tube computer trainer, which can be built by anyone with access to Soviet tubes such as the 6N3P, 6P1P, and 6Zh2P.

For $34.50, Control Data will provide a maintenance and training manual that contains <u>some</u> logic diagrams of the LGP-21 and RPC-4000.

A Navy training course, "Data Systems Technician 3 & 2," is available from the Government Printing Office[3]. It has three introductory chapters, six chapters on basic computer subsystems, and five on the NTDS (Navy Tactical Data System) computer CP-642A/USQ-20(V), the military version of the Univac 1206. This general-purpose computer has 30-bit words, 62 instructions, 36,768 words of core storage, and a main-frame volume of 58.6 cubic feet. There are 50 partial schematics on most of the circuits, but not all.

M.E.L. Sub-Assemblies

At one time a 16-page booklet was available from Amperex on "Building Your Teaching Computer with M.E.L. Sub-Assemblies," which are Philips logic modules, marketed by M.E.L. in England and by Amperex here. The booklet describes a simple computer that can be built in five stages. The first stage adds and subtracts eight-bit words, with one register and an accumulator; cost of the modules to build this stage is about $230. Stage Two multiplies and divides automatically, using comparator and auto-restart circuits; module cost, an extra $80. Stage Three adds extra storage with two eight-bit shift registers, along with circuits for transferring data between these registers and the accumulator or the main register; module cost, $300 more. For the Stage Four computer, there is only a block diagram to show how a delay line (for about $160) can be added for extra storage. The Stage Five block diagram indicates how paper tape might be used for input and output. Although there were many requests for this booklet, there were few orders for the modules required, so Amperex discontinued offering the publication.

Individual Circuit Schematics

If the overall computer schematic dug up by the hobbyist shows merely the interconnections of "black boxes," or if he wishes to interconnect individual circuits such as flip-flops and one-shots in his own way, then he is in trouble, unless he has an engineering background. When it comes to building individual circuits with transistors, there are very few schematics available with component information such as transistor types and resistor

(Please turn to page 29)

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A reexamination of some of the evidence relating to the assassination of John F. Kennedy — with emphasis on the possibilities and problems of computerized analysis of the photographic evidence.

EFFECTIVE PROGRAM DESIGN, by David W. Packer (July 1970, p. 37)
"The tendency of many programmers is to just start drawing a detailed flowchart, solving each problem as it occurs. This is analogous to building a house without a plan — one brick at a time. The result in either case is likely to be the creation of a monster."

DATA BANKS — A POSITION PAPER, by Prof. Caxton C. Foster (March 1971, p. 28)
A penetrating analysis of future likely developments of data banks, "when every interaction of an individual with society can be collected, sifted, and analyzed at low cost" producing erosion of constitutional rights.

THE SCIENCE OF INFORMATION MANAGEMENT, by Col. Carl J. Weinmeister, III (April 1971, p. 20)
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USING THE COMPUTER TO STEAL, by Harvey S. Gellman (April 1971, p. 16)
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COMMUNICATIONS MESSAGE SWITCHING — AN ANALYSIS, by Walter M. Aydelotte (July 1971, p. 8)
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Gray — *Continued from page 26*
values, for a family of digital logic modules. Only one or two manufacturers, out of several score, show such information on their data sheets.

The National Bureau of Standards published three Technical Notes[4-6] on "Transistorized Building Blocks for Data Instrumentation." A wide variety of circuits is described, using mainly the inexpensive 2N414 transistor. However, the DR435 diode specified is a gold-bonded type, costing $80 a hundred.

Although there have been many applications of these digital modules in various sections of the NBS, all but one are described in internal publications and are not available to the public. That one is AMOS, a "ceilometer computer" which keeps track of data relating to cloud heights; it involves no computing circuits. The Automatic Meteorological Observation Station is really an information storage and retrieval device.

ACCESS Computer

Brief mention is made, in one of the three NBS Technical Notes, of the ACCESS computer (built with the modules described), which was used by the Office of Emergency Preparedness along with FOSDIC (Film Optical Sensing Device for Input to Computers) to "extract information from films of questionnaire forms," for civil defense requirements. Although nearly a dozen publications are available with details of various peripherals, nothing at all can be obtained regarding the internal structure of ACCESS. Only one overall schematic was made, and it accompanies the machine.

A sidelight on ACCESS may be of interest, to indicate the fate of some government computers. ACCESS is not being used any more and, along with FOSDIC, is in a warehouse, waiting to be offered as surplus to a predetermined list of government bureaus: the Corps of Engineers, the Department of the Army, the Department of Defense, and so on down the line. If no government agency wants it, it will then be offered to state and local governments, which may have it for the cost of taking it away. Failing these outlets, ACCESS will be taken to Fort Belvoir, put on public viewing and sold to the highest bidder, for a few cents a pound.

Magazines

Data processing has advanced to the point that today's magazines dealing with the engineering side of computers are mainly devoted to complex articles of little use to the amateur. Once upon a time, some ten years ago, magazines carried articles about hardware that the amateur could understand and even adapt to his own uses. Current articles are now about such things as advanced memories, computer simulation, graphics, and highly intricate mathematical techniques, all of which may be of professional interest to the computer engineer-hobbyist while at work, but which are no help to him in designing or building his machine at home. An article may have a seductive title, such as "Synchronizing High-Speed Logic," and then turn out to be a mathematical exposition full of formulas that only a PhD specialist could understand.

Parts

Once the hobbyist decides to build his own computer, he is faced with the immediate problem of getting the parts. There are a great many used circuit boards on the surplus market, for as little as ten cents each; these are mostly from IBM computers of the pre-360 series. However, the "tab" ends have nearly all been broken off, making mounting quite difficult. The tabs contain the flat, finger-like contacts that are gold-plated so they will not tarnish; they are broken off because Federal law requires that the gold be recovered, even though there is only a few cents' worth on each board. Also, breaking off the tabs ensures that the boards (which may be defective) will not find their way back into an IBM computer.

There are some 3800 different circuit boards of this IBM type, known as the SMS series, for which there is no list of code numbers and corresponding circuit types. One IBM Customer Engineering manual gives schematics for six families of these cards, totalling no more than one or two hundred. As for the remaining thousands of board types, the hobbyist is on his own. Many are level-changing circuits, of little use to the amateur.

Although integrated circuits are now inexpensive, nearly all commercial devices for mounting them cost more, per circuit, than the ICs themselves: $140 for a Motorola 16-IC breadboard; $21 for a Cambion PC board that mounts eight flatpacks. An ACS member and a friend have formed a small Alabama company which, among other things, manufactures a PC board that will mount 32 of the 14-pin ICs, for $8.

Fairchild, Motorola, Signetics, National Semiconductor and Texas Instruments make a wide variety of medium-scale-integration ICs such as shift registers and read-only memories, yet not one of these manufacturers has available the schematics for a computer built from their circuits, not even a demonstration model. There is simply no demand; computer manufacturers design their own computers, often with computer-aided techniques that are too expensive for the IC manufacturers who provide the ICs that go into these computers.

Mounting

Mounting one's surplus or home-made circuit boards is not easy; one solution to using IBM boards is as follows. Al Sinclair, a transformer-station maintenance engineer with the Hydro-electric Power Commission of Ontario, Canada, mounted the IBM boards on plastic panels, and connected the circuit to eyelets that will accept AMP tapered pins. His computer operates on 12-bit words, with a 100-word core memory. Al recently rewired damaged core-memory frames to provide 1,024 words of 14 bits, which took two months of steady work, for his newer version.

Interconnections

If computer circuits are operated at low speeds, patchcords can be used for interconnections, although they are not cheap. But at high speeds, up in the millions of cycles a second, short wires and soldered connections must be used, to prevent spurious bits from being introduced. The problem with soldered connections is that the computer hobbyist, like the radio amateur, often makes changes in his circuits. With unsoldering and resoldering, tiny bits of solder can fall into places where they should not be, and make trouble. Wirewrapped terminals are nice and neat, but a hand-operated wrapping tool can cost over $60.

Input/Output

With only pushbuttons and lamps as input/output, programming is very difficult, as is the read-in of external data. Sooner or later the amateur wants automatic operation, and usually turns to used Teletypes which, although slow and awkward to use, are readily available and relatively cheap for older models.

Storage

Magnetic-drum memories are occasionally available, but they are usually from sledgehammered equipment, and may have been damaged. Read/write heads only a few thousandths of an inch out of alignment can scratch a drum surface beyong repair.

There is a variety of core memories available but, according to Sal Zuccaro, an engineer who has been designing memories for over ten years, "The used and surplus memory planes I've seen on the market are real antiques .... There are several possible reasons for core planes being in the reject bin. One is that too many cores in the matrix needed to be replaced. Another is that too many were replaced to pass the quality control requirements of some given project. One more is trouble in the manufacturing process, where the magnet wires are corroding for some reason. In like manner, a batch of cores could be too weak or bittle, and thus subject to breakage." In seeking core memories, then, let the buyer beware.

Tape drives cost money. One Philadelphia surplus company has advertised a Potter tape drive, without electronics or even a rack, for $150. Tape drives, including 727 and 2400 models, were being sold by a junk dealer near the IBM tape-drive plant in Colorado, at about 25 cents a pound, until some parts found their way into what was supposed to be new equipment, some of which was sold back to IBM. The new IBM policy at that Colorado plant is that no re-usable scrap will be sold to the public, but will be melted down for salvage.

THE AMATEUR COMPUTER SOCIETY

After several years of trying to build a digital computer in my spare time, I began to realize how difficult it must be for other computer hobbyists. The idea of a newsletter soon presented itself, in 1965, as much for soliciting information of help to me, as for sharing what little I'd been able to learn on my own.

After some months of trying to decide just how the society would operate, and what name it would have, letters were sent out in May 1966 to ten magazines -- seven electronics and computer trade magazines and three hobby publications. Response was slow at first, and then began to jump as each of five of the magazines printed the letter.

To those first inquirers was sent a two-page resume about the ACS, covering the requirements for membership, plus the information that a newsletter would be published "as soon as letters are received from enough people interested in building computers to make the effort worthwhile," and an outline of some of the areas where an amateur needs help. This outline included such questions as: Where can surplus computer circuits be bought? Where do you get the schematics? Can printed-wiring boards be made cheaply at home? Who makes the cheapest and most reliable integrated circuits? What are the best and cheapest ways of mounting them? Is fixed wiring practical? What plugwires, commercial or homemade, are cheapest and best? Where can overall computer schematics be obtained? Can an amateur design his own computer? What type of memory is cheapest? Which are cheapest, neon or incandescent lamps? What output is cheapest and most practical? What commercial companies are helpful in providing information or surplus parts, or both?

Answers by prospective members to these and other questions helped provide material for the newsletters. The first half-dozen issues were each devoted mainly to an individual topic such as sources of individual schematics, input/output (mainly Teletype), logic circuits, memory, a computer kit (pro and con letters from members), mounting and interconnections, and reference sources (where to find articles and books about computers).

Responses from prospective members ranged all the way from "I've been thinking about building a computer for some time" (two dozen of these) through "I have the shift registers completed" (a dozen of these) to "I've built a computer and am now programming it" (two of these).

ACS Membership

Over 160 men wrote in (but not one woman expressed an interest in the ACS.) Of the 160, 110 eventually became members of the Society; they live in five countries (USA, Canada, Italy, Japan and Switzerland), and 27 states. The greatest concentration, as might be expected, is in the Los Angeles area. Smaller groupings are in the areas of Boston, Washington, D.C., Philadelphia and Chicago. There are ACS members in computer companies such as IBM, General Electric, RCA, SEL, TRW, and Bunker-Ramo; in industrial concerns such as Hughes, Westinghouse, Lockheed, Litton and Motorola; in research institutions including Brookhaven and Bell Labs; manufacturing companies such as Western Electric and Teletype; and at Harvard, MIT, Annapolis, Arizona State, Tennessee Tech, Lehigh, and the Universities of Illinois, Michigan and Mississippi. Several are professors of electrical engineering; at least two were high-school students at the time they joined.

Not everybody gave his profession when he first wrote; some never did. Most, of course, are in the data-processing industry, or are engineers in other industries; several are presidents of their own companies. One of the high-school students was president of a group of students who were building a computer and financing it through the sale of magnetic cores and tape loops obtained cheaply from manufacturers.

The Average ACS Computer

In the seventh issue of the ACS Newsletter, a survey form was included, asking for details of each member's computer, whether in the works or only in the planning stages. The next newsletter gave the survey results.

Most of those who returned the survey form were using core memory, the majority equally divided between 4,000 and 8,000 words. Since most respondents did not specify whether they had actually installed a core memory, or had just planned to use one, there is no way of knowing how many actually have an operating core memory, which is the hardest part of the computer to get working.

Teletype is the most common input/output device. Some members also use paper tape, Nixie tubes, magnetic tape, and electro-mechanical typewriters.

Clock speeds of the amateur computers average 500,000 cycles.

Generally speaking, beginning computer amateurs hope to use a large number of instructions, from 50 to 100. Those who have gotten fairly well into the construction use no more than 11 to 34. The one exception was a member who had spent $1,000 and two years on his machine, and had (or had projected) 67 instructions.

The average length of data words and instruction words was 12 bits for each. The speed required for addition ranged from 8 microseconds down to 10 milliseconds.

The number of registers ranged from 2 to 11, with three the most popular. One member projected two registers for memory, two for data, one for operation code, and five address registers.

Special Features

Several interesting special features were reported; not all of these had yet been translated into hardware. One member had a digital-to-analog converter, for positioning a drive motor. Another used a tape recorder and a tape loop to provide voice output for his computer. Bill Greene, a diagnostic programmer with RCA's Graphic Systems Division in New Jersey, proposed:

> Contents of memory address zero and A register are swapped every cycle (inhibited on some instructions). Therefore one register serves as accumulator and program counter. Memory address 1 serves as index register.

As to "cost so far," the range was from zero to $1,500, with an average (among those reporting a cost) of $650. For "estimated cost when complete," the range was from $300 to "over $10,000," with an average of $2,100. Without that "over $10,000" estimate, the average was $1,100.

The large majority, over 80 percent, use fixed wiring.

The range of time spent so far ranged from "one month on the present model" to four years, with an average of two years.

Education

One of the most significant areas was in education. Most of those responding to the survey had at least one technical degree, including the BSEE, MEE, BA in Math, PhD in EE, and one "BA and BS and working on MS," in addition to several students.

After noting this high level of education among the membership, the Newsletter commented:

> Because the great majority of those sending in the survey have technical degrees, and because those who sent it in are among those who have advanced the most with their computers, it seems that lack of a technical education is holding back many ACS members from pushing ahead with their machines, or perhaps from just getting started. Unlike amateur radio, there just isn't enough circuit-level information available on how to build computers.

Several members described, on the survey form, some interesting sidelights on their computer-building. One was "supervising five explorer scouts who are doing much of the construction work, such as building PC cards. I became an Explorer adviser at my company's post to get more hands on the project and to force me to get on the ball and make some progress." Bill Greene reported: "Teletype controller and memory operational. Can presently transfer data from Teletype to register to memory and back. Delay-line memory stability problems solved — successfully retrieved data after eight hours."

More recently, Bill Greene said he'd had to drop the delay-line memory, because its long-term stability was poor. It would work fine for awhile, but later would shift by one or two bits, throwing it out of synchronization with the external clock. Bill tried core, then bought a used magnetic-drum memory from an airborne computer for $100, giving him 8,192 ten-bit words of drum storage. The logic for the delay-line version of Bill's computer was not very difficult.

Innovate or Copy?

Although many ACS members are engineers in the data-processing industry and are designing their own computers, there are just as many who don't have such a background, and who must therefore copy an existing design, as mentioned before. Several members are patterning their instruction set after that of the IBM 1401 or of the IBM 1620 computer. One Long Island member has software similar to that of the 1620, and hopes that his "1620 Model III" will be about 25 percent faster than IBM's 1620 Mod II, and will have its complete instruction repertoire (about 60).

The majority of those who are borrowing an instruction already in use, are copying that of the PDP-8 family, manufactured by Digital Equipment Corp., widely known as DEC. DEC, which is to minicomputers as IBM is to larger computers, has sold over 10,000 of the PDP-8, attractive because of its comparatively low price, variety of programs available, and a simple yet powerful set of instructions.

Part Two of this article is scheduled to appear in next month's issue. It will discuss plans and innovations of ACS members, evaluate proposals for an amateur computer kit, formation of the Amateur Digital Society and the society's prospects for the future.

The Assassination of President John F. Kennedy: A Model for Explanation

Vincent J. Salandria, Attorney
Philadelphia, Pa.

"While the researchers have preoccupied themselves with how the assassination was accomplished, there has been almost no systematic thinking on why President Kennedy was killed."

(Based on an address at the conference of the New England Branch of the Women's International League for Peace and Freedom, Cambridge, Mass., Oct. 23, 1971.)

For almost eight years the American people have failed to address themselves to the crucial issue of why President John F. Kennedy was killed. Much valuable time has been lost; it is becoming increasingly clear that our delay has cost mankind dearly. I urge that no one drop this question, for to do so is to abandon the serious search for peace internationally and for domestic tranquility.

Not "How?" but "Why?"

Since November 22, 1963, when President Kennedy was assassinated in Dallas, there has been a great deal of research into the micro-analytic aspects of the assassination. I have been among the earliest and guiltiest of the researchers in my protracted analyses of the shots, trajectories and wounds of the assassination. The ransacking of the facts of the assassination is not a source of pride for me but rather of guilt. While the researchers have involved themselves in consuming preoccupation with the micro-analytic searching for facts of how the assassination was accomplished, there has been almost no systematic thinking on why President Kennedy was killed. We have neglected this essential work of constructing a model of explanation which fits the data of the assassination and explains the why of it.

Government Evidence Cries Conspiracy

One who takes the trouble to study the micro-analytic material provided by the federal government must immediately conclude that there was a conspiracy to kill President Kennedy. How foolish it was of us to dwell so long on these governmentally supplied pacifiers, rather than to put them aside and undertake the serious work of constructing a model of explanation. In this connection it is important to take note that the very organization which made that mass of detailed microanalytic evidence available to us — the federal government — contended from the first that there was no conspiracy. But, the federal government's intelligence agencies must have known that the material which the government issued would indicate a conspiracy existed. Then why did we get the evidence?

This question presents a serious theoretical problem. Why would the federal government on the one hand wish to provide us with data which prove a conspiracy to kill President Kennedy and simultaneously contend on the other hand that there was no conspiracy?

So overwhelming and voluminous is the evidence of conspiracy provided for us by the government that we are compelled to conclude that if not the, at least a number of possible plots, were meant by the conspirators to be quasi-visible. The federal government has deluged us with evidence that cries out conspiracy.

New Rulers Timed Diffusion of Evidence

Another theoretical problem confronts us. If the killers were positioned in the highest echelons of the federal governmental apparatus, and by the assassination they had finally usurped the pinnacle of governmental power, then why did they not conceal the conspiracy? For, if they had accomplished a coup, they could have exercised their control by concealing evidence of conspiracy. But this coup was covert. The people would not have tolerated an overt coup against such a beloved man as President John F. Kennedy. Because of the covertness of the coup, I propose the explanatory thesis that the new governmental rulers were eager to reveal their work at differing levels of certainty to diverse people and at different times. In this way, they could avert a concerted counter thrust to their illegitimate seizure of power. Democratic forces could not unite against the new illegitimate governmental apparatus because of timing. The insights of what had occurred dawned in the minds of the decent citizens at different times and with different degrees of clarity. The transparent aspects of the conspiracy were permitted to flash signals to various elements of our population, much in the fashion of spot ads slanted at different times for selected audiences. The new rulers carefully and selectively orchestrated revelations of their bloody work, so as to gain therefrom the deference to which they felt they were entitled by their ascendancy to absolute power. I have long believed that the killers actually preempted the assassination criticism by supplying the information they wanted revealed and also by supplying the critics whom they wanted to disclose the data. Does it not make sense that if they could perpetrate a coup and could control the press, they would have endeavored to dominate likewise the assassination criticism? But the full explanation of this thesis must await another occasion.

Lone Assassin Myth Suggests Governmental Guilt

Let us examine this thesis of a transparent conspiracy. (This thesis was in large part inspired by and formulated with the invaluable assistance of my friend, Professor Thomas Katen of Philadelphia.) Anyone who has seen the Zapruder film knows that it provides powerful evidence to support a hit on the President by an assassin positioned in front of Kennedy and not behind him, where Oswald was at the time of the shooting. Anyone who studies this film more carefully learns that the strike on Governor John B. Connally of Texas was accomplished by a separate bullet from any which impacted on the President. Even more careful analysis of the Zapruder film reveals four separate (and horrible) bullet strikes on Kennedy. Now, the federal government was in possession of that film on the day of the assassination. The federal government was in a better position than you or I to know what the film revealed. Yet, despite this evidence and other most impressive data indicating a conspiracy, the government seized upon Oswald and declared him to be the lone assassin. At the official public level the government, in its adherence to the lone-assassin cover story, strained logic. The federal government even refused to take seriously the Newtonian laws of motion and forces. But, at a more sophisticated level, the same government knew that anyone who accepted the Newtonian laws of motion would eventually have to conclude that President Kennedy was killed by a multi-assassin ambush.

Where evidence of a conspiracy with respect to the Kennedy assassination surfaced, — and much did — thanks in the main to the government's disclosures, that same government from the very first and continuously to date has publicly refused to act on that evidence. Wherever any data appeared to be thoroughly ludicrous and incredible — and much of the lone-assassin evidence did violence to common sense — the federal government publicly and solemnly declared those data veracious. The unvarying governmental pattern of consistently and publicly supporting the lone-assassin myth, and equally uniformly rejecting the irrefutable conspiracy evidence, was too studied to be the function of mere bureaucratic stupidity or accident. I propose the thesis that this uniform governmental pattern did not speak to official innocence or ignorance but rather to the guilt of the government at the very highest echelons.

A Warning to Opponents

This systematic behavioral pattern persisted in by the government in a reckless and apparently unskeptical manner, I believe, was meant to communicate a message to the citizens: (1) about what really happened to their President; (2) about what was in store for any quixotic citizens who saw fit to oppose the new rulers of our land.

Those who saw the Zapruder film know that the government could not have been innocent of knowledge of a conspiracy. If you are tempted to want to believe that our leaders are just ignorant and capable of unremitting blundering, I urge that you abandon any such illusion.

The movement for peace in Vietnam has learned the hard way that it is naive to imagine that our government is capable of unrelieved error. Some of us in the peace movement thought that the U.S. course in Vietnam could be altered by pointing out to our rulers the mistake of becoming increasingly involved militarily in that unhappy land. But our rulers would not alter their course because their intentions were fixed — not responsive to the public will. To represent our government as always well-intentioned but consistently misinformed, does not fit with reality.

Those of us who had taken care to study the assassination knew too well and immediately that the Tonkin Gulf incident never happened except in the vivid imaginations of our governmental incident arrangers. So, too, it would be naive for the assassination researchers to think that we caught the government again and again with its guard down, and that we had outsmarted the Commission and all of the investigating agencies of the government which aided it. It should have occurred earlier to the assassination researchers that the government never wanted its guard up. It had a need to exercise a certain amount of exhibitionism in order for the coup to be recognized as a coup in the proper quarters. In my judgment, the assassination critics came up by and large with the evidence of assassination conspiracy which our new rulers wanted us to discover. We should have broken early and cleanly from the microanalytic — or nit-picking — approach in the assassination inquiry. We should have immediately undertaken the vital work of developing an adequate model of explanation, an adequate hypothesis, in order to pursue the reasons for the assassination. We here and now belatedly begin this vital work.

Silence of Kennedys Points to Top-Level Coup

I have heard it argued that the silence of the Kennedy family supports the lone-assassin myth. But the Kennedy family knows how overwhelming and transparently clear the conspiracy evidence is. Can there be any explanation for this silence other than that the assassination was the act of the very highest pinnacle of American governmental power? The taciturnity of the Kennedy family does not and cannot speak to the lack of conspiracy evidence. Rather that evidence stands on its own merits — massively and indestructibly. If we were to posit for purposes of argument a low-level conspiracy, <u>then</u> the Kennedy family silence would indeed be inexplicable. But, that silence of the Kennedys — when juxtaposed against the irrefutable conspiracy evidence — is plainly their mute acknowledgement that the assassination was perpetrated by our new rulers, who possess awesome power which dwarfs the power of the Kennedy family. So the silence of the Kennedy family, rather than refuting a conspiracy, tends to reinforce the feeling that all Americans entertain at some level of consciousness — what we <u>sense</u> and what the rest of the world <u>knows</u> — that the killing of Kennedy represented a coup d'état.

A. Which Group Was Responsible?

Once we are compelled to the conclusion that the American government destroyed its own chief of state, we are led to the specific question, "Which segment of the federal government was involved?"

To answer this question we must raise still other questions. Which agency would have thought to touch every ideological base in order to intimidate all ideologists in America, thereby dissuading all of them from delving too deeply into the meaning of the assassination? Which agency would think of structuring into the assassination cover story ideological elements which would tend to have the society divide against itself? Which agency would derive benefit from making the Dallas police, and by extension all local police forces, look bad? Which agency would get pleasure out of having the Secret Service criticized? Which agency would benefit from having the FBI placed in the silly position of turning in reports to the Warren Commission which contradicted the findings of the Warren Report while at the same time illogically conceding that those same findings were correct? Which agency was itself non-ideological enough, and yet ideologically so sophisticated, as to interweave into the Oswald assassination fabric all possible features of the American political left and right? Which agency could have arranged for Oswald to establish membership or contact with the Communist Party and the FBI — the anti-Communist Socialist Labor Party and the Soviet Union — the ACLU and the ultra right in Dallas — Fair Play for Cuba Committee and General Edwin Walker — the Socialist Workers Party and the American oil interests — the Cuban Government and United States Marines — and finally the American Friends and the Soviet secret police?

1. J. Edgar Hoover and the FBI?

Let us enumerate the agencies who are candidates for having accomplished this brilliant charade.

How about J. Edgar Hoover and the FBI? It is not plausible that the Federal Bureau of Investigation — if it had been involved in the assassination planing — would have chosen as a patsy a person who Attorney General Waggoner Carr of Texas would indicate immediately after the killing was a paid FBI informer. And if J. Edgar Hoover had effectuated the coup, then how could we explain that immediately after the assassination, and persisting through today, there has been a yelping in the land for Mr. Hoover's scalp? If J. Edgar Hoover were the new ruling tyrant, there would be far more reluctance on the part of our cowardly government officials and the media to take him on. No, I think that we can say with surety that the FBI did not kill President Kennedy.

2. The Left?

Could the Left have killed our President? Is it possible to believe that our militarists, our anti-communist politicians, and our communications media, would have concealed the evidence of a conspiracy to kill Kennedy if such a conspiracy had been (or had the slightest chance of having been) inspired by Communists?

3. The Right?

Could the Right have killed John Kennedy? Would Earl Warren have covered for and surrendered his credentials for the political non-governmental Right and/or the oil interests? There were liberals on the Commission and its staff. Liberals have been known to play the game in covering for state crimes, but for them to cover for the extra-governmental Right in matters of assassination is for them to sign their own death warrants.

It would also make no sense for the Right to kill Kennedy in an ultra-right city such as Dallas. To do so would be to impute blame to the Right.

4. President Johnson and Friends?

Were President Johnson and his friends the killers? Again, it would be impossible to conceive of President Johnson and his Texas cronies arranging to have the President killed in their own bailiwick where the world's suspicions would at once be directed against them. No, many careful studies show absolutely no evidence that President Johnson was involved in producing the assassination.

5. President Kennedy's Own Estimate of a Possible Military Takeover

Was the American military on its own capable of this degree of sophistication? It does seem rather beyond the intelligence of the American military to have accomplished this crime alone. But it is not inconceivable to imagine the American military as having been involved in a plot to eliminate Kennedy, in order to ensure the continuation of the Cold War. Kennedy himself did not regard a military take-over as implausible. We have an excellent articulation of his feeling on this matter in a discussion with Paul B. Fay, Jr.[1] This colloquy occurred one summer weekend in 1962 on the Honey Fitz, the Kennedy yacht. The President was asked what he thought of the possibility of a military take-over in the United States. The discussion grew out of the book Seven Days in May by Fletcher Knebel and Charles W. Bailey.

President Kennedy said: "It's possible. It could happen in this country, but the conditions would have to be just right."

The conditions outlined by the President were as follows:

1. The country would have to be led by a young President.

2. There would be a Bay of Pigs.

3. Military criticism of the President would follow.

4. Then, if there were another Bay of Pigs, the military would consider overthrowing the elected establishment, and finally,

5. "...if there were a third Bay of Pigs, it could happen."

Mr. Fay concluded this episode by describing how the President "pausing long enough for all of us to assess the significance of his comment, ...concluded with an old Navy phrase, 'But it won't happen on my watch.'"

These conditions were approximated during the Kennedy administration. President Kennedy was in fact a young President. There was a Bay of Pigs. The missile crisis which followed resulted not in the bombing of Cuba — as the military advisors had urged upon the President — but rather in a detente with Russia. This was followed by a nuclear test ban treaty which "...the Joint Chiefs of Staff declared themselves opposed to under almost any terms."[2]

The American University speech by President Kennedy following his reexamination of the Vietnamese policy, completely fulfilled the conditions set forth by President Kennedy for a take-over to happen on his watch.

Evidence for Military Involvement in the Assassination

There is much evidence to indicate military involvement in the assassination. There was the startling and incriminating action of the then Commander James J. Humes, the head of the Navy Bethesda autopsy team, who took the original autopsy notes —

and then burned them.[3] The autopsy was under the control of an army general who was not trained in medicine.[4] The autopsy was never completed.[5] The findings of the autopsy were contrary to the findings of the non-military physicians at Parkland Hospital. The pathologists were directed not to look at the Kennedy neck wound.[6] The x-rays were never turned over to the Commission by the military.[7] The burning of the notes by Commander Humes did not deter the military from promoting him to Captain.

Military-CIA Interests Coincided

Although at the time of the assassination the interests of the CIA and the military coincided, now evidence of a CIA-military rift abounds. The Boston Globe of July 20, 1971 stated that the Pentagon Papers revealed that "one agency...comes out...with a record for calling its shots correctly." So Ellsberg did not do badly by his "ex" employer. The Boston Globe of July 3 offered an item which indicates the "ex"-Pentagon people are hitting back at the "ex"-CIA Ellsberg. "A former Pentagon liaison officer with the Central Intelligence Agency said in London that President Kennedy engendered the hate of the CIA by trying to curb the agency's power. He also said he did not think Lee Harvey Oswald 'by himself killed President Kennedy.'"

"L. Fletcher Prouty, a retired Air Force colonel and the director of special operations for the Joint Chiefs of Staff in 1962 and 1963, said Kennedy issued two directives in 1961 to limit the CIA's power but the documents never surfaced and were not implemented."

Jack Anderson on April 21, 1971 said:

> "International espionage is seldom as efficient as the inter-departmental spying that goes on in Washington.
>
> "...the Central Intelligence Agency never makes a move without the Defense Intelligence Agency keeping close surveillance.
>
> "...Government agencies, in the best cloak-and-dagger tradition, snoop upon one another."[8]

I view the American military's motive for involving itself in the killing of Kennedy as pervertedly patriotic in nature. But at that period of time, there was, as we will demonstrate, a congruence of interests between the American military and the CIA. Kennedy was the enemy of both power groups at the time he was killed.

The Pentagon Papers — a CIA Jab at Military?

Of late, with the issuance of the Pentagon Papers by a long-standing CIA agent, Dr. Daniel Ellsberg, this alliance between the CIA and the military seems to have become strained. Dr. Ellsberg was one of the exclusive Society of Fellows at Harvard with McGeorge Bundy and his brother William.[9] When Ellsberg leaked the documents, he was employed at MIT's Center for International Studies and numbered among his colleagues Mr. William Bundy. In my assassination research I learned that ex-CIA people who undertook work to assist the research on the Kennedy assassination almost invariably turned out to be present CIA people. I would recommend that the public remain skeptical about Dr. Daniel Ellsberg, the ex-marine, ex-CIA, ex-hawk, ex-Kissinger aide and present fellow researcher of Mr. William Bundy at MIT.[10]

In fact, I would urge that the public hold open the hypothesis that the Pentagon Papers are designed as a thrust against the military by the CIA. I suggest that there has been a falling out between these two anti-democratic power blocs. The military is still determined to defeat Communism abroad, while the CIA is now primarily concerned with maintaining its power domestically.

How can we accept the Pentagon Papers as an honest and complete peering into the inner workings of our government? These papers predate and postdate November 22, 1963. Yet, these papers make no reference to the assassination and the enormous power and policy shift which occurred on that historical day when the republic expired.

Can the purpose of the disclosures of the Pentagon Papers really be to aid the CIA non-ideological elements in our government against the right wing, military, virulently anti-communist elements? Does not the evidence offered to support the existence of a present rift between the CIA and the military also support the concept that the Pentagon Papers were the offerings of the CIA to enlist assistance in its intra-governmental struggle against the military? And should decent, freedom-loving constitutionalists join either power bloc? or should they rather use this fortuitous rift to benefit freedom in this society and in the rest of the world by denouncing both cliques as the enemies of humankind?

6. Did the CIA Kill President Kennedy?

Well, then, we are reduced by the process of elimination to the question, "Was the CIA the prime mover in the killing of Kennedy?" Was the CIA sophisticated enough to have run Oswald across the whole gamut of political ideology in America in order to place all ideologists on the defensive as possible suspects? and in order to insure that the nation would be so divided ideologically that there could be no coalescence of forces which would seek retribution for the killing?

We will now examine the question of whether the CIA was the specific federal agency which was the prime mover in the killing of President Kennedy.

After the assassination of President Kennedy, the government which had refused to act on conspiracy evidence resorted to amazingly fast action in an area where one might have anticipated a slow and tentative feeling of the way. The fact is that after the assassination key foreign policy changes were put into effect immediately.

CIA Opposed Kennedy Anti-Cold War Policy

Before the assassination, thanks to President Kennedy, we were on a course which could have ended the Cold War. That course was described by D.F. Flemming as follows:

> "Fortunately, we had in President Kennedy at a new turning point in history a leader with both vision and courage. He had made certain that there were no missile gaps against us. He had won the acclaim of the West by the way he successfully played showdown nuclear politics in the 1962 Cuban missile crisis. He had faced the last of man's ultimate decisions on earth.
>
> "Then, in the summer of 1963, Kennedy turned his face resolutely toward life and unmistakably signaled the end of the Cold War.

Behind the patriotic facades of nuclear militarism, he saw the death of his own children and of all children. In a series of magnificent addresses, he urged us to reconsider our attitudes toward peace, the Soviet Union, and the Cold War. He won a treaty ending atomic testing above ground and then paused to wait a little for the more embattled of his cold-war compatriots to catch up with the times.

"At that moment, he was struck down..."[11]

"President Kennedy today faces his greatest opportunity to negotiate a permanent peace, but because of division inside his own Administration he may miss the boat.

"That is the consensus of friendly diplomats long trained in watching the ebb and flow of world events..."

President Kennedy knew that his efforts to end the Cold War were dangerous to his life. In this regard I quote Arthur Schlesinger:

....when he saw Nixon after the Bay of Pigs he said, "If I do the right kind of a job I don't know whether I am going to be here four years from now.... If someone is going to kill me,' he would say, 'they are going to kill me.'[12]

President Kennedy saw the danger to his efforts to end the Cold War which lay in the power of the CIA. So the New York Times quoted him as saying, that he wished "to splinter the CIA into 1,000 pieces and scatter it to the winds..."[13]

But that purpose was never accomplished by President Kennedy. The CIA is a policy-making body still. Eugene McCarthy is of this opinion. I quote him as follows:

"The general evidence is that in addition to gathering and interpreting information, the CIA does play an important part in influencing foreign policy, and certainly has become an important operating arm of the executive branch in this area of government responsibility."[14]

Andrew Tully states the position of the Kennedy administration with respect to the CIA after the Bay of Pigs:

"The official concern, then, was not so much that the CIA had bungled in the past, but that it either had been entrusted with or had seized the broad responsibility for making policy which belonged to the State Department."

"...during most of Eisenhower's tenure, his Secretary of State was John Foster Dulles, and John Foster relied much more heavily on brother Allen's estimates than he did on the reports from his ambassadors. In effect brother John Foster made of brother Allen's CIA a kind of super Foreign Service and apparently found nothing incongruous in the fact that in some embassies CIA personnel outnumbered Foreign Service employes. It was small wonder that the average citizen was confused, after Cuba, as to who was making foreign policy for the United States. Some top drawer members of the Washington diplomatic community were just as confused..."[15]

Kennedy Fired Dulles as CIA Head

After the Bay of Pigs, President Kennedy accepted the resignation of the head of the CIA, Allen Dulles. He had called in Dulles, Cabell and Bissell and told them that the three would have to be replaced. "Under the British system," he said, "I would have to go. But under our system I'm afraid it's got to be you."[16] But Allen Dulles was to return to government service immediately after the killing of President Kennedy. He appeared as one of the Warren Commissioners. Let us see whether the father of the CIA served the people and the search for truth concerning the death of the departed President, or whether he served the interests of the intelligence communities not only in the United States but in the Soviet Union as well.

Dulles Suppressed Evidence of Oswald's Soviet Intelligence Connections

On January 21, 1964, in a secret executive session, the Warren Commission had to deal with the problem of Marina Oswald giving evidence that Oswald was a Soviet agent.[17] Senator Richard Russell said: "That will blow the lid if she testifies to that."[18] And so it would have. How did the Commission deal with that problem? Well, we learn from the transcript of the secret executive session that Isaac Don Levine was helping Marina Oswald write a story for Life Magazine, which never got published. Allen Dulles, the original director of the Central Intelligence Agency who was fired from his position by President Kennedy, decided to see Levine. Dulles said simply: "I can get him in and have a friendly talk. I have known him."[19] Does that not sound as if Allen Dulles was contemplating suppression of information?

Isaac Don Levine had a central role in the Hiss case. I quote Whitaker Chambers as he described in his book, Witness, how Levine nursed him through his uncertainty about launching into his allegations against Mr. Alger Hiss. I quote:

"The meeting was arranged by Isaac Don Levine... For years he has carried on against Communism a kind of private war which is also a public service. He is a skillful professional journalist and a notable 'ghost.' It was Levine who led Jan Valtin out of the editorial night and he was working with General Krivitsky on I Was in Stalin's Secret Service when, sometime in 1938 I met both men.

"From the first, Levine had urged me to take my story to the proper authorities. I had said no. ...When he proposed that he arrange a meeting at which I might tell my story directly to President Roosevelt, I was reassured."[20]

And why was a Cold War warrior like Isaac Don Levine not interested in raising the specter of a political assassination by the left? Why was the idea of a leftist conspiracy unthinkable in the Cold War America where for twenty-five years a virtual paranoia concerning communist plotting had prevailed? Yet there was — as we have seen — some evidence of a leftist conspiracy, and it was not acted upon. Why not? What caused our government at the public level to be so immediately and permanently wedded to the lone-assassin myth?

We are introduced through the transcript of this secret executive session to a new ghostly role for the literary ghost, Isaac Don Levine. Levine, as a result of the intervention of his friend, Allen Dulles, apparently was successful in erasing from the prospective testimony of Marina Oswald any references to Soviet intelligence connections with Oswald. The intelligence communities across iron curtain lines apparently cooperate to keep the truth from their peoples.

Did Soviet and American Intelligence Agencies Cooperate?

Is it irrational to suggest that the Soviet and American intelligences cooperated in the American governmental game of killing the President? Could an intelligence assassination have been perpetrated against the head of the American state unless the Soviet intelligence services could have been counted on to remain silent?

How did the Soviet government respond to the assassination of President Kennedy? Khrushchev, with whom Kennedy was working to effectuate the end of the Cold War, was later deposed. I submit that, if the Cold War had been genuinely adversary in nature, there could not have been an intelligence assassination of Kennedy by either the American or the Soviet intelligence agencies. I don't see the Cold War as authentic. Rather I view it as a cooperative effort to foist on both the American and Russian civilian populations an enormous military-intelligence budget.

Senator Richard Russell was correct in being disturbed by Marina Oswald's prospective revelations about possible Soviet intelligence connections with Oswald. And therefore Allen Dulles quieted the matter with a discussion with Isaac Don Levine, a writer on intelligence and a Cold War warrior par excellence. Levine was the author of The Mind of An Assassin, a book that described the killing of Leon Trotsky by Stalin's intelligence. It is interesting that Levine's name, which has been so much associated with the study of political assassinations, was never mentioned by the American press as having been associated with Marina Oswald. It is also interesting that this expert on political assassinations never, to my knowledge, wrote for publication a single article on the Kennedy assassination. Was his function something other than that of a literary ghost? Was Levine assigned to Marina by the government to provide whatever testimony suited the political exigencies? Allen Dulles did not tell how he had come to know Levine. Was it through intelligence work?

Now, let us shift our attention from Allen Dulles, brother of John Foster, to McGeorge Bundy, and his brother, William Bundy. For McGeorge Bundy's roles in the governmental apparatus before and after the assassination are worthy of study, and William Bundy's services in and out of the CIA are also of interest to us.

Kennedy Adviser McGeorge Bundy's Ties to the CIA

With the Kennedy Administration, McGeorge Bundy was in foreign policy a hard-liner who had little use for Adlai Stevenson's idealistic approach to foreign relations.[21] McGeorge Bundy was one of the planners of the Bay of Pigs invasion.[22] Allen Dulles was in Puerto Rico, so Richard Mervin Bissell, Jr., was the CIA's man in charge of the planning.[23] As happenstance would have it, McGeorge Bundy, the President's Assistant for National Security Affairs, had been a student of Bissell's at Yale. He also had worked for Bissell on the Marshall Plan in 1948.[24] Also in on that planning, as coincidence would have it, was General Charles P. Cabell, the CIA's deputy director, who is brother of Mayor Earle Cabell, the Mayor of Dallas at the time of the assassination. McGeorge Bundy was — in the Kennedy and early Johnson Administration — the presidential representative and key man on the Special Group which makes the key intelligence decisions for the country. It has operated as the hidden power center of the government.[25]

As one of the planners for the Bay of Pigs, McGeorge Bundy must take some blame for not serving President Kennedy well and participating in the betrayal of the President in the Bay of Pigs planning operation. Schlesinger discusses that betrayal as follows:

> "Moreover, if worst came to worst and the invaders were beaten on the beaches, then," Dulles and Bissell said, "they could easily 'melt away' into the mountains." ...But the CIA exposition was less than candid both in implying that the Brigade had undergone guerrilla training...and in suggesting the existence of an easy escape hatch. ...the Escambray Mountains lay eighty miles from the Bay of Pigs, across a hopeless tangle of swamps and jungles...the CIA agents in Guatemala were saying nothing to the Cubans about this last resort of flight to the hills..."[26]

Bundy Also a Vietnam Hawk

But, despite Bundy's complicity with the CIA, which resulted in misleading the President in the Bay of Pigs, Kennedy turned over the direction of Vietnam policy largely to Bundy, along with Rusk, McNamara and Rostow. The best we can say for McGeorge Bundy's handling of Vietnam for President Kennedy was that he botched. Here is what Schlesinger said about Kennedy's feeling concerning the Vietnamese policy:

> "He was somber and shaken. I had not seen him so depressed since the Bay of Pigs. No doubt he realized Viet Nam was his great failure in foreign policy, and that he had never really given it his full attention."[27]

The announced intention of Kennedy as stated on October 2, 1963 by McNamara and Taylor was to withdraw most U.S. forces from South Vietnam by the end of 1965.[28] But that was not McGeorge Bundy's policy — and President Kennedy was soon to die — and McGeorge Bundy would be carrying on his hawkish concepts in playing a key role in shaping the aggressive foreign policy of President Lyndon B. Johnson.

Bundy Issued the First "No Conspiracy; Lone-Assassin" Statement

What was McGeorge Bundy doing on the day President Kennedy was dispatched? Theodore H. White in his book, The Making of the President, 1964, tells us that the Presidential party on its flight back to Washington on the afternoon of that fateful day "learned that there was no conspiracy, learned of the identity of Oswald and his arrest..."[29] This wss the very first announcement of Oswald as the lone assassin. In Dallas, Oswald was not even charged with assassinating the President until 1:30 A. M. the next morning. The plane landed at 5:59 P. M. on the 22nd. At that time the District Attorney of Dallas, Henry Wade, was stating that "preliminary reports indicated more than one person was involved in the shooting...the electric chair is too good for the killers."[30] Can there be any doubt that for any government taken by surprise by the assassination — and legitimately seeking the truth concerning it — less than six hours after the time of the assassination was too soon to know there was no conspiracy? This announcement was the first which designated Oswald as the lone assassin. Who was responsible for that announcement?

That announcement came from the White House Situation Room. Under whose direct control was the White House Situation Room? The Situation Room was under the personal and direct control of McGeorge Bundy.

I do readily concede that Mr. McGeorge Bundy is a most intelligent man. Joseph Kraft, a well known American political writer, said of Mr. Bundy in 1965 in Harper's:

> "His capacity to read the riddle of multiple confusions, to consider a wide variety of possibilities, to develop lines of action, to articulate and execute public purposes, to impart quickened energies to men of the highest ability seems almost alone among contemporaries..."[31]

John F. Kennedy shared this view of Bundy's intelligence for in speaking of him he said, "You just can't beat brains."[32] McGeorge Bundy himself is not known for his modesty on the question of his intelligence. He was reported to have been "mildly miffed" when a Kennedy aide quoted the President as remarking that Bundy was the smartest man he knew next to Ormsley Gore, a British diplomat.[33]

So, then, Mr. Bundy — this man of brains — this coordinator of intelligence for President Kennedy — had reason to know that his Situation Room's announcement of Oswald as the lone assassin on the afternoon of November 22, 1963, before there was any evidence against Oswald, was premature. Make no mistake about it. Bundy, who had been in the Pentagon[34] when the announcement of the assassination was issued, spent that fateful afternoon in the Situation Room. Jim Bishop tells how President Johnson was — while on Air Force One flying back to Washington — "...phoning McGeorge Bundy in the White House Situation Room every few minutes."[35]

Was Bundy's Statement a Warning from the 'New Rulers'?

I propose the thesis that McGeorge Bundy, when that announcement was issued from his Situation Room, had reason to know that the true meaning of such a message when conveyed to the Presidential party on Air Force One was not the ostensible message which was being communicated. Rather, I submit that Bundy, with "his capacity to read the riddle of multiple confusions, to consider a wide variety of possibilities" was really conveying to the Presidential party the thought that Oswald was being designated the lone assassin before any evidence against him was ascertainable. As a central coordinator of intelligence services, Bundy in transmitting such a message through the Situation Room was really telling the Presidential party that an unholy marriage had taken place between the U.S. Governmental intelligence services and the lone-assassin doctrine. Was he not telling the Presidential party peremptorily, "Now, hear this! Oswald is the assassin, the sole assassin. Evidence is not available yet. Evidence will be obtained, or in lieu thereof evidence will be created. This is a crucial matter of state that cannot await evidence. The new rulers have spoken. You, there, Mr. New President, and therefore dispatchable stuff, and you the underlings of a deposed President, heed the message well." Was not Bundy's Situation Room serving an Orwellian double-think function?

And, so, it came to pass that Bundy's Situation Room knew well whereof it spoke. For the federal government remained wedded to the lone-assassin myth in spite of the absence of evidence to support the proposition, and in the face of irrefutable proof which would demolish it as a rational idea.

The Presidential Party Got the Message

The Presidential party, which also numbered among it men of brains, apparently got the message. None, to my knowledge, of that Party has undertaken to express a single public doubt as to the veracity of the lone-assassin theory. Yet seeds of doubt have grown to mountainous dimensions among the less intimidated elements of the population who did not seek to hold or retain trappings of power. The lack of expressed skepticism among the Presidential party is not to be interpreted as evidence of their stupidity. On the contrary, their silence speaks more of their strong instincts of self-preservation and their penchant for governmental careers, rather than lack of intelligence.

Some among that Presidential party had no need to see the Zapruder film. They had on that fateful day witnessed first hand the bloody horror of the multi-assassin ambush. Doubts as to the veracity of the single-assassin story were more likely to give way to certainty of conspiracy in their minds. The message from Bundy's Situation Room was necessary to dispel other doubts. Perhaps some of the Presidential party leaned toward misreading the situation and were laboring under the belief that some sharp-shooting nuts had gotten lucky in Dealey Plaza and that punishment was in order. Bundy's Situation Room was putting them straight. Through that announcement it became clear to all in that Presidential party who could think, that the assassins, if madmen they were, were highly placed in the pinnacle of power of the intelligence community of the United States government and that punishment of them was out of the question.

Important Foreign Policy Changes Immediately Followed the Assassination

McGeorge Bundy was quite busy on November 22, 1963. After having spent a good deal of time on the telephone with President Johnson as Johnson was flying to Washington, he managed to be at the new President's side when Air Force One landed.[36] He was seen with Lyndon B. Johnson when the President emerged from the South Lawn of the White House.[37] History records that Bundy remained with President Johnson to be designated by him as one of the leading hawkish advisers of the Johnson Administration.[38]

What was the future to hold for the United States following the assassination of President Kennedy? What changed? The most important and immediate change following the assassination of President Kennedy occurred precisely in the area of foreign policy. The Cold War warriors of the Bundy brothers' stripe gained a stranglehold on the foreign policy of the nation, much in the same fashion that Allen Dulles and John Foster Dulles had in Eisenhower's administration. Of course, to note such a change is not to prove it was a deliberate consequence of the assassination. Yet, a careful examination of foreign policy following the killing of Kennedy is required to see whether the change might have been related to the killing of the President.

U.S. Promised Help to New Saigon Government

The book The Politics of Escalation in Vietnam has the following to say about the change:

> "Three weeks after the assassination, on December 19 and 20, 1963, McNamara and CIA Chief John A. McCone visited Saigon to evaluate the war efforts of the new Saigon government. McNamara told the junta leaders 'that the United States was prepared to help...'as long as aid was needed.'"[39]

> "...the United States had made the crucial decision to reverse the policy, announced during the last day of President Kennedy's administration, of gradually withdrawing U.S. troops from South Vietnam. Was it all a coincidence that a change in leadership in Washington was followed by a change in policy, and a change in policy by a corresponding change in Saigon's government?"[40]

That there should have been a change in Vietnamese policy so immediately after the murder of Kennedy when the external situation in Vietnam did not evoke it, raises serious questions about what caused it in our internal situation. What is at stake here is the issue not of how the assassination was accomplished, but the fundamental question concerning why it was done and which elements were and are behind it. At issue are questions of war and peace that involve the whole of humanity. For the movement for peace in Vietnam not to raise these questions is and has been irresponsible.

Militarization of the U.S.

It cannot be too strongly emphasized that the definite and deliberate policy of militarization of this country was quickly put into action immediately after the death of President Kennedy. There was no evidence of governmental traumatization, but rather a most efficient and abrupt movement to military policies.

Bundys Continued to Shape Hawkish Policies

McGeorge Bundy and his brother, William, continued to help shape the foreign policy of the Johnson Administration. McGeorge Bundy became part of Johnson's Tuesday lunch arrangement which was in fact the National Security Council, Johnson style.[41] Bundy did most of the foreign policy coordinating for Johnson in the early part of his administration.[42] It was McGeorge Bundy who by happenstance was in South Vietnam when Pleiku was shelled. After an inspection of the Pleiku base, he recommended to President Johnson instant retaliation. He urged upon the President a steady program of bombing the North, which recommendation was followed with horrendous consequences to peace.[43]

In the Gulf of Tonkin farce, Bundy was full of admiration for Johnson's decisiveness. Bundy said to friends that he had "...never seen a man who knew so clearly what he wanted to do or so exactly how to go about it."[44]

Ultimately, the Bundy brothers gave up their titular positions in government. McGeorge Bundy became President of the Ford Foundation. William Bundy joined the Center for International Studies at MIT.

Interconnections of the CIA and Foundation-Dominated Scholarship

Let us not imagine that these two architects of the Vietnamese War by taking on these new positions abandoned their penchant for power. Nor were the Bundy brothers retreating far from government in assuming these positions. David Horowitz said the following about the interlocking aspects of the CIA and the private foundations:

> "It should be noted in passing that the congeniality of foundation-dominated scholarship to the CIA reflects the harmony of interest between the upper-class captains of the CIA and the upper-class trustees of the great foundations. The interconnections are too extensive to be recounted here, but the Bundy brothers (William, CIA; McGeorge, Ford) and Chadbourne Gilpatric, OSS and CIA from 1943 to 1949, Rockefeller Foundation from 1949 on, can be taken as illustrative. Richard Bissell, the genius of the Bay of Pigs (and brother-in-law of Philip Mosely of Columbia's Russian Institute), reversed the usual sequence, going from Ford to the CIA."[45]

As for William Bundy's respite from the CIA and his State Department career, David Horowitz feels that the MIT Center is not in the least removed from the grip of the CIA:

> "MIT's Advisory Board on Soviet Bloc Studies, for example, was composed of these four academic luminaries: Charles Bohlen of the State Department, Allen Dulles of the CIA, Philip E. Mosely of Columbia's Russian Institute and Leslie G. Stevens, a retired vice admiral of the U.S. Navy.

> "If the MIT Center seemed to carry to their logical conclusion the on-campus extension programs of the State Department and the CIA, that was perhaps because it was set up directly with CIA funds under the guiding hand of Professor W. W. Rostow, former OSS officer and later director of the State Department's Policy Planning Staff under Kennedy and Johnson. The Center's first director, Max Millikan, was appointed in 1952 after a stint as assistant director of the CIA. Carnegie and Rockefeller joined in the funding, which by now, as in so many other cases, has passed on to Ford."[46]

How We've Paid For Our New Rulers' Ineptness

So, we have examined how the CIA and the military had committed American power to ruinous military adventures through staged international incidents — reminiscent of the Oswald charade — but on an international level. These adventures, following close upon the assassination, have spilled the blood and sapped the moral fiber of our youth. Our cities have been turned into tense and neglected seas of metastasizing blight. Our economy, buffeted by push-and-pull war-induced inflation, has become unbalanced. Our international trade position has deteriorated, so that now we find ourselves with not only an unfavorable balance of payments, but also an unfavorable balance of trade. Our urban public schools are relegated to bare custodial functions. The standard of living of our workers and the middle class has dipped along with the quality of their lives. All of us have paid for the ineptness of our new rulers who, by the killing of John F. Kennedy, had effectively overthrown the Republic.

The CIA's Follow-up Tactics

If our model of explanation, our hypothesis, of the assassination of John F. Kennedy accurately interprets the data of the assassination, then it should also be useful in ferreting out current operations in which the Central Intelligence Agency would have had to involve itself domestically as a natural and necessary followup to the Dallas assassination. For, as the CIA's clumsy cousin, the American military, persisted in its Vietnamese adventure, the costs became prohibitive.

Of course, secret elitist police organizations such as the CIA do not thrive on peace, democracy, and a contented and informed people. The power of intelligence agencies increases in direct proportion to the degree of sickness of a nation. A healthy and united people can localize the cancer of a power-usurping intelligence agency and eventually extirpate its malignant cells from the nation's political life. Therefore, the intelligence apparatus which killed Kennedy has a need to keep our society in turmoil. It has — in order to maintain its power — to generate a high degree of chaos. Chaos is required to make a people willing to accept such strong medicine as is administered by the secret police in order to restore order and to stabilize a disintegrating society. It takes an acutely sick society to be able to accept as palatable the terrible cure — totalitarianism.

The Assassination Model As a Key to Domestic Events

One must look to our model of the assassination for an explanation of what has happened to our domestic society since the killing of President Kennedy. Now that the Vietnamese War has been rejected by our people, we must keep our eyes and ears open for an inevitable split between the CIA and military. For, although the military still looks to winning on foreign fronts the war against Communism, the super-slick non-ideological CIA sees the need to bring the war home. We must be alert to CIA agents who would promote the polarization of our society. We must examine the evidence which indicates that fake revolutionaries, who are inciting insurrection in our cities, have had their pockets and minds stuffed by the CIA.

The movement for peace in Vietnam has been silent too long on the critical issue of the assassination of President Kennedy. We cannot rest with the official federal government version of his assassination.

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Pictorial Reasoning Tests, and Aptitudes of People — II

Neil Macdonald
Assistant Editor, Computers and Automation

In the October issue we published an article "Pictorial Reasoning Tests and Aptitudes of People" (see page 38.) We said that we believed that

> There is a place for non-verbal, non-mathematical testing, which is not culture-limited, and not background-limited — and which would enable finding and employing many useful people (including computer programmers) who do not have American, middle-class backgrounds.

This article included a "Pictorial Reasoning Test — C&A No. 1," which is printed again on the next page.

Response

This article produced an unusual number of responses. Up to November 5, 77 persons, readers of "Computers and Automation" and their friends, sent in their answers; then, just as we were writing the first draft of this report, another 64 responses came in from Professor Paul Moriarty of Voorhees Community College in New York City, who had given this test to all 64 of his students in data processing.

'Correct' Answers

We had intended to publish in this issue the "correct" answers to the test. Then, as we thought about doing that, it became evident that to publish the "correct" answers would effectively destroy the usefulness of the test. So we now plan to publish the "correct" answers later, after we have worked out more and better tests than this first experimental one, C&A No. 1.

We have here put quotes around the word <u>correct</u> because, for some items, it may not be possible to show conclusively that there is exactly one correct answer.

Using the "correct" answers, we have scored the two groups of respondents. The frequency of the scores is shown in Table 1.

Table 1

FREQUENCY OF SCORES ON TEST

(1) Number of "Correct" Answers	(2) Group 1: 77 Readers of C&A and Their Friends	(3) Group 2: 64 Data Processing Students in New York City
3	0	1
4	2	3
5	0	6
6	0	10
7	2	9
8	3	5
9	6	5
10	8	6
11	5	7
12	15	5
13	8	4
14	14	1
15	11	2
16	3	0
Total Frequency	77	64

High Scorers

The high scorers are:

16 right: F. H. Hicks, K. McKenzie, F. Switzer
15 right: E. B. Anderson, A. C. Ballard, D. R. Brown, S. Carr, G. Chir, S. Cho, J. Crnkovich, A. S. Kroin, M. Mason, J. E. Sands, C. J. Smith, G. E. Thorn, W. E. Waters.

The Items in Sequence of Difficulty

One interesting piece of information that does not reveal the "correct" answers is that the items in the sequence of increasing difficulty are as follows:

1, 6, 12, 11, 14, 3, 16, 10, 4, 7, 2, 19, 17, 20, 9, 5, 15, 18, 8, 13.

This sequence is based on the responses of Group 1 (77 persons), and is subject to change as more information is gathered. 96% obtained the "correct" answer on Item 1; only 16% gave the "correct" answer on Item 13.

Comments

Some interesting comments were:

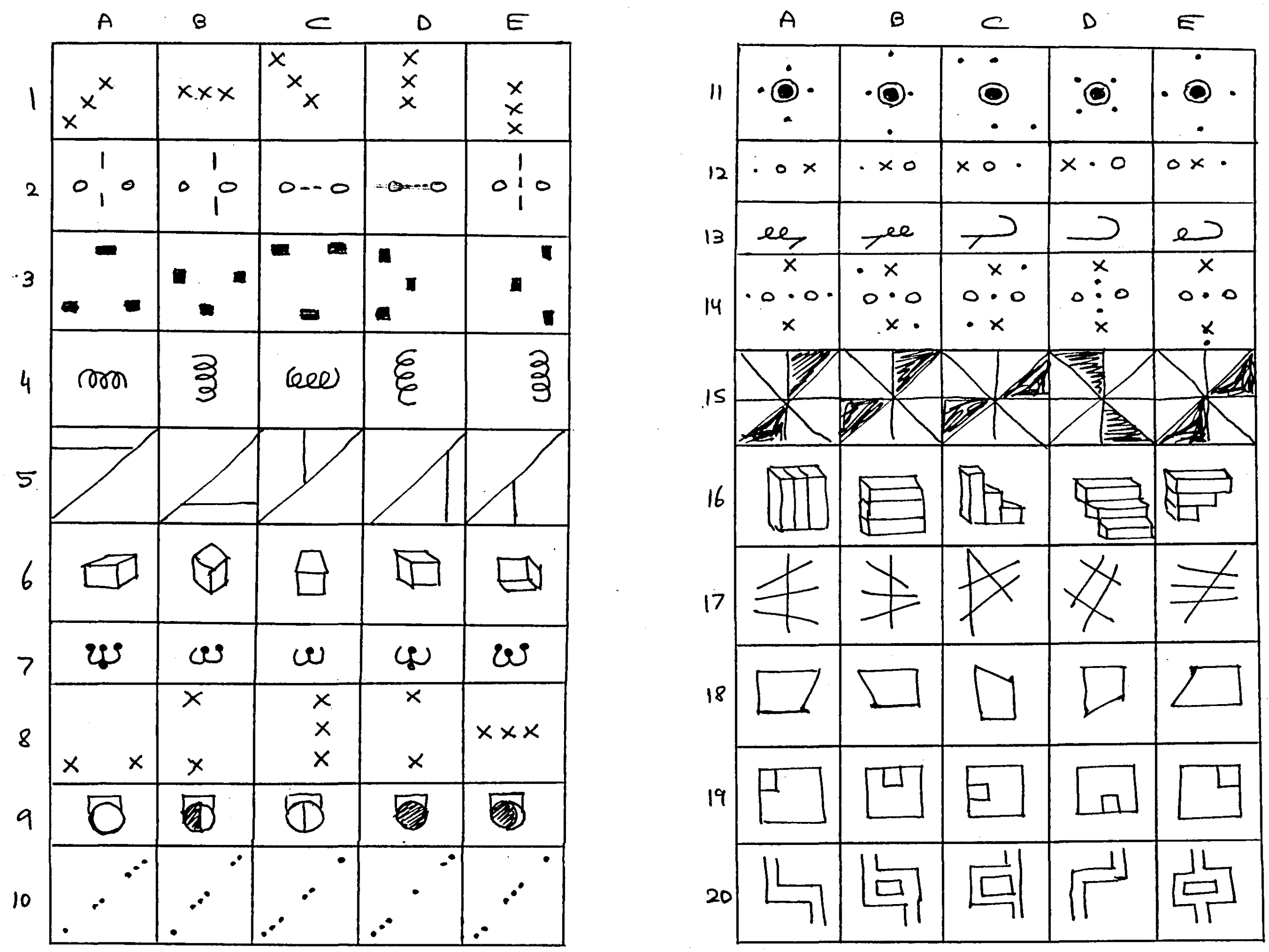
— R. Oravec: This project has a commendable goal. Good luck.
— J.H. Oxley: This sort of test should be a push-over for motion picture animators.
— H.E. Clark: This test seems to be a measure of one's inventiveness.
— D.C. Whitney: Thanks for the test. It was fun.

Deductions

Of course we do not yet have nearly enough results to deduce indications of the capacities of people. For example, one question we would like to study is "What score on which items is an indication of talent for computer programming?" So we invite our readers to continue to take the test (on the next page) and send their results to us. The test may be copied on any piece of paper.

PICTORIAL REASONING TEST — C&A No. 1 — *(may be copied on any piece of paper)*

1. The following Pictorial Reasoning Test (Figure 6) is a test to see how carefully you can observe and reason. It is not timed — but most people use about ten minutes.
2. In each row, find the four pictures that are alike in some way, and find the one that is not like all the others and write its letter as your answer.
3. If you become convinced that no picture is essentially unlike the others, write F (for "defective" or "fatally ambiguous") as your answer.



Answers: Insert in each blank one letter out of A, B, C, D, E, or F, designating your choice.

1 ____	5 ____	9 ____	13 ____	17 ____
2 ____	6 ____	10 ____	14 ____	18 ____
3 ____	7 ____	11 ____	15 ____	19 ____
4 ____	8 ____	12 ____	16 ____	20 ____

Survey Data: 1. Name ____________ 2. Title ____________

3. Organization ____________

4. Address ____________

	Average ?	Good ?	Excellent ?	Not your field?	Other ? (please specify)
5. In computer programming, are you:					
6. In systems analysis, are you:					
7. In managing, are you:					

8. What fields (not mentioned above) are you fairly good in (or even expert in) ? ____________

9. What other capacities do you have ? (Please don't be bashful — but be objective) ____________

10. Any remarks ? ____________

(attach paper if needed)

When completed, please send to: Neil Macdonald, Survey Editor,
Computers and Automation, 815 Washington St., Newtonville, Mass. 02160

(Please turn to page 56)

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

A COMPUTER STORES, COMPOSES, AND PLAYS MUSIC

Dr. Alan Ashton
University of Utah
Salt Lake City, UT 84112

The once-popular player piano finally has a "glorified" modern-day counterpart, developed by a group of computer scientists working on a musical research project at the University of Utah. The 1971 version is an experimental, all-electronic "player organ" which will flawlessly play — with the help of a small computer — as many complicated concertos, hymns, fugues, and sonatas as you may wish to program into it from sheet music. Or you can reverse the process, play in your favorite composition and the computer will provide the sheet music.

The computer organ, named "musicational organ", is still in experimental stages, but it has been demonstrated that the sophisticated, computerized "musical system" will work. The system's potential recently was recognized by the National Endowment for the Humanities, which awarded the research project a grant of $50,000 to help implement the computer organ as a teaching tool.

At the heart of the system are: (1) a $2,500 electric organ; (2) a small digital computer valued between $4,000 and $5,000; (3) an ordinary graphics display; and (4) a maze of wires linking the organ and computer. The system allows the musician to interact with the computer. When the musician depresses the organ keys he has instant communication with the computer, and on command, the computer can play back the composition, speed up the tempo, change the pitch, the phrasing or voice dynamics.

To feed a musical piece into the computer, sheet music is converted into a "linear language" — numbers, letters and symbols from an ordinary typewriter keyboard. The $ symbol on the terminal keys, for example, is the time signature. A measure of Bach's IV Praeludium would go like this:

K1! $3-8 "1" S F4 E G G A B / "2" (A'A C5 S F3) ... and so on. Transcription from musical score to linear language is a mere clinical task that can quickly be learned by anyone. The language is so simple that three high school students this summer were able to transcribe and program Haydn and Bach compositions into the computer.

After the linear language is stored in the computer's memory bank, a few buttons can be pressed and the organ will begin to play the piece.

The computer can store whole scores, and on command it will produce the separate parts for any or all of the musical instruments in the orchestra. Or a composer can sit down at the keyboard and the computer will automatically store his composition and later give him the score, as well as the orchestral parts. The last two capabilities, however, are still primarily limited to simple melodies.

The musicational organ will allow a child to sit down at the keyboard and begin composing immediately. He can listen to the playback and either save it or erase and try again. Or he can superimpose two melodies and create harmony.

The computer also can be programmed to play the sound only if the child presses the correct keys. Thus, the reward for playing something right would be to hear the sound. Lights can also be installed in the organ at each key to show the beginning student where the right keys are located. The system can easily be adapted to teaching children chords, scales, theory, harmony, and all of the fundamentals of music.

A dozen UU music students are working with the computer scientists to learn how to utilize the "musicational organ" for composing and teaching. One of the students, Lance Olsen of Los Angeles who is working on a master's degree in music composition, programmed his thesis (a modern, theoretical piece for orchestra), into the computer and has listened to the organ playback. "The only group in Utah that could play my composition is the Utah Symphony," he said. "But they haven't the time, money nor inclination to play it. Without the computer-organ, I never would have been able to hear the actual sounds."

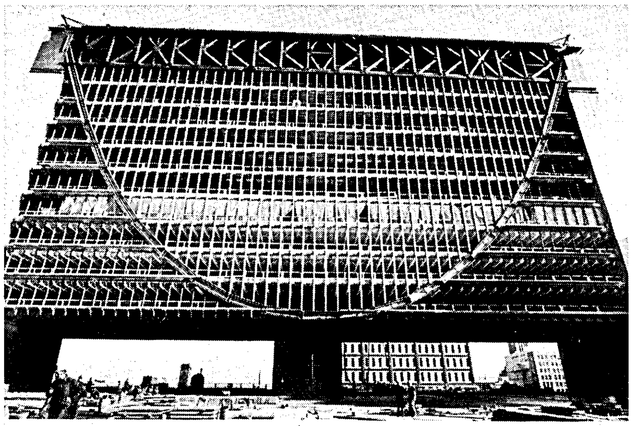
The "musicational organ" may not "catch on" in the American home as the player piano once did, but it will surely, one day, have an enormous impact on music education.

COMPUTER AIDS BUILDER IN ERECTING ONE-OF-A-KIND BUILDING

Tim Adams
Knutson Construction Co.
17 Washington Avenue North
Minneapolis, MN 55401

The first catenary-suspended building — akin to a suspension bridge — is being erected by Knutson Construction Co., with the help of an unusual apprentice — a computer. The building, when completed in the fall of 1972, will be the new Federal Reserve Bank of Minneapolis.

One of the interesting construction features is that much of the erecting was from the top down. Two concrete piers rise 230 feet above the foundation and sit 293 feet apart, spanned by the catenary-supported truss. Two large hydraulic cranes shuttle back and forth atop the truss to hoist the more than 2,500 tons of steel into place.



The novel design was conceived by architects Gunnar Birkerts & Associates to separate the bank's two functions. Office space will be in the 12-story building which will hang suspended from the two massive end piers 40 feet above street level. In three underground levels, 30 feet below street level, bank personnel will store and transfer securities. A two-and-a-half acre granite-paved plaza will separate the underground level and the office space.

The computer is helping keep track of a myriad of planning and building details as the one-of-a-kind building is being constructed. A master Project Control System lists each distinct work activity for the 2½-year work period by activity code number, area of the building, sequence and duration. Short and long completion dates are also listed so subsequent construction steps can be adjusted later to accommodate for delays such as strikes or weather conditions. The computer provides the speed to identify problems before they become serious enough to affect the next building step. The master schedule also is used to establish the cash flow for the project and to order materials.

Using the computer on complicated construction is not a new venture for Knutson Co. Computers have been used successfully for 10 years, not only for planning and scheduling but also for cost accounting and payroll. The computer currently used is an IBM System/360 Model 25.

EDUCATION NEWS

EDUCATORS IN THE PUBLIC SCHOOL SYSTEM OF WASHINGTON, D.C., ASK QUESTIONS OF A COMPUTER

Ted Greenleaf
Office of Public Affairs
Office of Education
Dept. of Health, Education, and Welfare
Washington, D.C.

A telephone-line link between a computer in McLean, Va., and a terminal in the Department of Research and Evaluation in the Washington, D.C., public schools is answering questions ten times as fast as the department used to handle them. In its first week of operation, the computer located within ten minutes the information that a D.C. educator had been seeking in a university library for two months. This efficiency is achieved by "on-line interrogation" — the rough equivalent of keeping a computer on the telephone for hours at a time instead of having it hang up after each question.

The system, called DIALOG, is being operated under a $135,000 contract between Lockheed Missiles & Space Co. and the National Center for Educational Communication (a part of the Office of Education). The contract also links the computer to a terminal in the OE's Washington headquarters. Each terminal consists of a 21-inch TV screen and a keyboard built into a simple desk. The researcher-operator orders information from the computer by typing commands into the keyboard. Almost instantly — a half-second is considered slow — the information is displayed on the TV screen. The computer's memory is stocked with 80,000 items of educational research, ranging from analyses of the success or failure of various teaching techniques to tips on managing the finances of junior colleges. The reports vary in length from one page to several hundred.

Lockheed's DIALOG system enables a researcher to engage in a question-and-answer exchange with the computer, constantly narrowing the scope of his search — or even changing its direction if he strikes a dead end — until he zeroes in on a manageable number of items that bear directly on his problem. Then, before reading any of the reports, he can tell the computer to display a 200-word abstract of each one to see which of the reports he wants in full. At that point, the investigator can order the complete documents from NCEC in microfilm or printed form.

Washington, D.C., is the first public school system in the nation to be connected with "on-line interrogation" of a computer for research purposes. If the system proves its worth, NCEC will help extend the service to other school systems.

NEW PRODUCTS

A 16-BIT MINICOMPUTER FOR $2850

G. W. Johns
Texas Instruments Inc.
Digital Systems Division-Houston
P.O. Box 1444
Houston, TX 77001

The Model 960A, latest development in the 900 series of Texas Instruments' computers, has 4000 registers of active-element semiconductor memory, and a 750-nanosecond cycle time. The hardware and software designs of the 960A which characterizes its dual-mode architecture makes it especially appropriate for: manufacturing automation; process control; and data collection systems.

The machine has a "Bit-Pusher" capability of using single bits of standard 16-bit words to perform sensing and control functions directly.

The $2850 price includes the power supply, a Direct Memory Access (DMA) channel, automatic parity checking, memory-write-protect, and a complete lockable front panel. Additional 4K memories, for $1500, also are available. The price of $2850 applies to quantities from one to one hundred.

MAGNETIC HEADS WRITE 100 TRACKS ON TAPE ONE INCH WIDE

R. E. Norris, Manager
Marketing Communications
Applied Magnetics Corp.
75 Robin Hill Rd.
Goleta, CA 93017

Each of a new series of magnetic heads writes 100 in-line tracks on one inch tape. The heads feature a special construction technique permitting precise track alignment. Although the tracks are very closely spaced, internal shielding limits intertrack crosstalk to within 10%.

Track width is .008" spaced on .010" centers. Approximate external dimensions are height 1.5" X width 1.2" X depth 1.0". Typical head inductance is 1.2mh. The head is capable of writing to a linear packing density of 5000 flux reversals per inch or higher.

VELO-BINDING — INSTANT BOOKS

Dr. William H. Abildgaard, President
Abildgaard Laboratories, Inc.
857 Maude Ave.
Mountain View, CA 94040

A new process, called Velo-Binding, allows for the production of quality-bound documents in twenty seconds or fully-cased hard-cover books in less than sixty seconds on equipment as easy to operate as the familiar copying machine.

The compact equipment operates on a very unusual approach to bookbinding by eliminating sewing and gluing in favor of a simpler, but superior mechanical device. It reduces the number of bookbinding steps from 16 to 3.

During the past several months, the new equipment has undergone testing by several business organizations in California, including Bank of America, North American Rockwell, Diamond National, Pacific Union College and Bechtel. The results have been gratifying.

Operational costs are low in comparison to any other permanent binding method. Results are both aesthetically and technically equal or superior. Velo-Binder equipment can be leased for a minimum of $50 per month and individual unit bindings can be as low as 10 cents per binding.

ORGANIZATION NEWS

"PUT NOT THY FAITH IN PRINCES":

ELECTRONIC MEMORIES & MAGNETICS CORP. DISCONTINUES SEMICONDUCTOR DEVELOPMENT

Thomas G. Wiley, Vice Pres.
Electronic Memories & Magnetics Corp.
3435 Wilshire Blvd.
Los Angeles, CA 90005

Electronic Memories & Magnetics Corp. had discontinued further funding of Semiconductor Electronic Memories, Inc., of Phoenix, Arizona, as of October 30, 1971.

EMM by October 30, 1971, had loaned SEMI in excess of $7,000,000, of which approximately $3,000,000 had been advanced in 1971. All or part of the total investment may be written off in the fourth quarter of 1971, depending upon new financing arrangements that may be made by SEMI. EMM will assist SEMI in seeking new financial support. It is regrettable that EMM's investment in semi-conductor memory technology has failed. The delay in demand, caused by the computer industry downturn of 1970-1971, and recent pricing policies by other semiconductor memory manufacturers, have together materially increased the price of entry into this new technology.

MISCELLANEOUS

PATENT GRANTED TO OPTOGRAMS' PRESIDENT FOR DIGITAL CONTROL SYSTEM

Dr. Geza von Voros, President
Optograms, Inc.
32 Spruce St.
Oakland, NJ 07436

Patent No. 3,610,935 — Incremental optical curve tracer with sequential logic — covers the first digital control systems which "provides perfect man/machine communication and will supersede most tape-controlled automation".

The system traces the line to be followed using the "blind man's" approach. After the system tracks one step forward, the line must continue ahead, to the left, or to the right by one step. The logic circuit "decides" the direction of the next step and actuates the positioner accordingly. Each step is followed by decision-making via the fast logic circuit, thus providing a sequential pattern to accurately trace a line.

Tracking accuracies of 25 millionths of an inch can easily be achieved by this method providing control signals for machine positioners or other type actuators directly in digital form. The resulting "rectilinear interpolation" dramatically simplifies the control circuitry used presently with any other tracking system.

The wide range of applications includes: direct mask production for intergrated circuits; automatic measuring and gaging; controlled laser and electron-beam machining and welding; medical electronics; and automated metal cutting and forming.

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
System Development Corp.,	Air Force System Command, Electronic Systems Division Hanscom Field, Mass.	Design, development and implementation of major portion of Tactical Information Processing and Interpretation (TIPI) System	$11.3 million
Century Data Systems, Inc., Anaheim, Calif.	Badische Anilin - & Soda-Fabrik A.G. (BASF), Ludwigshafen, West Germany	Disk drive and tape drive memory systems; expands an existing agreement	$16 million (approximate)
Xerox Data Systems, El Segundo, Calif.	General Electric Company, Valley Forge, Pa.	DP equipment (includes 3 Sigma 5's and 7 Sigma 3's) for Earth Resources Technology Satellite (ERTS) program; collected data will be used for better management of world's resources and will allow identification of trouble zones	$4+ million
Computing and Software, Inc., Los Angeles, Calif.	National Aeronautics and Space Administration (NASA)	Providing research data processing services and documents conversion for NASA's Langley Research Center, Hampton, Virginia	$3 million (approximate)
National Cash Register Co., Dayton, Ohio	State Street Bank & Trust Co., Boston, Mass.	Over 200 NCR 270 data terminals for use by tellers of banks subscribing to State Street's "on-line" data processing services	$2 million
California Computer Products, Inc., Anaheim, Calif.	General Services Administration (GSA)	Purchase of disk drive memory systems leased October 1970 to the Veterans Administration for use in offices located in nine US cities	$1.7 million
Electronic Associates, Inc., West Long Branch, N.J.	U.S. Postal Service	Manufacture of 300 Edger-Feeder machines each capable of processing up to 40,000 letters an hour; to be installed in post offices nationwide	$1.5 million
PRC Information Sciences Co., McLean, Va.	Naval Air Systems Command	Improving automated facilities of the Attack Carrier Integrated Operational Intelligence Center (CVA-IOIC)	$1.5 million (approximate)
Honeywell Information Systems Ltd.	Central Electricity Generating Board, Brentford, England	Five identical on-line, real-time data acquisition computer systems, one for each generating unit at the oil-fired power station being built on the Isle of Grain, Kent	$1.4+ million
Honeywell Information Systems	City of Phoenix Phoenix, Ariz.	A Honeywell Model 6040 computer to replace a Honeywell 427 computer; new system will have remote communications capability in addition to meeting current applications	$1.3 million (approximate)
Informatics, Inc., Canoga Park, Calif.	U.S. Air Force Systems Command	Extracting specific scientific and technical information from a wide variety of Eastern European and Soviet language open source literature	$1+ million
Howard International, New York, N.Y.	Datamedia International, Inc., Dallas, Texas	Manufacture of approximately 10,000 Vote-A-Corder Model 5's — a portable punch-card voting device	$850,000
Interdata, Inc., Oceanport, N.J.	Interstate Electronics Corp., Anaheim, Calif.	21 Model 4 computer systems for use in support of weapons systems being produced for the US Navy	$596,000
Syracuse University Syracuse, N.Y.	Advanced Research Projects Agency of the Defense Dept.	Research designed to develop a richer computational language system to try to make computers "reason" better and faster	$491,162
Burroughs Corp. Defense, Space and Special Systems Group,	Electronic Systems Div., United States Air Force Systems Command	Lease of five B 3500 computer systems for use in the Military Airlift Command (MAC) Overseas Terminal Data System; computers to be located at Bases in Japan, Philippines, Okinawa; Hawaii and Germany	$423,000
Cambridge Memories, Inc., Newtonville, Mass.	Intercomputer Corp. Phoenix, Ariz.	ExpandaCore 18 memory systems which are used in two of Intercomputer's computer lines, the I-50 and the I-270N series	$300,000+
TRW Inc., Redondo Beach, Calif.	Colorado Department of Highways	A real-time computerized traffic control system, SAFER II (Systematic Aid to Flow on Existing Roadways); initially will control 27 signalized intersections — can control up to 100 intersections	$144,000
Informatics, Inc., Canoga Park, Calif.	U.S. Marine Corps	A computerized manpower requirement system with an improved information retrieval capability	$135,000
Lockheed Missiles & Space Co. Sunnyvale, Calif.	National Aeronautics & Space Administration, Goddard Space Flight Center, Greenbelt, Md.	A study of use of communication satellite to aid proposed Biomedical Communication Network; network would tie medical personnel in remote areas with medical libraries, diagnostic centers, medical schools, etc.	$87,000
Financial Computer Corp., Clifton, N.J.	The National Cash Register Co., Dayton, Ohio	Development of application programs that will permit NCR's new 270 on-line financial terminal to be used in conjunction with the IBM System 360 computer	—
Computer Corporation of America, Cambridge, Mass.	U.S. Patent Office	A study of hardware/software requirements for a computer-based patent storage system; it will allow for full-text storage of over one million patents and provide rapid on-line access to this information from multiple remote locations	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B6500 system	Bankdata, Orebro, Sweden	All data processing operations of 4 Swedish banks (system valued at over $2 million)
Control Data CYBER 70 model 72	University of Minnesota	Additional computing facilities for student use, particularly undergraduates
Control Data 915-1700 page reader	University of Ulm, Germany	Handling all types of medical information on original source documents for local hospitals
Control Data 6400 system	Temple University, Philadelphia, Pa.	Research and classroom usage by faculty and students; also, payroll, student records, library inventory, and processing medical information for the Health Sciences Center
Honeywell Model 58 system	Compat Corp., Westbury, N.Y.	Accounting, payroll and inventory applications
Honeywell Model 115 system	Fulfillment Associates, Farmingdale, N.Y.	Maintenance of name and address lists for large-scale mailing and magazine fulfillment processing
	Sharp Electronics Corp., Paramus, N.J.	Sales reporting, sales analysis, inventory control and accounts receivable applications
	Western Connecticut State College, Danbury, Conn.	Administrative and instructional purposes
IBM System/3 Model 10	Cornwall Wood Products, South Paris, Maine	Handling customer credit-limits, order processing, billing, accounts receivable and collection, and a complete finished goods perpetual inventory reporting system
	Karlana Knitwear Ltd., New York, N.Y.	Applications in production and distribution ranging from the purchase of yarn to the shipping of finished goods; as well as varied management reports, and general business tasks
IBM System/7	United States Testing Co., Memphis, Tenn.	Analyzing soil samples from farmers, fertilizer dealers, fruit producers and large nurseries
IBM System/370 Model 145	Louisiana Polytechnic Inst., Ruston, La.	Data processing needs of students, faculty and administrative departments
IBM System/370 Model 155	Lane County, Oregon	Applications as diverse as court records, property assessment, roadway planning, and dog licensing; system is shared by cities, counties, and public utilities of region
IBM System/370 Model 165	Kentucky Department of Highways	Focal point of Management Information System (MIS); involves bringing 16 divisional offices on-line, monitoring nation's largest toll road network, and solving complex engineering problems
	Triangle Universities Computation Center, Research Triangle Park, N.C.	Educational network involving 46 universities, colleges and technical institutes sharing system via 138 terminals; student use ranges from courses in basic computer programming to high energy physics experiments, and voting trend analyses
NCR Century 50 system	Federal Home Loan Bank, Seattle, Wash.	Time-deposits accounting and statements, collateral and advance accounting, various management reports
NCR Century 100 system	City of Chicopee, Mass.	Preparing local tax bills: gives taxpayers an itemized breakdown of taxes on their bills
	City of Clearwater, Fla.	Payroll and utility bill preparation, processing accounts payable and handling budgetary accounting and several law-enforcement applications
	City of Tuscaloosa, Ala.	Preparing payrolls and processing 24,000 water bills each month
NCR Century 200 (2 systems)	Basler Kantonalbank, Basel, Switzerland	Linking its eight branches, via 13 teller terminals, on-line to one of the twin systems; second computer used for batch processing work and as backup
	Richmond, Fredericksburg & Potomac Railroad	Simplification of locating of freight shipments at any given time
SYSTEMS 810B/RTX	Pennsylvania Dept. of Transportation, Bureau of Materials, Testing & Research	Materials testing to assure quality of materials used in construction; evaluation of performance of vendors under contract to Commonwealth (system valued at over $275,000)
UNIVAC 9200 system	Carpenter, Inc., Birmingham, Ala.	Billing, sales analysis, general accounting and payroll processing.
	Elwyn Institute, Elwyn, Delaware County, Pa.	Student statistics, medical statistics, mailing lists, general accounting and payroll processing
	Gardner Baking Co., Madison, Wis.	Production control, route accounting, general accounting and payroll processing
	Kent County Vocational Technical Center, Woodside, Dover, Del.	Student instruction and administrative applications
UNIVAC 9200-II system	Computer Procedures Corp., a subsidiary of Colonial Commercial Corp. Valley Stream, N.Y.	A "support" system to relieve the company's main computer (a 360/30) of a growing volume of overloads
	F. T. Lowy Linoleum & Rug Co., St. Louis, Mo.	Inventory control, billing and general accounting
UNIVAC 9300 system	Cleveland Automobile Club, Cleveland, Ohio	A number of services for Club's 209,000 members including membership records, several general accounting chores, labels for mailing monthly magazine and automatic reminder to members to renew driver licenses
Xerox Sigma 9	CRC Information Systems Ltd., London, England	Service bureau operations (system valued at over $1.5 million)

MONTHLY COMPUTER CENSUS

Neil Macdonald
Survey Editor
COMPUTERS AND AUTOMATION

The following is a summary made by COMPUTERS AND AUTOMATION of reports and estimates of the number of general purpose electronic digital computers manufactured and installed, or to be manufactured and on order. These figures are mailed to individual computer manufacturers from time to time for their information and review, and for any updating or comments they may care to provide. Please note the variation in dates and reliability of the information. Several important manufacturers refuse to give out, confirm, or comment on any figures.

Our census seeks to include all digital computers manufactured anywhere. We invite all manufacturers located anywhere to submit information for this census. We invite all our readers to submit information that would help make these figures as accurate and complete as possible.

Part I of the Monthly Computer Census contains reports for United States manufacturers. Part II contains reports for manufacturers outside of the United States. The two parts are published in alternate months.

The following abbreviations apply:

- (A) -- authoritative figures, derived essentially from information sent by the manufacturer directly to COMPUTERS AND AUTOMATION
- C -- figure is combined in a total
- (D) -- acknowledgment is given to DP Focus, Marlboro, Mass., for their help in estimating many of these figures
- E -- figure estimated by COMPUTERS AND AUTOMATION
- (N) -- manufacturer refuses to give any figures on number of installations or of orders, and refuses to comment in any way on those numbers stated here
- (R) -- figures derived all or in part from information released indirectly by the manufacturer, or from reports by other sources likely to be informed
- (S) -- sale only, and sale (not rental) price is stated
- X -- no longer in production
- \- -- information not obtained at press time

SUMMARY AS OF NOVEMBER 15, 1971

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Part II. Manufacturers Outside United States							
A/S Norsk Data Elektronikk	NORD-1	8/68	2.0	0	56	56	31
Oslo, Norway	NORD-2B	8/69	4.0 (S)	0	5	5	13
(A) (Nov. 1971)	NORD-5	-	-	0	0	0	1
A/S Regnecentralen	GIER	12/60	2.3-7.5	0	40	40	0
Copenhagen, Denmark	RC 4000	6/67	3.0-20.0	0	16	16	3
(A) (Apr. 1971)							
Elbit Computers Ltd.	Elbit-100	10/67	4.9 (S)	-	-	225	50
Haifa, Israel							
(A) (Feb. 1971)							
GEC-AEI Automation Ltd.	Series 90-2/10/20 25/30/40/300	1/66	-	-	-	13	X
New Parks, Leicester, England	S-Two	3/68	-	-	-	1	X
(R)	130	12/64	-	-	-	2	X
(Jan. 1969)	330	3/64	-	-	-	9	X
	959	-/65	-	-	-	1	X
	1010	12/61	-	-	-	8	X
	1040	7/63	-	-	-	1	X
	CON/PAC 4020	-	-	-	-	0	X
	CON/PAC 4040	5/66	-	-	-	9	-
	CON/PAC 4060	12/66	-	-	-	5	-
International Computers, Ltd. (ICL)	Atlas 1 & 2	1/62	65.0	0	6	6	X
London, England	Deuce	4/55	-	0	7	7	X
(A)	KDF 6-10	9/61	10-36	0	58	58	X
(July 1971)	KDN 2	4/63	-	0	1	1	X
	Leo 1, 2, 3	-/53	10-24	0	59	59	X
	Mercury	-/57	-	0	13	13	X
	Orion 1 & 2	1/63	20.0	0	17	17	X
	Pegasus	4/55	-	0	30	30	X
	Sirius	-/61	-	0	22	22	X
	503	-/64	-	0	16	16	X
	803 A, B, C	12/60	-	0	83	83	X
	1100/1	-/60	5.0	0	22	22	X
	1200/1/2	-/55	3.9	0	68	68	X
	1300/1 /2	-/62	4.0	0	196	196	X
	1500	7/62	6.0	0	110	110	X
	2400	12/61	23.0	0	4	4	X
	1900-1909	12/64	3-54	0	2000	2000	C
	Elliott 4120/4130	10/65	2.4-11.4	0	160	160	C
	System 4-30 to 4-75	10/67	5.2-54	0	160	160	C
							Total: 400
Japanese Mfrs.	(Mfrs. of various models include: Nippon Electric Co., Fujitsu, Hitachi, Ltd., Toshiba, Oki Electric Industry Co., and Mitsubishi Electric Corp.)					Total: 4150 E	Total: 800 E
(N) (Sept. 1970)							
Marconi Co., Ltd.	Myriad I	3/66	£36.0-£66.0 (S)	0	37	37	9
Chelmsford,wEssex, England	Myriad II	10/67	£22.0-£42.5 (S)	0	17	17	12
(A) (Jan. 1970)							
N.V. Philips Electrologica	P1000	8/68	7.2-35.8	-	-	60	60
Apeldoorn, The Netherlands	P9200	3/68	-	-	-	300	50
(A)	P9200 t.s.	3/70	-	-	-	4	3
(July 1971)	P800	9/70	-	-	-	9	60
	ELX1	5/58	12.0	-	-	22	-
	ELX2/8	3/65	6-21	-	-	27	-
	DS714	-/67	-	-	-	27	8
	PR8000	1/66	-	-	-	23	-
Redifon Limited	R2000	7/70	-	0	12	12	6
Crawley, Sussex, England							
(A) (Sept. 1971)							
Saab-Scania Aktiebolag	D21	12/62	7.0	0	38	38	-
Linkoping, Sweden	D22	11/68	15.0	0	31	31	0
(A) (Oct. 1971)	D220	4/69	10.0	0	12	12	5
Selenia S.p.A.	GP-16	7/69	10.9 (S)	0	72	72	31
Roma, Italy	GP-160	-	5.6	-	-	-	250
(A) (Nov. 1971)							

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Siemens	301	11/68	0.75	-	-	82	C
Munich, Germany	302	9/67	1.3	-	-	28	C
(A)	303	4/65	2.0	-	-	70	C
(July, 1971)	304	5/68	2.8	-	-	63	C
	305	11/67	4.5	-	-	93	C
	306	-	6.5	-	-	-	C
	2002	6/59	13.5	-	-	39	C
	3003	12/63	13.0	-	-	32	C
	4004/15/16	10/65	5.0	-	-	99	C
	4004/25/26	1/66	8.3	-	-	54	C
	4004/35	2/67	11.8	-	-	185	C
	4004/135	-	17.1	-	-	-	C
	4004/45	7/66	22.5	-	-	248	C
	4004/46	4/69	34.0	-	-	10	C
	4004/55	12/66	31.3	-	-	22	C
	4004/150	-	41.0	-	-	10	C
	4004/151	-	51.5	-	-	22	C
	404/3	-	1.9	-	-	-	C
	404/6	-	-	-	-	10	C
							Total: 298
USSR	BESM 4	-	-	-	-	C	C
(N)	BESM 6	-	-	-	-	C	C
(May 1969)	MINSK 2	-	-	-	-	C	C
	MINSK 22	-	-	-	-	C	C
	MIE	-	-	-	-	C	C
	NAIR 1	-	-	-	-	C	C
	ONEGA 1	-	-	-	-	C	C
	URAL 11/	-	-	-	-	C	C
	URAL 11/14/16 and others	-	-	-	-	C	C
						Total: 6000 E	Total: 2000 E

CALENDAR OF COMING EVENTS

Dec. 7-8, 1971: Workshop on Digital Systems, Lehigh Univ., Bethlehem, Pa. / contact: Frank M. Towell, Western Electric Co., Allentown, Pa. 18103

Dec. 7-10, 1971: Applications of Simulation, Waldorf Astoria Hotel, New York, N.Y. / contact: Joseph Sussman, MIT, 77 Massachusetts Ave., Cambridge, Mass. 02139

Dec. 16-18, 1971: IEEE Conference on Decision and Control (including the 10th Symposium on Adaptive Processes), Americana of Bal Harbour, Miami Beach, Fla. / contact: Prof. J. T. Tou, Univ. of Florida, Gainesville, Fla.

Feb. 1-3, 1972: First International CAD/CAM Conference and Exhibits, Royal Coach Motor Hotel, Atlanta, Ga. / contact: Society of Manufacturing Engineers, Public Relations Dept., 20501 Ford Rd., Dearborn, Mich. 48128

Feb. 2-4, 1972: 1972 San Diego Biomedical Symposium, Sheraton Hotel, Harbor Island, San Diego, Calif. / contact: Norman R. Silverman, M.D., San Diego Biomedical Symposium, P.O. Box 965, San Diego, Calif. 92112

Mar. 8-10, 1972: Fifth Annual Simulation Symposium, Tampa, Fla. / contact: Annual Simulation Symposium, P.O. Box 1155, Tampa, Fla. 33601

Mar. 20-23, 1972: IEEE International Convention & Exhibition, Coliseum & N. Y. Hilton Hotel, New York, N. Y. / contact: IEEE Headquarters, 345 E. 47th St., New York, N. Y. 10017

Mar. 26-29, 1972: IEEE International Convention, Coliseum & N.Y. Hilton Hotel, New York, N.Y. / contact: J. H. Schumacher, IEEE, 345 E. 475th St., New York, N.Y. 10017

April 5-8, 1972: "Teaching Systems '72", International Congress, Berlin Congress Hall, Berlin, Germany / contact: AMK Berlin, Ausstellungs-Messe-Kongress-GmbH, Abt. Presse und Public Relations, D 1000 Berlin 19, Messedamm 22, Germany

April 25-28, 1972: Conference on Computer Aided Design, Univ. of Southampton, Southampton, England / contact: IEE Office, Savoy Place, London W.C. 2, England

May 15-18, 1972: 5th Australian Computer Conference, Brisbane, Queensland, Australia / contact: A. W. Goldsworthy, Chmn., Australian Computer Society, Inc., Computer Center, Australian National Univ., P. O. Box 4, Canberra, A.C.T. 2600

May 15-18, 1972: Spring Joint Computer Conference, Convention Ctr., Atlantic City, N.J. / contact: AFIPS Headquarters, 210 Summit Ave., Montvale, N.J. 07645

May 16-17, 1972: IIT Research Institute Second International Symposium on Industrial Robots, Chicago, Ill. / contact: K. G. Johnson, Symposium Chairman, IIT Research Institute, 10 West 35 St., Chicago, Ill. 60616

May 21-24, 1972: 7th Annual Mass Retailers' Convention and Product Exposition, Marriott Motor Hotel, Atlanta, Ga. / contact: MRI Headquarters, 570 Seventh Ave., New York, N. Y. 10018

May 24-26, 1972: Second Annual Regulatory Information Systems Conference, Chase-Park Plaza Hotel, St. Louis, Mo. / contact: William R. Clark, Missouri Public Service Commission, Jefferson City, Mo. 65101

June 12-14, 1972: Conference on Computers in the Undergraduate Curricula, Sheraton-Biltmore Hotel and Georgia Institute of Technology, Atlanta, Ga. / contact: Computer Sciences Project, Southern Regional Education Board, 130 Sixth St., N.W., Atlanta, Ga. 30313

June 12-14, 1972: International Conference on Communications, Sheraton Hotel, Philadelphia, Pa. / contact: Stanley Zebrowitz, Philco-Ford Corp., 4700 Wissahickon Ave., Philadelphia, Pa. 19144

June 19-21, 1972: International Symposium on Fault-Tolerant Computing, Boston, Mass. / contact: John Kirkley, IEEE Computer Society, 8949 Reseda Blvd., Suite 202, Northridge, Calif. 91324

June 19-21, 1972: Ninth Annual Design Automation Workshop, Statler Hilton Hotel, Dallas, Tex. / contact: R. B. Hitchcock, IBM Watson Research Center, P.O. Box 218, Yorktown Heights, N.Y. 10598

June 27-30, 1972: DPMA 1972 International Data Processing Conference & Business Exposition, New York Hilton at Rockefeller Center, New York, N.Y. / contact: Richard H. Torp, (conference director), or Thomas W. Waters (exposition manager), Data Processing Management Association, 505 Busse Hwy., Park Ridge, Ill. 60068

July 3-6, 1972: First Conference on Management Science and Computer Applications in Developing Countries, Cairo Hilton, Cairo, U.A.R. / contact: Dr. Mostafa El Agizy or Dr. William H. Evers, IBM Corporation, Armonk, N.Y. 10504

Sept. 19-22, 1972: Western Electronic Show & Convention (WESCON), Los Angeles Convention Ctr., Los Angeles, Calif. / contact: WESCON, 3600 Wilshire Blvd., Los Angeles, Calif. 90005

Oct. 8-11, 1972: International Conference on Systems, Man and Cybernetics, Shoreham Hotel, Washington, D.C. / contact: K. S. Nurendra, Yale Univ., 10 Hill House, New Haven, Conn. 06520 c.a

READERS' FORUM

MARTIN LUTHER KING MEMORIAL PRIZE CONTEST — FOURTH YEAR

(Please post this notice)

"Computers and Automation" announces the fourth year of the annual Martin Luther King Memorial Prize, to be awarded for the best article on an important subject in the general field of:

> The application of information sciences and engineering to the problems of improvement in human society.

The judges in 1972 will be:
Dr. Franz L. Alt of the American Institute of Physics; Prof. John W. Carr III of the Univ. of Pennsylvania; Dr. William H. Churchill of Howard Univ.; and Edmund C. Berkeley, Editor of "Computers and Automation.

The amount of the prize in 1972 will be $150.

The closing date for the receipt of manuscripts this year is April 30, 1972, in the office of "Computers and Automation", 815 Washington St., Newtonville, Mass. 02160.

The winning article, if any, will be published in a subsequent issue of "Computers and Automation." The decision of the judges will be conclusive. The prize will not be awarded if, in the opinion of the judges, no sufficiently good article is received.

Following are the details: The article should be approximately 2500 to 3500 words in length. The article should be factual, useful, and understandable. The subject chosen should be treated practically and realistically with examples and evidence — but also with imagination, and broad vision of possible future developments, not necessarily restricted to one nation or culture. The writings of Martin Luther King should be included among the references used by the author, but it is not necessary that any quotations be included in the article.

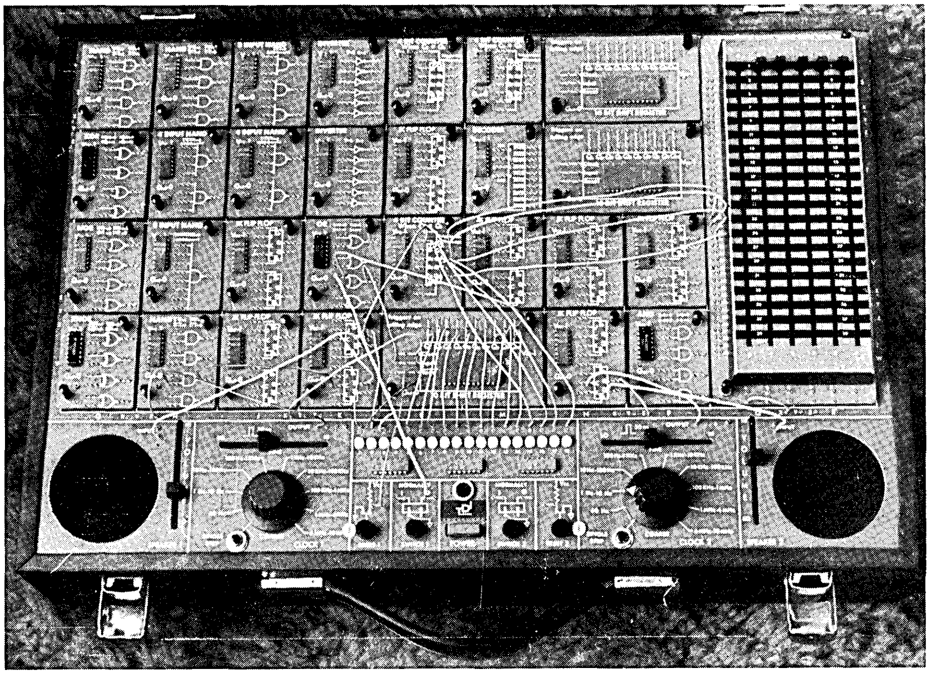
Articles should be typed with double line spacing and should meet reasonable standards for publication. Four copies should be submitted. All entries will become the property of "Computers and Automation." The article should bear a title and a date, but not the name of the author. The author's name and address and four or five sentences of biographical information about him, should be included in an accompanying letter — which also specifies the title of the article and the date.

"Many people fear nothing more terribly than to take a position which stands out sharply and clearly from the prevailing opinion. The tendency of most is to adopt a view that is so ambiguous that it will include everything and so popular that it will include everybody. ... Not a few men who cherish noble ideals hide them under a bushel for fear of being called different."

"Wherever unjust laws exist, people on the basis of conscience have a right to disobey those laws."

"There is nothing that expressed massive civil disobedience any more than the Boston Tea Party, and yet we give this to our young people and our students as a part of the great tradition of our nation. So I think we are in good company when we break unjust laws, and I think that those who are willing to do it and accept the penalty are those who are a part of the saving of the nation."

> — From "I Have a Dream" — The Quotations of Martin Luther King, Jr., compiled and edited by Lotte Haskins, Grosset and Dunlap, New York, 1968.
>
> Reverend Martin Luther King, Jr., was awarded the Nobel Peace Prize in 1964, when he was age 35.
>
> He was in jail in the United States more than 60 times.
>
> He was assassinated in Memphis, Tennesee, April 4, 1968.

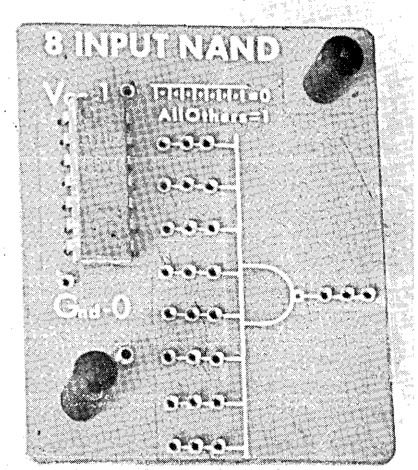


TDI introduces

a totally new modular

Digital Logic Laboratory

for both Education and Industry



The Logic Lab provides maximum flexibility in the application of digital logic — Accommodates "state of the art" digital logic TTL and LSI — Functionally separated into two basic sections, the mother board housing up to 40 daughter board stations each with separate power and ground connections. Each IC is mounted on an individual printed circuit board (daughter board) with MIL spec symbols and truth tables on the top side. Universal daughter boards are available for any 14, 16 or 24 pin TTL IC (DIP). Daughter boards plug directly into the mother board. A control and readout panel houses: two independent clocks with frequency selectable 1 Hz to 9 MHz, 60 cycles, and single step; switches (40^6 combinations); indicator lamps (18); and two-channel audio output. Interconnection utilizes plain, solid wire (22 gauge). The Logic Labs may be interconnected to themselves or to other peripheral equipment.

Without exception our Logic Laboratory is far superior in both price and performance to any similar device. It offers greater flexibility, circuit availability, degree of complexity, readout, and interpretation. In hardware, the Logic Lab offers four times as many IC's, twice as many readout lights, much greater switching (up to 40^6 combinations) with exclusive two-channel audio readout.

TDI has already delivered the Logic Lab to both educational and industrial organizations. One large institute has integrated the Logic Lab into a course on problem solving and digital logic design. Digital design engineers in industry can use the Logic Lab to breadboard and debug digital logic concepts, saving significant dollars and time by "handing over" digital circuits that have been thoroughly tested and debugged.

For additional information, including price and delivery, write or telephone:

Teaching Devices Inc.
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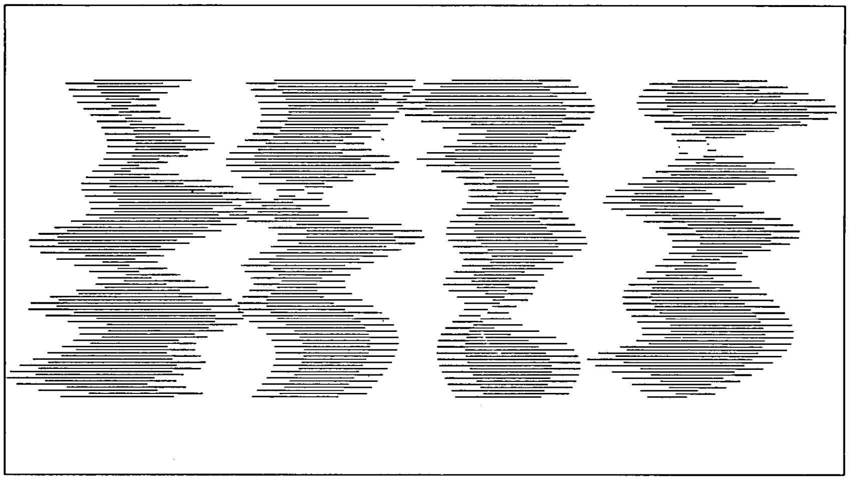

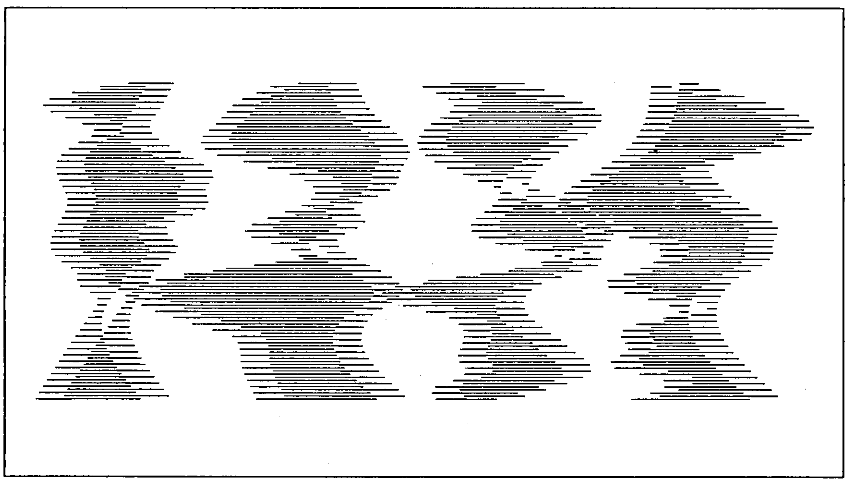

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