SCIENCE & TECHNOLOGY

July, 1972

Vol. 21, No. 7

computers and automation

LA PENSEUSE

Sample page from the Fifth Edition, "WHO'S WHO IN COMPUTERS AND DATA PROCESSING"

Who's Who in Computers

ANDERSEN, Hans Peter Brostrup / console operator / *b:* 1946 / *ed:* Denmark / *ent:* 1966 / *m-i:* B Ma P Sa / *t:* console operator / *org:* Tretorn Data Center, AB, 25225 Halsingborg, Sweden / *pb-h:* - / *h:* Tranemansgatan 14 3:e van, S-252 44 Halsingborg, Sweden

ANDERSON, Alfred O. / mathematician / *b:* 1928 / *ed:* BS, math / *ent:* 1953 / *m-i:* P / *t:* mathematician / *org:* Aberdeen Proving Ground, MD 21005 / *pb-h:* ACM / *h:* 602 Market St, Aberdeen, MD 21001

ANDERSON, Carl S. / systems analyst / *b:* 1934 / *ed:* BS, Univ of Kansas School of Business / *ent:* 1962 / *m-i:* A Mg Sy / *t:* computing systems analyst / *org:* The Boeing Co, 3801 S Oliver, Wichita, KS 67210 / *pb-h:* CDP / *h:* 806 N Florence, Wichita, KS 67212

ANDERSON, Edward J. / computer systems scientist / *b:* 1932 / *ed:* BS, Univ of California at Berkeley; MA, aerospace operations management, Univ of Southern California; MS, systems engineering, West Coast Univ / *ent:* 1959 / *m-i:* D Mg Sy / *t:* computer systems scientist / *org:* Computer Sciences Corp, 650 N Sepulveda, El Segundo, CA 90245 / *pb-h:* ACM, IEEE, "Design Considerations for a Telemetry Ground Support System", AIAA Aerospace Computer Systems Conference, 1969 / *h:* 1440 Florida St, Apt 8, Long Beach, CA 90812

ANDERSON, Frederick J. / engineer / *b:* 1923 / *ed:* Stanford Univ / *ent:* 1947 / *m-i:* A C / *t:* director of engineering / *org:* Sylvania Electric Products, Inc, 100 First Ave Waltham, MA 02154 / *pb-h:* - / *h:* 66 Woodridge Rd, Wayland, MA 01778 / *C64

ANDERSON, Herbert E. / senior programmer / *b:* 1927 / *ed:* Univ of California, Univ of New Mexico / *ent:* 1957 / *m-i:* A P; statistics / *t:* staff associate / *org:* Sandia Corp, Sandia Base, Albuquerque, NM 87115 / *pb-h:* ACM, CDP, several papers / *h:* 501 Mesilla NE, Albuquerque, NM 87108

ANDERSON, Jess / systems specialist / *b:* 1935 / *ed:* BA / *ent:* 1955 / *m-i:* A P Sy; research in physical sciences / *t:* specialist / *org:* Univ of Wisconsin, PO Box 6, Stoughton, WI 53589 / *pb-h:* several papers / *h:* 2838 Stevens St, Madison, WI 53705

ANDERSON, Kermit C. / systems analyst / *b:* 1943 / *ed:* BS, Penn State Univ / *ent:* 1969 / *m-i:* L Ma P Sy / *t:* systems analyst / *org:* Marsh & McLennan,70 Pine St, New York, NY 10005 / *pb-h:* - / *h:* 2 Park Ave, Green Brook, NJ 08812

ANDERSON, Marilyn B. (Mrs.) / junior engineer / *b:* 1927 / *ed:* Miami Univ / *ent:* 1949 / *m-i:* P /

Abbreviations include:

b:	born
ed:	education
ent:	entered computer field
m–i:	main interests
t:	title
org:	organization
pb–h:	publications, honors, memberships, other distinctions
h:	home address
v:	volume number

Main Interests:

A	Applications	Mg	Management
B	Business	Ma	Mathematics
C	Construction	P	Programming
D	Design	Sa	Sales
L	Logic	Sy	Systems

ANDERSON, Walter R. / president / *b:* 1929 / *ed:* AB, Clark Univ; BSEE, Worcester Polytech Inst / *ent:* 1958 / *m-i:* Ma / *t:* president / *org:* Spiras Systems Inc, 332 Second Ave, Waltham, MA 02154 / *pb-h:* IEEE, Committee on Numerical Control EIA TR-31 / *h:* 36 Winsor Rd, Sudbury, MA 01776

ANDERSON, Walter W. / systems auditor / *b:* 1934 / *ed:* BBA North Texas State Univ / *ent:* 1962 / *m-i:* A Sy / *t:* electronic data processing analyst / *org:* El Paso Natural Gas Co, PO Box 1492, El Paso, TX 79999 / *pb-h:* CDP / *h:* 10256 Luella, El Paso, TX 79925

ANDERSON, William M. / systems programmer / *b:* 1947 / *ed:* - / *ent:* 1967 / *m-i:* A P Sy / *t:* assistant data processing supervisor / *org:* Midway Platt Co, 2233 University, St Paul, MN 55104 / *pb-h:* - / *h:* 441 Lynnhurst W, St Paul, MN 55104

ANDRADE, Luciano P. / programmer / *b:* 1918 / *ed:* high school / *ent:* 1962 / *m-i:* P / *t:* senior computer programmer / *org:* HUD, Washington, DC 20410 / *pb-h:* - / *h:* 6419 Maplewood Dr, Falls Church, VA 22041

ANDREE, Richard V. / professor, author, lecturer, consultant / *b:* 1919 / *ed:* BS, Univ of Chicago, PhD, Univ of Wisconsin / *ent:* 1948 / *m-i:* A Ma P Sy; writing, information science / *t:* professor of math, research associate in computing science / *org:* Univ of Oklahoma, Norman, OK 73069 / *pb-h:* ACM, AEDS, ASL, DPMA, MAA, NCTM, SIAM lecturer, American Assn for the Advancement of Science, American Math Society, American Society for Engineering Education, Mu Alpha Theta, Pi Mu Epsilon, Sigma Xi, 3 fellowships, numerous committees, *Who's Who in America, World Who's Who,* editor, 12 books, 8 paperbacks, about 20 articles / *h:* 627 E Boyd, Norman, OK 73069

PEOPLE

THE MOST ESSENTIAL COMPONENTS IN COMPUTERS AND DATA PROCESSING

Who they are...
What they do...
Where they do it...

NOW YOU CAN STAY UP-TO-DATE ON "WHO'S WHO IN COMPUTERS AND DATA PROCESSING" . . .

Effective in April 1972, "Who's Who in Computers and Data Processing" was changed to an annual subscription basis as follows:

1. The latest Cumulative Edition (the 5th edition published 1971, containing over 15,000 capsule biographies, over 1,000 pages long, 3 volumes, hardbound) **PLUS**
2. At least 3 Updating Supplements per year, expected to total over 3,000 entries **PLUS**
3. An Inquiry Service: At your request we will obtain and report to you as a subscriber the capsule biography of any person in the computer field (if we can find his address and if he replies), to the extent of a dozen requests per year.

ALL for $49.50 per year in any year when a cumulative edition is supplied . . . and $22.00 per year in any year when a cumulative edition is not supplied.

BASED ON "Computers and Automation"'s continual data gathering from computer professionals

---

This reference will be particularly useful for:

Personnel managers
Libraries
Conference planners
Directors of computer installations
Suppliers to the computer industry
Executive search organizations
Prospective authors
Prospective speakers . . .

anyone who needs to keep up with the important people in the field.

Each computer professional has a capsule biography detailing: last name; first name and middle initial (if any); occupation; year of birth; university education and degrees; year entered the computer field; job title; organization and its address; publications, honors, and memberships; home address.

See sample page opposite.

We are confident that you will find the subscription will repay you many times over — one day when this wealth of material gives you the inside track with someone important to you, you'll find the information PRICELESS: the most essential component in EDP is GOOD PEOPLE.

RETURNABLE IN 10 DAYS
FOR FULL REFUND
(if not satisfactory)

-------- (may be copied on any piece of paper) --------

WHO'S WHO IN COMPUTERS AND DATA PROCESSING
815 Washington St., Newtonville, Mass. 02160

( ) YES, please enroll me as a subscriber to WHO'S WHO IN COMPUTERS AND DATA PROCESSING at the following rate:

( ) $49.50 including the last cumulative edition

OR

( ) $22.00 since I already have access to the last cumulative edition

I understand that in each 12 months: (a) I shall receive at least 3 updating supplements, expected to total over 3000 entries; and (b) that I can ask for and receive a dozen capsule biographies of specified computer persons (if the address can be found and if they respond).

RETURNABLE IN 10 DAYS
FOR FULL REFUND
(if not satisfactory)

Name ____________________

Title ____________________

Organization ____________________

Address ____________________

City ____________________ State & Zip ____________________

Your Signature ____________________ P.O. No. (if company order) ____________________

Vol. 21, No. 7
July, 1972

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, 12 issues per year, at 815 Washington St., Newtonville, Mass. 02160, by Berkeley Enterprises, Inc. Printed in U.S.A. Second Class Postage paid at Boston, Mass., and additional mailing points.

Subscription rates: United States, $9.50 for one year, $18.00 for two years. Canada: add 50 cents a year for postage; foreign, add $3.50 a year for postage.

NOTE: The above rates do not include our publication "The Computer Directory and Buyers' Guide"; see "Directory Notice" on the page stated in the Table of Contents. If you elect to receive "The Computer Directory and Buyers' Guide", please add $9.00 per year to your subscription rate.

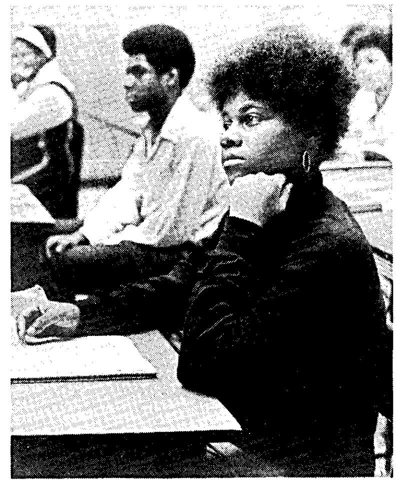
Please address all mail to: Berkeley Enterprises, Inc., 815 Washington St., Newtonville, Mass. 02160.

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.

computers and automation

The magazine of the design, applications, and implications of information processing systems – and the pursuit of truth in input, output, and processing.



Front Cover Picture

La Penseuse, "the thinker", is Catherine Taylor, a junior at Trenton High School; she is listening during an evening class in basic computer logic and programming given at the YMCA in Trenton. The class is intended for students interested in careers in the computer fields and is designed, organized, and taught by Chauncey Herring, an engineer at Western Electric Research Center, Princeton, N.J. See page 42.

NOTICE

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

Departments

Key

[A] – Article
[C] – Monthly Column
[E] – Editorial
[F] – Forum
[G] – The Golden Trumpet
[NT] – Not Technical
[R] – Reference Information
[T] – Technical

Common Sense, Wisdom, and Information Processing: The Notebook on Common Sense, Elementary and Advanced

Edmund C. Berkeley
Editor, Computers and Automation

1. A New and Important Subject

The engineering of wisdom —

The training and development of advanced common sense —

The systematic elimination of mistakes —

The application of advanced common sense to the computer field and many other fields —

A logical development and expansion of computing and data processing —

A subject that is probably more important than mathematics and which has been thoroughly neglected for more than 50 years —

A new and "glamorous" field with the opportunity to "get in on the ground floor" —

These are some of the properties of the subject which, starting a year ago, "Computers and Automation" began to report on in a new publication, "The C&A Notebook on Common Sense, Elementary and Advanced".

We promised at least 24 issues, newsletter style, for the first annual subscription. We have delivered 36 for good measure. For the titles, see Table 1 below.

2. Successful Project

Now a year later, we know that this project is a success. The Notebook has won — and continues to win — many enthusiastic subscribers. Here are a few of their comments:

Harold J. Coate, EDP Manager, St. Joseph, Mo.:
I believe these to be the best, if not the most important, reading that I have had this year.

William Taylor, Vice President, Calgary, Alberta:
Very good articles; something all managers should read.

Edward K. Nellis, Director of Systems Development, Pittsford, N.Y.:
As I am involved with systems work, I can always use one of the issues to prove a point or teach a lesson.

David Lichard, Data Processing Manager, Chicago:
Thoroughly enjoy each issue.

Richard Marsh, Washington, D.C.:
Keep it up. All are good and thought-provoking — which in itself is worthwhile.

Ralph C. Taylor, Manager of Research and Development, West Chester, Ohio:
Especially liked "Right Answers".

Jeffrey L. Rosen, Programmer, Toronto, Canada:
Your tendency to deal with practical applications is very rewarding.

The project began with an announcement in the April 1971 issue in the form of an editorial "The Most Important of All Branches of Knowledge". That editorial (updated) appears on the next page in case some readers have not previously read it.

3. Operational Definitions

One of the results of the investigation stimulated by producing the Notebook has been the proposing of an operational definition of common sense and wisdom (See Notebook Issue No. 24, "What is Common Sense? — An Operational Definition", and No. 36, "Wisdom — An Operational Definition").

An operational definition is one in which operations that can be performed (tests that can be made) are used in order to define a term. This kind of definition avoids the fallacy shown in "food is grub", "grub is chow", "chow is food". The fallacy of circular definition using synonyms is a common (and almost unavoidable) fault in most dictionaries.

4. An Operational Definition of Common Sense

Common sense behavior by an organism in regard to a problem implies that the organism: is observant and perceptive; shows initiative; demonstrates ordinary or common knowledge; displays intelligent behavior; modifies its behavior so as to adjust suitably to new factors; and effectively solves a large proportion of that kind of problem.

The behavior of a squirrel in regard to marauding a bird feeder often shows common sense — though his behavior in regard to finding buried nuts often shows a poor memory.

5. Future Issues

Among the next dozen issues are:

The Concept of Feedback and Feedback Control
Sixty Excuses for a Closed Mind
Benjamin Franklin, Scientist of Common Sense
Key Unlocking Information
The Evening Star and the Princess
Preventing Mistakes from Unforeseen Hazards

And we have a list of over 100 topics, that seem to us very significant, for covering in future issues.

We invite every reader of this brief report to try the Notebook. See the guaranteed "no-like-no-cost" offer on pages 8 and 9. We hope you will take advantage of the present offer. We expect that subscription rates may have to be increased.

The Most Important of All Branches of Knowledge

(Based on an editorial in *Computers and Automation*
published by Berkeley Enterprises Inc., 815 Washington St., Newtonville, Mass. 02160)

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

If so, we 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" or perhaps "wisdom".

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.

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" has published two articles "Common Sense, Wisdom, General Science, and Computers", which deal with this subject. For more than a dozen years, we have been studying this subject – ever since we 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 and great scientists, 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 modern public health practices – 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.

We 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 a series of notes in newsletter style called "The C&A Notebook on Common Sense, Elementary and Advanced".

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

Edmund C. Berkeley
Editor

QUESTIONS AND ANSWERS

about "The C&A Notebook on COMMON SENSE, ELEMENTARY AND ADVANCED"

INTERESTING: : Q: Is the Notebook interesting?

A: We think so — but you can judge for yourself. You can see the issues, and if not satisfactory, tell us to discontinue your subscription.

EXCITING: Q: Is the Notebook exciting?

A: Some of the issues, like "Falling 1800 Feet Down a Mountain" and "Doomsday in St. Pierre, Martinique", are among the most exciting true stories we know.

USEFUL: Q: Is the Notebook useful?

A: It ought to be useful to anybody — as useful as common sense. There exists no textbook on common sense; the Notebook tries to be a good beginning to common sense, science, and wisdom.

UNDERSTANDABLE: Q: Can I understand the Notebook?

A: Yes. It is nontechnical — written in everyday language and using vivid examples.

COVERAGE: Q: Do you cover in the Notebook all parts of common sense, wisdom, and science in general?

A: Yes, we plan to. The main subjects so far are: systematic prevention of mistakes; avoiding certain fallacies; important principles; important concepts; illustrative anecdotes, etc.

MISTAKES: Q: Will the Notebook save me from making important mistakes?

A: It ought to. One of the main purposes of the Notebook is preventing mistakes.

COST: Q: Will the Notebook be worth the cost to me?

A: At about 40 cents per issue (30 issues for $12), it is hard for you to lose out. EVEN ONE important mistake prevented, may save you much time, much trouble, and much money.

NUMBER OF ISSUES PER YEAR: Q: How many issues a year do you put out?

A: We promise 24 (newsletter style); we anticipate putting out at least 30 in each year.

PAST ISSUES: Q: I do not want to miss past issues. How do I get them?

A: Every subscriber's subscription starts at Vol. 1, no. 1. Every subscriber eventually receives all issues. Here is how it works. The past issues are sent him four at a time, every week or two, until he has caught up — and thus he does not miss important and interesting issues that never go out of date.

GUARANTEE: Q: If I do not like the Notebook, can I cancel at any time?

A: Yes. (1) You may return the first batch of issues we send you, for FULL REFUND, if not satisfactory. (2) Thereafter, you may cancel at any time, and you will receive a refund for the unmailed portion of your subscription. — We want only happy and satisfied subscribers.

TITLES: Q: What are the titles of the issues in the first annual subscription?

A: See the list in the next column.

TITLES — FIRST YEAR SUBSCRIPTION

1. Right Answers — A Short Guide to Obtaining Them
2. The Empty Column
3. The Golden Trumpets of Yap Yap
4. Strategy in Chess
5. The Barrels and the Elephant
6. The Argument of the Beard
7. The Elephant and the Grassy Hillside
8. Ground Rules for Arguments
9. False Premises, Valid Reasoning, and True Conclusions
10. The Investigation of Common Sense, Elementary and Advanced
11. Principles of General Science, and Proverbs
12. Common Sense — Questions for Consideration
13. Falling 1800 Feet Down a Mountain
14. The Cult of the Expert
15. Preventing Mistakes from Failure to Understand
16. The Stage of Maturity and Judgment in any Field of Knowledge and Experience
17. Doomsday in St. Pierre, Martinique — Common Sense vs. Catastrophe
18. The History of the Doasyoulikes
19. Individuality in Human Beings
20. How to be Silly
21. The Three Earthworms
22. The Cochrans vs. Catastrophe
23. Preventing Mistakes from Forgetting
24. What is Common Sense? — An Operational Definition
25. The Subject of "What is Generally True and Important": Common Sense Elementary and Advanced
26. Natural History, Patterns, and Common Sense
27. Rationalizing and Common Sense
28. Opposition to New Ideas
29. A Classification and Review of the Issues of Volume 1
30. Index to Volume 1 (first 30 issues)
31. Adding Years to Your Life Through Common Sense
32. The Number of Answers to a Problem
33. "Stupidity has a Knack of Getting Its Way"
34. Time, Sense, and Wisdom — Some Notes
35. Time, Sense, and Wisdom — Some Proverbs and Maxims
36. Wisdom — An Operational Definition

- - - (may be copied on any piece of paper) - - - - - - - - -

TO: Computers and Automation
815 Washington St., Newtonville, MA 02160

( ) YES, please enter my subscription to the Notebook, at $12 a year, 24 issues, newsletter style, and extras. Please send me issues 1 to 6 as FREE PREMIUMS for subscribing.

( ) I enclose ______ ( ) Please bill me.
( ) Please bill my organization.

Name____________________ Title____________

Organization______________________________

Address___________________________________

Signature_________________ Order No.________

The Shooting of Governor George C. Wallace, Candidate for President

On May 15, about 4:00 p.m., in Laurel, Md., Governor George C. Wallace of Alabama was shot. He was shot outdoors in a suburban shopping center, between a drive-in bank and a variety store, on his way to his car. At the time, he was escorted by a group of guards, and was shaking hands with persons greeting him in a crowd. He had just finished a campaign talk to about 1000 persons, where he had talked from a podium behind a transparent bullet-proof shield.

Most fortunately Governor Wallace, although shot many times, is at present writing recovering, except for the effect of a bullet lodged in or near his spine which so far is paralyzing his legs. So this event must be classified as an attempted assassination rather than a fulfilled one.

One suspect was immediately seized by bystanders and guards, and arrested by the police of Prince George's County, Maryland. His name is Arthur Herman Bremer; his last address was 2433 Michigan Ave., Milwaukee, Wisconsin; he is 21 years old. From February 15 to date he was unemployed.

A long summarizing article about him, written by Douglas E. Kneeland, and based on reporting by him and four more reporters, was printed in the *New York Times* of May 22; it contains much important information. Bremer was indicted on May 23 by Federal and county grand juries on 28 charges. No other person has yet been indicted.

Two crucial questions of course are:

- How should this event be classified – as the effort of a psychopathic criminal operating alone? or as the result of a conspiracy?
- How can assassination attempts and violent attacks on presidential candidates be prevented?

These questions are discussed at length in an article by Thomas Stamm and the Editor, in this issue, entitled "The Shooting of Presidential Candidate George C. Wallace: A Systems-Analysis Discussion" and including sections entitled:

- Questions
- The Number of Bullets, Guns, and Wounds
- The Expenses of the Suspect
- Cui Bono? (Who Profits?)
- Gun Control
- Systems Analysis Applied to the Protection of a Presidential Candidate

We hope that these and related questions will interest our readers. We invite additional data, discussion, and comment.

The United States must become a country where presidential candidates can live through their campaigning and live through their presidency without successful violent attacks upon them.

Edmund C. Berkeley

Edmund C. Berkeley
Editor

MANAGEMENT INFORMATION SYSTEMS:

The Trouble With Them

Colonel T. B. Mancinelli
U.S. Army
College of Naval Warfare
Naval War College
Newport, R.I. 02840

"Often the problems incident to the manual part and the automated part of a management information system are not even recognized, so that both parts go on their merry way uncoordinated."

During the past decade, in the business management arena, the popular phrase, "management information system(s) (MIS)", has become as common as mom's apple pie. For management writers it has become the sexy front cover often found on paperback fiction. If one wants to attract the notice of serious business readers, then including in the title some mention of management information systems, is a sure attention getter.

A Management Information System Jungle

Certainly there is no lack of scholarly writing on management information systems. Harold Koontz wrote of the "Management Theory Jungle"[1], and few would disagree that a "management information system theory jungle" has engulfed the business community. A visit to any well-stocked library and perusal through the card catalog will reveal hundreds of books and articles that deluge management with this fascinating and seemingly new topic. Most of these works are aimed at defining a MIS, telling how to design, to control, redesign, use, and misuse one. Also, there are some writings that adopt a negative approach, and, claiming that MIS do not exist, cannot be developed, are a utopia, and so on.

Why More on Management Information Systems?

If what has just been outlined is true, and few will disagree, then why this article on Management Information Systems?

During the past several years the author has, in two different positions, worked with a management information system in the U.S. Army. Few others can match this MIS in size and complexity. Actually, the Army doesn't call it an MIS, but by generally accepted definition, it is that. In Army terminology, it is called the Personnel Information System. Its purpose is to support, through the use of computers and automatic data processing, the management of Army personnel: their procurement; their individual training; their assignments; their use; and their eventual separation.

Since the Army's muster totals around a million personnel scattered to the four corners of the earth, the magnitude of the task is obvious. Add the fact that tens of thousands of personnel enter and leave the service each month, and tens of thousands of others are continually moving from one place to another, the magnitude and the complexity of the Army's Personnel Information System becomes staggering.

Based on some scholarly effort, considerable practical experience, and untold frustration, I have developed rather strong views and opinions concerning management information systems. Some of those views are set forth in this paper. They may be of some small value, I hope, to others grappling with the real-life problems of developing an effective MIS. The views set down here have been considerably influenced by actual experience in the Army's Personnel Information System. Nevertheless, it seems that some of these experiences reported and lessons learned are applicable to any management information system. In sum, these views are the practitioners' view rather than the conceptual or academic views so often found in today's literature.

What is a Management Information System?

Thus far the term "management information system" has been used at least a half dozen times and remains undefined. Taking the words literally, the definition of a MIS would be something like this:

> <u>Management</u>: Getting things done through other people.
>
> <u>Information</u>: That part of data of most value to the user.
>
> <u>System</u>: A group of inter-related parts making an irreducible whole.

Putting these ideas together with connectors, the definition of an MIS comes out like this:

> Getting things done through other people using that part of data of most value to the user so as to operate a group of inter-related parts making an irreducible whole.

Such a definition seems logical if not entirely clear. A better definition might be:

> A system that collects, processes, and provides management personnel with needed information for decision making that will result in the successful accomplishment of the organization's mission.

This latter definition is the one used in this article.

Even Moses Had One

Although the term, management information system, is somewhat new, in fact, management information systems have existed since the beginning of time. The Bible tells of the problems that Moses encountered in developing a MIS. Every organization in the past has had a MIS. All organizations in being today have one — and some have two or more. Although MIS are not new nor are their uses, yet there are some distinct differences between those of the present century and those of prior years. Four characteristics distinguish today's management information systems.

Enter the Computer

First and foremost, is the use of the computer and automatic data processing. Today, most large organizations have computers or some form of ADP. Increasingly, this is also true for smaller organizations. These so-called space-age marvels have been introduced into management information systems as a new tool — a new aid for helping management get their job done. It has always been necessary to collect and use data to operate organizations. Up until the computer age this was all done manually. Now management has a very efficient machine to help do this job. One might argue that the age-old definition of management now needs recasting to: "Getting things done through other people <u>and machines</u>".

Organizations Have Multiple MIS

Second, organizations that have introduced the computer have in reality at least <u>two</u> management information systems. There is the one that existed before the computer arrived — the manual MIS. Although it is probably true that the original MIS has been in part automated, yet some parts of the non-computer MIS still exist. Besides, there is the newly developed automated MIS, which has some parts of the old MIS and some new parts. No organization has yet developed a totally automated MIS, and in this century, there is little likelihood that any will. John Dearden of the Harvard Business School wrote of the "Myth of Real Time Management Information"[2], and it is a myth that any organization has a single integrated MIS. Large organizations may have a half dozen MIS, each with an automated and manual portion. Some of the problems inherent in this multiplicity of MIS are discussed below.

More and More Data Requirements

Third, organizations that have introduced the computer have developed an insatiable lust for more data. Invariably, the arrival of the computer in an organization triggers a new craze for more and more data. And all of this new data is needed in a more timely, accurate, and complete fashion. Functions and missions may not change but the claimed need for more data grows on and on. Functional managers insist that they must have more data and the data processors love this, for that enlarges the scope of their operations.

If one looks at the data available in an organization several years after the introduction of the computer, and compares it to what was available in the pre-computer days, the difference is almost always staggering. One wonders how the organization ever existed in the good old manual days.

Centralization is "In"

Fourth, and finally, present day MIS are characterized by increased decision-making at the top level. Decisions that were left to middle management and lower management in the pre-computer days are being moved to the "front office". Creeping centralization of the decision-making process is found in every large organization. It is found in the White House, in all governmental agencies, in the military, and in the business community. Likewise, the process of centralization is found more and more in our modern society in general. We are living in an age of centralization, like it or not. Centralization is "in" and decentralization is "out". Organizations appear to have no more chance of returning to the good old days of decentralization than there is a likelihood of returning to the horse and buggy.

What impact and what problems evolve from the aforementioned characteristics of present day management information systems? There are many. Here, only four of the more consequential will be touched on.

Incompatibility of Manual vs. Automated MIS

First, there is the problem of integration of the manual and automated elements of a MIS. Perhaps it is the lack of integration that is the perplexing problem. The larger and the more diversified the organization, the more difficult the issue becomes.

A MIS as a system has four inter-related parts: <u>Input</u>, <u>Processing</u>, <u>Output</u>, and <u>Storage</u>. When the computer is introduced into an organization, the parts of the MIS do not change, but their arrangement does. The parts in a manual MIS are arranged from Input, to Processing, to Use or Output, and finally to Storage. Not so for the automated part of the MIS. The arrangement is from Input to Storage to Processing and then to Ouput or Use.

This change in the arrangement of the elements of the MIS happens because when the computer is used, traditional methods for data processing are changed. Input is still collected as the first step, but then it is put into storage — into data banks, and then processed — by machine —, and then finally used. This incompatibility in the arrangement of the parts of the automated versus the manual elements of the MIS creates a number of organizational problems. The automated element, with few exceptions, is run by computer people — technicians, while the manual side is always in the hands of functional managers. What occurs is:

- duplicate and redundant data collection and processing;
- use of different criteria;
- lack of adequate communication;
- lack of coordination between the two parts, etc.

And this mentions but a few of the consequences. Frequently, there are disputes concerning credibility of information, with each side claiming to have the more accurate and complete data.

Timely, Accurate and Complete Data: The Biggest Problem

The number one problem in today's computer supported MIS is the lack of timeliness, accuracy, and completeness of data. Some may disagree with this assertion. However, based on painful experience, no other factor can have a more serious impact on achieving an effective MIS than an inability to obtain needed data that is sufficiently accurate, complete, and available in a timely way.

C.C. Weinmeister recently defined a successful MIS as "a system designed to provide operational management with accurate information upon which to make sound decisions that will result in the success of the endeavor".[3] The trouble with this definition is that it seeks to design a system that will provide accurate information. A computer system can be designed that will process accurate information, but it cannot be designed to provide only accurate information. True, there are numerous computer techniques for editing, checking, comparing, and testing for the validity of data, but as yet no one has designed the failsafe computer system that furnishes only accurate information on a timely basis. Data processors can design a highly efficient computer system that will, regrettably, also process inaccurate data just as efficiently as it processes accurate data.

To make the situation even worse, several factors work against data accuracy. Functional managers — the users — expect to be furnished the data they need in a timely and accurate fashion. They feel that the question of data accuracy, completeness, and timeliness is a technical problem to be solved by the data processors. On the other hand, the data processors see their job as computer systems designers and operators. Data accuracy is a management responsibility, say the data processors.

With management personnel demanding more and more data, this conflict is escalated, and in large organizations, it can lead to a continuing unmanageable crisis. The original claims for obtaining a computer were based on "how good things will be when the new system is operational". Thus, nowhere in the organization is the critical "data management" responsibility clearly assigned.

Nor are the people available needed to do the job. Just as man cannot live by bread alone, computer systems cannot provide accurate information by machines alone.

Changing Role of Middle Management

The third problem results from the creeping centralization found in present day management information systems. As an organization moves more of the decisions to the apex, the front office, the former middle management decision makers lose both authority and responsibility. No matter how much better the decisions may be, lower-level management personnel are anti-computer and anti-centralization. This is understandable for they are being stripped, slowly but inexorably, of their authority, responsibility, and former decision-making powers. What are they being given in return to compensate for their loss? Mainly, more requirements to collect and submit data to the new decision makers! Is it any wonder that middle and lower level management personnel show little enthusiasm for data accuracy, completeness, and timeliness? Especially in large organizations, middle and lower level management are being required, more and more, to operate strictly within the "system". There is little room left for individual initiative and the important role at this level is becoming more input oriented. This represents a most serious human problem to be overcome in highly centralized automated management information systems, and thus far no one has come up with many good answers.

Need for Information Managers

The fourth problem concerning present day automated management information systems is the lack of qualified "Information Managers". Some years ago one writer said, "Today (1958) an ability to make correct decisions most of the time on the basis of inadequate information is the mark of a good manager, even on the middle management level. In the future, the good middle management executive will be distinguished by his ability to utilize all of the data before making a decision, and then to make a decision in accordance with the dictates of the data."[4] The future is now — but who is training the manager to work under these new conditions? Unfortunately, too little training of real value in this area is available. Instead, everywhere there are executive training courses in computers and MIS that pay scant attention to the question of information management. Generally, these charm courses get all involved in technical hardware, software, and programming areas. Rather than telling executives how to manage a MIS, these courses teach him binary coded decimal notation, Boolean algebra, and FORTRAN. Often they send home executives enthusiastic for a "Real Time Management Information System". From the content of some of these courses, one can draw the conclusion that the computer people are trying to buffalo management into believing that computer technology is so complex that management had better let the data processors worry about a computer supported MIS.

No Easy Solutions

As is the case in many situations, it is much easier to define the problems than it is to offer concrete solutions. The answers to the problems cited in this article are not easy and not ready-made. Nonetheless, any executives that have an automated MIS must at least remove their heads from the sand and recognize these problems as a starting point. Often, the problems incident to the manual part and the automated part of a MIS are not even recognized, so that the both parts go on their merry way uncoordinated. Data accuracy is often treated as a minor and insignificant matter while the organization rushes to design and implement more complex computer systems — all using the same poor data. Many organizations are now going through the craze for sophisticated mathematical models, often overlooking the fact that the baseline data for such models is the same inaccurate data used in less sophisticated systems. Too little attention has been given to the issue of how middle and lower level management personnel can be motivated to provide timely, accurate, and complete data in the new era of centralization. Uppermost, there is the critical need for a new type of training in the science of information management. This needs to be training of management by management, training management by data processing personnel.

Available computer hardware and software has far outdistanced man's progress in the human aspects of developing effective management information systems. What is needed now is not fourth and fifth generation computers, but rather a new emphasis on the people part of MIS — a new emphasis on the second generation of management information systems. □

EDUCATION FOR DATA PROCESSING:

Yesterday, Today, Tomorrow

Thomas R. Tirney
Asst. Prof. of Economics and Business
University of Vermont
Burlington, Vt. 05401

"The colleges and the universities are in the best position of all formal education institutions to provide for the need of the community and the organization in this area."

Demand

The demand for qualified operators, programmers, systems analysts, and project leaders continues to be strong in a slow economy. Even though the number of advertised positions for these occupations decreased over the past year, the field of data processing still constitutes the highest percentage of jobs available — for confirmation, look in any large metropolitan newspaper. The future for careers in this area seems brighter than ever before.

It is my conclusion that qualified individuals now in the field and individuals qualifying themselves for careers in data processing will have unlimited opportunities.

This conclusion is based upon the following reasons:

1. Increased dependence on the EDP system to reduce inefficiencies within the organization

2. Development of new uses for the EDP system in order to increase productivity within the organization

3. Need for faster data communication in providing information for decision-making for top management down to the lowest management level

4. Acceptance of the computer by the computer-oriented manager in using the computer system as a tool in accomplishing his objectives

5. Rapid growth in the next few years in the number of organizations that will be computer-oriented and the number of computers in operation

6. Rapid growth of foreign nations in developing their inventory of computer installations and their sophistication in use of their computer system, coupled with the trend of many United States corporations to become multi-national in nature

The latter two trends, chiefly, will create a most impressive growth of opportunites in the field of data processing.

Number of Computers and Installations

One recent survey (*1) of general purpose computers estimated that there are 48,152 installations in the United States and 32,211 installations in foreign countries. In addition there are 13,879 unfilled orders. Thus a total of 80,363 installations in operation as of April 1, 1971, with a potential of 93,879 within 18 months (by the end of 1972). This assumes that, when the computers on order are delivered, these new systems will not release "used" computers to the secondary computer market. If this assumption is not valid (and there is no reason to expect it to be completely valid), then it is quite possible that by the end of 1972 there could be close to or over 100,000 general purpose computers in operation. This is in contrast to a projection made in 1966 (*2) that by 1975, 85,000 computers, both domestic and non-domestic, would be in operation. It seems that this forecast was met in early 1972. The number of variables that are involved in forecasting is vast, but if the trend continues, it is not inconceivable to have between 125,000 to 135,000 general purpose computers in operation by about 1975 to 1978.

This growth, plus the drive for more effective and efficient use of the computer system, will create a heavy demand for qualified individuals in the field of data processing. The demand is foreseeable, but the supply of qualified individuals is not. What will be done by the manufacturers, the educational institutions, and the users of the computers to try to meet the forecast needs? Before seeking to answer this question, it will be useful to put this question in perspective, as to what has been done and what is now being done.

A Dozen Years Ago

By 1959-60 the EDP Industry had grown to 6000+ computers in operation. This was in relation to 10 to 15 computer installations in 1949-50. The second generation computers were on line. The third generation computer was a blueprint on drawing boards. The career opportunities were unlimited. It was not uncommon that a "good" man could increase his annual salary $4,000 to $6,000 by job hopping. The job hop reminded many of the game of "musical chairs". In a survey conducted in 1959 (*3) in which 4,647 individuals working in systems responded, 47% of them changed jobs one or more times. The demand for operators, programmers, and systems analysts was far greater than the supply.

The basic premise that a programmer would be a coding clerk for the systems analyst was lost in the need to fill positions and to keep up with the work load. The programmer became an apprentice systems analyst. The programmers were in on the problem from the beginning: working with the "client", laying out the problem, designing input and output, constructing the flow-chart, coding the program, testing and debugging the program, and then finally creating the documentation for the operation of the program. Thus the programmer was a person who performed all the functions on a given program while the systems analyst was responsible for all the programs in a given system, while working on one of the programs himself. In practice it was hard to tell the difference between the two positions. Even in some companies the terms were interchangeable.

Pay and Qualifications

The average individual involved in systems work in this period was well paid ($12,000 median salary) (*3), highly educated (68% had at least an undergraduate degree) (*3), experienced (82% had four or more years of systems experience) (*3), and in the prime of his life (54% were under 40 years of age). The normal advice to college students was to pursue the career path that would lead to the EDP field. It was good advice, but the problem was how to prepare oneself when the wherewithal to do so was not available. At this time very few courses in data processing were being taught at the college level. And where courses were offered there was little or no opportunity to interact with the machine. If you were lucky and happened to hit on a "programming" course with computer time available, it was usually a first-generation computer. The lack of courses at formal education institutions was easily explained. If you were good enough to teach, then you were able to command a high salary for your talents in the work-a-day world. Thus how was one to "break" into the field of data processing?

The career path to a systems analyst was fairly simple. First, graduate from college with a degree in Accounting, Business Administration, or Mathematics. Then take a "programming aptitude test." If you passed that, you were on your way. After a few weeks of orientation and on-the-job training it was off to school again — but this time it was for only two, three, or four weeks — the computer manufacturer's type of school.

Instructors

The "instructors" for these courses were selected from the ranks of the manufacturer's personnel who had had experience in using that particular language. They were not educators, only experienced programmers. Thus in many, many cases they were unable to communicate to the students the fundamentals and complexities of the language. As these instructors acquired the experience in the "teaching role," they were usually transferred to another position in the company or they left for a better position. In addition, it was not uncommon to have two or three or more "instructors" during a two- or three-week course. Since the instructors were "technical experts" in a particular language and/or system, they were called into the field whenever a problem arose in their area of expertise.

These courses in programming language usually did not provide any machine time in which the student could "test" his new knowledge. Tests were administered, but in most cases these tests required retention and memorization rather than understanding. These students were "graduated" back to their organization as programmers.

It was fortunate that the qualifications of the future programmer were high. It was for this reason that most of the "graduates" from manufacturer's schools learned almost in spite of the course. But hold on, these courses were free. What did you expect for nothing? Yes, the courses were free, but the users of the computer paid the price for educating their programmers. The price was paid in wasted computer time, wasted production time, and inefficient programs.

Many recognized these problems, but I am sure their reply to the state of the education in the EDP field at this time would have been: "The industry is young. We are still learning. The educational process of the future will be better."

In 1969

By 1969 it seemed like the prophesy was coming true. A great many universities were now committed to provide education for students wishing to pursue careers in data processing. All across the nation computer schools had sprung up to provide instruction for future programmers. The manufacturers seemed to be setting up separate divisions for the EDP education process.

The opportunities were still available for individuals. The number of computers now in operation exceeded 40,000. Many third generation computers were on line with hundreds on order. The demand for EDP personnel far outnumbered the available supply. Job hopping was still a way of moving up the organization structure quicker but to a lesser degree than in 1959. Although the educational requirements were somewhat relaxed for entry into the EDP field (high school graduates passing the aptitude test), the median salary had increased to $16,000. There were also more younger (58% under 40 years of age) individuals working in this field. Thus the advice of pursuing a career in data processing still seemed valid.

There were 251 institutions of higher education offering majors in Data Processing and Computers, or Information Science *3). In addition there were many other universities planning or ready to implement a major degree in this field. The basic problem that all of these institutions faced was acquiring the qualified personnel to staff these programs. This need placed an additional burden on a market already short on qualified individuals.

The graduates of four-year programs might provide some relief to the high manpower demand — but this relief will not materialize for another two to five years and will be directed at positions above the programming level. The reasons are:

1. The demand for teachers at the university and college level is still high. The "cream of the graduating" classes will be influenced to pursue a graduate degree (MBA or Ph.D.) while teaching at the university level.

2. The graduates with majors in data processing will not accept jobs as programmers because in most cases they will have knowledge and experience far superior to individuals at this level. The positions which they would seek and expect would be at a higher level.

Commercial Computer Schools

Outside of the delay, the college programs seem to fit well with the developing education system, since computer schools supposedly would provide the programmers and operators that would be needed.

But an article in the Wall Street Journal by Dan Rottenberg entitled, "Many Computer Schools Charged With Offering A Useless Education" (*4), quickly deflated the value of computer schools for supplying manpower for these positions. Mr. Rottenberg points out cases of misrepresentation of the school's facilities to the student, the example of the unflunkable aptitude tests, the outright fraud by some schools, the financial failure of schools with the students left holding the bag, the poor facilities of sachools (many do not own a computer nor do they rent computer time for the students), and the poor qualifications of the instructors.

Mr. Epstein, of the Massachusetts Attorney General's office, stated that "Computer schools have become the latest version of the old shell game." "About 75% of [these] schools should be closed. The training they provide simply does not prepare their students for the kind of jobs that are available," commented Anton Myse, the coordinator of data processing for the U.S. General Services Administration in six midwestern states. As the final blow to the credibility of these schools, most firms will not give preference to computer school graduates even when it comes to filling the lowest level of computer operator aides.

Manufacturers Schools

This left the responsibility of providing manpower needs to the schools sponsored by the manufacturers of the computers. At this same time the manufacturers announced that these educational services were no longer free. Even though many users were upset over the additional cost, they envisioned a better educational effort by the manufacturers, thus providing better qualified "graduates."

The expectation of the users did not materialize. The manufacturers changed little if anything in providing education to users personnel, except in charging a fee. The quality of the "graduated" programmer did not get better; it got worse. No longer could the "students" learn in spite of the material because the educational background of the class was heterogenous.

Many companies were hiring high school graduates for program trainee positions. In a survey conducted in 1970 (*5) 62.5% of the responding companies indicated that their educational requirement for a program trainer was a high school degree. These courses thus became a two-way exchange between the instructor and a dominant sub-group and, in most cases, this sub-group was the college graduates. The result was that most of the students (the high school students) learned little.

The results were: a small number of college graduates majoring in data processing available for employment; almost unemployable graduates of the computer schools, and the deterioration of the education received in the manufacturer's school. So it seems that the educational aspects of the EDP profession have reached an all time low.

Now the retort from the majority of users had changed from "will be better" to "must be better."

Organization Within-House Instruction

The failure of external sources has required more and more companies to look within the organization for the resources to meet their educational needs in data processing. The 1970 survey (5) revealed that 33.8% of the organizations indicated that they had created in-house educational programs for data processing personnel. Of the 61.5% who are continuing to use outside sources, approximately half (30.1%) stated that this reliance would be temporary until they too were able to perform this function themselves. The remainder would use external resources as their primary source of education with on-the-job training as a supplement, because of the financial expenses incurred for an in-house training program.

Learner-Controlled Instruction

As the years roll by, the in-house training centers will evolve into the type of educational environment envisioned by Simon Ramo (6) in 1957:

> ... this [environment] has some special equipment. Each chair includes a special set of push buttons. ... A motion picture will provide the material for the student. He is asked questions about the material just presented, usually in the form of alternatives. Sometimes he is told that the concept will be repeated and the questions reasked. ... He may even be asked whether, in his opinion, he understood what was being presented.

This environment requires little human guidance or need for full-time instructors. The student will be able to progress at his own speed and to fit his education into his schedule at his discretion. The "expert" would be called upon only to clarify or to answer questions that develop from the presentation. The student will be able to review any or all sections of a course. The interaction between student and machine provides immediate feedback during the presentation of the material. The available film library will include courses for the operators, programmers, systems analysts, and other personnel in the organization. The approach can be used by a large group or a single individual.

Joint Training Centers

Some companies will combine their resources to provide for joint training centers. This center, in addition to providing for their need, would offer education to small organizations not in a financial position to create an in-house center, to social organizations such as hospitals and non-profit agencies, and to local and state government. The availability to social organizations and government may be on a cost basis, or as a tax credit, or without cost as a gesture of the organization's social responsibility.

The future function of the manufacturer's school will be primarily that of providing courses of special interest such as the unique aspects of their own systems. The computer programming schools, unless a new approach is taken, will fade out of existence.

College Courses

College and universities will step into this gap by providing certificate programs in data processing. The program will include courses in program languages, theory of computers, communication, mathematics and statistics, management, accounting, finance, information systems, and many, many hours on their second-generation and third-generation computers. The emphasis will be the integration of the computer into all phases of the program. The students will have access to qualified professional educators, excellent facilities, and will be in an atmosphere and environment conducive to learning. These programs will usually be offered at night and be designed to be completed within two years, if the student attends classes for two nights a week.

The two-year part-time college programs will open the door quickly to individuals interested in data processing careers. The in-house training programs will provide the need for personnel to update their skill and to further their knowledge in order to progress along their career paths.

The four-year college program will fulfill the supply for personnel at the systems level and executive level.

Cost and Timetable

In answering the question "What is being done by manufacturers, educational institutions, and users of computers to meet the need for qualified personnel in data processing?" other questions are generated. These questions deal with cost and the timetable for realizing these predictions.

Simon Ramo recognizes that his system would be an "enormously expensive operation." One course would not involve one or two hours of film, but ten to fifteen hours. He stated that, "if we pay something like fifty cents an hour to see an ordinary motion picture, then [say] a trigonometry course would cost thousands of dollars per student" (*6). In 1957 this may have been true. But with today's advances in method and technology and the use of video tape the cost is no longer a prohibitive factor. Although the cost to implement this concept in a school system would run into millions of dollars for equipment and software programs, the cost for a specific course, say FORTRAN V Programming language, is well within the budget of the majority of today's organizations. In fact there exist many video tape courses in the field of data processing but without the concept of interaction.

The machine of which Simon Ramo spoke is no longer a concept of the future. It is here today — responsive television. During 1972 this machine and accompanying software programs on various data processing subjects will be available through membership in a data processing education network.

Certificates in Data Processing

So far little effort has been made by universities and colleges in providing certificate programs in data processing. But universities and colleges all across the nation are re-evaluating their relation and purpose to the community and the organizations which are the employers of their products. Members of the community need direction and education in order to pursue a worthwhile career. The education that the majority of individuals require is below a college degree. But organizations need skilled and educated personnel. With the expert professional educator and their computer facilities, the universities are in the best position of all formal education institutions to provide for the need of both the community and the organization in this area. A beginning has been made at some universities. For example, Temple University in Philadelphia, Pennsylvania, has a Certificate Program in Data Processing. At last report (Spring 1971) this two-year night program had 75 to 100 students enrolled.

Thus the ingredients for tomorrow's education are here today. The growth, expansion, and effectiveness of these ingredients to meet the needs for qualified data processing personnel will depend upon the foresight and ingenuity of educators, organizational executives, and data processing professionals. □

References

(1) "EDP Industry Report," April 1, 1971; by International Data Corporation, Newtonville, Mass.

(2) "The State of the Information Processing Industry," Datamation Data Sheet, 1966.

(3) "Profile of a Systems Man," Association for Systems Management, 1970, Cleveland, Ohio.

(4) Rottenberg, Dan, "Many Computer Schools Charged With Offering a Useless Education," in Wall Street Journal, June 10, 1970.

(5) The results of a survey conducted in a large metropolitan area in the summer of 1970 by University Affiliates, a consulting firm; 227 companies responded to a mail questionnaire pertaining to equipment, training, and recruitment.

(6) Ramo, Simon, "A New Technique of Education," in "Engineering and Science Monthly," Vol. 21, October, 1957.

The Impact of the Computer on Society – Some Comments

Joseph Weizenbaum
Prof. of Computer Science
Mass. Institute of Technology
Cambridge, Mass. 02139

"The computer industry . . . is rather like an island economy in which the natives make a living by taking in each other's laundry."

The structure of the typical essay on "The impact of computers on society" is as follows: First there is an "on the one hand" statement. It tells all the good things computers have already done for society and often even attempts to argue that the social order would already have collapsed were it not for the "computer revolution." This is usually followed by an "on the other hand" caution which tells of certain problems the introduction of computers brings in its wake. The threat posed to individual privacy by large data banks and the danger of large-scale unemployment induced by industrial automation are usually mentioned. Finally, the glorious present and prospective achievements of the computer are applauded, while the dangers alluded to in the second part are shown to be capable of being alleviated by sophisticated technological fixes. The closing paragraph consists of a plea for generous societal support for more, and more large-scale, computer research and development. This is usually coupled to the more or less subtle assertion that only computer science, hence only the computer scientist, can guard the world against the admittedly hazardous fallout of applied computer technology.

In fact, the computer has had very considerably less societal impact than the mass media would lead us to believe. Certainly, there are enterprises like space travel that could not have been undertaken without computers. Certainly the computer industry, and with it the computer education industry, has grown to enormous proportions. But much of the industry is self-serving. It is rather like an island economy in which the natives make a living by taking in each other's laundry. The part that is not self-serving is largely supported by government agencies and other gigantic enterprises that know the value of everything but the price of nothing, that is, that know the short-range utility of computer systems but have no idea of their ultimate social cost. In any case, airline reservation systems and computerized hospitals serve only a tiny, largely the most affluent, fraction of society. Such things cannot be said to have an impact on society generally.

(Reprinted with permission from the author and from *Science*, Volume 176, No. 4035, 12 May 1972, published by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005)

Side Effects of Technology

The more important reason that I dismiss the argument which I have caricatured is that the direct societal effects of any pervasive new technology are as nothing compared to its much more subtle and ultimately much more important side effects. In that sense, the societal impact of the computer has not yet been felt.

To help firmly fix the idea of the importance of subtle indirect effects of technology, consider the impact on society of the invention of the microscope. When it was invented in the middle of the 17th century, the dominant commonsense theory of disease was fundamentally that disease was a punishment visited upon an individual by God. The sinner's body was thought to be inhabited by various so-called humors brought into disequilibrium in accordance with divine justice. The cure for disease was therefore to be found first in penance and second in the balancing of humors as, for example, by bleeding. Bleeding was, after all, both painful, hence punishment and penance, and potentially balancing in that it actually removed substance from the body. The microscope enabled man to see microorganisms and thus paved the way for the germ theory of disease. The enormously surprising discovery of extremely small living organisms also induced the idea of a continuous chain of life which, in turn, was a necessary intellectual precondition for the emergence of Darwinism. Both the germ theory of disease and the theory of evolution profoundly altered man's conception of his contract with God and consequently his self-image. Politically these ideas served to help diminish the power of the Church and, more generally, to legitimize the questioning of the basis of hitherto unchallenged authority. I do not say that the microscope alone was responsible for the enormous social changes that followed its invention. Only that it made possible the kind of paradigm shift, even on the commonsense level, without which these changes might have been impossible.

Is it reasonable to ask whether the computer will induce similar changes in man's image of himself and whether that influence will prove to be its most important effect on society? I think so, although I hasten to add that I don't believe the computer has yet told us much about man and his nature. To come to grips with the question, we must first ask in what way the computer is different from man's many other machines. Man has built two fundamentally different kinds of machines, nonautonomous and autonomous. An autonomous machine is one that operates for long periods of time, not on the basis of inputs from the real world, for example from sensors or from human drivers, but on the basis of internalized models of some aspect of the real world. Clocks are examples of autonomous machines in that they operate on the basis of an internalized model of the planetary system. The computer is, of course, the example par excellence. It is able to internalize models of essentially unlimited complexity and of a fidelity limited only by the genius of man.

It is the autonomy of the computer we value. When, for example, we speak of the power of computers as increasing with each new hardware and software development, we mean that, because of their increasing speed and storage capacity, and possibly thanks to new programming tricks, the new computers can internalize ever more complex and ever more faithful models of ever larger slices of reality. It seems strange then that, just when we exhibit virtually an idolatry of autonomy with respect to machines, serious thinkers in respected academies [I have in mind B. F. Skinner of Harvard University (*1*)] can rise to question autonomy as a fact for man. I do not think that the appearance of this paradox at this time is accidental. To understand it, we must realize that man's commitment to science has always had a masochistic component.

Time after time science has led us to insights that, at least when seen superficially, diminish man. Thus Galileo removed man from the center of the universe, Darwin removed him from his place separate from the animals, and Freud showed his rationality to be an illusion. Yet man pushes his inquiries further and deeper. I cannot help but think that there is an analogy between man's pursuit of scientific knowledge and an individual's commitment to psychoanalytic therapy. Both are undertaken in the full realization that what the inquirer may find may well damage his self-esteem. Both may reflect his determination to find meaning in his existence through struggle in truth, however painful that may be, rather than to live without meaning in a world of ill-disguised illusion. However, I am also aware that sometimes people enter psychoanalysis unwilling to put their illusions at risk, not searching for a deeper reality but in order to convert the insights they hope to gain to personal power. The analogy to man's pursuit of science does not break down with that observation.

Each time a scientific discovery shatters a hitherto fundamental cornerstone of the edifice on which man's self-esteem is built, there is an enormous reaction, just as is the case under similar circumstances in psychoanalytic therapy. Powerful defense mechanisms, beginning with denial and usually terminating in rationalization, are brought to bear. Indeed, the psychoanalyst suspects that, when a patient appears to accept a soul-shattering insight without resistance, his very casualness may well mask his refusal to allow that insight truly operational status in his self-image. But what is the psychoanalyst to think about the patient who positively embraces tentatively proffered, profoundly humiliating self-knowledge, when he embraces it and instantly converts it to a new foundation of his life? Surely such an event is symptomatic of a major crisis in the mental life of the patient.

I believe we are now at the beginning of just such a crisis in the mental life of our civilization. The microscope, I have argued, brought in its train a revision of man's image of himself. But no one in the mid-17th century could have foreseen that. The possibility that the computer will, one way or another, demonstrate that, in the inimitable phrase of one of my esteemed colleagues, "the brain is merely a meat machine" is one that engages academicians, industrialists, and journalists in the here and now. How has the computer contributed to bringing about this very sad state of affairs? It must be said right away that the computer alone is not the chief causative agent. It is merely an extreme extrapolation of technology. When seen as an inducer of philosophical dogma, it is merely the reductio ad absurdum of a technological ideology. But how does it come to be regarded as a source of philosophic dogma?

Theory versus Performance

We must be clear about the fact that a computer is nothing without a program. A program is fundamentally a transformation of one computer into another that has autonomy and that, in a very real sense, behaves. Programming languages describe dynamic processes. And, most importantly, the processes they describe can be actually carried out. Thus we can build models of any aspect of the real world that interests us and that we understand. And we can make our models work. But we must be careful to remember that a computer model is a description that works. Ordinarily, when we speak of A being a model of B, we mean that a theory about some aspects of the behavior of B is also a theory of the same aspects of the behavior of A. It follows that when, for example, we consider a computer model of paranoia, like that published by Colby *et al.* (*2*), we must not be persuaded that it tells us anything about paranoia on the grounds that it, in some sense, mirrors the behavior of a paranoiac. After all, a plain typewriter in some sense mirrors the behavior of an autistic child (one types a question and gets no response whatever), but it does not help us to understand autism. A model must be made to stand or fall on the basis of its theory. Thus, while programming languages may have put a new power in the hands of social scientists in that this new notation may have freed them from the vagueness of discursive descriptions, their obligation to build defensible theories is in no way diminished. Even errors can be pronounced with utmost formality and eloquence. But they are not thereby transmuted to truth.

The failure to make distinctions between descriptions, even those that "work," and theories accounts in large part for the fact that those who refuse to accept the view of man as machine have been put on the defensive. Recent advances in computer understanding of natural language offer an excellent case in point. Halle and Chomsky, to mention only the two with whom I am most familiar, have long labored on a theory of language which any model of language behavior must satisfy (*3*). Their aim is like that of the physicist who writes a set of differential equations that anyone riding a bicycle must satisfy. No physicist claims that a person need know, let alone be able to solve, such differential equations in order to become a competent cyclist. Neither do Halle and Chomsky claim that humans know or knowingly obey the rules they believe to govern language behavior. Halle and Chomsky also strive, as do physical theorists, to identify the constants and parameters of their theories with components of reality. They hypothesize that their rules constitute a kind of projective description of certain aspects of the structure of the human mind. Their problem is thus not merely to discover economical rules to account for language behavior, but also to infer economic mechanisms which determine that precisely those rules are to be preferred over all others. Since they are in this way forced to attend to the human mind, not only that of speakers of English, they must necessarily be concerned with all human language behavior—not just that related to the understanding of English.

The enormous scope of their task is illustrated by their observation that in all human languages declarative sentences are often transformed into questions by a permutation of two of their words. (John is here → Is John here?) It is one thing to describe rules that transform declarative sentences into questions—a simple permutation rule is clearly insufficient—but another thing to describe a "machine" that necessitates those rules when others would, all else being equal, be simpler. Why, for example, is it not so that declarative sentences read backward transform those sentences into questions? The answer must be that other constraints on the "machine" combine against this local simplicity in favor of a more nearly global economy. Such examples illustrate the depth of the level of explanation that Halle and Chomsky are trying to achieve. No wonder that they stand in awe of their subject matter.

Workers in computer comprehension of natural language operate in what is usually called performance mode. It is as if they are building machines that can ride bicycles by following heuristics like "if you feel a displacement to the left, move your weight to the left." There can be, and often is, a strong interaction between the development of theory and the empirical task of engineering systems whose theory is not yet thoroughly understood. Witness the synergistic cooperation between aerodynamics and aircraft design in the first quarter of the present century. Still, what counts in performance mode is not the elaboration of theory but the performance of systems. And the systems being hammered together by the new crop of computer semanticists are beginning (just beginning) to perform.

Since computer scientists have recognized the importance of the interplay of syntax, semantics, and pragmatics, and with it the importance of computer-manipulable knowledge, they have made progress. Perhaps by the end of the present decade, computer systems will exist with which specialists, such as physicians and chemists and mathematicians, will converse in natural language. And surely some part of such achievements will have been based on other successes in, for example, computer simulation of cognitive processes. It is understandable that any success in this area, even if won empirically and without accompanying enrichments of theory, can easily lead to certain delusions being planted. Is it, after all, not terribly tempting to believe that a computer that understands natural language at all, however narrow the context, has captured something of the essence of man? Descartes himself might have believed it. Indeed, by way of this very understandable seduction, the computer comes to be a source of philosophical dogma.

I am tempted to recite how performance programs are composed and how things that don't work quite correctly are made to work via all sorts of strategems which do not even pretend to have any theoretical foundation. But the very asking of the question, "Has the computer captured the essence of man?" is a diversion and, in that sense, a trap. For the real question "Does man understand the essence of man?" cannot be answered by technology and hence certainly not by any technological instrument.

The Technological Metaphor

I asked earlier what the psychoanalyst is to think when a patient grasps a tentatively proffered deeply humiliating interpretation and attempts to convert it immediately to a new foundation of his life. I now think I phrased that question too weakly. What if the psychoanalyst merely coughed and the cough entrained the consequences of which I speak? That is our situation today. Computer science, particularly its artificial intelligence branch, has coughed. Perhaps the press has unduly amplified that cough—but it is only a cough nevertheless. I cannot help but think that the eagerness to believe that man's whole nature has suddenly been exposed by that cough, and that it has been shown to be a clockwork, is a symptom of something terribly wrong.

What is wrong, I think, is that we have permitted technological metaphors, what Mumford (*4*) calls the "Myth of the Machine," and technique itself to so thoroughly pervade our thought processes that we have finally abdicated to technology the very duty to formulate questions. Thus sensible men correctly perceive that large data banks and enormous networks of computers threaten man. But they leave it to technology to formulate the corresponding question. Where a simple man might ask: "Do we need these things?", technology asks "what electronic wizardry will make them safe?" Where a simple man will ask "is it good?", technology asks "will it work?" Thus science, even wisdom, becomes what technology and most of all computers can handle. Lest this be thought to be an exaggeration, I quote from the work of H. A. Simon, one of the most senior of American computer scientists (*5*):

> As we succeed in broadening and deepening our knowledge—theoretical and empirical—about computers, we shall discover that in large part their behavior is governed by simple general laws, that what appeared as complexity in the computer program was, to a considerable extent, complexity of the environment to which the program was seeking to adapt its behavior.
>
> To the extent that this prospect can be realized, it opens up an exceedingly important role for computer simulation as a tool for achieving a deeper understanding of human behavior. For if it is the organization of components, and not their physical properties, that largely determines behavior, and if computers are organized somewhat in the image of man, then the computer becomes an obvious device for exploring the consequences of alternative organizational assumptions for human behavior.

and

> A man, viewed as a behaving system, is quite simple. The apparent complexity of his behavior over time is largely a reflection of the complexity of the environment in which he finds himself.
>
> . . . I believe that this hypothesis holds even for the whole man.

We already know that those aspects of the behavior of computers which cannot be attributed to the complexity of their programs is governed by simple general laws—ultimately by the laws of Boolean algebra. And of course the physical properties of the computer's components are nearly irrelevant to its behavior. Mechanical relays are logically equivalent to tubes and to transistors and to artificial neurons. And of course the complexity of computer programs is due to the complexity of the environments, including the computing environments themselves, with which they were designed to deal. To what else could it possibly be due? So, what Simon sees as prospective is already realized. But does this collection of obvious and simple facts lead to the conclusion that man is as simple as are computers? When Simon leaps to that conclusion and then formulates the issue as he has done here, that is, when he suggests that the behavior of *the whole man* may be understood in terms of the behavior of computers as governed by simple general laws, then the very possibility of understanding man as an autonomous being, as an individual with deeply internalized values, that very possibility is excluded. How does one insult a machine?

The question "Is the brain merely a meat machine?", which Simon puts in a so much more sophisticated form, is typical of the kind of question formulated by, indeed formulatable only by, a technological mentality. Once it is accepted as legitimate, arguments as to what a computer can or cannot do "in principle" begin to rage and themselves become legitimate. But the legitimacy of the technological question—for example, is human behavior to be understood either in terms of the organization or of the physical properties of "components"—need not be admitted in the first instance. A human question can be asked instead. Indeed, we might begin bv asking what has already become of "the whole man" when he can conceive of computers organized in his own image.

The success of technique and of some technological explanations has, as I've suggested, tricked us into permitting technology to formulate important questions for us—questions whose very forms severely diminish the number of degrees of freedom in our range of decision-making. Whoever dictates the questions in large part determines the answers. In that sense, technology, and especially computer technology, has become a self-fulfilling nightmare reminiscent of that of the lady who dreams of being raped and begs her attacker to be kind to her. He answers "it's your dream, lady." We must come to see that technology is our dream and that we must ultimately decide how it is to end.

I have suggested that the computer revolution need not and ought not to call man's dignity and autonomy into question, that it is a kind of pathology that moves men to wring from it unwarranted, enormously damaging interpretations. Is then the computer less threatening that we might have thought? Once we realize that our visions, possibly nightmarish visions, determine the effect of our own creations on us and on our society, their threat to us is surely diminished. But that is not to say that this realization alone will wipe out all danger. For example, apart from the erosive effect of a technological mentality on man's self-image, there are practical attacks on the freedom and dignity of man in which computer technology plays a critical role.

I mentioned earlier that computer science has come to recognize the importance of building knowledge into machines. We already have a machine —Dendral—(*6*) that commands more chemistry than do many Ph.D. chemists, and another—Mathlab—(*7*) that commands more applied mathematics than do many applied mathematicians. Both Dendral and Mathlab contain knowledge that can be evaluated in terms of the explicit theories from which it was derived. If the user believes that a result Mathlab delivers is wrong, then, apart from possible program errors, he must be in disagreement, not with the machine or its programmer, but with a specific mathematical theory. But what about the many programs on which management, most particularly the government and the military, rely, programs which can in no sense be said to rest on explicable theories but are instead enormous patchworks of programming techniques strung together to make them work?

Incomprehensible Systems

In our eagerness to exploit every advance in technique we quickly incorporate the lessons learned from machine manipulation of knowledge in theory-based systems into such patchworks. They then "work" better. I have in mind systems like target selection systems used in Vietnam and war games used in the Pentagon, and so on. These often gigantic systems are put together by teams of programmers, often working over a time span of many years. But by the time the systems come into use, most of the original programmers have left or turned their attention to other pursuits. It is precisely when gigantic systems begin to be used that their inner workings can no longer be understood by any single person or by a small team of individuals. Norbert Wiener, the father of cybernetics, foretold this phenomenon in a remarkably prescient article (*8*) published more than a decade ago. He said there:

> It may well be that in principle we cannot make any machine the elements of whose behavior we cannot comprehend sooner or later. This does not mean in any way that we shall be able to comprehend these elements in substantially less

time than the time required for operation of the machine, or even within any given number of years or generations.

An intelligent understanding of [machines'] mode of performance may be delayed until long after the task which they have been set has been completed. This means that though machines are theoretically subject to human criticism, such criticism may be ineffective until long after it is relevant.

This situation, which is now upon us, has two consequences: first that decisions are made on the basis of rules and criteria no one knows explicitly, and second that the system of rules and criteria becomes immune to change. This is so because, in the absence of detailed understanding of the inner workings of a system, any substantial modification is very likely to render the system altogether inoperable. The threshold of complexity beyond which this phenomenon occurs has already been crossed by many existing systems, including some compiling and computer operating systems. For example, no one likes the operating systems for certain large computers, but they cannot be substantially changed nor can they be done away with. Too many people have become dependent on them.

An awkward operating system is inconvenient. That is not too bad. But the growing reliance on supersystems that were perhaps designed to help people make analyses and decisions, but which have since surpassed the understanding of their users while at the same time becoming indispensable to them, is another matter. In modern war it is common for the soldier, say the bomber pilot, to operate at an enormous psychological distance from his victims. He is not responsible for burned children because he never sees their village, his bombs, and certainly not the flaming children themselves. Modern technological rationalizations of war, diplomacy, politics, and commerce such as computer games have an even more insidious effect on the making of policy. Not only have policy makers abdicated their decision-making responsibility to a technology they don't understand, all the while maintaining the illusion that they, the policy makers, are formulating policy questions and answering them, but responsibility has altogether evaporated. No human is any longer responsible for "what the machine says." Thus there can be neither right nor wrong, no question of justice, no theory with which one can agree or disagree, and finally no basis on which one can challenge "what the machine says." My father used to invoke the ultimate authority by saying to me, "it is written." But then I could read what was written, imagine a human author, infer his values, and finally agree or disagree. The systems in the Pentagon, and their counterparts elsewhere in our culture, have in a very real sense no authors. They therefore do not admit of exercises of imagination that may ultimately lead to human judgment. No wonder that men who live day in and out with such machines and become dependent on them begin to believe that men are merely machines. They are reflecting what they themselves have become.

The potentially tragic impact on society that may ensue from the use of systems such as I have just discussed is greater than might at first be imagined. Again it is side effects, not direct effects, that matter most. First, of course, there is the psychological impact on individuals living in a society in which anonymous, hence irresponsible, forces formulate the large questions of the day and circumscribe the range of possible answers. It cannot be surprising that large numbers of perceptive individuals living in such a society experience a kind of impotence and fall victim to the mindless rage that often accompanies such experiences. But even worse, since computer-based knowledge systems become essentially unmodifiable except in that they can grow, and since they induce dependence and cannot, after a certain threshold is crossed, be abandoned, there is an enormous risk that they will be passed from one generation to another, always growing. Man too passes knowledge from one generation to another. But because man is mortal, his transmission of knowledge over the generations is at once a process of filtering and accrual. Man doesn't merely pass knowledge, he rather regenerates it continuously. Much as we may mourn the crumbling of ancient civilizations, we know nevertheless that the glory of man resides as much in the evolution of his cultures as in that of his brain. The unwise use of ever larger and ever more complex computer systems may well bring this process to a halt. It could well replace the ebb and flow of culture with a world without values, a world in which what counts for a fact has long ago been determined and forever fixed.

Positive Effects

I've spoken of some potentially dangerous effects of present computing trends. Is there nothing positive to be said? Yes, but it must be said with caution. Again, side effects are more important than direct effects. In particular, the idea of computation and of programming languages is beginning to become an important metaphor which, in the long run, may well prove to be responsible for paradigm shifts in many fields. Most of the commonsense paradigms in terms of which much of mankind interprets the phenomena of the everyday world, both physical and social, are still deeply rooted in fundamentally mechanistic metaphors. Marx's dynamics as well as those of Freud are, for example, basically equilibrium systems. Any hydrodynamicist could come to understand them without leaving the jargon of his field. Languages capable of describing ongoing processes, particularly in terms of modular subprocesses, have already had an enormous effect on the way computer people think of every aspect of their worlds, not merely those directly related to their work. The information-processing view of the world so engendered qualifies as a genuine metaphor. This is attested to by the fact that it (i) constitutes an intellectual framework that permits new questions to be asked about a wide-ranging set of phenomena, and (ii) that it itself provides criteria for the adequacy of proffered answers. A new metaphor is important not in that it may be better than existing ones, but rather in that it may enlarge man's vision by giving him yet another perspective on his world. Indeed, the very effectiveness of a new metaphor may seduce lazy minds to adopt it as a basis for universal explanations and as a source of panaceas. Computer simulation of social processes has already been advanced by single-minded generalists as leading to general solutions of all of mankind's problems.

The metaphors given us by religion, the poets, and by thinkers like Darwin, Newton, Freud, and Einstein have rather quickly penetrated to the language of ordinary people. These metaphors have thus been instrumental in shaping our entire civilization's imaginative reconstruction of our world. The computing metaphor is as yet available to only an extremely small set of people. Its acquisition and internalization, hopefully as only one of many ways to see the world, seems to require experience in program composition, a kind of computing literacy. Perhaps such literacy will become very widespread in the advanced societal sectors of the advanced countries. But, should it become a dominant mode of thinking and be restricted to certain social classes, it will prove not merely repressive in the ordinary sense, but an enormously divisive societal force. For then classes which do and do not have access to the metaphor will, in an important sense, lose their ability to communicate with one another. We know already how difficult it is for the poor and the oppressed to communicate with the rest of the society in which they are embedded. We know how difficult it is for the world of science to communicate with that of the arts and of the humanities. In both instances the communication difficulties, which have grave consequences, are very largely due to the fact that the respective communities have unsharable experiences out of which unsharable metaphors have grown.

Responsibility

Given these dismal possibilities, what is the responsibility of the computer scientist? First I should say that most of the harm computers can potentially entrain is much more a function of properties people attribute to computers than of what a computer can or cannot actually be made to do. The nonprofessional has little choice but to make his attributions of properties to computers on the basis of the propaganda emanating from the computer community and amplified by the press. The computer professional therefore has an enormously important responsibility to be modest in his claims. This advice would not even have to be voiced if computer science had a tradition of scholarship and of self-criticism such as that which characterizes the established sciences. The mature scientist stands in awe before the depth of his subject matter. His very humility is the wellspring of his strength. I regard the instilling of just this kind of humility, chiefly by the example set by teachers, to be one of the most important missions of every university department of computer science.

The computer scientist must be aware constantly that his instruments are capable of having gigantic direct and indirect amplifying effects. An error in a program, for example, could have grievous direct results, including most certainly the loss of much human life. On 11 September 1971, to cite just one example, a computer programming error caused the simultaneous destruction of 117 high-altitude weather balloons whose instruments were being monitored by an earth satellite (*9*). A similar error in a military command and control system could launch a fleet of nuclear tipped missiles. Only censorship prevents us from knowing how many such events involving nonnuclear weapons have already occurred. Clearly then, the computer scientist has a heavy responsibility to make the fallibility and limitations of the systems he is capable of designing brilliantly clear. The very power of his systems should serve to inhibit the advice he is ready to give and to constrain the range of work he is willing to undertake.

Of course, the computer scientist, like everyone else, is responsible for his actions and their consequences. Sometimes that responsibility is hard to accept because the corresponding authority to decide what is and what is not to be done appears to rest with distant and anonymous forces. That technology itself determines what is to be done by a process of extrapolation and that individuals are powerless to intervene in that determination is precisely the kind of self-fulfilling dream from which we must awaken.

Consider gigantic computer systems. They are, of course, natural extrapolations of the large systems we already have. Computer networks are another point on the same curve extrapolated once more. One may ask whether such systems can be used by anybody except by governments and very large corporations and whether such organizations will not use them mainly for antihuman purposes. Or consider speech recognition systems. Will they not be used primarily to spy on private communications? To answer such questions by saying that big computer systems, computer networks, and speech recognition systems are inevitable is to surrender one's humanity. For such an answer must be based either on one's profound conviction that society has already lost control over its technology or on the thoroughly immoral position that "if I don't do it, someone else will."

I don't say that systems such as I have mentioned are necessarily evil—only that they may be and, what is most important, that their inevitability cannot be accepted by individuals claiming autonomy, freedom, and dignity. The individual computer scientist can and must decide. The determination of what the impact of computers on society is to be is, at least in part, in his hands.

Finally, the fundamental question the computer scientist must ask himself is the one that every scientist, indeed every human, must ask. It is not "what shall I do?" but rather "what shall I be?" I cannot answer that for anyone save myself. But I will say again that if technology is a nightmare that appears to have its own inevitable logic, it is our nightmare. It is possible, given courage and insight, for man to deny technology the prerogative to formulate man's questions. It is possible to ask human questions and to find humane answers. □

References and Notes

1. B. F. Skinner, *Beyond Freedom and Dignity* (Knopf, New York, 1971).
2. K. M. Colby, S. Weber, F. D. Hilf, *Artif. Intell.* **1**, 1 (1971).
3. N. Chomsky, *Aspects of the Theory of Syntax* (M.I.T. Press, Cambridge, Mass., 1965); ——— and M. Halle, *The Sound Pattern of English* (Harper & Row, New York, 1968).
4. L. Mumford, *The Pentagon of Power* (Harcourt, Brace, Jovanovich, New York, 1970).
5. H. A. Simon, *The Sciences of the Artificial* (M.I.T. Press, Cambridge, Mass., 1969), pp. 22–25.
6. B. Buchanan, G. Sutherland, E. A. Feigenbaum, in *Machine Intelligence*, B. Meltzer, Ed. (American Elsevier, New York, 1969).
7. W. A. Martin and R. J. Fateman, "The Macsyma system," in *Proceedings of the 2nd Symposium on Symbolic and Algebraic Manipulation* (Association for Computer Machines, New York, 1971); J. Moses, *Commun. Assoc. Computer Mach.* **14** (No. 8), 548 (1971).
8. N. Wiener, *Science* **131**, 1355 (1960).
9. R. Gillette, *ibid.* **174**, 477 (1971).

BARRIERS IN APPLYING COMPUTERS

Edmund C. Berkeley
Editor, Computers and Automation

"The neglect of important barriers in applying computers has caused a probable loss of at least 10% and perhaps as much as 30% of all the money that has been spent on seeking to apply automatic computers."

Outline

1. The Newness of Computers
2. 2100 Applications to Date
3. Barrier: Insufficient Speed
4. Barrier: Insufficient Capacity
5. Barrier: Organizing Sensory Data Into Objects
6. Barrier: Understanding Words and Sentences
7. Barrier: Deriving Meanings from Objects
8. Barrier: Putting Together Information from Many Sources
9. Barrier: Automatically Correcting Wrong Instructions
10. A Convincing Example of When Not To Use a Computer
11. Conclusions

One of the questions that all computer people either think about or are asked about, or both, is this one:

> Will computers eventually perform every activity in problem solving and handling information? or are there definite barriers or limits? and if so, what are they? and how permanent are they?

1. The Newness of Computers

To try to answer these questions completely and finally now in 1972 is hardly reasonable, because human experience with computers is still brief; but it is worthwhile examining the questions.

Computers have been functioning for less than 30 years. The first automatic digital computer began operating in 1944. It was called the Harvard IBM Automatic Sequence Controlled Calculator; it operated with numbers of 23 decimal digits, performed 3 additions per second, and could hold in erasable storage 72 such numbers at one time. In contrast, recent powerful automatic digital computers may hold numbers of 9 decimal digits, may perform more than a million additions per second, and may hold in erasable storage over 200 thousand numbers. Such computers represent a revolutionary change in society's capacity to handle information automatically.

2. 2100 Applications To Date

In 1944 the Harvard IBM Automatic Sequence Controlled Calculator was devoted almost entirely to one application: computing a numerical table of the values of Bessel functions. Its output constituted page after page of the Annals of the Harvard Computation Laboratory.

From 1960 to 1971 a list of known applications of computers has been published each year in "The Computer Directory and Buyers Guide" annual issue of "Computers and Automation". In the 1960 issue the number of listed applications was a little over 300; in 1971, the number of listed applications was over 2100.

In the 1971 listing, there are four main categories: (1) "Business and Manufacturing in General", with two main divisions, "Office" and "Plant and Production"; (2) "Business, Specific Fields", with 24 categories from "Advertising" to "Transportation" and a 25th one "Miscellaneous"; (3) "Science and Engineering" with 26 categories from "Aeronautics and Space Engineering" to "Statistics"; and finally (4) "Humanities" with the categories and applications shown in Table 1.

There thus exists an actual inventory of noticed applications of computers which has continued from year to year; and it provides a useful historical record of the remarkable increases in the applications of computers.

(This article is based on an article by Edmund C. Berkeley, contributed to the Kodansha Encyclopedia, Tokyo, Japan)

Table 1

APPLICATIONS OF COMPUTERS IN THE AREA OF HUMANITIES

(Source: Computer Directory and Buyers' Guide, 1971, p. 23)

1. Anthropology
   - Cords and string: analysis
   - Content analysis for cross-cultural values study

2. Archeology
   - American Indians, prehistoric cultures: analysis and cataloging
   - Archeological data: information retrieval and analysis
   - Artifacts found at sites: analysis, classification, reconstructing
   - Museum accession records: information retrieval and analysis
   - Pottery, Egyptian: cataloging, classification, storage and retrieval
   - Pottery shards found at sites: analysis, classification, reconstruction
   - Stones found at sites: determination whether of natural or human origin based on analysis of angles and other characteristics

3. Art
   - Designs by computer
   - Graphic representation by computer
   - Paintings by computer: inks, oils, water colors
   - Pictures by computer
   - Sevres porcelain: cataloging, classification, forgery detection
   - Three-dimensional art, generation of

4. Games of Skill
   - Bridge, bidding: championship play
   - Chess: excellent play
   - Gomoku: excellent play
   - Instant Insanity: excellent play
   - Kalah: excellent play
   - Nim: perfect play
   - Quad: excellent play
   - Tit-tat-toe: perfect play

5. Genealogy
   - Cataloging
   - Data analysis
   - Research
   - Surnames: storage and retrieval

6. Geography
   - Map production
   - Record matching
   - Spatial pattern analysis
   - Theory testing

7. History
   - Census records — ecological implications: analysis, summaries
   - Congressional voting records — social implications: analysis, summaries
   - Court records and decisions — implications: analysis, summaries
   - Diplomatic records — implications re prevailing attitudes: analysis, summaries
   - Election statistics — implications: analysis, forecasting results, summaries
   - Ship sailing records — historical and economic implications: analysis, summaries

8. Language
   - Ambiguity determinations
   - Dead languages: deciphering, translating
   - Human voice: analysis, simulation
   - Language analysis
   - Navajo dictionary: compilation
   - Syntax pattern analysis
   - Translation from one language to another
   - Verification of translations
   - Vocabulary trends: analysis
   - Word classification: analysis, summaries
   - Word frequency counts: analysis

9. Literature
   - Author determination via key function words
   - Author determination via style analysis
   - Automatic abstracting
   - Biblical research
   - Bibliography construction
   - Concordance construction
   - Index construction
   - Poetry style: analysis
   - Proofreading
   - "Quik-index" by keyword of titles in context

10. Music
    - Composition
    - Composition features such as range, phrases, patterns, refrains, cadences, etc.: analysis, simulation, synthesis
    - Harmonies: analysis
    - Musical information: analysis, retrieval, storage
    - Music printing
    - Pitch for singers: instruction
    - Simulation and models
    - Sounds: analysis, synthesis
    - Statistical analysis of style
    - Stereophonic music: play

In fact, there is no doubt that digital computers can be applied in every field of science and knowledge in which observations are made and records are kept and correlated, or where mathematics, logic, statistics, classification, and other methods of precise reasoning may be applied.

But it is not now demonstrable that computers will eventually apply to every activity in recognition of problems, solving problems and handling information. The barriers and limits to the applications of computers are serious and are likely to continue for many years. Some of the barriers will now be pointed out.

3. Barrier: Insufficient Speed

Although the speed of a modern powerful computer is over a million (10^6) calculating operations a second, there are problems of such magnitude that even this speed will not solve them.

One example is looking ahead in the game of chess, to foresee the consequences of a move. In order to determine all the consequences of a move at the start of a chess game, it has been calculated that even if a computer could perform a trillion (10^{12}) calculating operations per second, more than 10 billion (10^{10}) years of computation would be required (the expected future life time of the sun and planets) and even then only a very small part of the calculations necessary would have been made.

Another example is the calculation of an accurate weather forecast even for 24 hours ahead. This also would require so many calculating operations that they could not be completed until after the forecasted weather had arrived; so, to deal with this problem, practical approximations are needed, and in fact are being worked out and used.

The limitation from speed makes it necessary to modify computer programs, changing them from accurate

(please turn to page 28)

C.A 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: Andrew M. Langer, Newton High School, Newton, Mass.

NUMBLE 727

```
           T H E
     x H A S T Y
     -----------
         S O T O
       O V H H          A L U Y = R N V I
       T H E
   U L T V
 E E V I
 ---------------
= H S H O P H Y O               L E A P S
+ E Y S U V T H S E           x O V E R
=E O E I E T T E A = E O E I E T T E A
```

4216 0069 8752 8231

Solution to Numble 726

In Numble 726 in the June issue, the digits 0 through 9 are represented by letters as follows:

U = 0	M = 5
E = 1	H = 6
I = 2	G,F = 7
N = 3	T = 8
S,R = 4	O = 9

The message is: The night is the mother of thoughts.

Our thanks to the following individuals for submitting their solutions — **to Numble 725:** D. F. Martin, Los Angeles, Calif.; and David P. Zerbe, Reading, Pa.

ADVANCED NUMBLES — Our thanks to Dr. Mitchell Snyder, Ramat-Gan, Israel for submitting his solutions to **Advanced Numble Nos. 72031 and 72032.**

PICTORIAL REASONING TESTS—Part 6

Neil Macdonald
Assistant Editor, Computers and Automation

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

The pictorial reasoning tests which we have been publishing since October, 1971, require observation, perception, comparison, recognition of shapes and designs, and reasoning. These operations are difficult for a computer program (except for the reasoning), yet stimulating to a human being. The techniques needed are those which we as human beings have had to use (and improve) all our lives — and it is fun to do something you're good at! The readers of "Computers and Automation" are a group of alert and intelligent people — so far as we can tell — and they seem to like contributing to the explorations we are making through these pictorial reasoning tests.

Prior articles on Pictorial Reasoning Tests (PRTs) in "Computers and Automation" are:

Oct. 1971 / PRTs and Aptitudes of People — I / Test 1
Dec. 1971 / PRTs and Aptitudes of People — II / Test 1 (repeated)
Feb. 1972 / PRTs and Aptitudes of People — III / Tests 2, 3
March 1972 / PRTs — Analysis and Answers / Tests 4, 5
April 1972 / PRTs — Part 5 / Test 6

In case any reader has missed these articles, we can supply back copies at moderate cost.

New Styles of Test

In this issue we publish a sample of a new style of test, Style 4: the first three frames display three samples of a property; the question for each of the next seven frames is "Is the same property shown?"

Answers

The answers and comments that you, our readers, send us are very useful and give us much data to work from and think about. Our warm thanks to all of you. It is not easy to respond to individual persons who ask to know "the answers". But we have decided to publish eventually the answers to all of our tests. The "correct" answers to C&A Reasoning Test No. 1 (which was printed in October 1971 and again in December 1971) were printed in the March 1972 issue. In many cases, it is impossible to prove that a certain answer is correct; accordingly, what we publish are so-called correct answers, denoted using quotation marks, as "correct" answers.

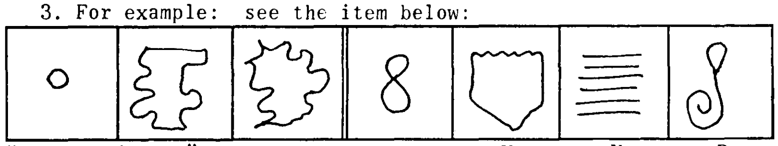
"The figures have been drawn freehand and not too carefully. It is a myth that all figures should be drawn professionally; one can do a great deal with an author's freehand, approximate drawings, and the reader's eyes to interpret them; and such drawings make the gap between the author and the reader less formidable."

PICTORIAL REASONING TEST: C&A No. 7 — *(may be copied on any piece of paper)*

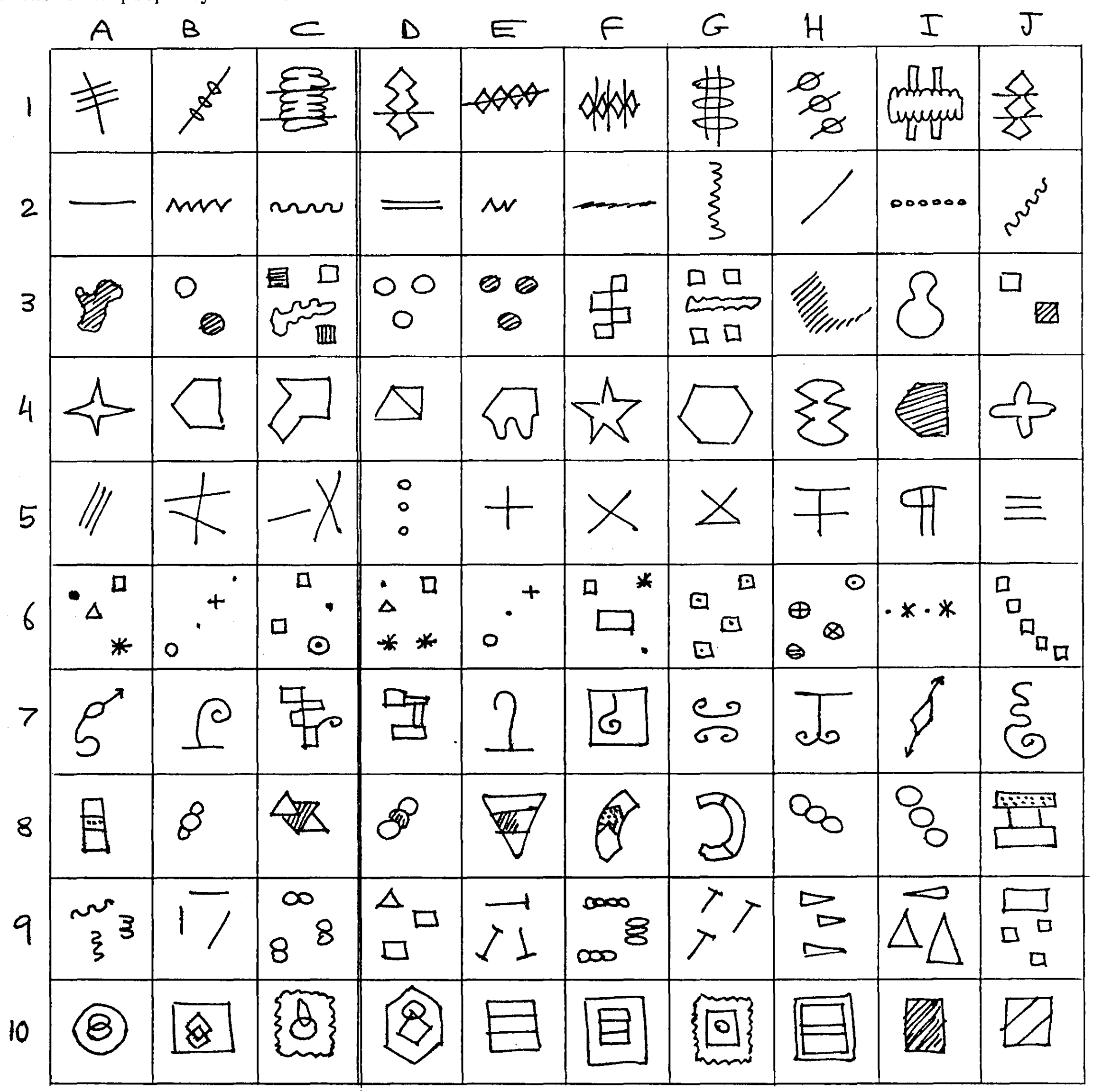
1. The following is a test to see how carefully you can observe and reason. It is not timed.

2. In each item the first three pictures A, B, and C are samples that express a certain property of objects or sets of objects. For each of the remaining seven pictures (D to J), consider the question "Does the picture express the same property?" Then write the code for your choice of answer in the cell provided. The codes are: V for "yes"; X for "no"; P for "logically, perhaps yes, perhaps no"; N for "not applicable".

3. For example: see the item below:



"Correct Answer": X V N P



Answer: In each cell, insert the code for your choice of answer:

Item	D	E	F	G	H	I	J	Item	D	E	F	G	H	I	J
1								6							
2								7							
3								8							
4								9							
5								10							

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, MA 02160

Berkeley — *continued from page 25*
to approximate, so that the solution will be obtained in the time needed in order for the solution to be useful. The computer of course permits much more extensive and elaborate approximations than unaided human beings can use — but the approximations are still approximate.

4. Barrier: Insufficient Capacity

The capacity of a computer to hold a quantity of information is also limited.

A computer may hold in its most rapidly accessed store or memory 256,000 items of information, each of 36 bits (where a bit is a yes or no, a report true or false, a one or a zero, etc.). This amount is approximately equal to 10^7 bits. Let's compare this with an ordinary collegiate dictionary. Data: 1000 pages of text; 2 columns per page; each column, about 100 lines; each line, about 11 words; each word, about 5.5 characters; and each character, 7 bits. Multiplying out, we find that this one book contains approximately 10^8 bits, ten times as much data. The Library of Congress in Washington, D.C., probably contains about 10^{16} bits of information.

Capacity therefore is another limitation which restricts the application of computers.

5. Barrier: Organizing Sensory Data into Objects, etc.

Another barrier is that no computer can rapidly perceive, observe, recognize, organize, and synthesize many facets or aspects of a situation or environment, thus converting sensations into recognized objects or things, such as a traffic light or a rose perfume. In order to notice the operation of converting sensations into recognized objects, try this experiment on some of your friends: Part 1: Take 20 small objects that commonly occur in a household or office, such as a pin, a nail, a thumbtack, a button, an eraser, etc., and place them separately on a tray under a cover. Then uncover the tray in front of some friends, and allow them to look for just one minute. Then cover the tray and ask them to make a list from memory of the objects which they have just seen. Most people will list between 14 and 18 of the 20 objects. Part 2: Then take 20 small metal stampings produced by a stamping machine, such as a washer, a clip, a fastening, a rivet, a glider, a prong, etc. Display them for just one minute. Then ask your friends to make a list from memory of what they have seen. Most people will list (or draw pictures of) 3 to 5 of the 20 objects.

In other words, what we see depends enormously on what is in our minds already in the form of knowledge or experience — stored recognizable concepts.

The same sort of barrier applies to sounds, smells, tastes, feelings, etc. How does one know which smell is the smell of rose? How does a good telephone operator at a company switchboard, in less than a quarter of a second, recognize the voice of each of the company's 500 employees who, when making a call, talk to her? In the absence of knowing clearly how the process works with human beings, it is hard to imagine how we might program a computer to perform it.

6. Barrier: Understanding Words and Sentences

Another major barrier is that a computer cannot quickly understand the meaning of spoken or written words and symbols, so that ideas may be acquired and communicated.

Every normal human child learns to understand spoken words and to use them himself, first singly, then in groups of two or three, and finally in long sentences; and he learns this behavior before he is four or five years old. The vocabulary of a five-year old child is regularly more than 5000 words. It makes no difference what language he may be immersed in — and there are approximately 1700 spoken languages on earth. Often the child will learn more than one language. How this learned behavior occurs with human beings is a great mystery. In spite of much study, only small corners of the curtain concealing the process have been lifted. It is clear that a loving family to teach the child, and an environment presenting common objects and common situations, are very desirable factors for learning and may even be necessary. But the process using inherited capacity and environmental experience by which human beings learn a language with which to communicate seems to be barred to a computer. So it is hard to imagine how a computer could be programmed to learn a language and use it intelligently to express ideas.

When the words are written down in characters and the characters are presented to a computer, it is of course possible to teach the computer to respond to the meaning of some of the characters or character sets. Thus the character "5" or even the string of characters "five" can be interpreted by a computer so that it will perform a specified operation five times. However, deciding upon meanings in a context of free vocabulary and free sentences may be beyond the power of any computer program of the present day, though ten years from now, it may not be.

7. Barrier: Deriving Meanings from Objects

The purpose of an animal in recognizing objects in the environment is to classify them relative to the goals or purposes of the animal. Some objects are food to be sought; some objects are danger to be avoided; some objects are shelter in which to rest or sleep; etc.

A higher animal, such as most mammals, is not usually born with the capacity to identify appropriately all the objects in its environment. It has to learn. Sometimes it is taught by its mother and father, sometimes by older animals, sometimes by experience, sometimes by observing what other members of its species do, etc. An inexperienced dog learns the hard way about porcupines — by getting painfully pricking quills in its nose. But the dog learns, or it dies.

A computer however does not move, but sits still in a room. It has no perceptors to perceive its environment. It has no instinct to survive. Its food is electricity and maintenance service. Its shelter is the computer room. It is presumably never in a danger to which it must react, to stay "alive". And accordingly all the meanings of the objects it deals with — the numbers, data, and programs that it deals with — are rather irrelevant to it, for it is just a manipulator of ones and zeroes, yeses and noes, binary digits, in extraordinarily intricate patterns. Whatever meanings the computer deals with, at present must be bottle-fed to it by the human programmer.

8. Barrier: Putting Together Information from Many Sources

Animals, including human beings, have a capacity to put together information from many sources, and thus "understand" a situation.

Once, in June, 1964, I watched a squirrel raid a bird feeder. The experience was so impressive I have never forgotten it. The bird feeder was an inverted glass cylinder, with a wide, sloping, conical lid to keep out rain, and a round base trough, into which sunflower seeds and other seeds fed slowly by gravity through openings. The feeder was tied by a short string to a pole; the pole rested in a forsythia bush projecting about two feet beyond the bush. When I first saw the squirrel, he was investigating and eating some of the fallen sunflower seeds on the ground below the bird feeder, and then he rose up and tried to reach the bird feeder from the ground; but it was too high for him, and he could not reach it. A little later I saw him crawling out on the pole towards the bird feeder. Then, holding on to the pole with his right hind paw only, he lowered himself slowly along the bird feeder, preventing it from swinging out with his left hind paw. He stretched his full length upside down towards the base of the feeder, got his front paws on the seeds, and proceeded to eat all he wanted for about five minutes, remaining head downward. Finally, he drew himself back up to the pole, and left along the pole through the bush.

I have often thought about that squirrel. He could not have had instincts that dealt with bird feeders: they are too recent. He did not have language, by means of which older and wiser squirrels might have instructed him how to solve that kind of problem. He did not have instructions from a human programmer, as a computer faced with that problem might have had. But that squirrel made a number of deductions and traveled a long way around to solve his sunflower seed problem: he had a good idea, and I would say that the squirrel understood the situation!

The squirrel's idea however is not demonstrable — because I cannot look into the squirrel's mind, and of course he cannot tell me anything about what is in his mind, because we do not speak each other's language. But the squirrel's "understanding" is demonstrable: he showed he was able to perceive relevant features of the situation, adapt means to ends, and fulfill his goal.

A computer has capacity to put together information from many sources, and behave "sensibly" about the information, but only if programmed, never by itself, never independently.

9. Barrier: Automatically Correcting Wrong Instructions

A human being usually has the capacity not to do something which is obviously stupid. For example, if you tell a boy "mow the lawn", and the lawn contains a small flower bed, the boy usually will not mow the flower bed but leave the flowers standing, even if you did not mention the flower bed to him.

In other words, a human being (unlike a computer) is likely to do what you mean and not what you say, when the words of your instructions contain small mistakes. But the computer will not. The computer will do what you say, regardless of what you mean. The computer is thus an "idiot savant" which, doing just what you say, will do the wrong thing a million times a second.

The day may eventually come when a computer will be able to apply "common sense" and "judgment" — and correct "wrong" instructions. The capacity is not magic, and derives from good, well-debugged supervisory programs. But this capacity regularly provided is probably some time in the future. No software house seems yet to be advertising software with "common sense".

10. A Convincing Example of When Not to Use a Computer

On one occasion I visited the central office of a large paper company in New York. This office had to produce weekly and monthly summary reports for some 200 products produced by 29 plants here and there all over the United States and Canada. At one time, they had had a punch card installation with some 8 machines and 7 people for the purpose, and they found they could not obtain their summaries quickly and correctly. That installation was gone. They now used an ordinary table, some perforated forms, and an arrangement of pins. The forms listed all possible products in the same sequence for every plant; zero would apply if some product was not produced at a plant; and for each reporting period the completed forms giving the production figures were mailed in from all over the country. As soon as the 29th report was in, the forms were aligned by the pins on the table, and a clerk would go across each row on the forms, picking up the figures for a particular product, adding them with an adding machine, and entering the total on a 30th form. Then another clerk would check the adding machine tape and the entry. Thus the office avoided the entire input, output, sorting, and collating of punch card operations. They handled each figure only twice, once for adding and once for checking. Here is a fine example of a simple, direct, fast, efficient method avoiding both computer and punch card machines.

In almost every case where a figure is going to be added only once, it makes no sense to put it into some input device, add it inside a computer, and then take it out through some output device. It is better to use some other process.

Basically there is always the same flaw in poor or wasteful applications of computers, and in application failures where computers are subsequently thrown out.

This flaw is the failure of a group of human beings to understand:

- What computers are good for, and what they aren't good for at all;
- The ironclad necessity for correct programming, covering all the possible cases, more than most clerks encounter in 10 years of working at a clerical job;
- The need for sensible trials on a small scale before operating on a large scale;
- The importance of investigating improvements in methods that <u>do not use</u> computers.

11. Conclusions

Although computers are powerful and even marvelous machines, they have limitations, and they cannot be applied indiscriminately.

It is necessary to think about their input, output, storage, speed, programming, etc., and particularly how a computer will mesh with other requirements of the system in which it is to be used.

The neglect of important barriers in applying computers has caused a probable loss of at least 10% and perhaps as much as 30% of all the money that has been spent on seeking to apply automatic computers. □

The Neglect of Significant Subjects, and the Information Engineer

by Peter J. Nyikos and
Edmund C. Berkeley

"It is far more realistic to consider the silence . . . as part of the unfathomable mystery of what the media (and by inference, the public) consider newsworthy."

1. Introductory Note

Edmund C. Berkeley, Editor
Computers and Automation

It has been a long time since "Computers and Automation" has received a communication from a reader which to us has seemed as important and significant as the letter we have received from Peter J. Nyikos published below.

I think that Mr. Nyikos has put his finger on a most important issue:

1. Many subjects that are significant and important for human society receive almost no attention, discussion, or reporting.

2. Conservatives, liberals, newspapers, magazines, socialists, capitalists, alike — even persons who want to call themselves information engineers, — devote almost no attention or discussion to these subjects.

3. The problem, he says, cuts across all conceivable ideological lines. It does.

2. "Why No Wide Publication?" — Comment

Peter J. Nyikos
Management Information Systems Directorate
Edgewood Arsenal, Md. 21010

Your brief comment "Why no Wide Publication?" on page 33 of the May issue touched off a flurry of ideas. I hope you find them in keeping with your remarks on input and output of data systems in a broad sense on page 28.

"Why is information about atrocities of these kinds not widely published and distributed throughout the newspapers and media of the United States? So that Americans with a sense of common decency can roar their protests?

"There seem to be two answers: One is the cooperation of the American press with the American establishment. The other is the failure of Americans to be as concerned about Asian civilians and American cancer victims as they are concerned about drafted American soldiers. This is a moral failure."]

[May issue, p. 28: See policy statement entitled "Unsettling, Disturbing, Critical", reprinted in this issue — see Table of Contents.]

The first answer to your question is "the cooperation of the American press with the American Establishment." In view of, say, Agnew's complaints about the press and TV, or the repeated denunciations of U.S. Vietnamese policy in the New York Times and the Washington Post (to name only two important publications), or the wide coverage given to "antiwar" (more about this moniker in a minute) protests and the views of McGovern and other Democratic and Republican "antiwar" candidates — in view of these and like phenomena, I don't think "cooperation" is the lead to pursue. I think it is far more realistic to consider the silence you speak of as part of the unfathomable mystery of what the media (and, by inference, the public) consider newsworthy.

This problem cuts across all conceivable ideological lines. Not only U.S. atrocities but also those of the VC, NVA, and the ARVN, are largely ignored. Wars and uprisings in Yemen, Sudan, and Angola, and goodness knows where else, seldom make the pages of newspapers or news magazines. If I want to find out what is going on in these places, as well as in such formerly and potentially (and, for all I know, presently) explosive areas as Tibet, Cuba, Venezuela, Panama, Brazil, Burma, Iraq, Cyprus, Nigeria, the Congo (or whatever it is called today), Indonesia, Southern Rhodesia, etc., I have little recourse but to wait for the next yearbook of the Encyclopedia Britannica or some similar end-of-the-year publication.

Nor are international affairs the only area in which these deficiencies exist. The bulk of coverage of medical research, science, and religion seems to be devoted to endless articles on heart transplants, the hazards of smoking, cyclamates, and other food additives, space "spectaculars" (not including weather and communications satellites, let alone those for reconnaissance), defections from the priesthood, and loosenings, real or imaginary, of long-standing religious rules.

There is some slight hope in that some subjects which were once hardly mentioned have finally attained the status of "good copy": pollution, conservation of natural resources, battered children, unsafe automobiles. But, whether it is from the media misreading public interests, or some fault at the bottom of American society itself, we have a long way to go.

As you suggest, there is a "failure of Americans to be as concerned about Asian civilians ... as they are concerned about drafted American soldiers." This is true of most liberals as well as conservatives. For example, last month I heard a liberal commentator on a national TV news program say smilingly that he did not give a hoot about what happened to the Vietnamese, it was Americans he was concerned about — and calling his conservative counterpart a "bleeding heart" for his concern for the South Vietnamese.

There is ethnocentrism in the very terminology applied to this war. Protesters against American involvement in the Vietnam war have been labeled "antiwar" protesters from the very beginning. Yet from public statements it should have been clear that the only facet of the war that most "doves" objected to was U.S. participation therein. Then, too, almost no one on either the Left or the Right objected to Nixon's equating withdrawal of American troops with "winding down the war" and "bringing the war to an end". All of this betrays a deep-rooted insularity.

As for solutions, I of course have none. One small step in the right direction, though, might be to run a regular column in your magazine listing "neglected subjects." If there is enough reader interest, the names of the subjects alone should take up quite a bit of space.

3. Escaping Limitations in Thinking and Perceiving

Edmund C. Berkeley, Editor
Computers and Automation

Ever since I was a child loaded with curiosity and a student asking questions that my teachers could not (or would not) answer, I have been wondering about limitations in thinking, knowing, and perceiving. Over and over again I would say to my parents, "Why shouldn't I?" Father often gave me good answers. Mother usually gave me the answer, "What would people think if ... "; that never satisfied me but made me rebellious. I remember Mr. William Francis who taught me college algebra at Phillips Exeter Academy explaining synthetic division to the class; I held up my hand and asked "Sir, if that is synethic division, what would synthetic multiplication be?" He said "That's a good question. Work it out, and bring it in to class tomorrow." (And I did.)

1. Doesn't evolution operate in thousands of situations, not only the evolution of living species? (Preliminary answer: — Yes, of course; see, for example, the evolution of inventions, the evolution of landscapes, the evolution of a group of people waiting for a bus, etc.)

2. What are the limits to solving problems with computers? (Preliminary answer: — See an article in this issue "Barriers in Applying Computers".)

3. What are the most important ideas and concepts in communication? (See an enormously interesting book, "Language and Communication", by George A. Miller, published by McGraw-Hill Book Co., New York, N.Y., 1951, 298 pp.)

4. Does language prevent you from thinking certain ideas that you could think if you had words more fitted to reality? (See a very interesting book "Language, Thought, and Reality" by Benjamin Lee Whorf, jointly published by Technology Press, Mass. Inst. of Techn., Cambridge, Mass., and John Wiley & Sons, New York, N.Y., 1956, 278 pp.)

How do we escape the "deep rooted insularity" which Nyikos speaks of, and which almost all human beings so clearly suffer from, so that we can find the significant subjects?

Here are the steps that it seems to me can be usefully taken

1. See, observe, notice the problem of relative invisibility.

2. Maintain and publish a list of significant subjects, as Nyikos suggests.

3. Look for news, books, and information on these subjects.

4. Prod various publishers (some of them are looking for material to publish) to publish on one or more of these subjects.

5. Cultivate the discussion of these subjects among one's friends, in letters to the editor, etc.

6. If you can, persuade some prominent person to talk about it — a national leader, a senator, a presidential candidate (not quite as good), a college president (not nearly as good), etc.

7. Never give up.

Take the subject of Boolean algebra, for example. Starting in 1934, I used to talk about this subject to friends of mine in actuarial work in the life insurance company home office where I used to work. I even wrote a paper and got it published in 1937 in an actuarial journal, "Boolean Algebra (The Technique for Manipulating AND, OR, NOT and Conditions) and its Applications to Insurance". I knew if I did not put the definition into the title nobody would even be curious enough to find out what I was talking about! For six years I talked. I used to describe my progress as "in six years I went from a blank stare to a broad smile". But Boolean algebra is a recognized subject now. It has "arrived" — in the design of computer circuits, in the new math, etc.

Take the subject of unidentified flying objects (UFOs) for example. To date there have been many thousands of reports of visual observations, probably over 50 photographs, and probably over 1000 radar observations of unidentified flying objects. Many of these reports have clearly been decorated with misinformation, exaggeration, or lies by the reporter. But many other reports certainly have not been. One proffered explanation is extra-terrestrial visitors. But what have the establishments done? Not one government, not one national scientific association, that I know of has acted in a scientific way about these reports. Instead, ridicule of the reporters, and attempts to press psychological

(please turn to page 35)

The Shooting of Presidential Candidate George C. Wallace: A Systems-Analysis Discussion

Thomas Stamm
2705 Bainbridge Ave.
Bronx, N.Y. 10458

and

Edmund C. Berkeley
Editor, Computers and Automation

"A systems analysis discussion of . . . the protection of presidential candidates against violent attacks hinges on the study of two systems: the system of pursuit and attack used by the assassination team or individuals; and the system of protection used by the presidential candidate."

Outline
by Thomas Stamm

1. Questions

by Edmund C. Berkeley

2. The Number of Bullets, Guns, and Wounds
3. The Expenses of the Suspect
4. Cui Bono? (Who Profits?)
5. Gun Control
6. The Systematic Protection of Presidential Candidates

by Thomas Stamm:
1. Questions

The attempt to kill Governor Wallace in Laurel, Maryland, on May 15, bristles with problems. Let me indicate a few. According to the New York Times accounts, the hand gun used by the would-be assassin had a capacity of five bullets. All were fired, at virtually point-blank range, and frontally. Wallace and three other individuals were wounded.

Each of the three beside Wallace sustained single wounds. But confusion surrounds the number suffered by Wallace:

> One bullet, the doctors said, passed through the upper arm and another through the right forearm. One or both of two wounds in the chest are thought to have been possibly caused by bullets that passed through the arm first. Wounds in the right shoulder and left shoulder blade [the Times diagram identifies both shoulder blades] were superficial and evidently the bullets causing them did not lodge in the body. A bullet is lodged against the first lumbar vertebra, just below the ribs, and is presumed to be the cause of the present paralysis in Governor Wallace's legs (p. 28, col. 3).

Four days later, James T. Wooten, leading off the Times "The Week In Review" with a piece on Wallace, did not enumerate all of Wallace's wounds, nor note any inaccuracy in the Times listing of May 17, but referred to "two superficial wounds in his back" and implied yet another wound with the statement, "One bullet was removed from his abdominal cavity ..."

By the Times account of May 17 five bullets inflicted ten wounds on four individuals. It is possible, but is it so? If Wallace's abdominal wound is added, the total number of wounds is eleven. And if the back wounds are also added the total may rise to thirteen, which strains credulity. Does the confusion resulting from these discrepant and ambiguous statements derive from usual journalistic imprecision? or is it evidence of something more sinister, hidden from view, and to be dug out?

What happened to the bullets? Two lodged in Wallace, none, apparently, in the other victims. One bullet was removed from Wallace's abdominal cavity. Another, at this writing, is soon to be removed from his spinal canal. Where are the bullets which caused his arm, chest, and superficial shoulder-blade wounds, and/or the superficial back wounds? And the wounds of the other victims? Were other bullets recovered?

Also, what should we make of the late discovery by the local police of another hand gun in a wheel well beneath the trunk of the would-be assassin's car several days after the FBI and Secret Service, according to the Times, virtually took the car apart but, it seems, missed the weapon? Is it characteristic incompetence on the part of police agencies or is evidence being manufactured? To what end? Can the second gun have some bearing on the difficulty of explaining how one gun fired five bullets into four persons, causing ten or eleven or thirteen wounds? Is there another explanation?

Wallace is a candidate for nomination by the Democratic Party for President of the United States. His attempted murder was a political act which has had and will continue to have political consequences. What was the motive?

I found no statement by the would-be assassin, or by any official source. Only the usual irrelevant comment by politicians, journalists, and psychiatrists on the climate of violence in the country and the "senseless" criminality of alienated, sexually incompetent loners. Has anyone come across anything meaningful? Is the government of Nixon, like the government of Johnson, unable to find motivation for political murder and attempted assassination? Or is it suppressing the motive?

by Edmund C. Berkeley:

2. The Number of Bullets, Guns, and Wounds

A "systems-analysis" discussion of the assassination attempt on Governor Wallace, and the protection of presidential candidates against violent attacks hinges on a study of two systems:

- The system of pursuit and attack used by the assassination team or individuals; and
- The system of protection used by the presidential candidate.

The offense looks for a weak link in the protective system. The defense looks for the maximum amount of protection that can be found, constructed, or arranged. Neither system produces a probability of 100% success, but a very great deal can be done that affects probabilities.

We will begin with a discussion of the number of bullets, guns, and wounds.

The gun which the suspect, Arthur Herman Bremer, used was a Charter Arms, .38-caliber, snub-nosed, five-shot revolver, bought by Bremer for about $80, on January 13, in Milwaukee.

"The New York Times" on May 17 showed in a diagram the locations of eight bullet wounds in Governor Wallace. One or two bullets lodged in him. In addition, three other persons were wounded:

- Captain E. C. Dothard of the Alabama State Highway Patrol (shot in the abdomen);
- U.S. Secret Service Agent Nicholas Zarvos, second in command of the security detail assigned to protect Governor Wallace; (bullet lodged in left jaw);
- Wallace campaign worker Mrs. Dora Thompson of Hyattsville, Md. (shot in the leg).

It seems to me rather remarkable that five shots could produce 11 wounds; but there was a dense crowd around the shooting.

There has been no report so far of the number of bullets collected and where found. If there were 6 or more, then there would have to be more than one person shooting.

Edward Walsh and Bob Woodward of the Washington Post reported in a dispatch published on May 19:

> Police in Prince George's County, Maryland, yesterday found a 14-shot semi-automatic pistol often used as a military weapon in Bremer's car. The local police discovered the 9mm weapon after the FBI had thoroughly searched Bremer's 1968 Rambler. ... There was no explanation of why the FBI, which had searched Bremer's car Tuesday, failed to discover the second weapon.

3. The Expenses of the Suspect

According to an important summary report by Donald Kneeland, published in the New York Times, May 22, Bremer stopped working at his last job in Milwaukee on February 15. Then he did a lot of traveling, which included a visit to Ottawa, a two night stay in the Waldorf Astoria in New York, trips to Michigan, Maryland, and other places. Then Kneeland writes:

> How did the former bus boy and janitor, who earned $3016 last year according to a Federal income tax form found in his apartment, support himself during his unemployment, and manage to buy the guns, tape recorder, portable radio with police band, binoculars, and other equipment he was carrying, as well as finance his travels?

Kneeland does not answer the question he raises. But he does suggest that savings accumulated by Bremer in an account with the Mitchell Street Savings Bank in Milwaukee might have provided the funds. The bank refused to give information to the investigating news reporters.

Kneeland's report further says:

> Agents of the Federal Bureau of Investigation, who are also retracing that puzzling path [the path of Bremer over the last year] have told many potential sources not to talk to newsmen.

Such instructions by the FBI are illegal and have no force of law. Furthermore, such instructions are wrong in a democracy, because they prevent the public from knowing what the public has a right to know. It is regrettable that many people take at face value misinformation that they receive from FBI agents.

4. Cui Bono? (Who Profits?)

In any contest where there are many candidates, the elimination of any one candidate favors all the others.

In a presidential contest for votes, the elimination of a conservative "law and order" candidate would tend to favor to great extent other conservative candidates standing for "law and order."

According to this reasoning, the candidate who would receive the most benefit from the elimination of Governor George C. Wallace — especially if Wallace were running as a third party candidate — would be the candidate holding a position closest to Wallace's platform.

It is conceivable therefore that a <u>de facto</u> conspiracy interested in supporting another conservative "law and order" candidate would consider that the elimination of Governor Wallace would be beneficial to their intentions.

But it is almost inconceivable that such a <u>de facto</u> conspiracy would use such a clumsy and ineffective agent and method as the ones chosen on this occasion. One would expect greater efficiency from a carefully planned conspiracy.

The National Commission on the Causes and Prevention of Violence examined over 80 attacks on presidents, congressmen, state governors, and other officeholders and found:

> In case after case the [study] reveals the attacks were prompted by fanatic allegiance

to a political cause or revenge for some petty slight or imagined evil.

The thesis most often offered in newspaper reports to date has been

> Now Arthur Bremer is known

This correlates with Bremer's taking out two books from the Milwaukee Public Library on the assassination of Robert F. Kennedy, which were found in his car.

5. Gun Control

Another systems aspect that has been much talked about is gun control. The "Wall Street Journal" on May 17 published

> The first of a series of articles on guns, where people get them, what people do with them, and what people think about them.

The yearly toll in the United States from death by guns is over 21,000, or an average of 57 a day. The article was unusual and interesting, because it named 12 persons who died from gun shots in the 24 hours from noon May 15 to noon May 16, and told a little about each person — so as to give a sampling of what the statistics mean.

Unfortunately, the article made no comparison with other countries, where the death rate from guns is less than a hundredth of the death rate in the United States.

The use of guns in the United States is pretty much dictated by the "gun lobby" led by the National Rifle Association with a million members. It consists of an alliance of hunters, target shooters, and gun manufacturers. Its vote-getting ability recently was a major element in retiring former Senator Tydings of Maryland, who had spoken out in favor of much more extensive gun control.

Governor Wallace's own remarks (before he was shot) express an important point of view:

> Restrictive gun legislation wherever it might be — at the national level or the state level — really in the long run restricts the law-abiding citizen who owns a gun. But the law violator doesn't pay attention to any law whether it is gun control or any other law ... If I were convinced that gun control legislation would control crime in this country and would stop the high homicide rate and crimes of passion, and the other planned crimes, I would be for it ... But we know that it is not going to do that. This false liberalism that in the last decade or so has brought about such legislation as gun controls at the national level and the state levels in many states is the same liberalism that has brought heroin addiction in the streets ... [If restrictive gun legislation came about] it would arm completely the outlaws, and that's no way to reduce crime.

From the point of view of a useful, systems-analysis action now, to protect presidential candidates in this 1972 election, any gun control legislation is completely unrealistic.

Even if "gun control" could be enacted widely before November 1972, the enormous supply of probably more than two million guns at present in the possession of individuals all over the country would not dry up.

So, it is a futility, a waste of breath, to talk about gun control. Instead, systematic protection of candidates against guns and against efforts to assassinate them is an important factor to be considered.

6. The Systematic Protection of Presidential Candidates

In regard to the defense of a presidential candidate against attempts to assassinate him, there are a number of procedures (belonging to common sense, wisdom, safety engineering, systems analysis, and general strategy), that can be adopted quite easily.

1. Ambush. What an assassination team or individual needs most is reliable information ahead of time as to where the candidate will be. Once they or he knows that, a place for the ambush can be chosen deliberately and plans can be implemented.

2. Travel Information and Itinerary. The candidate should therefore make systematic efforts to prevent the preparation of ambush. He should announce he will travel by one route but when the time comes he should use another. His staff should say he will leave the speaking hall by one route, but when the time comes, he should use another. Etc.

In the assassination of Senator Robert Kennedy, Sirhan B. Sirhan waiting in the hotel pantry repeatedly inquired "Is he coming out this way?"

3. Private Plane Travel. No private plane should ever be used repeatedly.

In the case of Walter Reuther, auto union leader who died in an airplane crash in Michigan in May 1970, there was an official report many months later that the altimeter in his rented plane had been put together defectively, so that it read a higher altitude than the real altitude. Reuther threw away many opportunities for protection by systematically using the same privately rented plane to fly from Detroit to the UAW vacation resort on weekends.

4. Bulletproof Shield when talking. When the candidate talks before an audience, he should use a bullet proof shield.

Wallace probably would have been shot and perhaps killed by Bremer from his seat in the audience if there had not been the bulletproof transparent plastic shield around Wallace's podium.

5. Bulletproof Vest. On occasions when planned shooting might occur, the candidate should wear a bulletproof vest, such as policemen in anticipated shoot-outs wear.

Wallace probably would not now have paralyzed legs, if he had been wearing a bulletproof vest.

6. Shaking Hands. Whenever a group of people want to shake hands with a candidate, on an occasion which is not absolutely spontaneous (as for example when the candidate suddenly chooses to stop his car at Pennsylvania Ave. and 12 St.), they should be invited to form into a single line, and the line should be checked by the same kind of metal detectors that some airlines have installed to detect hijackers.

It would be easy to explain this arrangement to supporters of the candidate, in the same way as many airline passengers are reassured by the checking, by accomplished metal detectors as they walk into their plane, for it reduces their fears that their plane may be hijacked.

7. Secret Service Guards. The Secret Service guards assigned to presidential candidates certainly do some good. But they did not do Wallace any good on May 15. They are far from being enough. Why were they so incompetent?

8. Distraction. The greatest advantage that an assassin can have is distraction. It is truly remarkable how much one can accomplish by distraction: you focus people's attention on one thing, and then you suddenly do something else.

To prevent the use of the technique of distraction, one or two trustworthy guards should be continually assigned to pay no attention to the number one thing going on but to watch for the number two thing that may start to happen.

Bremer is supposed to have engaged in distraction. The "New York Times" on May 16 reported:

> "Hey George, Hey George! Come over here! Come over here!", the man shouted insistently according to several witnesses.

9. Systems Analysis and Information Engineering. The entire system of the protection of a presidential candidate against assassination (or violent attack) should be studied by a competent group of trustworthy assistants to the candidate, and sensible procedures adopted, with the benefit of modern technology. And the faster and the sooner, the better.

The United States cannot afford to lose presidential candidates or presidents, to violent illegal attacks, or elimination, or liquidation, or death. □

Unsettling, Disturbing, Critical . . .

Computers and Automation, established 1951 and therefore the oldest magazine in the field of computers and data processing, believes that the profession of information engineer includes not only competence in handling information using computers and other means, but also a broad responsibility, in a professional and engineering sense, for:

— The reliability and social significance of pertinent input data;
— The social value and truth of the output results.

In the same way, a bridge engineer takes a professional responsibility for the reliability and significance of the data he uses, and the safety and efficiency of the bridge he builds, for human beings to risk their lives on.

Accordingly, Computers and Automation publishes from time to time articles and other information related to socially useful input and output of data systems in a broad sense. To this end we seek to publish what is unsettling, disturbing, critical — but productive of thought and an improved and safer "house" for all humanity, an earth in which our children and later generations may have a future, instead of facing extinction.

The professional information engineer needs to relate his engineering to the most important and most serious problems in the world today: war, nuclear weapons, pollution, the population explosion, and many more.

Nyikos — *continued from page 31*

interpretations upon the public have been made. The subject of UFOs has not "arrived".

What is the nature of the obstacles to recognizing significant subjects that are unrecognized?

- Failure to understand and apply the scientific method;
- The preference for simple explanations over more complicated ones;
- Ignorance;
- Prejudice and bias;
- Contentment with a narrow point of view;
- Authoritarianism: "What ... says is good enough for me";
- The desire of establishments to mold public opinion;
- The desire of many people to have their thinking done for them because it is easier that way;
- The desire of advertisers to have people listen to commercial advertising;
- The desire of experts to have a monopoly of expertise;
- The addling of people's minds by a great deal of TV, radio, and newspapers;
- The moral failure of being exhausted after putting out a certain amount of moral indignation; etc.

The list is a long one.

Knowing the nature of the obstacles, information engineers should find it easier to deal with them.

4. Significant Subjects that are Inadequately Covered

Proposed List

Genocide in Vietnam, Laos, Cambodia

Genocide in the past in:

> Turkey; Armenia; Indonesia; Germany; Romans vs. Carthaginians in Carthage; Americans vs. Indians and Negroes in the U.S.; etc.

Genocide, causes of

Wars and/or uprisings in:

> Tibet; Cuba; Venezuela; Panama; Brazil; Burma; Thailand; Iraq; Cyprus; Nigeria; Congo; Indonesia; Southern Rhodesia; Philippines; South Africa; Haiti; Uruguay; Guatemala

Disarmament, inspection for

Population explosion, different limits in different countries

United Nations, more accomplishments by

Man in perspective

Civilization, nature of, vs. the "American Way" □

Computer-Field Information vs. Social Rag

I. From: Arthur Martin, President
Computer Covenant Corp.
1156 East Ridgewood Ave.
Ridgewood, N.J. 07451

To: Computers and Automation

May 18, 1972

I read your subscription renewal letter with interest. We have been a subscriber to C&A for a number of years, but do not plan to renew.

The reason is quite simple — your magazine does not provide what you say it does, or at least not according to priorities of design, applications, and implications of information processing.

At one time we looked to C&A to supply application design techniques, but the magazine has turned into a social rag. We are not questioning your editor's politics, but only saying that if you portray that you are in the computer information business, why not produce it?

II. From: Edmund C. Berkeley
Editor, Computers and Automation

May 23, 1972

Your letter has been referred to me.

First, thank you for expressing plainly and directly your point of view, and for signing your letter. Many letters like yours come to us unsigned, and with no address — and so we do not know how to reply to the writer.

I enclose copies of the tables of contents of the April and of the May issues of C&A. There are six standard computer-field articles in the April issue, and four standard, computer-field articles in the May issue, and in both issues additional standard, computer-field items of information.

Now it is quite possible (and indeed normal) for a reader to simply pass over and pay no attention to any parts of a newspaper or magazine he is not interested in. Thus some readers pass over the real estate pages in a Sunday newspaper because they have absolutely no interest in real estate. But these readers do not write to the Sunday paper and say, "If you continue to publish real estate information, I won't continue to buy your Sunday paper."

Could you please tell me how the collection of computer-field articles and items in the April and May issues fall short of giving you a good monthly bill of fare in the computer field? I'd like to know.

We are trying our best to publish in each month interesting and important articles in the computer field, to the same degree as in the past — no matter how much we fill up the pages that used to be advertising pages with matter related to "the pursuit of truth in input, output, and processing".

If you would prefer to telephone me instead of writing, would you please call me station-to-station collect; and if I am not in, the call will not be accepted.

III. Note:

Up to our going-to-press date June 10, no reply from Mr. Martin had been received.

Ba Toi

PACIFICATION: The Story of Ba Toi

American Friends Service Committee
48 Inman Street
Cambridge, Mass. 02139

Ba Toi's mother, Pham Thi Toi, was 24 when American troops visited her village of My Lai. Her family was working near their hut when the Americans took them away from the village. Later the remains of Ba Toi's mother, old uncle, oldest brother and sister, and two younger boys were found in a pile of bodies. Ba Toi and her sister had not been near the hut when the soldiers arrived. They ran and hid and survived.

None of the survivors of the massacre were allowed to return to their village. They were rounded up by the South Vietnamese government and ordered to build a fence around an American outpost. Though the people protested that the site chosen for the camp was heavily mined, the American and ARVN soldiers forced them to go ahead with the work of gathering bamboo for the fence and driving stakes into the ground.

Ba Toi was bending over picking up bamboo when she triggered a mine that blew off both her legs. Both her arms were badly damaged as well and had to be amputated at the province hospital.

Ba Toi remained in the province hospital for several months, and then began to receive treatment at a Quaker rehabilitation center on the hospital grounds. There she had another operation on her stumps and was fitted with artificial legs and arms. One of the arms had a hook that could be manipulated like fingers, and the other had a plastic hand that could carry objects.

Ba Toi made a great effort to master her artificial legs and arms, and by the time she left the rehabilitation center she was able to walk quite well and was very proud of her achievement. When she left the center, the Quakers also gave Ba Toi a small amount of money — the equivalent of ten American dollars — to buy what she would need to start a small concession.

Ba Toi returned to the refugee camp where the survivors of My Lai were being kept. She and her sister built a small lean-to which became their home and shop. They soon began to earn a little money, selling canned milk, tobacco and cooking supplies to their neighbors in the refugee compound. They did not make enough, however, to buy all the rice they needed.

Last April, the NLF began to advance rapidly down the road toward My Lai, burning the refugee camps and telling the people to return to their villages. During the fighting ARVN troops lobbed American shells into Ba Toi's camp. One of the shells landed in Ba Toi's hut. Her sister was killed, and shrapnel hit Ba Toi in the stomach. As she struggled to put on her legs and get into the bunker, she was caught in a cross fire, and a bullet penetrated the stump of one of her arms.

It was several hours before a friend could get Ba Toi to the province hospital. She didn't complain of pain but repeated that she was "tired, very tired." She said, "I'm tired of war and being hurt. I'm tired of death. Please give me something to sleep."

After another operation on her stump, Ba Toi lay in the province hospital for two days. She lay nude, a heavy blanket thrown over her mid-section, her breasts and three remaining stumps lying bare. She was hitched up to an intravenous bottle, but the nurses at the desk didn't notice when it stopped running. On the night of the second day, she died.

The same day, two A37 subsonic jets flew from Danang and dropped bombs on the refugee camps near My Lai.

The death and destruction resulting from United States intervention in Indochina has far exceeded the most pessimistic predictions. In response to the devastation the American Friends Service Committee has committed itself deeply to efforts to end the war in Indochina and to relieve its victims. The story of Ba Toi was taken from reports written by staff members of the Quaker Rehabilitation Center in Quang Ngai.

Present American policy means indefinite continuation of the war in Indochina — war which features the massive automated bombing of civilians like Ba Toi and her family, few American casualties, and our silent consent.

You can use your voice to help stop that war now. Let the Congress and President know where you stand. Demand that Congress reassert its constitutional authority in regard to war, peace, and national priorities. Take what direct action you can in opposition to the war. If you need more information on American involvement in the war, fill out the attached coupon and mail it to us.

Ba Toi is dead.

How many more Ba Tois will there be?

Can we — will we — work for life?

- - - -(may be copied on any piece of paper)- - - - - - - -

American Friends Service Committee
48 Inman St., Cambridge, Mass. 02139

I was interested in the story "PACIFICATION: The Story of Ba Toi" published in the July 1972 issue of Computers and Automation

( ) Please send me the paper INDOCHINA 1972: PERPETUAL WAR

( ) Enclosed is a check to support the peace work of the AFSC.

Name____________________

Address____________________

City__________ State________ Zip________

Unhappy Subscriber to Satisfied One

I. From: John Kaler
1610 Richvale Lane
Houston, Texas 77058

February 6, 1972

About 3 months ago you wrote me stating that my subscription to Computers and Automation had lapsed. I replied that I had sent you a check for a year's subscription in May 1971 so my subscription must be good at least until the renewal date in 1972. With the letter I enclosed a photostat of the cancelled check. I stated that perhaps the error was due to the processing of a change of address for me last summer when I moved from 330 Arrowhead Blvd., Apt. 34-D, Atlanta, Georgia, 30236, to the address shown above.

My subscription has still not been reinstated and I would appreciate your immediate attention to this matter. For your reference, the numbers shown on my address label were 4877058 KALE161J80 06117105. When the reinstatement is accomplished would you please extend it to whatever point is necessary so that I will receive 12 issues of the magazine as a result of the last renewal.

II. From: Edmund C. Berkeley
Editor, Computers and Automation

May 17, 1972

This is a checkup on the matters referred to in your letter of February 6 to us in regard to your subscription to "Computers and Automation" and your nonreceipt of it.

You appear not to be on our roll of subscribers at this time receiving copies regularly, as I believe you should be, and I want to make sure that you are put on.

If you will let me know which issues you think you should have received, and do not have, I will gladly send those issues to you from this office.

Also, would you be kind enough to send us again a photostat of your cancelled check? (I enclose $1 on account of your expenses in dealing with us.)

We want all our subscribers to be happy and satisfied.

I enclose a business reply envelope marked "Personal" so that I shall be sure to see your reply when it comes.

I regret very much that we have not treated you in the red carpet way in which we like to treat our subscribers.

III. From: John Kaler

May 20, 1972

As you requested in your letter dated 5/17/72 I am sending along a photostat of the check which I sent you in 1971 for a renewal subscription. I am also sending along a copy of my address as it appeared on your records at time of lapse.

I do not know exactly which issues I did not receive. I wrote to you first about this matter on 11/1/71 and had not received any issues for several months prior to that time. I think it is safe to assume that the July or August issue was the last one that I received. Rather than get copies of the back issues I would much prefer to go back as a current subscriber and get the next 9 or 10 issues, if this is possible.

I have always enjoyed your magazine very much and have especially enjoyed the change in editorial emphasis that has taken place over the past several years.

I am enclosing a check for $10.00 and would like you to use it for current expenses in publishing your magazine or for any other purposes that you might feel to be appropriate.

IV. From: the Editor

June 19, 1972

Thank you very much for your letter of May 20, the copy of your check of May 1971, and your current check for $10. Your kind remarks and your contribution to us (and to what we are working for) overwhelm me. Thank you!

Separately I am sending you the June issue which came out on June 13, and which you may not have received in the regular course. I have not yet received the June galley for checking to make sure that you are included.

We are reentering your subscription currently to run from June 1972 to May 1973. Although you suggest that you do not need the back issues, I believe that they may be of sufficient interest to you to be worth scanning the table of contents; so I am also sending you the back issues July 1971 to May 1972; if they are not useful, you may return them to us at our expense (we will refund your postage).

I am truly glad that you say:

> I have always enjoyed your magazine very much, and have especially enjoyed the change in emphasis that has taken place over the past several years.

As you know, I believe it is more than time for computer professionals to lift their sights to the broad horizon and prepare to become "information engineers", socially responsible human beings with professional competence in dealing with information and with truth. □

CORRECTION

In the May 1972 issue of *Computers and Automation*, the name of the author of "Effective Management of an Instrument Pool" was printed incorrectly in several places:

Please replace "D. H. Townsend" by "D. R. Townsend" on the cover page, page 4, and page 8. We regret the error.

ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

Table of Contents

APPLICATIONS

GRAVITY EFFECTS STUDIED UNDER COMPUTER-CONTROLLED EXPERIMENTS

Wenner-Gren Research Laboratory
University of Kentucky
Limestone & Euclid
Lexington, Ky. 40506

Monkeys are riding thousands of miles around and around a large laboratory at the University of Kentucky as researchers try to learn more about the effects of gravity.

Computer-controlled experiments involving a 50-foot radius centrifuge have two aims, according to Prof. James F. Lafferty of the Wenner-Gren Research Laboratory: "First, we are trying to determine what effects increased gravity has on an organism's behavior; and, coincidentally with those studies, we are trying to determine the effects upon an organism's health."

A single IBM 1800 data acquisition and control system runs each experimental effort on a large rotating centrifuge. As its speed increases, the centrifuge creates conditions of increased gravitational pull on the capsule and experimental subject riding in it. "We have found that rats can feel very small changes in gravity — as little as a tenth of a G — and some monkeys are quite sensitive to changes, too," Prof. Lafferty said.

Designing a series of experiments to learn how much a monkey will do to avoid higher and higher levels of gravity pull, the research team has programmed the computer to increase the centrifuge speed until the monkey activates a lever inside his capsule. Tripping the lever notifies the computer to reduce speed for 20 seconds. If the lever is tripped again, speed is further reduced for a 20-second period. As the monkey experiences less and less gravity, he may ignore the lever for 20 seconds or more. Then, speed picks up again until he notices increased gravity and again activates the lever.

Miss Sandra Beaver, a research assistant trained in psychology, noted, "We give the monkeys no training. They learn by trial and error to activate the lever if they want to reduce gravity. Now we are running from 1.05 to 2.05 G's to insure no physical harm comes to the animals. Each is examined on a regular basis to determine what effects, if any, the increased G's have on health."

As the experiments continue, massive amounts of data are gathered by the IBM system. At the conclusion of each run, it prints summary statistics, including the average gravitational force on the monkey during the hour-long runs, his response time at various levels of gravity and other analytic values.

"We will be correlating a wide variety of data later," Miss Beaver said, "to determine with precision how well the animals detect gravity changes and how much they will do to avoid high levels of gravity."

Some hints on the effects of weightlessness, the opposite of increased gravity, may result from the studies, too, Prof. Lafferty said. "As longer and deeper space missions evolve, we hope to know in advance what weightlessness will do to man's health and behavior," he said. "Artificial gravity may have to be designed into space vehicle engineering to assure astronaut safety and ability to perform tasks."

COMPUTER HELPS ANALYZE WORLDWIDE POLITICAL BEHAVIOR

University of Southern California
University Park
Los Angeles, Calif. 90007

Dr. Charles A. McClelland, an inventive political scientist at the University of Southern California, believes computer analysis can help experts anticipate future trouble spots in the complex realm of international political behavior. He uses a computer in USC's computing center to compile a historical file of relations between countries. He can illustrate this interplay with computer-generated graphs showing the ups and downs of political life between any of 169 nations around the world — more than 25,000 pairs of countries in all.

Now in its fifth year, the federally funded project is built on thousands of facts culled from the Los Angeles Times, London Times and New York Times. The studies are being carried on in the international relations department's research institute, which Dr. McClelland directs.

"We're able to reconstruct a simplified record of what has happened in a certain international situation, compare it with today's events and draw some conclusions about the possible result," he said. "We want to try to find out if the big, eyeball-to-eyeball confrontations so common today have any predictable pattern."

One of Dr. McClelland's biggest tasks is in keeping up with his data. Each item from the three source newspapers dealing with international affairs is clipped, and a coded version goes onto a punched card and is stored in the computer. A single day's crop may exceed one hundred articles. "We clip every item that crosses a national boundary," he explained. "As long as it in some way relates to the dealings between two countries, we include it in our model."

The coding system is simple, quick and understandable. "First we assigned each nation a permanent code number," he said. "Then we established 63 categories of international political activity, from the mildest sort of action to outright war. "Number 013, for instance, records a nation's admission of guilt, an apology to another nation or verbal retreat. From there we go through comments, praise, promises and assurances, expressions of regret, diplomatic recognition, giving economic aid, giving military aid, agreements and proposals."

After that the mood changes. The next category is rejection — of a treaty offer, for instance. Then come such increasingly offensive actions as charges, denunciations, complaints, protests, demands, threats, demonstrations, armed displays, cancellation of treaties or aid, breaking off of diplomatic relations, expulsion of envoys, detentions and arrests, non-military injury or destruction and finally military force.

"Thus when Denmark recently announced that it planned formal recognition of the new nation of Bangladesh, the item was coded 390-025-765 on the IBM card," Dr. McClelland said. "The 390 is Denmark's permanent number, the 025 reflects a statement of policy and 765 represents Bangladesh." When Denmark formally recognizes the new Asian nation, the action will be coded 390-064-765, the 064 denoting diplomatic recognition. "At any time, then, we can get back from the computer a complete listing of all the goings-on between any two countries," Dr. McClelland said. "And when we direct the IBM system to plot out the results in graph form, we can see both the number of transactions between these countries and the seriousness of those actions."

The USC professor feels automated systems such as his offer a new perspective on the world situation. "It seems apparent that patterns of international conduct can be boiled down and sorted out by computer," he said. "For instance, we can expect to discover that a certain nation always makes threats before it strikes, always says things in the same kind of language. Once such a pattern is established, we could be better able to figure out in advance what's likely to happen in a particular world trouble spot — or pinpoint such a trouble spot before the situation gets totally out of hand."

Dr. McClelland emphasized that the goal of the research is to perfect the system of computer procedures that facilitates the analysis of patterns in international events. "Government information sources that, in some cases, may be many times more detailed than the available newspaper facts ultimately can be used in the system," he said. The computer is an IBM System/370 Model 155.

Though the system is still being developed, it already has attracted attention from the Navy. A similar project is being tested at the U.S. Naval Post-Graduate School in Monterey, Calif., and a system modeled after USC's was begun in January at the U.S. Naval Academy.

CASHLESS-SOCIETY PROJECT REPORTS PROGRESS IN N.Y.

Digimatics Inc.
1000 Franklin Avenue
Garden City, N.Y. 11530

Today, in the Long Island community of Syosset, the nation's first fully automated point-of-sale funds transfer system is replacing cash, checks and credit cards in hundreds of retail transactions.

The system, called "Instant Transaction" (IT), was developed over a three year period by Digimatics, Inc. for the Hempstead Bank to overcome certain limitations that exist in the present payment system, such as fraud and a constantly increasing volume of paper processing. First units were installed at 32 retail establishments. Consisting of an optical card reader, standard 12 button touch-tone keyboard and a printer, each point-of-sale terminal can not only complete a transaction in 30 seconds but requires no technically trained personnel for its operation.

IT was designed to be independent of the subscriber's accounting system. Thus, any subscriber can utilize IT by merely issuing cards meeting the specifications of machine readability; forwarding cardholder balance files in a fixed format to the host computer; and accepting transaction files from the host computer in a fixed format.

At the start of each business day, the bank forwards a file containing the account number and "available funds" (any combination of balances or credit lines defined by the bank) for each of its cardholders to the computer.

During the day, the computer continuously updates the cardholder's available funds as his transactions are processed and simultaneously makes two records of the transaction — one to debit the cardholder's account and the other to credit the participating merchant. This data is then posted by the bank at the close of business.

The IT identification card contains an account number and a secret code. The code, which is embedded in the card, is of a proprietary nature. It is not detectable by x-rays, ultraviolet light, etc.

Upon activation of the terminal, the sales clerk inserts a multi-part sales slip which is locked in the printer. The customer then enters his secret code in the verifier board. If a valid code comparison is made, the computer signals that it is ready to receive transaction data and the clerk enters the amount of the transaction. If there are sufficient funds in the customer's account and a verification "go" signal was received, the customer's and merchant's accounts are updated by the transaction amount, a transaction record is generated and stored on both magnetic tape and disk, and a valid transaction message is formatted and transmitted back to the terminal. This message includes the date, customer's account number, merchant's account number, transaction code and the amount of the transaction.

At this point, the system shuts itself off releasing the sales slip, one copy of which is given to the customer as his receipt and the other is retained by the sales clerk as a permanent record of the transaction.

According to Digimatics president E. Paul Leedom, the IT system is not a new type of credit card but a new means through which the consumer can have access to whatever funds the card issuer makes available to him. These funds might consist of checking or savings account balances or various lines of credit. Although only the Hempstead Bank is presently on the IT system, the established procedures would apply to future subscribers, such as other banks and credit card issuers, without major modification.

COMPUTER INCREASING CRIMINAL ARRESTS BY 10 PER CENT

RCA Government and Commercial Systems
Moorestown, N.J. 08057

A computer normally used for scientific purposes has been credited by police authorities with increasing criminal arrests by 10 per cent in Camden, N.J.

Located at the RCA Advanced Technology Laboratories in Camden, the computer makes it possible to deploy police forces more effectively by providing a weekly analysis of the location, day of week and hour that crimes are most likely to occur.

"Computer runoffs, which are easy to interpret, make it possible to concentrate police efforts in predicted high-crime areas during hours when crimes are most likely to occur," according to Joseph Benton, who heads the crime-fighting computer program for the police.

The computer is particularly valuable in deploying Camden's 27-man Tactical Force, a group which has no permanent assignment, but reinforces regular patrols in locations forecast by the computer as trouble spots.

Recently, for example, the computer data indicated a high rate of larceny from automobiles was occurring in the vicinity of Rutgers University. Officers dispatched to the area placed notes on windshields of parked cars, asking drivers to help prevent thefts by keeping doors locked. The result was a drop of more than 95 per cent in larcenies from vehicles during the forecasted period.

The weekly analysis produced by the computer is based on information programmed into it on offenses that occurred during the previous two weeks. Evidence on each crime is broken down according to location, time, day of week, item stolen, mode of operation and details on the victim and perpetrator.

A recent profile on purse snatching, for example, specified nine of the 43 sectors of Camden in which they were predicted to occur, with the highest rate on Thursday and Friday, between the hours of noon and 4:00 p.m., and currency as the prime target. Victims were listed as females, 30 years of age and upward, with attacks occurring chiefly at bus stops. The perpetrators generally were described as being under 18 years of age, ranging in height from 5 feet 6 inches to 6 feet, and weighing between 121 and 140 pounds.

Each seven-day profile run off by the computer is first reviewed by police District Commanders who inform their men on the forecasts, he pointed out.

The computer also produces special reports on request. These can include, for example, reports on the type of businesses most frequently burglarized during the summer months, the correlation between strong-arm robberies and week of the month, type of item most often stolen from cars during the past two months, or any of hundreds of other combinations of crime factors. For more information contact Beryl O'Donovan.

EDUCATION NEWS

HELPING OUT

Western Electric Company, Inc.
195 Broadway
New York, N.Y. 10007

For better or no, the young Huck Finns of yesterday are gone. In today's frenetic society there is precious little time for loafing by the riverbank; youth are quickly caught up in a technological, computer-oriented society that promises the moon but demands early dedication to one of a diversity of specialized fields.

Western Electric people are helping young people make a sound choice. On their own time, with skills honed through experience and with a desire to use these skills in social settings, Western Electric employees around the country are volunteering to help the next generation cope with a frighteningly complex world. Chauncey Herring, Jr. is a good example.

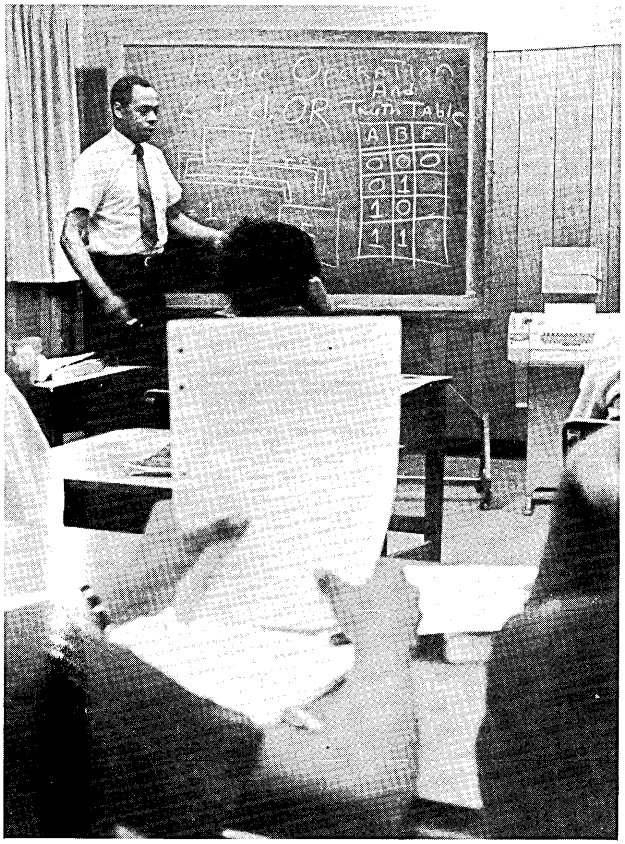
Chauncey Herring is a Western Electric engineer at the company's Princeton, N.J. Research Center. Since last October, he and a dozen Trenton, N.J. junior and senior high school students have been meeting each Tuesday and Thursday night at the "Y" for exercises in basic computer logic and programming. It's part of a computer education program designed, organized and taught by Chauncey for the Central Branch of the Trenton YMCA.

The program is aimed at students interested in possible careers with computers, and includes everything from computer numbering systems through programming logic. And it's not all book learning either.

When he sold the YMCA Youth Director on the course idea last fall, Chauncey also arranged to borrow a mini-computer from the Princeton Junior Museum to give the students actual experience with programming and de-bugging. The class is a long time dream come true for Chauncey. He's been searching for some time for a way to work with kids in an educational setting.

"It's amazing what kids can absorb, if you just present it right," he said. "I remember when we first started. I told them we'd be covering things like Boolean Algebra and Hexidecimal numbers and you could just see the fright in their faces. But I didn't do anything about it right away. I just started teaching the basics at a level they could understand. After a couple of weeks I announced that we weren't going to cover Boolean Algebra after all. Then I told them we'd just finished it."

Chauncey has two main goals for the class: first, to give each class member enough of the basics of computer logic and programming to enable him to go on to further development, either



with a job or more education; and second, to see the class become self-sustaining, with old-timers teaching the basics to newcomers.

In the first area, he reported that one of his students has already found a computer trainee job for the summer and plans to enroll as a computer science major in college this fall. To help the class become self-sustaining, Chauncey periodically reviews recent study material by asking the students to run the class and to present the material to each other.

"That way we get a good idea of how well they understand it and can present it to someone else. When we bring in new kids for the next class, it'll be a lot easier to get to them with another student who's been through the same program and speaks the same language."

DENTAL SCHOOL EXPLORES COMPUTER-AIDED INSTRUCTION

University of Kentucky
Limestone & Euclid
Lexington, Ky. 40506

Dental students at the University of Kentucky "talk" with a computer as part of a program to speed them through their studies. Dedicated to a flexible curriculum that will permit brighter students to complete coursework in less than four years, the College of Dentistry is studying how best to use computer-assisted instruction (CAI).

Four courses involve CAI — oral pathology is taught entirely by CAI, with all third-year Oral Pathology students receiving facts and questions from a typewriter-like IBM 2741 communications terminal and a slide viewer alongside. Dental practice environment, oral anatomy and endodontic technique also have CAI segments ranging from a review of anatomy to 16 problem situations involving simulated patients, their symptoms and histories.

"Our effort is not directed at replacing teachers. There is no substitute for personal teaching and learning. However, because of our increased emphasis on service to the student in a period of manpower shortages and rising costs, we see CAI as one means of varying the rate at which students complete their dental educations."

In a typical student-computer interchange, dental students communicate with an IBM System/360 Model 65 in the university's computing center by means of a typewriter-like terminal. The student signs on with his assigned computer number and begins the program he has chosen. The computer states information about a patient or dental problem and then asks the student a question. The computer analyzes the student's answer, telling him if he was right or guiding him to the right answer if he was wrong. It might suggest that he consult slides projected alongside the terminal. At the end of each session, the computer tells the student his total score.

"The immediate feedback which is a part of CAI is what makes it such a good teaching device," said Prof. Smith. "The student knows right away whether his answer is right or wrong and why. This way he can remember the material better, a fact which has been proved in many educational studies."

CANADIAN COLLEGES AND HIGH SCHOOLS ARE MEMBERS OF DARTMOUTH'S TIME-SHARING COMPUTER NETWORK

Dartmouth College
Office of Information Services
302 Crosby Hall
Hanover, N.H. 03755

Twelve Canadian colleges and high schools are now members of the Kiewit Educational Time-Sharing Computer Network operated by Dartmouth College. The Canadian institutions join some 50 other colleges and high schools in the United States who regularly use the Dartmouth Time-Sharing System (DTSS).

According to officials of the Kiewit Computation Center, the Canadian institutions logged 860 hours of computer terminal time, 11,313 seconds of computer processing time, and stored 128,000 words in memory during the month of March.

The DTSS system, which can handle 160 simultaneous users, and the widely used computer language BASIC, a combination of English and high school algebra, were developed in the early 1960s by a team of Dartmouth undergraduates and Dartmouth President John G. Kemeny and Mathematics Professor Thomas E. Kurtz, director of Kiewit.

The Kiewit Educational Network was extended into Canada in 1971 under an agreement with the firm of Joseph and Chambers, Ltd., of Montreal, sole Canadian representatives of DTSS in that country.

In addition to the Canadian network, Dartmouth provides time-sharing computer services for its 3,800 undergraduate and graduate students and 500 faculty members; some 10,000 students at schools in seven eastern states; a private foundation and a major hospital in New York City; and a number of commercial firms.

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Univac Division of Sperry Rand France, Blue Bell, Pa.	French National Railway Co. (SNCF), Paris, France	UNIVAC 1110 systems (3) for direct message switching in national network to expedite freight car control, keep track of equipment maintenance, prepare train schedules, traffic flow surveys, and compiling statistics	$13 million (approximate)
Computer Terminal Corp., San Antonio, Texas	North American Corp., New York, N.Y.	Purchase of C.T.'s Datapoint equipment	$12 million
Codex Corp., Newton, Mass.	Defense Communications Agency	Data communications equipment and related services for The Fefense Communications systems High Speed Channel Packing Subsystem	$7.5 million (approximate)
Ampex Corp., Marina del Rey, Calif.	U.S. Navy	Model DS-8430 disk storage systems to replace Fastrand drum storage systems and add storage capacity to Univac computers at four Naval data processing centers	$3.15 million
Honeywell, Inc., Tampa, Fla.	U.S. Air Force Oklahoma City Air Material Area, Okla.	Nine AN/UCC-4 multiplexer systems each for a specific military communications site	$2.7 million
Control Data Corp., Minneapolis, Minn.	Washington Metropolitan Area Transit Authority (WMATA), Washington, D.C.	Designing automatic fare collection system for 98-mile subway system being constructed in D.C. and adjacent areas in Md. and Va.; initial phase of contract covers engineering development services; production portion includes negotiated maximum production prices on 4 major types of terminals for first 37 stations of the 86-station system; equipment for remaining stations to be negotiated later; estimate of manufacture, installation, and maintenance of entire system will cost approximately $46.4 million	$2.5 million
Rapidata, Inc., Fairfield, N.J.	New York Telephone Co., New York, N.Y.	A renewed and expanded long term contract to include a second dedicated computer system	$1.7+ million
SYSTEMS Engineering Laboratories, Inc., Fort Lauderdale, Fla.	Sikorsky Aircraft Div., Stratford, Conn.	A large SYSTEMS 86 computer system to be used as the hub of firm's Flight Data Processing Center Ground Station in Stratford	$1.6+ million
Datacraft Corp., Fort Lauderdale, Fla.	Harris-Intertype Corp.	66 computers to be used in a number of products produced by the firm's divisions	$1.5 million (approximate)
Univac Division of Sperry Rand Corp., Blue Bell, Pa.	Societe Europeenne de Propulsion (SEP), Puteaux, Paris, France	UNIVAC 1106, to be delivered in 1973, will process technical and scientific calculations resulting from SEP's activities in both civil and military fields of rocket propulsion	$1.5 million (approximate)
Varian Data Machines, Irvine, Calif.	PRD Electronics, Syosset, N.Y.	A series of R622/i computer systems used in Navy's AN/USM-247 Versatile Avionic Shop Test (VAST) System; PRD Electronics is prime contractor for the program	$1.26 million
Univac Division of Sperry Rand Corp., Blue Bell, Pa.	Companhia Portuguesa de Electricidade (CPE), Lisbon Portugal	UNIVAC 1106 system for scientific work and establishing management information system; later will include real-time monitoring of electric power network throughout Portugal	$1.1 million
Univac Division of Sperry Rand Corp., Blue Bell, Pa.	Lebole Euroconf, S.p.A. of Italy, Arezzo, Italy	UNIVAC 1106 computer system for production control, budgeting, inventory control, general accounting, and payroll processing	$1+ million
SYSTEMS Engineering Laboratories, Inc., Fort Lauderdale, Fla.	Western Electric Co., Winston-Salem, N.C.	A real-time interactive computer graphics system to be used in the Defense Activities Division to generate SAFEGUARD Maintenance Data System (MDS) data frames	$900,000 (approximate)
EMR Computer, Minneapolis, Minn.	Gulf Research and Development Co., Houston, Texas	Upgrading firm's existing EMR 6100 Series Computer System which is used to process seismic exploration data at Gulf's Houston installation	$250,000
Computer Sciences Corp. (CSC), Los Angeles, Calif.	U.S. Passport Office, Washington, D.C.	Research and development of a new form of travel document to replace the present passport	$150,000
Computer Sciences Corp. (CSC), Los Angeles, Calif.	Manufacturers Bank, Los Angeles, Calif.	Performing all data processing required by Manufacturers and its correspondent banks, for five years	——
Honeywell, Inc., Wellesley Hills, Mass.	International Brotherhood of Teamsters, Washington, D.C.	Lease of Series 6000 system known as Titan (Teamsters International — Terminal and Accounting Network) for an on-line network to handle dues, health and welfare accounting, for over 2 million union members in the U.S., Puerto Rico and Canada	——
Honeywell, Inc., Wellesley Hills, Mass.	Suburban Police Automated Information System, Quincy, Milton, Braintree and Weymouth, Mass.	A model 1642 time-sharing system to implement Suburban Police Automated Information System (SPAIS); joint use by 4 communities will provide common source of information pertaining to crime within their jurisdiction	——
TRILOG Associates, Inc.	Cardo Automotive Products,	Total data processing for 3 year period	——

NEW INSTALLATIONS

OF	AT	FOR
Control Data 3400 system	Petroleum Data Consultants, Lafayette, La.	Supporting data processing services to the petroleum industry and to commercial business enterprises
Honeywell Model 2015 system	Associated Hospital Service of Arizona, Phoenix, Ariz. (2 systems)	A variety of hospital- and insurance-related data processing services for 36 member hospitals throughout the state; replaces three Honeywell Series 200 systems
IBM System/3 Model 10	Velva Sheen, Cincinnati, Ohio	Production control, inventory control and financial support functions
IBM System/7	Buckbee-Mears Company, St. Paul, Minn.	Monitoring one of its highly automated production lines that makes a component of color television
IBM System 7	Motion Picture Laboratories, Inc., Memphis, Tenn.	Monitoring the printing of 25 kinds of raw film on each of firm's automated, high-speed printers
IBM System/360 Model 195	Mellon National Bank and Trust Co., Pittsburgh, Pa.	Helping process almost 2 million bank and financial account records each day; the multi-million-dollar system enables reduction of the number of separate computers in use from a high of 22 in 1969 to 3 by mid-1973, and simultaneously serves future marketing support needs of the bank
IBM System/370 Model 135	Bertea Corp., Irvine, Calif.	Production control; involved in every step of design and production processes
NCR Century 50 system	Bowling Green-Warren County Hospital, Bowling Green, Ky.	Post-discharge accounting, payroll processing and general accounting
	Farmers Co-op, Van Buren, Ark.	Managing patronage accounts and other general accounting purposes
	Howard Community College, Columbia, Md.	Administrative and teaching purposes
	Multiple Listing Service of Greater Baltimore, Inc., Baltimore, Md.	Inventory control of homes listed, sales statistics and general accounting
	Peterson-Puritan Co., Danville, Ill.	Inventory control and payroll preparation
	Smith Cabinet Manufacturing Co.,	Payroll, order billing, invoicing, inventory control and accounts receivable
NCR Century 100 system	Anthony Co., Streator, Ill.	Production scheduling, accounts payable and receivable and payroll processing
	Financial Data Corp., Baltimore, Md.	Processing savings accounts, certificates of deposit and mortgages, and general accounting for 11 branches of two firms
	Richland Memorial Hospital, Columbia, S.C.	Accounts payable and receivable, in patient records, inventory control, general ledger and payroll accounting, and medical audit statistics
	Riddle Memorial Hospital, Media, Pa.	Payroll and in-patient records and post-discharge accounting
NCR Century 200 system	City National Bank, Fort Smith, Ark.	Managing its Central Information File
	Sunbrand Corp., Chamblee, Georgia	Order processing, inventory management, sales analysis and manufacturing control
UNIVAC 1106 system	Canadian Department of National Revenue and Taxation, Ottawa, Canada	Management Information System enabling inquiries to be handled from 28 district offices
UNIVAC 1110 system	University of Paris, Paris, France	Use in the scientific research program of the Laboratory for Theoretical Physics and High Energy (system valued at $2.5 million)
UNIVAC 9200 system	Anaconda Company, Sahuarita, Ariz.	Payroll processing and general accounting
	Housing and Commercial Development Inc. (HUD), Newport Beach, Calif. (2 systems)	Business and administrative applications, e.g., patient billing and payroll processing, maintenance scheduling, mortgage loan accounting
UNIVAC 9200 II system	University of Western Ontario Computer Sciences Department, London, Ont., Canada	Supplementing its UNIVAC 9300 computer which is used for student instruction in data processing
UNIVAC 9211 B system	Chem Tech Company, St. Louis, Mo.	Sales analysis, invoicing, inventory control, and general accounting
UNIVAC 9300 system	Louisiana Wild Life and Fisheries Commission, New Orleans, La.	Keeping track of all motor boat registrations and commercial licenses; maintaining data from oyster surveys, records of funds received from Federal Government, and perform payroll and accounting tasks the Commission and the New Orleans Levee Board
	Fred Sanders Co., Detroit, Mich.	Inventory and production control, scheduling and general accounting
UNIVAC 9400 system	ADP Service Center, Colorado State Hospital, Colorado Dept. of Institutions, Pueblo, Col.	Increasing data processing capacity to provide improved handling of management information. office applications and many clinical operations including patient movement; other state institutions will be able to use the computer
	University of Houston's College of Business, Houston, Texas	Student "hands-on" operating experience as well as simultaneously processing problems derived from classroom instruction
Xerox Sigma 8 system	NASA Ames Research Center, Mountainview, Calif.	Simulating flight characteristics of advanced aircraft; will also be used by FAA for aircraft certification studies and research on flying quality requirements by the National Transportation Safety Board for investigation of accidents (system valued at $1.2 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 JUNE 15, 1972

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 1. United States Manufacturers							
Autonetics	RECOMP II	11/58	X	30	0	30	X
Anaheim, Calif. (R) (1/69)	RECOMP III	6/61	X	6	0	6	X
Bailey Meter Co.	Metrotype	10/57	40-200 (S)	8	0	8	0
Wickliffe, Ohio	Bailey 750	6/60	40-250 (S)	37	15	52	0
(A) (6/72)	Bailey 755	11/61	200-600 (S)	7	0	7	0
	Bailey 756	2/65	60-400 (S)	15	12	27	2
	Bailey 855/15	12/72	50-400 (S)	0	0	0	2
	Bailey 855/25	4/68	100-1000 (S)	16	0	16	0
	Bailey 855/50	3/72	100-1000 (S)	0	0	0	12
Bunker-Ramo Corp.	BR-130	10/61	X	160	-	-	X
Westlake Village, Calif.	BR-133	5/64	X	79	-	-	X
(A)	BR-230	8/63	X	15	-	-	X
(4/72)	BR-300	3/59	X	18	-	-	X
	BR-330	12/60	X	19	-	-	X
	BR-340	12/63	X	19	-	-	X
	BR-1018	6/71	23.0 (S)	-	-	-	-
Burroughs	205	1/54	X	25-38	2	27-40	X
Detroit, Mich.	220	10/58	X	28-31	2	30-33	X
(N)	B100/B500	7/65	2.8-9.0	-	-	-	-
(1/69-5/69)	B2500	2/67	4.0	52-57	12	64-49	117
	B3500	5/67	14.0	44	18	62	190
	B5500	3/63	23.5	65-74	7	72-81	8
	B6500	2/68	33.0	4	-	4	60
	B7500	4/69	44.0	-	-	-	13
	B8500	8/67	200.0	1	-	1	5
Computer Automation, Inc.	108/208/808	6/68	5.0 (S)	165	10	175	110
Newport, Calif.	116/216/816	3/69	8.0 (S)	215	20	235	225
(A) (4/71)							
Consultronics, Inc.	4700	4/69	1.8	18	0	18	-
Garland, Texas	DCT-132	5/69	0.9	35	85	120	-
(A)(6/72)							
Control Data Corp.	G15	7/55	X	-	-	295	X
Minneapolis, Minn.	G20	4/61	X	-	-	20	X
(R)	LGP-21	12/62	X	-	-	165	X
(7/71)	LGP-30	9/56	X	-	-	322	X
	RPC4000	1/61	X	-	-	75	X
	636/136/046 Series	-	-	-	-	29	-
	160/8090 Series	5/60	X	-	-	610	X
	921/924-A	8/61	X	-	-	29	X
	1604/A/B	1/60	X	-	-	59	X
	1700/SC	5/66	3.8	-	-	425-475	0
	3100/3150	5/64	10-16	-	-	83-110	C
	3200	5/64	13.0	-	-	55-60	C
	3300	9/65	20-38	-	-	205	C
	3400	11/64	18.0	-	-	15	C
	3500	8/68	25.0	-	-	15	C
	3600	6/63	52.0	-	-	40	C
	3800	2/66	53.0	-	-	20	C
	6200/6400/6500	8/64	58.0	-	-	108	C
	6600	8/64	115.0	-	-	85	C
	6700	6/67	130.9	-	-	5	C
	7600	12/68	235.0	-	-	8	C
							Total: 160 E
Data General Corp.	Nova	2/69	9.2 (S)	-	-	910	-
Southboro, Mass.	Supernova	5/70	9.6 (S)	-	-	190	-
(A) (6/72)	Nova 1200	12/71	5.4 (S)	-	-	1350	-
	Nova 800	3/71	6.9 (S)	-	-	190	-
	Nova 1210, 1220	2/72	4.2;5.2 (S)	-	-	10	-
Datacraft Corp.	6024/1	5/69	54-300 (S)	16	0	16	2
Ft. Lauderdale, Fla.	6024/3	2/70	33-200 (S)	94	13	107	53
(A) (7/72)	6024/5	12/71	16-50 (S)	2	0	2	35
Digiac Corp.	Digiac 3060	1/70	9.0 (S)	78	-	78	8
Plainview, N.Y.	Digiac 3080	12/64	X	16	-	16	X
(A) (5/72)	Digiac 3080C	10/67	X	8	-	8	X

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
Digital Computer Controls, Inc.	D-112	8/70	10.0 (S)	496	87	583	-
Fairfield, N.J.	D-116	1/72	10.0 (S)	69	2	71	-
(A) (6/72)							
Digital Equipment Corp.	PDP-1	11/60	X	48	2	50	X
Maynard, Mass.	PDP-4	8/62	X	40	5	45	X
(A) (5/72)	PDP-5	9/63	X	90	10	100	X
	PDP-6	10/64	X	C	C	23	X
	PDP-7	11/64	X	C	C	100	X
	PDP-8	4/65	X	C	C	1402	X
	PDP-8/I	3/68	X	C	C	3127	X
	PDP-8/S	9/66	X	C	C	918	X
	PDP-8/L	11/68	X	C	C	3699	X
	PDP-8/E	-	4.9 (S)	C	C	3787	-
	PDP-8/M	-	3.9 (S)	C	C	365	-
	PDP-8/F	5/72	3.9 (S)	C	C	2	-
	PDP-9	12/66	X	C	C	436	X
	PDP-9L	11/68	X	C	C	40	X
	DECSystem-10	12/67	700-3000 (S)	C	C	243	-
	PDP-11/20	-	10.8 (S)	C	C	2740	-
	PDP-11R20	-	13.8 (S)	C	C	14	-
	PDP-11/05	-	10.8 (S)	0	0	0	-
	PDP-11/45	-	-	0	0	0	-
	PDP-12	9/69	-	C	C	620	-
	PDP-15	2/61	17.0 (S)	C	C	545	-
	LINC-8	9/66	X	C	C	200	X
						Total: 18456	
Electronic Associates Inc.	640	4/67	1.2	107	60	167	4
Long Branch, N.J. (A) (4/72)	8400	7/67	12.0	20	8	28	1
	PACER 100	-	17.2 (S)	0	0	0	0
EMR Computer	EMR 6020	4/65	5.4	-	-	-	-
Minneapolis, Minn.	EMR 6040	7/65	6.6	-	-	-	-
(A)	EMR 6050	2/66	9.0	-	-	-	-
(4/72)	EMR 6070	10/66	15.0	-	-	-	-
	EMR 6130	8/67	5.0	-	-	48	0
	EMR 6135	-	2.6	-	-	28	8
	EMR 6000	-	-	-	-	53	1
General Automation, Inc.	SPC-12	1/68	-	-	-	1200	-
Anaheim, Calif.	SPC-16	5/70	-	-	-	400	-
(A) (6/72)	System 18/30	7/69	-	-	-	150	-
General Electric	GE-PAC 3010	5/70	2.0	10	0	10	25
West Lynn, Mass.	GE-PAC 4010	10/70	6.0	21	3	24	32
(Process Control Computers)	GE-PAC 4020	2/67	6.0	197	59	256	36
(A)	GE-PAC 4040	8/64	X	45	20	65	X
(6/72)	GE-PAC 4050	12/66	7.0	23	2	25	1
	GE-PAC 4060	6/65	X	18	2	20	X
Hewlett Packard	2114A, 2114B	10/68	0.25	-	-	1182	-
Cupertino, Calif.	2115A	11/67	0.41	-	-	333	-
(A) (8/71)	2116A, 2116B, 2116C	11/66	0.6	-	-	1171	-
Honeywell Information Systems	G58	5/70	1.0	-	-	-	-
Wellesley Hills, Mass.	G105A	6/69	1.3	-	-	-	-
(R) (6/72)	G105B	6/69	1.4	-	-	-	-
	G105RTS	7/69	1.2	-	-	-	-
	G115	4/66	2.2	200-400	420-680	620-1080	-
	G120	3/69	2.9	-	-	-	-
	G130	12/68	4.5	-	-	-	-
	G205	6/64	X	11	0	11	X
	G210	7/60	X	35	0	35	X
	G215	9/63	X	15	1	16	X
	G225	4/61	X	145	15	160	X
	G235	4/64	X	40-60	17	57-77	X
	G245	11/68	X	3	-	3	X
	G255 T/S	10/67	X	15-20	-	15-20	X
	G265 T/S	10/65	X	45-60	15-30	60-90	X
	G275 T/S	11/68	X	-	-	10	X
	G405	2/68	6.8	10-40	5	15-45	-
	G410 T/S	11/69	1.0	-	-	-	-
	G415	5/64	7.3	70-100	240-400	240-400	-
	G420 T/S	6/67	23.0	-	-	-	-
	G425	6/64	9.6	50-100	20-30	70-130	-
	G430 T/S	6/69	17.0	-	-	-	-
	G435	9/65	14.0	20	6	26	-
	G440 T/S	7/69	25.0	-	-	-	-
	G615	3/68	32.0	-	-	-	-
	G625	4/65	X	23	3	26	X
	G635	5/65	47.0	20-40	3	23-43	-
	H-110	8/68	2-7	180	7	255	0
	H-115	6/70	3.5	30	-	30	-
	H-120	1/66	4.8	800	160	960	-
	H-125	12/67	7.0	150	220	370	-
	H-200	3/64	7.5	800	275	1075	-
	H-400	12/61	10.5	46	40	86	X
	H-800	12/60	30.0	58	15	73	X
	H-1200	2/66	9.8	230	90	320	-
	H-1250	7/68	12.0	130	55	185	-
	H-1400	1/64	14.0	4	6	10	X
	H-1800	1/64	50.0	15	5	20	X
	H-2200	1/66	18.0	125	60	185	-
	H-3200	2/70	24.0	20	2	22	-
	H-4200	8/68	32.5	18	2	20	-
	H-8200	12/68	50.0	10	3	13	-
	DDP-24	5/63	2.65	-	-	90	X
	DDP-116	4/65	X	-	-	250	X
	DDP-124	3/66	X	-	-	250	X
	DDP-224	3/65	X	-	-	60	X
	DDP-316	6/69	0.6	-	-	450	-

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
Honeywell (cont'd)	DDP-416	-	X	-	-	350	X
	DDP-516	9/66	1.2	-	-	900	-
	H112	10/69	-	-	-	75	-
	H632	12/68	3.2	-	-	12	-
	H1602	-	-	-	-	-	-
	H1642	-	-	-	-	-	-
	H1644	-	-	-	-	-	-
	H1646	-	-	-	-	-	-
	H1648	11/68	12.0	-	-	20	-
	H1648A	-	-	-	-	-	-
IBM	305	12/57	3.6	40	15	55	-
White Plains, N.Y.	650	10/67	4.8	50	18	68	-
(N) (D)	1130	2/66	1.5	2580	1227	3807	-
(6/71)	1401	9/60	5.4	2210	1836	4046	-
	1401-G	5/64	2.3	420	450	870	-
	1401-H	6/67	1.3	180	140	320	-
	1410	11/61	17.0	156	116	272	-
	1440	4/63	4.1	1690	1174	2864	-
	1460	10/63	10.0	194	63	257	-
	1620 I, II	9/60	4.1	285	186	471	-
	1800	1/66	5.1	415	148	563	-
	7010	10/63	26.0	67	17	84	-
	7030	5/61	160.0	4	1	5	-
	704	12/55	32.0	12	1	13	-
	7040	6/63	25.0	35	27	2	-
	7044	6/63	36.5	28	13	41	-
	705	11/55	38.0	18	3	21	-
	7020, 2	3/60	27.0	10	3	13	-
	7074	3/60	35.0	44	26	70	-
	7080	8/61	60.0	13	2	15	-
	7090	11/59	63.5	4	2	6	-
	7094-I	9/62	75.0	10	4	14	-
	7094-II	4/64	83.0	6	4	10	-
	System/3 Model 6	3/71	1.0	-	-	-	-
	System/3 Model 10	1/70	1.1	-	-	-	-
	System/7	11/71	0.35 and up	-	-	-	-
	360/20	12/65	2.7	7161	6075	13236	1780
	360/25	1/68	5.1	1112	759	1871	1287
	360/30	5/65	10.3	5487	2535	8022	-
	360/40	4/65	19.3	2453	1524	3977	1363
	360/44	7/66	11.8	109	57	166	39
	360/50	8/65	29.1	1135	445	1580	662
	360/65	11/65	57.2	601	144	745	562
	360/67	10/65	133.8	57	6	63	99
	360/75	2/66	66.9	50	17	67	12
	360/85	12/69	150.3	11	1	12	55
	360/90	11/67	(S)	5	-	5	-
	360/190	-	-	13	2	15	-
	360/195	4/71	232.0	-	-	-	48
	370/135	5/72	14.4	-	-	-	-
	370/145	9/71	23.3	-	-	-	-
	370/155	2/71	48.0	-	-	-	-
	370/165	5/71	98.7	-	-	-	-
	370/195	6/73	190.0-270.0	-	-	-	-
Interdata	Model 1	12/70	3.7	175	70	245	100
Oceanport, N.J.	Model 3	5/67	-	-	-	200	X
(A) (4/72)	Model 4	8/68	8.5	270	115	385	40
	Model 5	11/70	X	70	20	90	X
	Model 15	1/69	20.0	40	24	64	X
	Model 16	5/71	X	1	5	6	X
	Model 18	6/71	X	2	6	8	X
	Model 50	5/72	6.8	3	1	4	15
	Model 70	10/71	6.8	130	15	145	110
Microdata Corp.	Micro 400	12/70	1.8-30	100	0	100	-
Santa Ana, Calif.	Micro 800	12/68	1.8-30	1340	400	1740	-
(A) (4/72)	Micro 1600	12/71	1.8-30	50	2	52	-
NCR	304	1/60	X	5	2	7	X
Dayton, Ohio	310	5/61	X	8	0	8	X
(A) (2/72)	315	5/62	7.0	425	300	725	-
	315 RMC	9/65	9.0	125	50	175	-
	390	5/61	0.7	250	375	625	-
	500	10/65	1.0	1000	1700	2700	-
	Century 50	2/71	1.6	200	-	200	-
	Century 100	9/68	2.6	1500	525	2025	-
	Century 200	6/69	7.0	460	215	675	-
	Century 300	2/72	21.0	0	0	0	-
Philco	1000	6/63	X	16	-	-	X
Willow Grove, Pa.	200-210,211	10/58	X	16	-	-	X
(N) (1/69)	2000-212	1/63	X	12	-	-	X
Raytheon Data Systems Co.	250	12/60	X	115	20	135	X
Norwood, Mass.	440	3/64	X	20	-	20	X
(A)	520	10/65	X	26	1	27	X
(4/72)	703	10/67	12.5 (S)	175	31	206	0
	704	3/70	8.0 (S)	195	44	239	30
	706	5/69	19.0 (S)	69	14	83	3
Scientific Control Corp. purchased by Consultronics, Inc., which see							
Standard Computer Corp.	IC 4000	12/68	9.0	9	0	9	2
Los Angeles, Calif.	IC 6000-6000/E	5/67	16.0	3	0	3	-
(A) (6/72)	IC 7000	8/70	17.0	4	0	4	1
	IC-9000	5/71	400.0 (S)	1	0	1	-
Systems Engineering Laboratories	SYSTEMS 810B	9/68	2.6	162	8	170	-
Ft. Lauderdale, Fla.	SYSTEMS 71	8/72	.9	-	-	-	-
(A)	SYSTEMS 72	9/71	1.0	12	3	15	-
(6/72)	SYSTEMS 85	7/72	6.0	-	-	-	-
	SYSTEMS 86	6/70	10.0	24	1	25	-

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
UNIVAC Div. of Sperry Rand	I & II	3/51 & 11/57	X	23	-	-	X
New York, N.Y.	III	8/62	X	25	6	31	X
(A) (4/72)	File Computers	8/56	X	13	-	-	X
	Solid-State 80 I,II, 90, I, II, & Step	8/58	X	210	-	-	X
	418	6/63	11.0	80	39	119	23 E
	490 Series	12/61	30.0	76	14	90	15
	1004	2/63	1.9	1522	610	2132	-
	1005	4/66	2.4	617	248	865	72
	1050	9/63	8.5	136	59	195	-
	1100 Series (except 1107, 1108)	12/50	X	9	0	9	X
	1107	10/62	X	8	3	11	X
	1108	9/65	68.0	103	129	232	58 E
	9200	6/67	1.5	1106	835	1941	725
	9300	9/67	3.4	412	62	474	510 E
	9400	5/69	7.0	82	41	123	83 E
	LARC	5/60	135.0	2	0	2	-
UNIVAC - Series 70	301	2/61	7.0	154	-	-	-
Blue Bell, Pa.	501	6/59	14.0-18.0	20	-	-	-
(A) (5/72)	601	11/62	14.0-35.0	3	-	-	-
	3301	7/64	17.0-35.0	78	-	-	-
	Spectra 70/15, 25	9/65	4.3	23	-	-	-
	Spectra 70/35	1/67	9.2	116	-	-	-
	Spectra 70/45	11/65	22.5	312	-	-	-
	Spectra 70/46	-	33.5	38	-	-	-
	Spectra 70/55	11/66	34.0	14	-	-	-
	Spectra 70/60	11/70	32.0	10	-	-	-
	Spectra 70/61	4/70	42.0	10	-	-	-
	70/2	5/71	16.0	50	-	-	-
	70/3	9/71	25.0	2	-	-	-
	70/6	9/71	25.0	13	-	-	-
	70/7	12/71	35.0	3	-	-	-
Varian Data Machines	620	11/65	X	-	-	75	X
Newport Beach, Calif.	620i	6/67	X	-	-	1300	X
(A) (6/72)	R-620i	4/69	-	-	-	80	-
	520/DC, 520i	12/69;10/68	-	-	-	350	-
	620/f	11/70	-	-	-	199	10
	620/L	4/71	-	-	-	436	125
	620/f-100	-	-	-	-	-	18
	620/L-100	5/72	-	-	-	7	15
	Varian 73	-	-	-	-	-	5
Xerox Data Systems	XDS-92	4/65	1.5	43	4	47	-
El Segundo, Calif.	XDS-910	8/62	2.0	170	7-10	177-180	-
(N)	XDS-920	9/62	2.9	120	5-12	125-132	-
(2/72)	XDS-925	12/64	3.0	10-20	1	10-21	-
	XDS-930	6/64	3.4	159	14	173	-
	XDS-940	4/66	14.0	28-38	3	28-41	-
	XDS-9300	11/64	8.5	25-30	4	25-34	-
	Sigma 2	12/66	1.8	60-110	10-15	70-125	-
	Sigma 3	12/69	2.0	10	0	10	-
	Sigma 5	8/67	6.0	15-40	6-18	21-58	-
	Sigma 6	6/70	12.0	-	-	-	-
	Sigma 7	12/66	12.0	24-35	5-9	29-44	-
	Sigma 9	-	35.0	-	-	-	-

CALENDAR OF COMING EVENTS

Aug. 6-12, 1972: Rio Symposium on Computer Education for Developing Countries, Rio de Janeiro, Brazil / contact: Luiz de Castro Martins, C.P. 38015 - ZC-20, Rio de Janeiro — GB Brazil

Aug. 7-11, 1972: SHARE Meeting, Toronto, Canada / contact: D.M. Smith, SHARE, Inc., Suite 750, 25 Broadway, New York, N.Y.

Aug. 15-17, 1972: Seminar on ADP in Law Enforcement, Washington, D.C. / contact: ADP Management Training Center, U.S. Civil Service Commission, Washington, D.C.

Aug. 21-23, 1972: Sixth Annual Mathematical Programming Seminar and Meeting, Vail, Colo. / contact: George M. Lowel, Symposium Directory, Haverly Systems Inc., 4 Second Ave., Denville, N.J. 07834

Oct. 1-4, 1972: New York State Assoc. for Educational Data Systems' 7th Annual Conference, Fallsview Hotel, Ellensville, N.Y. / contact: Alfred N. Willcox, Educational Data Processing Center, 17 Westminster Ave., Dix Hills, N.Y. 11746

Oct. 3-5, 1972: AFIPS and IPSJ USA-Japan Computer Conference, Tokyo, Japan / contact: Robert B. Steel, Informatics Inc., 21050 Vanowen St., Canoga Park, Calif. 91303

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

Oct. 16-20, 1972: IBI-ICC World Conference on Informatics in Government, Venice, Italy / contact: Intergovernmental Bureau for Informatics (IBI-ICC), 23 Viale Civitã del Lavoro, 00144 Rome, Italy

Nov. 9-10, 1972: Second National Conference of Society for Computer Medicine, Williamsburg, Va. / contact: Society for Computer Medicine, Box M488, Landing, N.J. 07850

Nov. 15-17, 1972: DATA CENTRE '72, Sheraton-Copenhagen Hotel, Copenhagen, Denmark / contact: Data Centre '72, Danish IAG, DIAG, 58 Bredgade, DK 1260, Copenhagen K, Denmark

Nov. 20-21, 1972: 8th Data Processing Conference in Israel, Tel Aviv Hilton, Tel Aviv, Israel / contact: Information Processing Assoc. of Israel, Programme Committee, The 8th Data Processing Conference, P.O.B. 16271, c/o "Kenes", Ltd., Tel Aviv

December 5-7, 1972: Fall Joint Computer Conference, Anaheim Convention Center, Anaheim, Calif. / contact: AFIPS Headquarters, 210 Summit Ave., Montvale, N.J. 07645

Jan. 17-19, 1973: 1973 Winter Simulation Conference, San Francisco, Calif. / contact: Robert D. Dickey, Bank of California, 400 California St., San Francisco, Calif. 94120

Jan. 31-Feb. 1, 1973: San Diego Biomedical Symposium, Sheraton-Harbor Island Hotel, San Diego, Calif. / contact: Dr. Robert H.

(please turn to page 50)

Calendar — Continued from page 49.

Riffenburgh, Program Chmn, San Diego Biomedical Symposium P.O.Box 965, San Diego, Calif. 92112

Mar. 4-9, 1973: SHARE Meeting, Denver, Colo. / contact: D.M. Smith, SHARE, Inc., Suite 750, 25 Broadway, New York, N.Y.

April 10-12, 1973: Datafair 73, Nottingham University, Nottingham, England / contact: John Fowler & Partners Ltd., 6-8 Emerald St., London, WC1N3QA, England

April 10-13, 1973: PROLAMAT '73, Second International Conference on Programming Languages for Numerically Controlled Machine Tools, Budapest, Hungary / contact: IFIP Prolamat, '73, Budapest 112, P.O.Box 63, Hungary

May 14-17, 1973: Spring Joint Computer Conference, Convention Hall, Atlantic City, N.J. / contact: AFIPS Hdqs., 210 Summit Ave., Montvale, N.J. 07645

"THE COMPUTER DIRECTORY AND BUYERS GUIDE" ISSUE OF "COMPUTERS AND AUTOMATION"

NOTICE

The U.S. Postmaster, Boston, Mass., ruled in January 1972, that we may no longer include "The Computer Directory and Buyers' Guide" issue of "Computers and Automation", calling it an optional, thirteenth issue of "Computers and Automation" regularly published in June, and mailing it with second class mailing privileges.

The plan mentioned previously for publishing the directory as a quarterly with second class mailing privileges has been disapproved and disallowed by the Classification Section of the U.S. Postal Service in Washington, D.C.

Accordingly, in 1972 "The Computer Directory and Buyers' Guide", 18th annual issue, will be published in one volume as a book, and mailed as a book.

The domestic price for "The Computer Directory and Buyers' Guide" will be $14.50, but regular subscribers to "Computers and Automation" may subscribe to the directory at $9.00 a year (there is thus no change for them).

"The Computer Directory and Buyers' Guide" issue of "Computers and Automation" has been published in every year from 1955 to 1971, and 1972 will not be an exception.

ADVERTISING INDEX

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

UNIVERSITY OF NAIROBI

KENYA -- openings

LECTURERS -- COMPUTING CENTRE

Four Positions

Applications are invited for the following posts:—

LECTURER (4 POSTS) – COMPUTING CENTRE AC/4/91/72

The lecturers are to give courses and advice to computer users on programming and the applications of computer methods in research. They should have had experience in at least two of the following languages: PLAN, FORTRAN, ALGOL and COBOL. They should be versed in one of the following fields of Computer application: Linear Programming, Simulation, Statistical Analysis.

Applicants should hold a degree which includes subjects in Computer Science, and a higher degree in Computer Science, or should have several years of equivalent experience.

The Central University computing facilities are based on ICL 1902 system.

Salary Range: K£ 1500 + £84, £2256 + £108, £2580 per annum.

Terms of service include membership in: a senior staff annuity fund or F.S.S.U.; a non-contributory Medical Scheme; and a generous housing allowance or in case of contract staff, subsidized housing. Expatriate appointments are for tours each of two years, renewable, and include passage for up to 5 adults on appointment, on termination, and between tours.

Applicants from government or parastatal organizations should forward their applications through the heads of their departments.

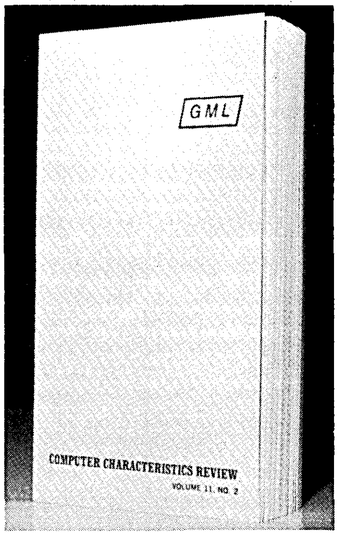
An applicant should give the names and addresses of three academic references, and at the same time request those persons to forward promptly their recommendations in regard to him to the Registrar.

Applications should be made in writing, 6 copies, and give full details in regard to age, marital status, educational qualifications including subjects and degrees, experience, and present employment; and should be addressed to:—

The Registrar,
University of Nairobi,
P.O. Box 30197
NAIROBI,
Kenya.

Applications should reach the Registrar not later than 15th August, 1972.

A Quick, Easy, Fingertip Reference



(POCKET SIZE)

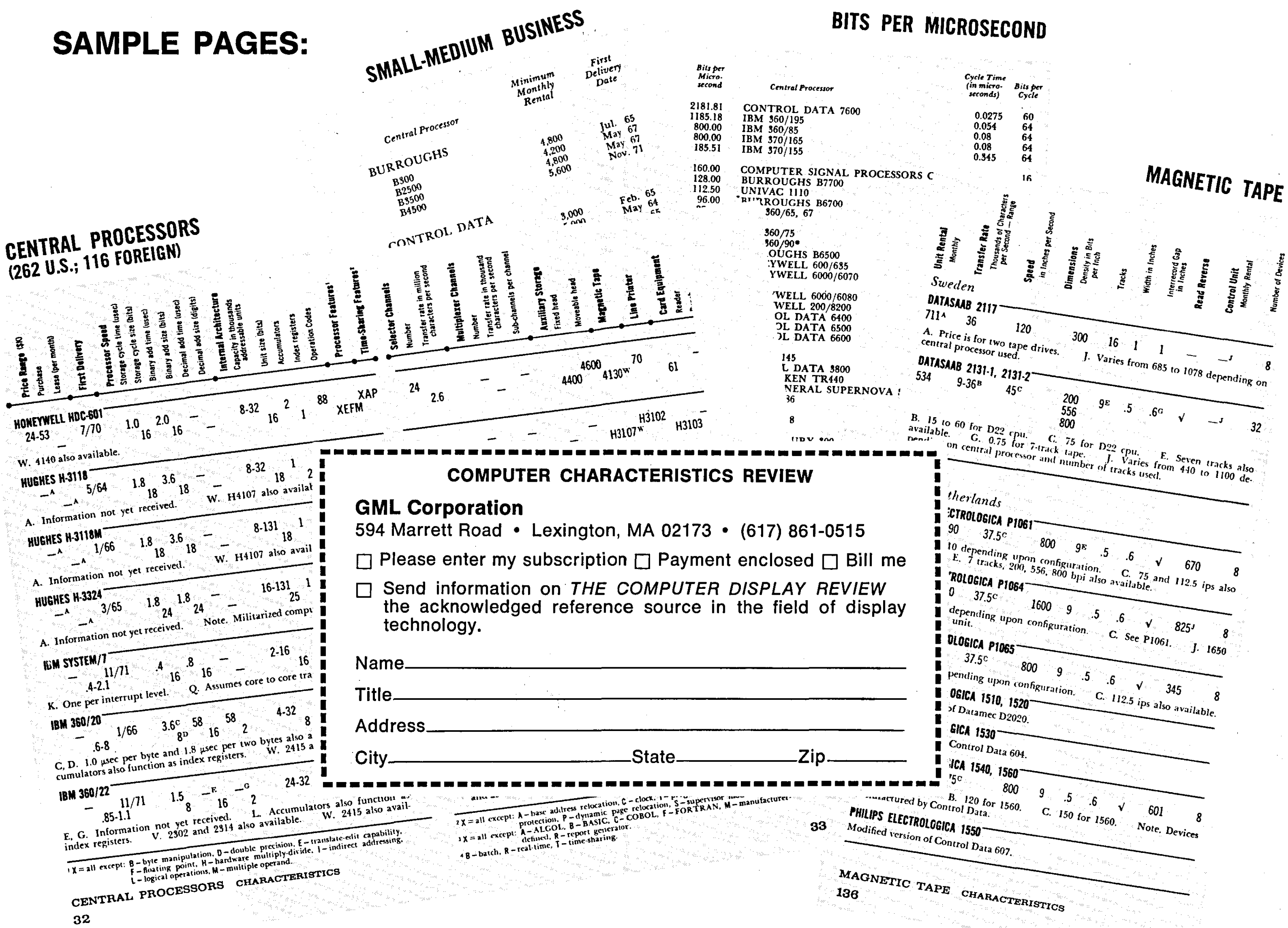
COMPUTER CHARACTERISTICS REVIEW

. . . the most current, complete, compact, professional computer reference source available anywhere.

$25/YEAR

Three issues. Each over 250 pages of objective, authoritative, detailed data on all computers (mini, midi, maxi), associated peripherals (auxiliary storage, magnetic tapes, card equipment, line printers, paper tape equipment, alphanumeric displays, interactive graphic displays), applications, systems configurations and power classification. A directory of manufacturers is standard.

SAMPLE PAGES:



COMPUTER CHARACTERISTICS REVIEW

GML Corporation
594 Marrett Road • Lexington, MA 02173 • (617) 861-0515

☐ Please enter my subscription ☐ Payment enclosed ☐ Bill me

☐ Send information on *THE COMPUTER DISPLAY REVIEW* the acknowledged reference source in the field of display technology.

Name________________________

Title________________________

Address________________________

City____________ State________ Zip________

GML CORPORATION *594 Marrett Road • Lexington, Massachusetts 02173*
Publishers of Computer Display Review *(617) 861-0515*