[redacted]



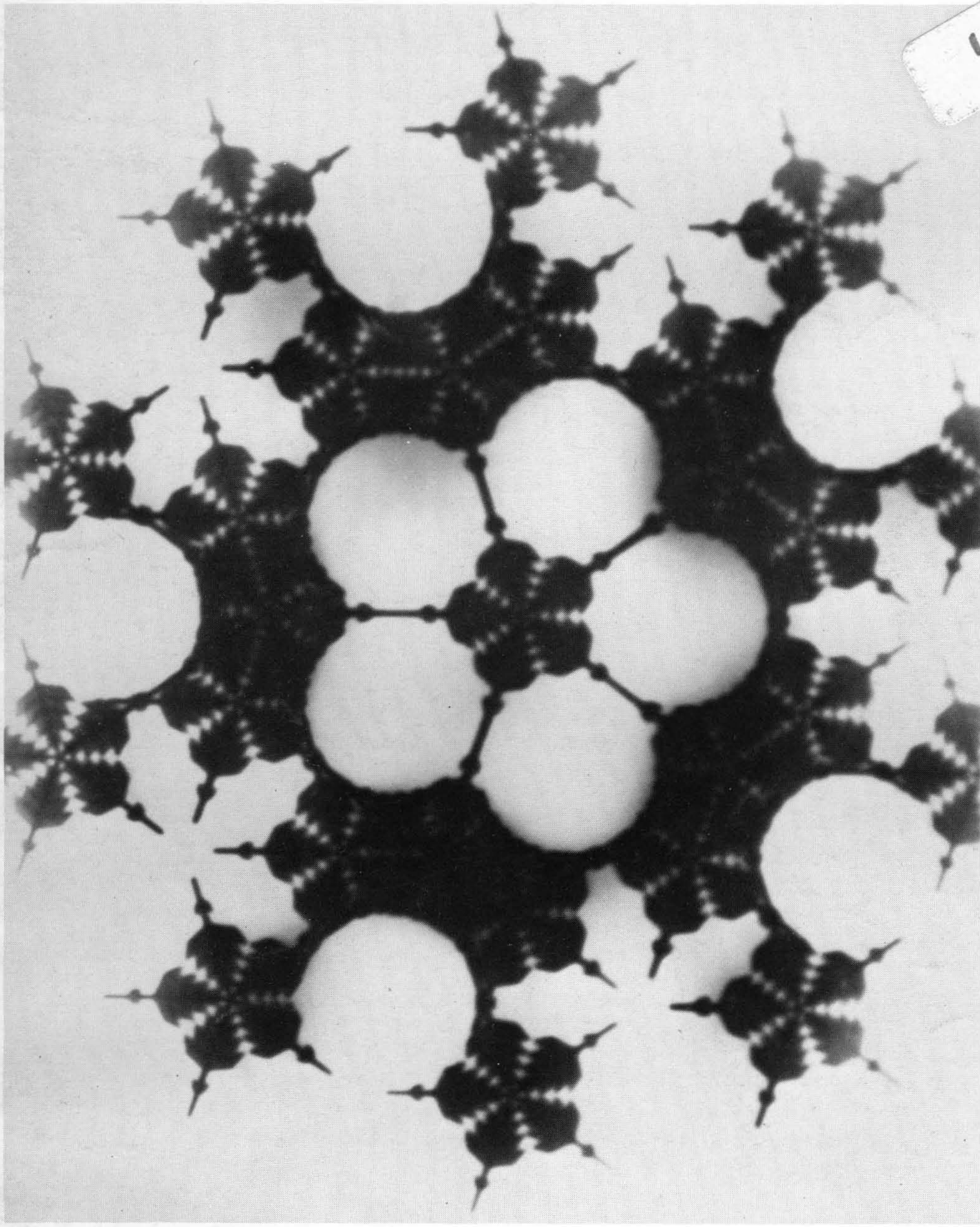
# computers and people

formerly *Computers and Automation*

*July, 1975*
*Vol. 24, No. 7*







*SNOWFLOWER* by *Judy Kintzinger*

[redacted]

# IMPORTANT NOTICE

TO: All foreign subscribers to "Computers and People" (formerly "Computers and Automation") who are outside the United States, Canada, and Mexico

FROM: Berkeley Enterprises Inc., publisher

As a result of circumstances outside of our control, we have adopted the following procedure, effective June 1, 1975:

1. If you had a subscription to our magazine in force on August 1974, we are sending you free the July and August issues of 1975.

2. We ask you to write us immediately and tell us (if possible before August 20, 1975):

   (1) up to what date your latest subscription to our magazine is or was in force;

   (2) when your subscription was paid for;

   (3) how much you paid; and

   (4) in what way you paid.

3. If you have failed to receive any issues to which you are entitled, please write us at once and ask for those issues. We shall try to arrange that those issues are sent to you promptly.

4. Effective June 1, 1975, the price for subscriptions to "Computers and People" outside of the United States and Canada is as follows:

| Period | Without Directory Issue | With Directory Issue |
|---|---|---|
| One Year | $17.50 | $32.50 |
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   Berkeley Enterprises Inc.
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   Newtonville, Mass. 02160, U.S.A.

6. All subscription correspondence should be directed to us.

Announcing plans for a new quarterly magazine:

# COMPUTER GRAPHICS AND ART

To: All persons interested in: Applied Arts and Graphics / Architectural Graphics / Cartography Systems / Computer Aided Design / Computer Assisted Instruction in Computer Graphics / Computer Graphics in Physics, Chemistry, Mathematics, and Other Sciences / Computer Graphics in Literature, Semantics, Fine Arts, Applied Arts, and other Fields / Computer Graphics in Business, Industry, and Other Branches of Knowledge / Interactive Graphics Languages / Courses in Computer Graphics / ....

Dear Colleague,

At the present time we are exploring the possibility of publishing a new magazine on interdisciplinary computer graphics and computer art aimed at the college level. We need your feedback concerning the graphic interests that you have and that you know of. We want this magazine to be useful to you and your colleagues.

Accordingly, this is your invitation to submit material and to begin subscribing (or indicate your intention of subscribing) to

COMPUTER GRAPHICS AND ART

a new quarterly to be published starting probably in January 1976, and for which I have been asked to be the editor.

At the present time an advisory board of distinguished people and a group of contributing editors well known in graphic fields are being assembled. Your suggestions and nominations will be welcome.

You and your colleagues are cordially invited to submit papers, articles, computer graphics, photographs, reviews, computer art, ideas, etc. — no holds barred — for us to consider for publication. In addition, your suggestions about authors whom you would like to have papers from will be most welcome. One of our goals is to publish materials on computer graphics early; and then authors can more quickly establish their professional claims for origination of good ideas and programs. Every author receives permission to reprint his or her material unlimitedly, although the magazine is copyrighted by the publisher.

We look on subscribers as colleagues in a mutual effort, and not as listeners in a lecture room.

Your help and cooperation in this mutual undertaking is warmly invited and will be most appreciated. May we hear from you?

Cordially,

Grace C. Hertlein
Editor, "Computer Graphics and Art"
Associate Professor
Department of Computer Science
California State University, Chico
Chico, Calif. 95926

*Here is your chance for feedback to us:*

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

TO: COMPUTER GRAPHICS AND ART
Berkeley Enterprises, Inc., Chico Branch
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( ) 1. Yes, please enter my annual subscription to the quarterly COMPUTER GRAPHICS AND ART:
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( ) 7. I suggest you send information to my friends and associates whose names and addresses follow:

______________________________________ *A

8. Any Remarks or Comments?____________________

______________________________________

______________________________________ *A

- - - - - - - - - - - - - - - - - - - - - - - - -

Name______________________________Title________

Organization___________________________________

Address________________________________________

*A - attach paper if needed

*Vol. 24, No. 7*
*July, 1975*



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|---|---|
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NOTE: The above rates do not include our publication "The Computer Directory and Buyers' Guide". If you elect to receive "The Computer Directory and Buyers' Guide," please add $12.00 per year to your subscription rate in U.S. and Canada, and $15.00 elsewhere.

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**computers and people** formerly *Computers and Automation*

## *The Computer Industry*



## *Computer Applications*



## *Computers and Society*

*The magazine of the design, applications, and implications of information processing systems — and the pursuit of truth in input, output, and processing, for the benefit of people.*



*Front Cover Picture*

The snowflake design (but fivefold instead of sixfold), rotated and repeated, was produced by a computer program on a microfilm plotter. Then the microfilm was manipulated with photographic techniques.

Judy Kintzinger was an August 1974 graduate of the Dept. of Computer Science, Univ. of Iowa, Iowa City, and became a programmer at Sears Tower in Chicago. She was a student of Professor Grace C. Hertlein, Art Editor of *Computers and People,* who taught a course in computer graphics for the School of Art and Art History at the University of Iowa in the 1974 summer session.


For more information on
*PEOPLE AND THE PURSUIT OF TRUTH*
See the announcement on the back cover.


*Key*

| | | |
|---|---|---|
| [A] | — | **Article** |
| [C] | — | **Monthly Column** |
| [E] | — | **Editorial** |
| [F] | — | **Forum** |
| [N] | — | **Newsletter** |
| [R] | — | **Reference** |

**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.

CORRECTION: The following entries should have appeared in the Table of Contents of the June issue:

## EDITORIAL

# Computer People and Deeply Political or Social Issues

In 1969, which was six years ago, the Association for Computing Machinery voted on a "Question of Importance":

> Shall the Constitution of the ACM be revised to permit Association comment or action on deeply political or social issues?

The result was: yes, 2059; no, 7938.

Two examples of issues (with political or social implications) about which computer people and the ACM might consider taking a position are:

> (1) Supplying computers and weapons systems involving computers to foreign countries is a threat to world peace, and hence sending such things should be opposed.
>
> (2) On-line patient care involving computers is too uncertain and dangerous to be safely implemented any time in the near future, and legislation to prevent it is needed.

These issues are quoted from an editorial by the President of the ACM in the May 1975 issue of the "Communications of the ACM".

Three more examples of issues with political or social implications are:

> (3) Supplying computers and data base systems to the governments of countries which are dictatorships can result in vast infringement of rights of privacy and civil liberties for the citizens of those countries, and hence should be opposed.
>
> (4) Computer systems for large complex anti-ballistic-missile networks are not able to be effectively tested under real conditions, and so cannot be made reliable, and hence should be opposed.
>
> (5) Applying computers to the design of systems for the dissemination of poison gas, and for bacteriological and radiological warfare, is for many reasons morally wrong, and hence should be opposed, and participation in such system design should also be opposed.

---

It is regrettable that the ACM — through a provision in its Constitution and a vote taken six years ago — should find itself so confined. Those six years have seen: the Watergate revelations; the resignation in disgrace of a president of the United States; the defeat of the United States and its policies in Vietnam; and investigations of the U.S. Central Intelligence Agency, revealing its record of interference in the domestic affairs of other countries and the United States, including participation in the assassination of leaders opposed to policies of the United States. And the ACM and its Council find themselves bound to make no comment and to take no action on any political or social issue which can be classified as "deeply political or social"!

---

The policy of this magazine is to discuss, comment on, and present many sides of all kinds of issues relating in one way or another to computers. If the issues are political or social, fine. If the issues are business or industrial or economic, fine. If the issues arouse heated controversy, fine. If only mild controversy is aroused, also fine.

The worth of a forum or an association is diminished when it stops itself from talking, discussing, commenting, or making recommendations, on any selected class of important issues.

The ACM is an important and respected professional organization. It can wield a great influence for good, responsible, and humane uses of computers. Whe the ACM is silent and cannot express its professional views for these constructive purposes, the entire computer industry loses.

Edmund C. Berkeley

*Edmund C. Berkeley*
*Editor*

# MULTI-ACCESS FORUM

```
// FOR
*ONE WORD INTEGERS
*IOCS(TYPEWRITER)
*IOCS(KEYBOARD)
*LIST SOURCE PROGRAM

      INTEGER OUTPT(60),OPSEQ(60)

      DIMENSION INPUT(11)

      DATA OUTPT/60*' '/
      DATA OPSEQ/1,2,3,11,4,5,3,6,3,7,1,11,8,9,5,11,1,2,3,11,4,5,3,6,3,7,
     1,1,11,1,2,3,11,8,10,1,10,5,3,11,8,9,5,11,1,2,3,11,8,10,1,10,5,3,11
     2,11,11,11,11/

    5 READ(6,15)INPUT
      DO 10 I=1,60
      K=OPSEQ(I)
      OUTPT(I)=INPUT(K)
   10 CONTINUE
      WRITE(1,15)OUTPT
   15 FORMAT(60A1)
      GO TO 5
      END

FEATURES SUPPORTED
 ONE WORD INTEGERS
 IOCS

CORE REQUIREMENTS FOR
 COMMON      0  VARIABLES     136   PROGRAM      78

END OF COMPILATION

// XEQ
```

**Figure 1. FORTRAN Program for Maximdij Substitution**

## MAXIMDIJ PUZZLES FOR MAY AND JUNE — SOLUTIONS AIDED BY A FORTRAN PROGRAM

*John McCormick*
*Ken Cook Transnational*
*9929 West Silver Spring Rd.*
*Milwaukee, Wisc. 53225*

Figure 1 shows a short FORTRAN program which enables me quickly to test guesses of solutions to the MAXIMDIJ puzzles. This program enables me to plug in values and makes solutions quite easy. Took about 12 tries for April's puzzles, but only 5 tries for May's. Got it the same day as the magazine arrived. Figure 2 shows the sequence of guesses for the May puzzle.

Operating instructions: Just assign a numeric value from 1 to 10, and set array elements in data statement in order to plug characters into correct slots (and do not make a frequency count).

```
THEXSRNWAO
THE XSERENT WAS THE XSERENT THE WOTOSE WAS THE WOTOSE
THEPSRNWAU
THE PSERENT WAS THE PSERENT THE WUTUSE WAS THE WUTUSE
THEPRSNWAI
THE PRESENT WAR THE PRESENT THE WITIRE WAR THE WITIRE
THEPRNSWAU
THE PRENEST WAR THE PRENEST THE WUTURE WAR THE WUTURE
THEPRSNFOU
THE PRESENT FOR THE PRESENT THE FUTURE FOR THE FUTURE
```

**Figure 2. Substitutions for the May puzzle**

```
IFTSORXN   .
IF IT IS OR XO IT.IF IT IS NOT OR XO NOT XO IT.
ITSFORXN   .
IT IS IF OR XO IS.IT IS IF NOS OR XO NOS XO IS.
IFTSOKXN   .
IF IT IS OK XO IT.IF IT IS NOT OK XO NOT XO IT.
IFTSOKDN   .
IF IT IS OK DO IT.IF IT IS NOT OK DO NOT DO IT.
```

**Figure 3. Substitutions for the June puzzle**

The program worked again for June's puzzle. Took about 4 minutes due to comtemplation cycle of operator, choosing guesses.

1) Three 2 character words with same first letter. Must be: "IF, IS, IT".
2) Using "IF IT IS" — 3 character combination must be "NOT". That makes a 2 character combination starting with "O". The word ending with "O" can't be "SO"; plug "X" in as unknown.
3) Assuming "OR" combination correct, try different patterns of "IF, IT, IS".
4) No good. Think of 2 character word starting with "O", not "OR", "OF", etc. Try "OK"!
5) Must be "DO"!

Should have skipped the second trial. Could have had it in 3 tries.

Figure 3 shows the sequences of guesses for the puzzle in the June issue.

One question: What does MAXIMDIJ stand for? The "MAXIM" portion I understand. The "DIJ" has got me. DOW JONES INDUSTRIALS" in a code?

Editor's Reply: "DIJ" is short for "DIGIT". This word refers to the fact that regularly only 10 different characters represented by 10 different digits or signs are used. We can't use "dig" for short for "digit", because the sound of "g" in the word "dig" is wrong. □

## AN INTERCONTINENTAL DIALOG ABOUT "COMPUTERS AND PEOPLE"

*Dennis Jarret, Barge "Mo"*
*Swan Dock, Battersea Church Road*
*London SW1, England*

(The editor replied to Mr. Jarret's letter by squeezing his remarks— marked E — into spaces between the sentences in the letter.)

Look, it's a really good paper and I agree with your editorial policy and I like the articles and they're either genuinely interesting or genuinely useful (I'm a freelance journalist in DP). ((E: I'm glad you think so.)) I only wish I could afford some of the other things you publish.... ((E: Tell us what they are — maybe we can do something.))....

BUT

how come I get my copies in batches of three from someone in Switzerland? ((E: This is not correct.)) And how come they're always at least two months out of date (Jan., Feb. and March all arrived May 17)? ((E: This should not happen.)) Now I'm not complaining too much, but I think I'd like to read January's issue in say, March, at the latest... ((E: Of course. The arrangement with the company in Switzerland stopped as of the end of May.))

Still, as I say I like the paper too much to complain too aggressively. It's one of the best industry papers around — certainly there's nothing to touch it over here, except possibly a science-for-the-people alternative-technology mag called Undercurrents. ((E: I'd like to see that — send me a copy?))

Who's Thomas Land? ((E: A good person — look him up.))

And why don't you carry more European stuff? Or indeed more non-US matter? ((E: Would like to.)) There is life outside America: we don't exist just to tend the graves of your forefathers. ((E: Of course.))

How about SCRAPBOOK, a nice easy-to-use cheap database manager for non-technical people to use on an everyday basis? ((E: What is this? Please tell me.)) Great for text-editing, information retrieval, file updates, cross-referencing: an ordinary man's (or woman's) MIS. That's being done at the National Physical Lab over here, where they've got a lot of man-machine interaction projects that deserve more exposure. ((E: Please send me a copy.)) Particularly they have a guy called Chris Evans working on it — he's a psychologist, which sadly seems to be the best way to approach the interface between people and computers ... outsiders seem to be the only people capable of seeing that relationship at all constructively. ((E: Tell me more.)) Tomeski's piece in your March issue threw up enough cliches to pave the road to Judy Garland's version of heaven.

And how about our very own National Computing Centre? Nothing like it in the world — a kind of government-sponsored super-users-association. ((E: Tell me more.))

And how about the EEC's imminent attempt to prosecute IBM World Trade in Europe on lines similar to Justice's antitrust case? ((E: Tell me more.))

There are things happening here. ((E: Of course. Please tell me. I'm not good at telepathy.))

Meanwhile, why don't you promote the People's Computer Company a bit more — or at all? ((E: Maybe we can.)) Now they seem a bunch of people whose views on computing and humanity seem to mesh with yours.

Oh look, I can't keep rabbitting on like this. ((E: Please keep it up.)) You're doing a great job. All power to you, and best wishes, etc. ((E: Thanks.)) □

## ADAPSO APPOINTS THREE TO ITS 1975 SUMMER FELLOW RESEARCH PROGRAM

*J. L. Dreyer, Exec. V.P.*
*ADAPSO*
*210 Summit Ave.*
*Montvale, N.J. 07645*

The Association of Data Processing Service Organizations (ADAPSO) has named two law students and a graduate lawyer as its first Summer Fellows.

The Fellows will concentrate their legal research on these topics:

- Collection of all state and local sales, use, property and other taxes with regard to hardware and software products and services.
- Analysis of various privacy legislative proposals on the Federal, state and local levels.
- Analysis of various Electronic Funds Transfer Systems proposals.
- Contracts.
- Industry Standards.

The Fellows were selected from among nearly forty applicants. They are:

Mr. Robert Goldman, Brooklyn, N.Y., presently studying for his J.D. degree at Columbia University School of Law. He holds a New York State Regents Scholarship and the degree A.I.L.E. (Accelerated Interdisciplinary Legal Education).

Ms. Elaine Shea, New York, N.Y., presently studying for J.D. at Rutgers University School of Law; she is a member of the staff of the "Rutgers Journal of Computers and the Law". Ms. Shea holds a B.A. from Manhattanville College.

Ms. Lilli Anne Yanow, Elizabeth, N.J., presently studying for Master of Laws from Columbia University School of Law. Ms. Yanow holds a doctorate from New York University and a J.D. from Rutgers University. At Rutgers, she was Editor of its "Journal of Computers and the Law".

ADAPSO represents the computer services industry; its members consist of companies in the fields of data centers, software, timesharing, and facilities management.

### MAGNETIC DRUM DONATED TO UNIV. OF HAWAII

*Adrian Delfino*
*Maintenance Operations Center*
*San Francisco International Airport*
*San Francisco, Calif. 94128*

United Airlines has donated a Bryant magnetic drum storage unit to the University of Hawaii for the school's use in data processing.

The equipment is a peripheral random access device in the Collins C-8500 computer system; it was used by United with automatic test equipment at its maintenance operations center in San Francisco.

Acquired by the airline in 1969, the Bryant drum receives data from the Collins computer and stores these until information is retrieved by the computer or replaced with new data. In addition to power systems, the unit's major functional parts include head select and reading/writing data logic, timing generator, clock reader/writer, and file test logic and circuits. The Bryant drum is provided with 1,024 data heads and 8 clock heads and has a storage capability of four million bytes.

### COMPUTER HATCHES EGG FOR UKRAINIAN MONUMENT

*Jim Bapis*
*Public Relations Office*
*University of Utah*
*308 Park Building*
*Salt Lake City, Utah 84112*

The expertness of a computer scientist at the University of Utah has ended a Canadian villages's long search for a unique but endemic monument to the town's Ukrainian heritage. Associate Professor Ronald Resch succeeded in designing a massive Easter egg replica destined to tower some 30 feet over a memorial park in Vegreville in the western province of Alberta. It will stand as a multi-colored monument to the farming community's Ukrainian inhabitants, where the folk art of elaborately decorating Easter eggs by hand is steeped in tradition.

These intricately designed eggs are called "pysanky" by the Ukrainians from the verb "pysaty," which means "to write." It is a revered custom they brought from their homeland. After previous failures by others at building the egg from concrete, wood, fiberglass and plastics, the Canadians turned to Mr. Resch, who has done extensive research in geometric designs. The scientist gave them what they wanted: a lightweight, precisely defined egg-shaped structure fabricated with materials that would assure permanence of colors.

Mr. Resch, a 35-year-old associate research professor, says he and his group solved the egg construction problem by achieving what may be a first mathematical definition of the shape of an egg. "In researching the problem we found that no one had ever defined an egg's shape in mathematical terms," the U professor explained. "To define and construct an egg on this scale required a precise analytical definition."

The egg will be comprised of 1,600 pieces of 1/16 of an inch-thick aluminum siding, equally divided between star-shaped pieces and equilateral triangles bolted together. Having completed computation of the geometry, Mr. Resch now will cut the individual parts with a custom-made tool. Also each part will be engraved with an identifying code to simplify assembly of the modules when they reach Vegreville.

The parts will be chemically colored and finished at the Ogden, Utah, plant of the Permalloy Corporation. Final details depend on the Ukrainian design planned for the egg's surface.

Professor Resch says a second benefit of the project was the development of a new structural geometry that can be applied to a large number of unusual architectural structures.

### TRUTH AND SOCIAL CONCERNS IN SYSTEMS

*Pete Johnson, President*
*Human Integral Systems*
*102 Charles St., Suite 223*
*Boston, Mass. 02114*

I am delighted to see the progress of the positive social outlook of "Computers and People" as expressed in your new publication "People and the Pursuit of Truth". The word truth, in these times of double-speak, has become very poorly defined and understood. Rarely is truth practiced. The very pressing danger of this rarity is that concepts, systems, and societies built on false premises will fall. The pursuit of truth must be inherent in all system development and operation activities.

Future technical success at every level must become a function of truth and humanistic social awareness. Otherwise a free society will not be able to tolerate increasing use of computing machine tools. Truth should be a system quality as fundamental as utility and reliability. Facts can't be continually forced to fit a falsely perceived reality. (MIS, anyone?)

Please continue to print some if not all of your social system articles in "Computers and People" so dedicated technicians will have an opportunity to become aware of the human side of systems. Technical purists that resist mixing social and technical articles remind me of the food faddist who restricts his diet to brown rice. It isn't enough for health, safety and freedom!

Another reason technicians may resist social articles relates to the "Scarsdale effect" which is the phenomenon that occurs when a child has been taught an ideal but false reality and is shocked to

*(please turn to page 17)*

# MINICOMPUTERS AND MICROCOMPUTERS:

## Their Impact on the Computer Services Business

*William R. Roach*
*Executive Vice President*
*Optimum Systems Inc.*
*2801 Northwestern Parkway*
*Santa Clara, Calif. 95051*

*"In order to take advantage of new opportunities and protect current market positions, new investment will be required, and added risk can be expected."*

This article discusses the impact of minicomputers and microcomputers on the computer services business, and the implications for computer service vendors. I have tried to discuss mainly the impact that minis and micros might have on service vendors, both on small business and large business customers. In addition I have tried to assess the technical impact minicomputers and microcomputers are having on computer architecture, on data communications, and terminals or data collectic equipments, and how this may affect the operations and the business of computer service vendors.

An example of a minicomputer system is the Eclipse System from Data General. It is a system that many small businesses are looking at now to do their entire data processing job. In addition, large companies are looking at this and other systems like it to serve remote locations in a distributed processing system — in other words, a remote batch terminal with local processing capability.

A microcomputer is one or two chips of silicon or similar material the size of a typewritten capital M with circuits deposited on it. What a difference there is from the tall box of the Eclipse System! The difference, of course, is in the electronics. Yet architecturally and functionally the two are similar.

From the point of view of similarities: the architecture, general nomenclature, and many end user applications are similar for both minicomputers and microcomputers. (See Figure 1.) The differences, however, are substantial.

Minicomputers use discrete technology, which means basic logic functions are each separate components — either boxes or separate groups of circuits. In microcomputers, most of these functions are integrated on one or just a few individual chips. As a result of this use of advanced state-of-the-art technology, the price of a microcomputer can be less than one-tenth the price of a minicomputer. However, there are limitations currently in the capacity of microcomputers due to current microcircuit manufacturing technology. These limitations will be eliminated in the future.

Another reason for the lower price is that the software for microcomputers is only now emerging, whereas minicomputers have a relatively established operating as well as applications software in many cases. Support for microcomputers is almost nonexistent at the present time, whereas minicomputers usually offer a "no frills" support.

It is important to point out that the microcomputer is still emerging, and that almost every vendor

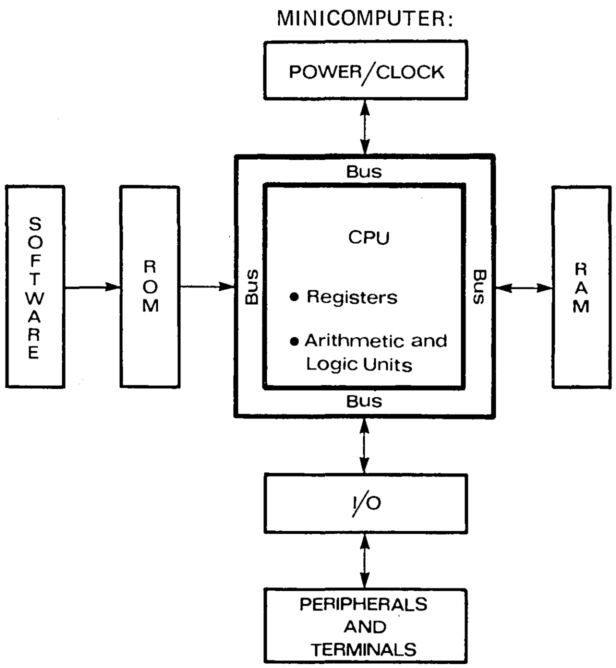
| | MINICOMPUTER | MICROCOMPUTER |
|---|---|---|
| SIMILARITIES | • Architecture<br>• Nomenclature<br>• Many Applications | |
| DIFFERENCES | • Discrete Circuit Technology<br>• Price $3K to $25 K<br>• Word Size 8-32 bits<br>• Main Memory Size 4K-16K Words<br>• Established Software<br>• "No Frills" User Support | • Integrated Circuit Technology<br>• Price $500-$1,500<br>• Word Size 4-16 bits (current)<br>• Main Memory Size 500-4K Words<br>• Emerging Software<br>• Almost No User Support |

**Figure 1: Definitions**

Based on a talk given at the ADAPSO 42nd Management Conference, Mexico City, April 1975.

can specify different definitions and different objectives for current product design. But the key point is that microcomputers and minicomputers are similar in function and architecture, and the differences have to do primarily with capacity, price, software, and related support levels. Many of these differences may be eliminated over time, as technology advances and microcomputers become more familiar in application and user environments.

We see in Figure 2 that the same design really is used in both the minicomputer and the microcomputer, but the bracketed system components are integrated on one or several very small integrated circuit chips. This is what the microcomputer is all about.




MICROCOMPUTER:
ONE OR SEVERAL LSI (Large Scale Integration) CHIPS

**Figure 2: Mini/Microcomputer Architecture**

We have identified six different ways in which minicomputers and microcomputers can impact the computer services vendors. (See Figure 3.) Minicomputers already are well known for their ability to displace computer services. A customer, for example, who purchases a Basic/Four System or an IBM System/32 no longer will need a computer service vendor for his primary EDP activities. A larger company which uses extensive outside timesharing services can, for example, purchase a Hewlett-Packard 3000, or DEC System or Xerox System and pull this outside expenditure in-house. As the cost of peripherals, printers, and low-speed terminals declines, then in-house minicomputers will become even more of a threat to computer services.

However, there also are substantial disadvantages to in-house computer operation for certain users. We will talk about them later in this article.

Minicomputers also are being used in many large batch terminals to extend the capability for data entry, correction, and local processing. Minicomputers already are extensively used to develop concentrator-type message switching services that enhance communication networks. As such, they make it easier for the in-house user to develop his own distributed computing system.

Microcomputers are capable of replacing some minicomputers and carrying out similar functions at a substantially reduced cost. Thus most of the impacts of minicomputers will be felt more strongly as a result of microcomputers. For example, microcomputers will be able to extend terminal capability even further than minicomputers can, upgrade data collection devices by giving them more intelligence and memory capacity, and provide an expanded capability for almost every peripheral and control component on any computer system, large or small. As such they will allow in-house users to do substantially more with their computing systems. Microcomputers will also allow users to develop more sophisticated and comprehensive distributed computing systems based on entirely new concepts in state-of-the-art computer system architecture.

These impacts mostly sound negative for computer service vendors, and this is what has been widely published in the press and trade journals. But is this really the case? At Optimum Systems we think it is definitely not the case.

*MINICOMPUTERS*

- DISPLACE COMPUTER SERVICES
- ENHANCE REMOTE TERMINALS
- EXPAND CAPABILITY OF COMMUNICATION NETWORKS

*MICROCOMPUTERS*

- REPLACE SOME MINICOMPUTERS
- ENHANCE TERMINALS (EVEN MORE), DATA COLLECTION DEVICES, AND COMPUTER SYSTEM COMPONENTS
- ENABLE NEW COMPUTER SYSTEM ARCHITECTURE, e.g., DISTRIBUTED COMPUTING

**Figure 3: Impact on Computer Services**

There are many reasons to be concerned about the negative impact of minicomputers and microcomputers on the services business. However, there are probably more reasons to be happy about the advancement of technology. Figure 4 illustrates the relative concern, or happiness, which we think service vendors should show toward each of the minicomputer and microcomputer impacts shown in the previous figure. In the remainder of this article we will explore each of these in some detail.

Only in the case of small business computers should service vendors be extremely concerned. In the case of all other impacts, we believe any concerns are more than outweighed by the opportunities that exist for service vendors to exploit the benefits that the minicomputers and microcomputers offer computer users. For example, an enhanced terminal or an enhanced data collection system made possible thru a microcomputer can lower the cost of providing services, as well as reduce the cost of in-house computer operation. This factor, combined with the inherent economic advantage of providing computer services on a shared-cost approach suggests that at worst the services vendors will be no worse off than before,

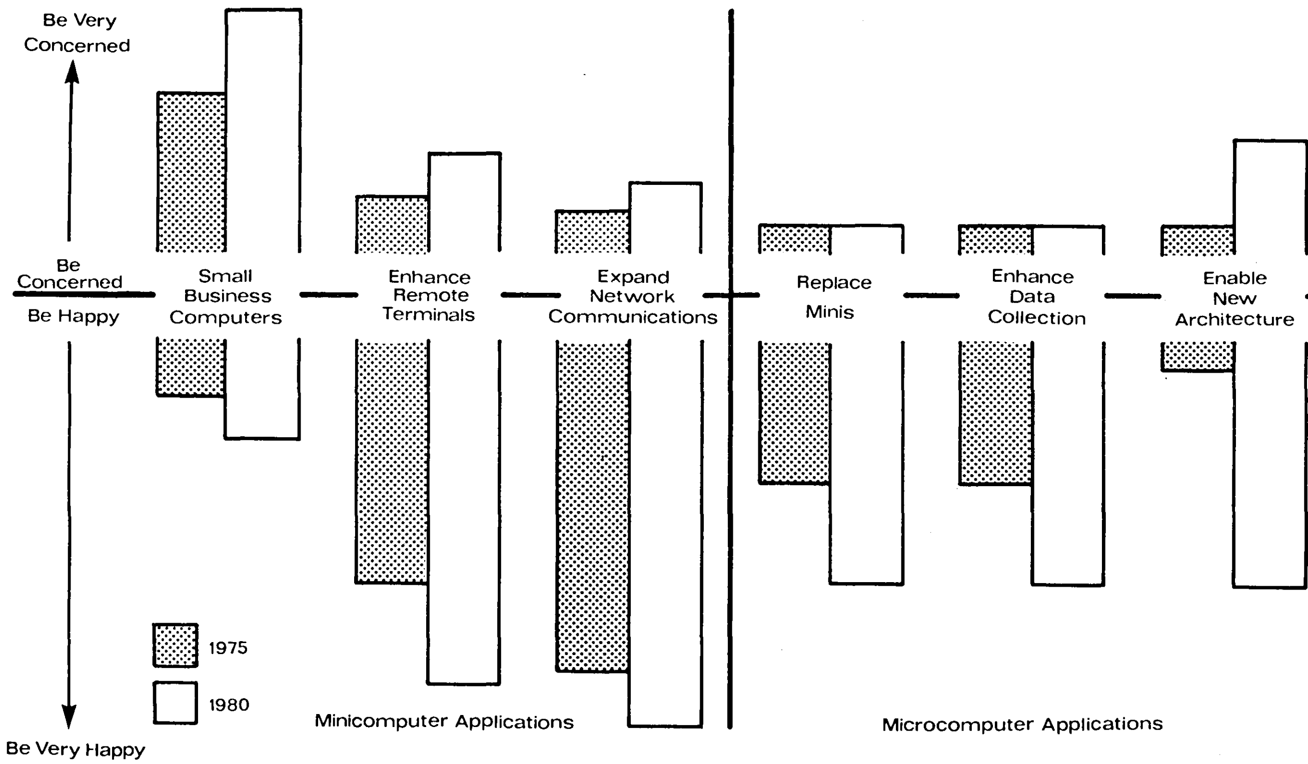



**Figure 4: Service Vendor Posture Toward Mini/Microcomputers**

and at best will be able to take faster and more opportunistic advantage of the technical developments, providing new approaches, services, and specific applications to users. Also as technology grows harder for users to keep up with, users will look more to service vendors to interpret and implement these developments.

Now we will examine each of these impacts in detail.

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- SMALL BUSINESS
  - IN-HOUSE SYSTEM – CONTROL
  - SINGLE SOURCE EDP
  - COSTS MAY BE HIGHER
- LARGER BUSINESSES
  - IN-HOUSE TIMESHARING
  - DEDICATED APPLICATIONS
  - DATA ENTRY AND OTHER UTILITY FUNCTIONS

**Figure 5: Microcomputers Displace Services**

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The first impact — and the most severe for service companies — is that minicomputer systems can displace the service vendor revenues. For small businesses, most computer manufacturers, such as IBM and smaller independents, offer some form of minicomputer-based data processing system. These are general purpose. They are promoted as providing the end user a higher level of in-house control than can be obtained from an outside service company. A small business that purchases a minicomputer therefore no longer has need for a service vendor, and the service business goes away. But we will show in a moment how some of these arguments for in-house computing in small businesses may not be as sound as they are promoted to be.

In the case of larger businesses, outside expenditures for interactive timesharing, dedicated applications, or data entry can be performed on small business computers tied into the company's own host computer. Acquisition of a minicomputer-based system can bring the outside service expenditures back in-house, assuming that the in-house staffs can duplicate the service vendor's software and support.

The potential for competitive impact of minicomputers on small business service revenues is illustrated in Figure 6. For end users in the sales or revenue size range up to $15 million to $20 million, which usually is the upper threshold for a small business, small business systems compete against Network Information Services (NIS) — often called timesharing — and batch services, for all but the smallest firms below $1 million in annual revenues.

Now, in responding to these kinds of threats, a service vendor needs to recognize that a minicomputer is not a small business system unless peripherals, software, and support are available with the minicomputer in an integrated package. Purchase of a minicomputer does a small business no good unless it can economically obtain these other critical system elements.

There are basically two kinds of small business systems: one which rents below $1,000 a month, and the other from $1,000 to $4,000 per month. They are obtained primarily from three sources: software or system houses that purchase the equipment components and develop the other system components internally; and computer and minicomputer manufacturers who offer a completely integrated system from one source.

Minicomputer manufacturers have only recently begun to offer full-scale integrated systems complete

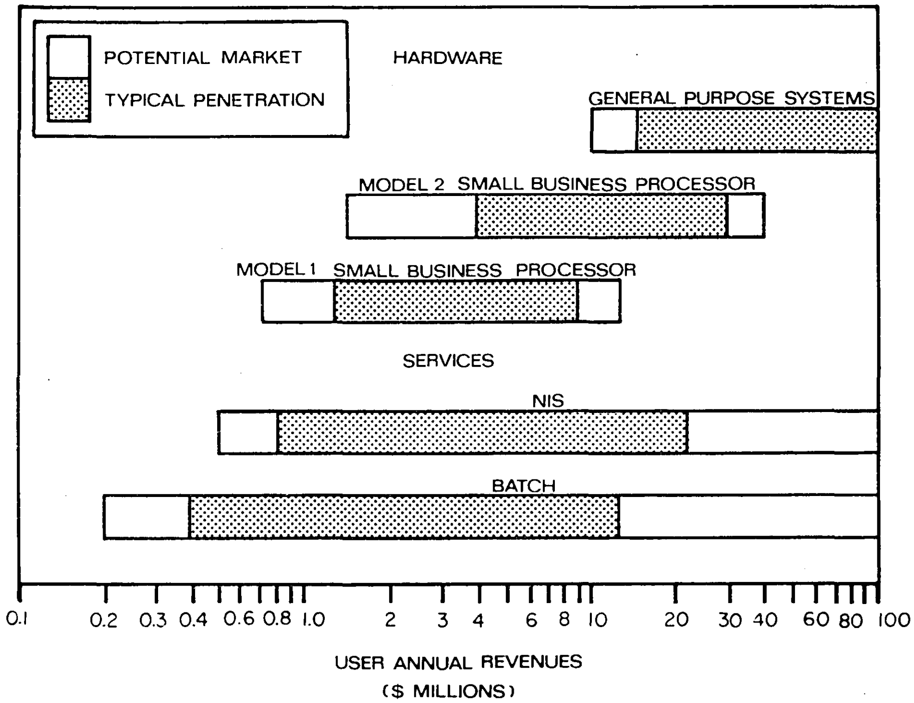


**Figure 6: Competition Between Computer Hardware and Services Industries Small Business EDP Expenditures**

with end user support. Many are having difficulty equaling the support traditional from large-scale computer manufacturers, and as can be expected, the costs of the support are far more than planning people estimated.

Thus, while the competition from minicomputers is formidable, the services vendor still may be far ahead when it comes to solving the end-user's total applications problem — if vendors prepare now.

In a study of small business data processing requirements recently completed by Quantum Science Corporation, the dominance of in-house approaches to data processing was clearly identified; but significantly, the growing penetration of services was also apparent. (See Figure 8.)

By no means will the computer services industry lose out to minicomputers. However, service vendors do have an uphill fight. What are some of the responses that can be used?

We already have stated that support and software are critical elements needed before a minicomputer can effectively compete with a service company. But there are other issues where a user can be misled on the advantages of an in-house system. Too often a minicomputer is sold on the basis of equipment rental cost versus the total service vendor fee. It has been our experience, however, that equipment often is less than 40% of the total operating costs that a user will have to incur.

Next, IBM and other computer manufacturers tell the user he will gain control over his processing by

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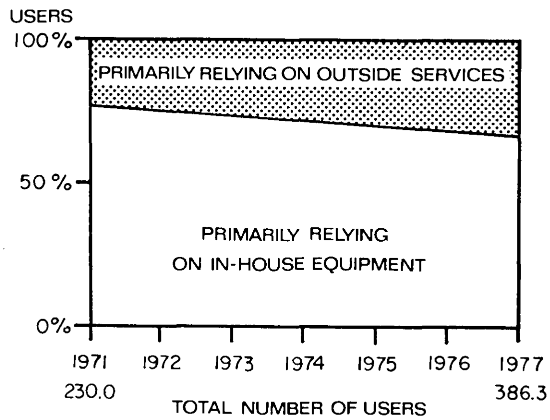
A MINICOMPUTER IS *NOT* A SMALL BUSINESS SYSTEM

- PERIPHERALS REQUIRED
- SOFTWARE REQUIRED
- SUPPORT REQUIRED

| SYSTEM SIZE | SOURCES | | |
|---|---|---|---|
| | SOFTWARE HOUSES | COMPUTER MFGRS' SYSTEMS | MINI MFGRS' SYSTEMS |
| SMALL BUSINESS SYSTEM #1 (<$1K/MONTH) | BASIC/FOUR<br>QANTEL<br>CASCADE | IBM SYSTEM/32<br>BURROUGHS 700<br>NCR 399<br>SINGER 6800 | DATA GENERAL ECLIPSE<br>DEC<br>MicroDATA REALITY |
| SMALL BUSINESS SYSTEM #2 ($1K to $4K/MONTH) | BASIC/FOUR<br>QANTEL | IBM SYSTEM/3<br>BURROUGHS 1700<br>SINGER SYSTEM 10 | DEC 300, 500 |

**Figure 7: Minicomputers Displace Services — Implications**




Source: Quantum Science Corporation

**Figure 8: Where Will New Users Go?**

## IMPLICATIONS

- HOW CAN SERVICE VENDORS COMPETE FOR THE SMALL BUSINESS USER?
  - FOCUS ON TOTAL COSTS OF OPERATING IN-HOUSE SYSTEMS – EQUIPMENT OFTEN LESS THAN 40%
  - SHOW HOW IN-HOUSE USER MAY LOSE CONTROL OVER EDP DUE TO NEW KINDS OF DEPENDENCE
  - OFFER MINIBASED TURNKEY SYSTEMS
  - ENHANCE BATCH SERVICES WITH NIS OR IMPROVED DATA COLLECTION
  - REVIEW PRICING
  - REVERSE THE "IN-HOUSE PHILOSOPHY"

**Figure 9: Minicomputers Displace Services**

going in-house. But when a new user has to worry about hiring EDP-skilled people, has responsibility for operating the system and constantly evaluating vendor new product offerings, is required to perform his own programming, software maintenance, and new program development, must set up security measures, and must configure space for the installation, the small businessman has new things to worry about. He has new dependencies he has to manage. In our estimation, this adds up to loss of control rather than gaining of control.

Service vendors also have to review related business areas in order to compete effectively with minicomputers. This includes enhanced service with NIS-type on-line inquiry to data files. They also must review pricing, not just granting discounts, but examining new approaches to pricing, such as volume-related or transaction-related pricing, as opposed to just pricing out computer time. There is also the opportunity for service vendors to develop mini-based turnkey systems that perform the applications on an in-house basis that were previously done on a service basis. By adding communication capability, the work may be brought to the service vendor at some future date when the user work requirements expand beyond the capability of the in-house system.

Of course only certain applications and industries are appropriate for this strategy. Usually a large data base for inventory control or account update should be part of the application. Such a large data base would exceed the capacity of a minibased system — thus the need for a remote computer service. Even IBM might follow this strategy in future years when System/32 users run out of capacity.

Now this may sound like heresy — supporting the "enemy". But let me tell you that we have done this successfully at OSI. We took on responsibility for an entire project, using a minicomputer-based system for data collection and local editing and processing at the user's site, and performing larger file updating and file management over telephone lines at our main host computer. This has been an effective application for us, and it sets in place a new strategic direction for our company. It helps us to what I call, "Reverse the in-house philosophy" that many users have been mistakenly led into.

In another situation, our E.B.S. Data Processing, Inc. subsidiary is currently proposing a mini-based system installation in the remote offices of a major equipment dealer where there is no near-term prospect for remote batch services. We would have preferred the remote batch approach, but the client was sold on in-house minis. The client wanted a qualified "systems house" to develop and install the systems. We are qualified to develop dedicated mini-based systems, and can take the assignment.

In a further effort to "join the enemy", some service vendors who have extensive software capability may be able to capitalize on the large number of IBM System 3s and System 32s and other mini system installations existing and planned. Many of these systems will need outside developed software and there is no reason current vendors can't offer this service.

We mentioned that often the small businessman is addressing only 40% of his in-house costs when he talks about computer rental versus a services fee. Here is where those other costs lie. He must purchase software, as shown in Figure 10, or pay a vendor generally the equivalent of six to eight months' system rental. Despite what the mini manufacturers say, an operator is required — maybe two — and certainly some time of an in-house or outside service cost of $4,000. However, this is just the first year. In the second year you can be sure the manufacturer will be trying to add on disk drives — maybe even a tape system — thereby increasing the equipment and personnel costs.

| COSTS SERVICE BUREAU | | COSTS IN-HOUSE (1st year) |
|---|---|---|
| — | *EQUIPMENT RENT* | $2,000/MONTH |
| — | *PURCHASED SOFTWARE* | 400 |
| — | *PERSONNEL* | 1,200 |
| $3,500 | *SERVICE FEES* | 250 |
| 500 | *SUPPLIES* | 500 |
| — | *OTHER* | 200 |
| TOTAL $4,000 | | TOTAL $4,550/MONTH |

**Figure 10: Comparative Costs for a $5 Million Manufacturing Firm**

FOR LARGER BUSINESSES

- SERVICE VENDORS CAN DEVELOP MINICOMPUTER-BASED APPLICATION SYSTEMS COMBINING ON-SITE AND REMOTE SERVICE PROCESSING
- OSI USES A MINISYSTEM FOR HEALTH CARE PROCESSING PROCESSING
- SYSTEM HOUSES DEVELOP TURNKEY SYSTEMS FOR TELEPHONE COMPANY APPLICATIONS SERVED BY IN-HOUSE HOST COMPUTER OR BY OUTSIDE COMPUTER
- WORD PROCESSING SYSTEMS CONNECT TO COMPUTER SERVICES

Figure 11: Minicomputers Displace Services — Implications

To counter the inclination of larger users to acquire minicomputer systems and bring services work inside (see Figure 11), service vendors actually can help the larger user develop his minicomputer system, with the idea of immediately or later tying it into the host computer at the service vendor's location. This in effect is an extension of distributed processing into the services environment.

In addition to our own experience, we have seen a number of systems houses develop turnkey systems for telephone company applications. In most cases these are served by in-house host computers, but now OSI is proposing to use the turnkey system as a remote job entry terminal to our computer utility service.

Word processing systems are another example of use of a minicomputer system on-site in the user environment to do the basic text management functions, where other business applications, and perhaps large-scale document retrieval and storage applications, are accomplished on a host computer run by a computer utility. A number of law firms that we have contacted are utilizing the front end data communication capability of their word processing systems to access computer service vendors. This looks like a trend, particularly among the larger law firms.

Minicomputers already have had major impact on enhancing data collection and calculation devices of all types, and microcomputers already are pushing this trend even further. Just look what the micro-

DATA COLLECTION AND CALCULATION DEVICES UPGRADE TO TERMINALS

SIMPLE TERMINALS UPGRADE TO USER-PROGRAMMABLE (INTELLIGENT) AND ACQUIRE MEMORY

- FLEXIBLE DESIGN FOR USER INTERFACE (e.g., KEYBOARD)
- MODULARITY TO MEET VARYING USER REQUIREMENTS
- SIMPLIFY COMMUNICATION INTERFACE AND SOFTWARE IMPACT

INTELLIGENT TERMINALS UPGRADE TO COMPLETE DATA PROCESSING SYSTEMS

- DATA ENTRY AND EXIT
- LOCAL PROCESSING
- PRINT/DISPLAY
- COMMUNICATIONS

Figure 12: Minicomputers and Microcomputers — Enhance Terminals

DISTRIBUTED PROCESSING MEANS POTENTIAL LOSS OF REVENUES. THEREFORE, TO PROTECT REVENUE BASE:

NIS VENDORS MUST EXPAND SERVICES

- ACQUIRE PROPRIETARY DATA BASE RIGHTS
- MORE COMPREHENSIVE APPLICATIONS
- LARGER SHARE OF USER'S EDP WORK AND EDP $

BATCH VENDORS MUST EXPAND SERVICES

- MORE ACCURATE, EASIER DATA COLLECTION
- NIS ENHANCEMENTS TO BATCH PROCESSING

Figure 13: Minicomputers and Microcomputers Enhance Terminals — Implications

computer has done to data entry. Keypunch installations have been converted to key-to-disk systems, such as those supplied by Inforex, Computer Machinery, and General Systems, are capable of being tied into large-scale host computers.

Microcomputers are now being used to upgrade substantially the capability of stand-alone data collection devices, giving them both formatting and error correction capability, as well as converting them to low-cost terminals that can be tied into remote host computer systems.

Yes, these developments can enable the user to do more work in-house, but just think of what it can mean for even the smallest service company, which normally has to spend 30% to 40% or more of all costs on the data entry and conversion function. These new terminals and data collection devices allow data entry function and many related costs to be put back onto the user. Later, data can be transmitted directly to service bureaus, or data collected and converted onto floppy disks or tape cassettes which can be mailed in to the service center. A big advantage is that the data finally entering the host computer is cleaner, and reruns are reduced.

Through microcomputers you can see the day not too far off when specific kinds of collection devices can be custom-designed for payroll, accounts receivable, and other applications, or even specific customers. Firms like MSI Data, which manufactures low-cost data entry systems, already are doing this today. Moreover, in volume levels of 100 units, end product-oriented semiconductor manufacturers like National Semiconductor can get very interested. Some time after 1980 we probably will even see the replacement of the pegboard system with low-cost, sophisticated data collection systems based on microcomputer technology.

Microcomputers and minicomputers also allow simple terminals, such as low-speed CRTs and keyboard devices, to be upgraded into uder-programmable or intelligent terminals. This is because the mini or micro allows logic and memory for data editing and some limited processing to be added. As a result, the intelligent terminal has flexible design for simplified user interface including custom keyboards, modularity to meet a variety of user requirements including control of other terminals, and buffering capability to simplify the communications interface and the impact on host computer software. In other words, more and more of the communications function can be done inside the terminal rather than at the host computer site.

Microprocessors are also being used in all functional areas of terminal design, including print mechanisms, carriage control, interface control, and maintenance testing.

Larger companies, such as First National City Bank, Mobil Oil, and Equitable Life Assurance, are beginning to use minicomputer-based systems for dedicated applications or replacement of timesharing. In effect, this really is extending intelligent terminals one step further, and adding large-scale memory and larger internal memory capability to build up an entire data processing system.

The impact of this whole discussion is that service vendors have as much or more to gain than in-house users from the use of minis and micros in the terminal/data collection environment.

But this "gain" is not easily obtained. Reflect for a moment that potentially, the more intelligence that is placed in a remote device, the less intelligence is required in the host computer. Therefore, the service company must operate both the host computer and install and operate the terminal, or the service company is likely to lose revenue.

This means that service vendors of all types are going to have to expand their service capability in order to take advantage of the minicomputer/microcomputer. Vendors are going to have to address more comprehensive applications. Vendors are going to have to be willing to take on a lot more responsibility for the user's EDP workload. Vendors may have to acquire proprietary data base rights related to applications services.

SWITCHING NETWORKS UPGRADE TO COMMUNICATION NETWORKS

- STORE AND FORWARD
- MULTIPOINT SWITCHING
- BACKUP SYSTEMS
- ERROR CORRECTION
- VOICE/DATA TRAFFIC HANDLING
- ALTERNATIVE COMMON CARRIER SELECTION

HOST COMPUTER RELIEVED OF COMMUNICATIONS OVERHEAD PROCESSING

MULTIPLE COMMUNICATION SPEEDS AND MODES POSSIBLE

**Figure 14: Minicomputers and Microcomputers — Expand Communications**

Batch vendors are going to have to evaluate and eventually distribute and install more sophisticated microcomputer-based data collection systems. Batch vendors also will have to devleop remote data processing enhancements to their batch service, such as inquiry to user data files stored on the vendor's computer.

Improving data communications is another way that minis and micros have and will continue to impact computer service vendors. Almost all NIS vendors today have at least a rudimentary switching network. Of course many, such as Tymshare, GE Information Systems, Cybernetics, NCSS, and Control Data, have more sophisticated networks that include not only switching, but many other communication functions. These networks have been developed because of the availability of low-cost minicomputers which can be located in remote areas to manage communications. In the future, microcomputers will be used to extend the capability of these multiplexor and concentrator devices, and also place even more communication capability in the terminals themselves.

Additional functions that minicomputers and microcomputers permit are storage and forwarding of data, switching to multipoints, providing backup circuits and systems, providing extensive error detection and control, and correcting data before it is entered into the host computer; in some cases, handling of both voice and data traffic and a capability to select from a variety of common carriers are features also available.

One of the key results of this improved communication is that the host computer is relieved of extensive communications overhead processing. The development of more sophisticated front end processing equipment, such as supplied by Comten and other independents, as well as the computer manufacturers, also relies extensively on minicomputers, and more recently on microcomputers, to act as an integral part of the total data communications network.

Improvements in data communications handling will directly benefit computer service vendors because they can quickly take advantage of the improvements and relay them on a shared-cost basis to users. In addition, some vendors with a sophisticated network already in place may begin to offer common carrier-type services to obtain another source of revenue. Already firms like Tymshare and GE have been able to sell network information services to very large firms because of their ability to access remote manufacturing or sales sites of these large companies and bring all the processing together in one place.

Users of course could develop their own communication networks, but it would be costly and probably years away, whereas the NIS vendors have it today.

COMMUNICATION SERVICE UPGRADE TO ADDITIONAL REVENUE SOURCE FOR NIS VENDORS

- SMALL BUSINESSES
- DEDICATED SPECIAL SYSTEMS, e.g. TRADE ASSOCIATIONS
- IN-HOUSE ORIENTED LARGER USERS
- REGULATORY IMPLICATIONS

LOWER COST/RISK FOR BATCH VENDORS TO ADD REMOTE PROCESSING SERVICES

- FILE INQUIRY
- ON-LINE DATA COLLECTION
- FULL-SCALE NIS

**Figure 15: Minicomputers and Microcomputers — Expand Communications — Implications**

For traditional batch service bureaus, the improvements in data communications — particularly the services provided by the emerging new common carriers such as Datran, and Southern Pacific Communications — will permit the batch companies to add remote NIS services at a lower cost and risk than would have been the case before minicomputers and microcomputers generally were available.

This also states, in effect, that the NIS vendors that now have an advantage in having extensive data communications facilities, will gradually have that advantage eroded away over the next five to ten years as new independent common carriers offer data communication services.

The lower cost and functional similarities of microcomputers versus minicomputers is resulting in the replacement of some minis by micros. The first minis to be replaced will be those with lower capacity, such as those used in providing intelligence to terminals, controlling peripherals, and in controlling other industrial applications, such as machine tools.

MICRO's ARE TO MINI's AS MINI's ARE TO SMALL BUSINESS SYSTEMS

LOWER CAPACITY MINI's ARE FIRST CANDIDATES FOR REPLACEMENT

- TERMINALS
- PERIPHERAL CONTROLS
- MACHINE TOOLS

REPLACEMENT OF HIGH CAPACITY MINI's IS 1980++

Figure 16: Microcomputers Replace Some Minicomputers

Remember, the microcomputer is really an outgrowth of the calculator circuits developed in the early 1970s to replace and extend the capabilities of the old electromechanical and electronic desk-top calculators that we all used then. Similar developments have occurred more recently with watches. It is this type of replacement we will see for the next few years.

Replacement of higher capacity minis, for example those that offer many thousands of words of storage and large 32-bit word length, will not be achieved for some years. However, we may see the use of microcomputer components within these large capacity minisystems to meet specific functional or application requirements.

The implications of the replacement cycle shown in Figure 17 for service vendors are that many of the benefits and some of the threats of minicomputers will be accelerated, and since on balance we believe the minicomputers represent a favorable impact for service vendors, this acceleration should be viewed positively.

There are also several application areas where microcomputers will open up new applications and replacement on minicomputers is not a factor. We have already begun to see this in several industrial products, consumer products, and automotive systems. The inherent advantages of low price, small size and weight, custom design potential, and relatively higher internal speed of microcomputers will cause the new opportunities to be developed.

ACCELERATED BENEFITS FROM MINICOMPUTERS

NEW POTENTIAL (NON-REPLACEMENT) APPLICATIONS OF MICROCOMPUTERS ARE THE MAJOR IMPLICATION

- LOW PRICE
- SMALL SIZE AND WEIGHT
- CUSTOM DESIGN POTENTIAL
- HIGHER INTERNAL SPEED

MICRO's' ADVANTAGES WILL CREATE BREAKTHROUGHS IN COMPUTER SYSTEMS TECHNOLOGY AND ARCHITECTURE

Figure 17: Microcomputers Replace Minicomputers — Implications

One of the major problems in the acceptance by users of microcomputers to replace minicomputers, has been the lack of available software and compilers. Now these are becoming available. OSI is pleased to be one of the first service vendors to offer a microcomputer language compiler on a remote processing basis. The system we are offering is for Intel Microcomputers and was developed by Zeno Systems.

Another key advantage of microcomputers is the higher reliability inherent in the LSI manufacturing process. This reduces down time and maintenance costs. In the future, these advantages will also provide designers the opportunity for design of new architectures in computer systems. At Optimum Systems we feel that large computer service vendors will mostly benefit from these system enhancements.

MINI/MICROCOMPUTERS NOT JUST A THREAT

INSTEAD, THEY

- OPEN NEW SOURCES OF REVENUE
- INCREASE FLEXIBILITY OF TERMINALS FOR TRANSACTION APPLICATIONS
- LOWER COSTS
- IMPROVE LEVEL OF SERVICE

NEW INVESTMENT REQUIRED AND ADDED RISK TO TAKE ADVANTAGE OF THESE OPPORTUNITIES

- MULTISERVICE APPROACH TO USERS
- PROCESSING, SOFTWARE — EVEN EQUIPMENT SERVICES

Figure 18: Conclusion

I hope this article enables vendors of computer services to view minicomputers and microcomputers in a much more favorable light. They are not just threats to the base service business, but rather, provide several ways in which the ability to provide services and the opportunities for increased revenues can be enhanced and expanded. In order to take advantage of these new opportunities and protect current market positions, new investment will be required, and added risk can be expected. Finally, service vendors must recognize the imperative — move now to plan use of minicomputers and microcomputers or risk being left behind. □

Forum - *Continued from page 9*

discover the true reality. Your May 1970 publication was very shocking to me.

I believe it is vital that more technicians be shocked into broader perspectives and truthful insights. All our systems, no matter how important we think they are, are sub-sets of the social system. (I like one of the dictionary definitions of a system — "People and things in interaction and interdependence." — emphasis added.)

We need to expand the use of electronic tools for greater personal and social development in a freer and more humanistic society. The Industrial Age, with its narrow technical specialists, is closing. The Social age is reborn. The new leaders will be generalists in the modern sense of having multiple specialties along with a comprehensive overview.

Humanistic social awareness and the pursuit of truth must become a specialty area for all, especially for the systems technicians who instigate change.

By publishing both technical and social articles you offer more comprehensive system awareness which can help bridge the dangerous and destructive rift between technical and social systems.

Let's get our society back together — remove the rift and integrate technical and social systems. Technicians seeking the truth and making humanistic social advances will attain an even stronger and freer society.

Thank you for your great efforts, which deserve vast applause and emulation. □

# The Making of a Computer Auditor

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*Encino, Calif. 91436*

*"When an individual accepts one of the many titles in computer auditing such as EDP auditor, computer auditor, computer audit specialist or data processing auditor, he is expected to have a different type of specialized knowledge."*

The many technical advances made in the last ten years to both computing hardware and application systems, plus the announced advances coming in the future, have control problems associated with them. The function of the computer auditor is to evaluate these controls and make recommendations where they are inadequate. The question facing many organizations today is: "Where do these <u>bilingual</u> auditors come from?"

This new breed of auditor is in short supply today, as those who are trying to hire a computer auditor have discovered. This article concerns the situation: When you can't hire a computer auditor, how do you make one?

### Synopsis of Differences in Auditing Computer Systems

There are many ways to categorize the differences between traditional-type auditing and data processing auditing. The approach chosen here is to illustrate the problems that exist in the sphere of responsibility and concern of the computer auditor.

The following three areas of control are given to illustrate the difference between conventional and computer auditing.

First, the tremendous additional quantity of information that is going to be held in the new memories and mass storage devices will make the systems more valuable for accounting business data processing purposes. On the other hand, because the data are centrally located and humans are less involved in the transaction cycle, it will become more susceptible to manipulation and accidental or intentional destruction. Internal control problems will become much more critical, and problems involving the correction of errors in present systems will be transformed into even more serious problems in the forthcoming systems environment.

Second, the accessibility and entry of information from communication terminals will shorten the transaction cycle and eliminate hard copy documents. We may expect almost all of the original data to come through a machine-readable keyboard or other kind of input terminal device. This could result in the potentially serious audit problem of the disappearing audit trail. Without hard copy documents, the traditional methods of control will be inadequate, requiring new concepts in controlling and auditing business systems.

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Third, the integrated aspects of advanced EDP systems result in one system causing another system or even a system in another company to perform a process. Controls within one computer system are difficult to define, but the aspects of one system triggering a series of transactions in subsequent systems adds a new dimension to the problem of controlling EDP systems.

### Auditing in the Computer World

A sign that is prominently displayed in many engineering areas stating that "two years ago I couldn't even spell <u>engineer</u>; now I <u>are</u> one" is illustrative of the current status of many computer auditors. One night the supervisor decides that he needs a computer auditor and selects his most promising candidate and the next day promptly bestows this individual with a new title. Now he assumes that the data processing area is under control.

When an individual accepts one of the many titles in computer auditing such as EDP auditor, computer auditor, computer audit specialist or data processing auditor, he is expected to have a different type of specialized knowledge.

There is little unanimity as to what an ideal computer auditor is, but most people would generally agree on four minimum requirements for an auditor involved in data processing:

1. He should understand the data processing jargon and be able to identify visually all of the major systems components. For example, CPU, tape drives, disk drives, keypunchers, printers and communication terminals. He should be able to discuss the functions of these components in an intelligent manner with the people who design systems, write programs or operate the system.

2. He should know and understand what he sees and works with when he enters the data processing areas. That is, he must recognize how data are defined and organized, how and why data are manipulated by this system, and how the system is organized and effectively controlled.

3. He should know the potential weak points in a computer system and be able to recognize the important weaknesses and strengths that affect the internal control of a particular system. For example, he should understand computer documentation, control messages and control logs, check digits, header and trailer records on computer files and other basic elements of control in a computer system.

4. Based on his evaluation of the system, he should be able to recommend changes in the design or operation of the system that may be needed to resolve potential control problems. Here the auditor uses both his background in auditing and data processing to make these recommendations.

It should be obvious from the above that one does not become a computer auditor overnight. The data processing people can readily spot the difference between a true computer audit pro and one who merely carries the title. It has been my experience that data processing personnel have little time for the "title-carrying-only computer auditor". However, when they encounter an auditor skilled in his specialty, data processing people become most cooperative and solicit his opinions and advice.

### When to Add a Computer Auditor

The logical question an audit manager may ask himself is when to add the first computer audit specialist.

The logical answer to this question is to add the computer audit specialist when your organization installs computer hardware. However, there are a number of other considerations such as the function of the computer, the size of the audit staff and the complexity of the computer systems. Then, of course, most organizations already have a computer installed.

Therefore, the following criteria are suggested as a guide to determine when you might add a computer audit specialist to the auditing department staff. If any one of the following four questions can be answered "yes", it is time to consider a computer audit specialist.

1. Are one or more critical systems performed by utilizing the computer?

2. Is the auditor in a position where he is dependent upon the data processing people for computer extracts?

3. Is it difficult to verify the accuracy of financial data from computer systems without obtaining supporting computer data by computer extracts?

4. Are segments of audits eliminated because it is too costly to do the segment by manual means?

The audit manager may address the EDP control problem in ways other than by adding a computer audit specialist to his staff, but the result will not be as effective. Some of these alternate means are:

1. Train an individual in data processing to a limited degree so he can utilize audit software packages.

2. Have the Data Processing Department set up an independent control function.

3. Rely on outside auditors and/or consultants to perform the audit control function.

### Ideal Computer Auditor Mold

The preceding sections have discussed some of the control problems in data processing and the type of knowledge that an auditor must possess to operate effectively in an EDP environment. Prior to a discussion on the type of backgrounds and training required in the making of a computer auditor, let's consider what we would like the end product to be.

Illustrated below are the characteristics and skills that should be found in the computer auditor. This is illustrated in Figure 1 by showing what proportion of each should be found in the ideal computer auditor.

As you will see, the ingredients going into the mold are the following four: (1) EDP experience; (2) auditing and accounting experience, (3) audit instinct and (4) organization experience.

These captions and quantity allocations warrant further explanation.


**Figure 1**
Ideal Computer Auditor Mold

### EDP Experience

The EDP experience constitutes the major ingredient in the mold. This is based on the fact that a solid knowledge of data processing is an essential ingredient to the job. This experience would comprise some of the following traits:

- Ability to code programs in one or more source languages
- A working knowledge of operating systems and associated operating systems languages
- The ability to develop a systems flowchart to solve typical EDP systems problems
- The ability to prepare test data and debug computer programs and systems
- The ability to define data and problems in a language that may be readily understood by data processing personnel

It is easy to see that to obtain this type of experience would require a minimum of two years' full-time work experience in a data processing environment.

### Auditing and Accounting Experience

The next ingredient in making a computer auditor is auditing and accounting experience. Much of this background may be gained by the educational route of studying the theory of accounting. However, practical experience in this area is extremely helpful. The desirable mix of education and experience in this area for a computer auditor would be:

1. Courses in introductory, intermediate and advanced principles of accounting.
2. An understanding of generally accepted accounting procedures.
3. An understanding of the principles of auditing.
4. An understanding of taxation.
5. A minimum of six months' conventional auditing experience.
6. A minimum of six months as a user of financial data. Preferably, this would include accumulation and recording of financial data.

It should be remembered that the above items are minimum and additional experience is certainly desirable. However, the above mix would give an individual a reasonable appreciation of accounting theory and practice.

### Audit Instinct

The next segment in the mold is filled with "audit instinct". This is by far the most difficult to define yet one which is easy to spot. The type of individual we're looking for is inquisitive, enthused about his work and ambitious. It's the type of characteristic an individual has that compels him not to accept the answer "we have always done it this way." It is the spark that propels the auditor to explore an area a little deeper to see that, if superficial problems are encountered, they are truly superficial and not representative of a deeper, more serious problem.

It is difficult to assign a weighting to the characteristic of audit instinct because, if an individual has this trait, he can overcome deficiencies in any of the other areas. It's a difficult trait to quantify and, therefore, hard to deduct from a resumé.

### Organization Experience

The last ingredient to be poured into the mold is sufficient organizational experience so as to enable the auditor to operate effectively within the organization. This is necessary to get around the "you - don't - understand - the - way - we - operate - around - here" syndrome. What you're looking for within this sphere of company experience is for the individual to:

1. Be respected by the management of the company.
2. Understand company policies and procedures.
3. Know the company systems and how they operate.
4. Have many contacts within the company.
5. Know how to obtain results within the organizational structure of the company.

Again, it's difficult to state exactly how an individual may obtain this type of appreciation for an organization; but my best guess would be that it requires somewhere in the range of two to five years associated with an organization to score well on this criterion.

### Survey of the Real World

Over a period of time, I have conducted an informal survey among numerous organizations to determine how operational computer auditors compare against my ideal computer auditor. The survey has no statistical validity; however, it does represent a feeling expressed by numerous audit managers.

Generally speaking, there are only a handful of people in the computer auditing profession that meet the criteria outlined here for an ideal computer auditor.

Let me summarize briefly below the conclusions that I have assimilated from this informal survey. These conclusions are:

- Computer auditors are obtained primarily from two specific backgrounds: accounting/auditing and data processing. Audit managers are generally very explicit from where they like to draw their computer auditors. However, there seems to be little consensus of opinion as to which background is strongly preferable.
- Those audit managers that prefer the accounting/auditing background are from financial institutions such as banks and life insurance companies, whereas those that choose the data processing background are from manufacturing companies and service-oriented organizations.
- Only about one out of ten individuals who call themselves computer auditors would come anywhere close to qualifying as the ideal computer auditor. Most individuals in data processing auditing are still the traditional auditors who have been put through a one-to-two-week training school. The training is generally to qualify them to use audit software; but, in reality, they require massive doses of aid to get even the simplest audit program operational.
- Of those who might be considered computer auditors, the background ratios are about three from accounting/auditing for every one out of data processing. This may be attributed to two facts: first, financial institutions are leaders in the computer auditing area and have traditionally preferred the accounting/auditing background; and second, there is a reluctance on the part of data processing personnel to move into the auditing area where a career path for them is uncertain.
- Computer auditors are generally better paid than traditional auditors. The normal starting salary for a trained computer auditor is in the $20,000 - $22,000 range with a standard growth in salary up to approximately $30,000.
- Computer auditors tend to travel less than traditional-type auditors.

- Computer auditors, in general, get two to three times the amount of training that a non-computer auditor obtains.

- Computer auditors are generally happier in their job than the non-computer auditors, perform in a more professional manner but feel they receive less support in their work than in conventional-type auditing.

### Advantages of an Auditing Background

Those looking for a computer auditor will find that a conventional-type auditor has many of the traits and characteristics that are desirable in a computer auditor. This is not to say that any auditor will make a computer auditor. But, rather, the comment is centered around the premise that the traits and characteristics needed for auditing are valuable in a computer auditor. What one must look for in an auditor is an interest and enthusiasm in pursuing a career in data processing.

While the title "auditor" appears in both conventional auditing and data processing auditing, the approach and interests are radically different. Traditional-type auditing is a historical look at events that have occurred to verify their validity. Data processing auditing is an involvement in the development of systems and a futuristic look at systems to prevent the discrepancies that the traditional auditor looks for in his historic approach. Assuming that the traditional auditor has the right frame of mind, the following background characteristics prove beneficial in the function of data processing auditing.

### Understands Auditing

The auditor is trained in accounting principles and practices. He understands double entry bookkeeping and is familiar with financial procedures and with reading and interpreting financial statements and data. The auditor knows how financial transactions originate, flow through the accounting system and are consolidated into financial reports.

### Usually Knows Company Policies and Procedures

Accountants traditionally work from a series of accounting procedures and/or standards. The adherence to these, in developing data processing systems, is important. A familiarity with them, as well as a logical understanding of the reasons behind them, is a valuable attribute in the systems development phase of data processing.

### Is Trained to Look at Controls

Much of good accounting and auditing practice and theory is based on the implementation of controls within the accounting system. One example is the control concept of division of responsibility. The type of controls that the auditor is familiar with are financial controls as opposed to data processing controls.

### Understands the Audit Function

The auditor is expected to be familiar with generally accepted auditing procedures. He should be aware of the pronouncements of the American Institute of Certified Public Accountants. When it is necessary to undertake an audit, the traditional auditor is familiar with the standards of field work required as well as the traditional auditing techniques.

### Is Trained to Verify Operations by Testing

Many systems people, when involved in the interviewing technique to gather facts for development of computer systems, rely very heavily on the answers they are given. The auditor, at the conclusion of this same interviewing session, would then undertake tests to verify that what he has been told is correct. While this verification concept is valuable to the systems analyst, it is not his normal nature to undertake such verification; however, this is normal procedure for the auditor. Therefore, at the end of the interview and the verification procedure, the auditor is knowledgeable as to what is supposed to happen as well as what actually happens.

### Training Required for the Auditor in EDP

If it has been decided to take a traditional auditor and train him to be proficient in data processing auditing, he will require extensive data processing training. A minimum of three months of full-time training should be given to him. The next year to year and a half of his training may be considered on-the-job training. The traditional auditor cannot be expected to be a fully participating member of the data processing audit staff for about two years. Up until that time, he will require extensive supervision and advice. The typical three-to-four-months' training session might flow along the following lines:

1. Read an introductory book on data processing and take one of the programmed instruction introductory courses to data processing concepts.

2. Enroll in a two-to-four-week course in computer programming for a language used in his organization.

3. Take a short assignment in the Data Processing Department so as to actually write a computer program in the language learned in the previously mentioned computer programming course.

4. Take an assignment in the computer operations area for approximately one week to function as a computer operator. While it is not expected that the auditor would have a major role in the operation of the large-scale computer, the auditor could become familiar with mounting tapes, mounting disks, running high-speed input and output devices and getting generally familiar with scheduling and job-control language.

5. Take an assignment in the Data Processing Department as a coordinator for staging computer jobs. This is the type of function that would involve checking in input, getting all the necessary files out of the data file library, assembling the appropriate job-control cards and generally overseeing the preparation of the input to the computer and review and distribution of outputs from the computer system.

At the end of this training, the auditor would have enough data processing knowledge to be able to function as a member of a data processing auditing team. He should be able to write small audit extract programs and audit in the more traditional manners but with the additional use of audit software. It would take many months of on-the-job training before he could function effectively as a member of an EDP systems development team.

### Advantages of Data Processing Background

The selection of an individual with data processing background to become a data processing auditor offers several advantages. One of the major obstacles to overcome in selecting a data processing person to become a computer auditor is to convince him that he has a career path in the auditing function. As the traditional auditor must be somewhat unique to have the interest and enthusiasm to become involved in data processing auditing, so must the data processing person. The involvement in data processing auditing takes him out of the project supervisor function and transforms him into a highly skilled specialist.

The traits that make him valuable in the Auditing Department are the following:

The data processing individual is at home in the data processing environment. He understands the language, the way data processing people operate and, more importantly, the way they think.

The data processing trained person understands the jargon of the data processing people. He normally comes from their area and is respected by them. This point cannot be overemphasized because, if the data processing people do not respect the auditor for his knowledge in the data processing area, he will not be able to operate effectively within the data processing environment.

The systems person will take the systems approach to an audit job. Too often auditors are accused of nit-picking and not being able to see the major problems. The systems person probably takes just the opposite approach in that he will overlook many of the minor deficiencies of the system to see major ways in which the system may be improved. His objective is more along the lines of operational auditing as opposed to financial auditing.

Because of the data processing experience that this type of individual brings to the Auditing Department, he can go back and become effective as a participant in the systems development team. His thinking must be reoriented along the lines of controls, but he does have their respect and understands their problems. This will enable the data processing trained person to discuss various methods of implementing what he feels his control needs are on a "how-to" basis.

If the audit function involves actually testing the computer system either through preparation of test data or extensive probing by audit software, the data processing trained individual will be effective almost immediately.

### Training for the EDP Person in Accounting/Auditing

Because data processing is a relatively new area and not taught extensively in many schools and universities, the data processing community is geared to train individuals in required data processing skills. On the other hand, accounting and auditing are old professions and taught extensively within colleges and universities. Therefore, it is assumed that most people entering the auditing and accounting areas of an organization have already been trained in the basic principles of that discipline during previous schooling. Therefore, organizations are not geared to train individuals in the basic accounting and auditing skills.

It is more difficult to provide adequate training for a data processing person in auditing than it is to train the auditor in data processing skills. However, the type of training that a data processing person might undertake would be as follows:

1. The data processing individual should take either a correspondence or college course in accounting and auditing. The number of courses taken would depend on the amount of background that the individual had, his practical training in accounting that he picked up through working in his organization and the complexity of the accounting records of the organization for which he works.

2. The data processing person should be provided with three to four months of on-the-job training in traditional auditing. This would include most of the basic audits that a junior auditor would perform. For example, this person should take part in a cash count, physical inventory observation, confirmation of assets, physical observation of a capital assets inventory, verification of operation of some of the routine operations of the organization such as billing and purchasing, and some basic introduction to the financial consolidations function.

3. Informational assignments lasting approximately one week could be helpful in two or three accounting areas. For example, the data processing individual might be assigned for one week to the general Accounting Department and another week in another accounting-related area such as payroll.

4. To familiarize the data processing individual with how financial transactions flow through the organization, he should spend some time following the flow of physical documents and financial data as it flows through the system. For example, he may begin with a creation of an order and follow all the paper work and financial flow through the shipment of the order, the entries required to reduce inventory, the billing of the accounts receivable, the collection of cash and the consolidation of these figures into the financial statements of the organization.

### Recommended Approach to Computer Auditing

In reviewing the traits that are desirable in the two disciplines, it becomes obvious that there are very few candidates for the position of data processing auditor that have all the attributes of both backgrounds listed. Therefore, the discipline selected will tend to be the prime discipline of the individual as he progresses through his data processing auditing career.

For example, the data processing individual will tend to take the systems approach and not get into some of the testing and probing performed by the traditional auditor. He may also lack what we have termed "audit instinct". On the other hand, the traditional auditor will always rely on that discipline in his approach to data processing auditing. He will find much of the discussions in the systems development phase difficult to understand and be more interested in getting to the probing and testing part to see what is really happening.

If it is not possible to get many individuals combining the desirable characteristics of both disciplines, the best approach to any computer audit is to assign a team of which one individual has come from the accounting/auditing discipline and the other from the data processing discipline.

Depending on what the assignment is, it can be decided who should lead it. For example, if the assignment is to become involved in a systems development phase of the data processing system to specify controls, the obvious leader for the assignment is the individual with the data processing discipline. The auditor assigned with him can compensate for his shortcomings in the audit discipline.

However, if the assignment is to perform an audit of the data processing system, it is more desirable to have the individual with the auditing background lead the job and to let the data processing individual assist him with the mechanics of developing the necessary probing programs to give him the information needed.

### A Summary of Selection Criteria

Much of the above discussion has been aimed at giving the reader an appreciation for the criteria that should be considered in selecting an individual to become a data processing auditor. However, it would be negligent not to give some guidance and direction for managers of internal auditing functions in the selection of an audit staff to perform in the data processing area. The general conclusions that I would like to leave with you are:

1. If the audit staff size permits, the computer audit function should be comprised of individuals of both backgrounds: auditing and data processing.

2. It takes a large investment of time and money to train a computer auditor regardless of background. Therefore, much effort should be devoted to the selection of the person to fill this position.

3. An effort should be made by the manager of internal auditing to establish a career path for the data processing auditor. While it may be regarded as a highly skilled specialist function, it needs to be <u>recognized</u> as such and so rewarded. Effort should be made to provide a definite career path for able people in this function.

4. Computer auditing should not be considered a training ground, as many organizations consider internal auditing. Instead of using it for short vocational training, it should be utilized as a long-term, highly skilled assignment.

### Answering the Original Question

In the beginning, we posed the question: when you can't hire an EDP auditor, how do you create one? The answer was necessarily long and involved because making an EDP auditor is not a simple task. In essence, here is the procedure:

1. Decide on the characteristics and skills you need.

2. Select the person who best suits your needs.

3. Offer that person a future with adequate incentives.

4. Provide the training he or she needs.

5. Arrange for him or her to get the practical experience needed.

6. Allow sufficient time for the individual to really become a computer auditor.

If you follow these steps, you will be engaging in a profitable and creative exercise — the making of a computer auditor. □


For more information on

*WHO'S WHO IN COMPUTERS AND DATA PROCESSING: 6th Cumulative Edition, 1975-76*

See the announcement on page 35 of this issue.


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# COMPUTERS AND SOCIETY:

## A Current Course Outline for General Education

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*"If we consider the goal of higher education, to prepare students for the present and the future, can this goal be met without an exposure to the computer?"*

### Introductory Note

This article presents a suggested course outline for a lower division course on computers and society for general education for non-computer science majors and minors.

This is a revision of a syllabus for a thoroughly class-tested course on computers and society. This version has been developed for use by a number of groups: The Association for Computing Machinery and the National Science Foundation, National Computer Conference and Exhibition, Anaheim, Calif., May, 1975; Faculty Colloquium Series, University of Southern California, Los Angeles; California Educational Computing Consortium; Future Studies Committee, Department of Computer Science, and the Center for Information and Communications, California State University, Chico, Calif.

The suggested text is "Man and Computers" by Richard Dorf.

Comments and questions by users and reviewers are welcome.

### Course Proposal

This is a course proposal for general education for freshmen and sophomore students, who are non-computer science majors or minors. It has been class-tested thoroughly, with excellent results. This syllabus is very similar to the proposal discussed at Conference on Computers and the Undergraduate Curriculum, No. 5 (CCUC/5), Pullman, Washington, in 1974. A greater range of topics however has been developed, to strengthen the course. For discussions as to reception of the course by students, and other details, the reader is referred to the paper, "Computers, Society, and Man", "Proceedings", CCUC/5. The philosophy of this course, and the approach remains the same, indicating a course sufficiently tested to pass on to other institutions.

This course could well be taught at the high school level, if computer terminals are available for student use. This syllabus is not recommended without terminal use. (See the discussion of machine usage below, under Method of Presentation.)

### Background

A great many courses by this title have been appearing on campuses, first for computer science majors (in accordance with ACM requirements), and then adapted for non-computer science students. Sometimes they have charming titles, as "Computers for Ordinary People", and growing attention has been given to teaching computer appreciation courses for all kinds of students on an exposure basis, often at the freshman, sophomore level. In these courses, students are introduced to the computer.

### A Vital Influence

The time has come when the computer has become such a vital influence in everyone's life, that people from all walks of life need an exposure course to computers, so that they will know what a computer is, what it can do, and what it cannot do. In a few years from now (perhaps another generation), the computer will be so commonly in use by so many kinds of people, that we will not have to teach such a course. But we are presently in a transitional phase, wherein professionals communicate with the black box in fairly rigid machine languages, and humanists and other kinds of people experience distress, dislike, and often paranoia regarding the computer. People need to use the computer, and by successful usage without too much pain, they may then exhibit some degree of affirmation of the machine that promises to revolutionize calculating, comparing, sorting, processing, etc. But more important, people need to know something about the computer in order to legislate constructive laws regarding computers, privacy, data banks, etc. To use a Boolean expression, we need to know what the machine is, by knowing what it is not, and vice versa.

### The Tide of Technological Change

We cannot retreat within non-technology, nor perhaps even stem the tide of the electronic revolution. What we can do is harness the power and potential of the computer for constructive purposes for mankind and the earth. And this requires acceptance of the gauntlet of technology and computers.

### Mandatory Course or Elective?

Should "Computers and Society" be a mandatory course for general education, or should the offering be an exciting and stimulating elective? Further, if we consider the goal of higher education, to prepare students for the present and the future, can this goal be met without an exposure to the computer? And, are many courses relevant without the use of computers? Or to phrase it in another way, how much more relevant many courses would now be, if they used the computer as an aid or augmentation. This is not to say that everything should be computer-aided, but far more disciplines should be using the computer in order to remain up-to-date. The computer is like the electric typewriter — a very helpful, precise aid in communicating and processing.

### Method of Presentation

A tripartite approach appears to be the most meaningful:

1. Introduction to computers and computer science.
2. Exposure to computers, their applications, and effects within society.
3. Experience in using a simple language (BASIC or another user-oriented language).

This approach departs from pure seminar methods, or the lecture method, and includes these elements, but also focuses on using computers, and thus laboratory methods are integrated within the course. The introduction to computer usage should be as early as possible, and continue throughout the semester. Much of the introduction to computers (flow-charting, vocabulaty development, etc.) is accomplished more readily be actual use of computers. Terminals are preferred over batch methods, since the students respond more actively to the seemingly real-time feedback of the terminals. Could this be taught with batch mode? Yes, for this is better than nothing, but interactive computer usage is much more effective with beginning students. Further, if interactive graphics are available, this further enhances learning.

To teach this course without computer use is not recommended. People do not know what they are talking about, and the class disintegrates into blue-sky sessions. It is as though a person gained his knowledge of food from reading a cookbook, without ever having tasted a real meal. There is a term used in education, "realia" — the real thing; and in this case, the real thing is using a computer without too much difficulty or hassle, In fact, the more the game aspect is stressed, the fewer hang-ups students will experience, and the more readily they will "play" with the machine.

### General Objectives of the Course

1) To acquaint the non-computer science student with computers, what they are, what they are not.
2) To introduce computer usage to general education students via terminals and an easy interactive language (BASIC, SNOBOL, etc.)
3) To understand the fundamentals of how a computer works, and to observe (and use) varied peripheral devices.
4) To learn something about flow-charts, decision-making, and logical thought processes.
5) To become more precise in defining ideas, and communicating these ideas to the computer (and to people).
6) To see how computers are used in one's discipline, and how they aid people in solving problems and doing their work.
7) To gain beginning insights into varied computer applications in many areas of human endeavor, with particular emphasis on humane, non-destructive uses of computers.
8) To focus on important social issues of computer usage, and study current legislation on these matters.
9) To become more aware of the potential of computers and technology, so that students and citizens may exercise social responsibility in the uses of technology for mankind and the earth.

### Students in the Course

This is primarily a "computer appreciation" course for high school students, or college or university freshmen and sophomores from varied disciplines, who are not computer science majors or minors. It may also be taught as adult education for interested people.

### Suggested Topics for Reading and Discussion

General Introduction to Symbol Formation, Communication, Machines and Man

- Prehistoric Man and Symbol Formation in Art, Music, Natural Languages
- Tool and Machine Inventions, Applications
- Refinement of Tools, Machines, Human Communication Systems
- Beginnings in Science
- Mathematics, Beginnings, Uses, and Refinements
- History of More Complex Machines, Measuring Devices, Calculating Machines, Aids
- Keeping Track of Things Via Records, Libraries
- Analysis of Communication Systems in Man and Animals
- Natural Languages, Machine Languages, Artificial Languages

Important Machines, Inventions, and Revolutionary Ideas

- Analysis of the Important Inventions of Man, and Their Refinements
- The Revolutions of Man Via New Ideas, New Machines
- Comparisons of Machines and Their Effects on Man and Society
- The Industrial Revolution Vs. the Computer Revolution
- The Communication Revolution, Electronic Systems and Mass Communications
- Machines as Power, and Emerging Elite Groups
- Machines and Technology as Extensions of Man
- Man as a Machine?
- Predictions of Future Machines, Inventions, etc. — Science Science Fiction, Fact

Introduction to Computers

- What is a Computer? How Does It Work?
- Kinds of Computers (Digital, Analog, Hybrid Systems)
- Input, Output: Methods; Devices
- What is Processing, Manipulation?
- Introduction to Flow-Charting, Formulation of Simple Algorithms
- Comparisons of Synthetic Languages, Uses, How They Differ, etc.
- Calculating Devices, Calculators (Programmable and Non-Programmable), Comparisons with Computer Systems
- Medium-Sized Systems, Minicomputer Systems, Examination, Easy Exposure Use
- Introduction to Computer Arithmetic, Data Presentation
- Number Games in Varied Number Systems
- Information Storage and Retrieval
- Use of Bell Telephone's CARDIAC Game
- Hardware, Software, Programs, and People
- Beginning Development of Definitions and Computer Terminology
- The Computer as an Information Processing Machine
- Introduction to Computer Terminals
- Computers of the Future, Predictions, Science Vs. Science Fiction

Using Computers

- Brief Introduction to Using Minicomputers, Programmable Calculators, etc.
- Introduction to BASIC (or Another Interactive Language), Playing Games
- Learning Machines
- What is Programming? Learning to Program in BASIC
- Independent Use of Terminals (without Help) to Program Self-Assigned Problems
- Becoming Facile in Terminal Usage — Programming More Complex Problems
- Integrating Vocabulary, Computer Concepts with Actual Computer Usage
- Examination of Complex Programs in BASIC from Other Disciplines, Applications
- Planning and Execution of a Final Computer Project
- Demonstrating Ideas and Programs to the Group

Computers, Use in the Community and University

- Tours of Local Computer Facilities, Off-Campus
- Tours of University Facilities, Laboratories
- Discussions of Computer Applications with More Advanced Students
- A Personal Interview with an Advanced Professional or Researcher
- Analysis and Listing of Nearby Computer Applications (or Installations Visited during Vacations)
- Brief Overview of Interdisciplinary Uses of Computers in the University or College
- Kinds of Systems and Languages Used on Campus
- Resource Speakers on Varied Topics Relating to Computer Applications
- Educational, Administrative Uses of Computers in the Area
- Local Government (or State) Uses of Computers
- Industrial and Utilitarian Uses of Computers — How They Save Time and Money
- Tour of an Instructional Media or Learning Center — Integrating Media

Computers and General Applications, Societal Effects, Concerns

- Automation, Employment, Unemployment
- The Protestant Work Ethic Vs. the Leisure Ethic
- The Credit Card Society and the Cashless Society
- Definitions of Privacy, Civil Liberties
- The Dossier Society, History of Dossiers
- Manual Vs. Automated Records
- The National Data Center — Pros and Cons
- Computers and the Professions (Law, Medicine, Education, etc.)
- Computers and the Social and Behavioral Sciences, Physical, Natural Sciences
- Computers and the Humanities — Examples (and Uses)
- Urban, City, Rural, Regional Planning and Computers
- Federal, State, Local Government and Computers
- Computers in Business, Trade, Finance (State, National, International)
- The Limits to Growth; Introduction to Models and Simulation
- Survey of Computer Applications
- Information Retrieval Systems, Data Banks — Pros and Cons
- Computers of the Future (Education, Home, Business, etc.)
- Education and Computer Systems (CAI, CMI, VAI)
- Computers and Social Responsibility — Meaning?
- Computers and Becoming an Educated Person

Computers, Man, and the Future

- Guest Lectures on Present and Future Computer Systems
- Computers, Technology, and Future Studies (Planning Alternative Futures)
- Artificial Intelligence, Man, and Intelligent, Creative Systems
- Managing Technology and Computers
- Computers in the Service of Man
- Introduction to Future Studies and Interdependent Technological Systems
- The Teacher, the Student, Future Educational Systems
- Jobs of the Future and Changes in Jobs
- Future Shock Vs. How to Live with Computers and Technology
- Mankind, Predictions of the Future — Comparisons, Pessimism Vs. the Benign Environment
- Personal Analysis and Definition of a Constructive Role in a Computerized Society

## Evaluation of Students

Because some cognitive materials are presented, there can be limited use of true/false questions, examinations, as well as multiple choice testing. Students may need an introduction to writing essays; outlines (as well as essays) should be encouraged. A variety of presentations, oral, written, etc., are suggested. Debates are highly successful at this level; even shy students will participate spontaneously using such an approach. Class participation is emphasized. Laboratory work, programs, and specific assignments should be finished on time; programs should work. Particular note should be made of differences in attitudes caused by successful use of the computer. Adaptation of laboratory assignments to the student's discipline is encouraged. Self-assigned research from many topics may assume many forms: reading, interviews, reviews of films, periodicals, newspaper clippings, etc., afford variety of participation and expression. Emphasis on sharing of diverse ideas and cooperative ventures can lend a stimulating tone to class experiences. (For suggestions and details, see the paper, "Computers, Society, and Man", "Proceedings", CCUC/5.)

## References


/1/ "Computers and Man", by Richard C. Dorf, published by Boyd and Fraser Publishing Co., 3627 Sacramento St., San Francisco, Calif., 94118, copyright 1974, 469 pp. □

# Computing and Data Processing Newsletter

## COMPUTER RESEARCH MAY HOLD HOPE FOR TOTALLY DEAF

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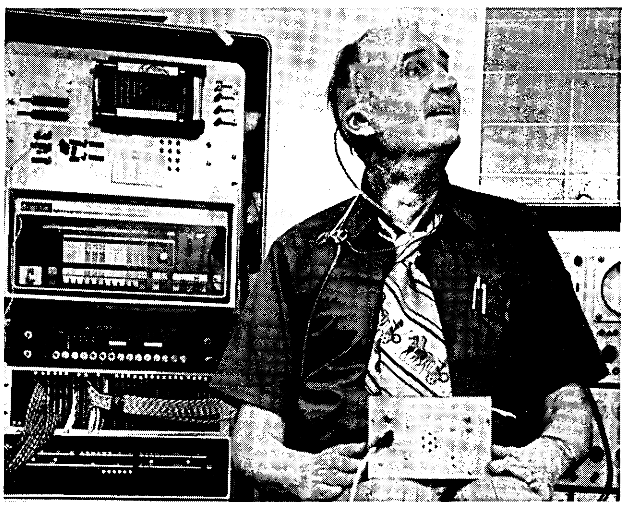
Miniaturized computers may play a key role in the future development of artificial hearing for tens of thousands of deaf persons who cannot be helped by conventional hearing aids.



A STEP TOWARDS THE ARTIFICIAL EAR. A system incorporating a minicomputer permits this patient who has been deaf since birth to report "sounds" when he presses a keyboard. The volunteer-patient controls the experiment through the keyboard, and can differentiate between the "sounds" he perceives and "vibrations."

Researchers representing the Neuroprostheses Program at the University of Utah in Salt Lake City and the Ear Research Institute in Los Angeles have described experimental work employing minicomputers to stimulate the inner ear. They have reported that a subject, deaf from infancy, was able to sense "sounds" from the computer and differentiate them from vibrations.

Their latest experiments involved implanting a series of platinum electrodes the size of a pinhead within the tiny, snail-shell-like cochlea (or inner ear), each connected to an array of photo-isolated stimulus drivers designed by the Utah researchers. These drivers are controlled by a minicomputer. The drivers are interfaced to the electrodes via a special connector, with a pyrolytic carbon shell and platinum contacts, fastened to the skull and protruding through the skin behind the ear. Deaf patients recognize different tones depending upon which electrode is stimulated, and further changes in sound can be achieved by changing the stimulus frequency. More complex sounds can be created by stimulating different electrodes at different frequencies under computer control; such experiments are now in progress.

Once their experiments have been completed, the scientists plan to build portable devices containing appropriate microprocessors. They estimate such devices might be available in about three years. The computer used was a DEC PDP-8 minicomputer.

## NOT ENOUGH BREAD? TOO MUCH MEAT? UNIVERSITY OF WISCONSIN ANALYZES DIETS

*Peter J. Sigmund*
*Sperry-Univac*
*P.O. Box 500*
*Blue Bell, Pa. 19422*

Are you eating too much meat? and not enough bread?

Wisconsin residents can check such questions with a computer which has been programmed to show the percentages of various common nutrients in a diet.

Over 12,000 people thus far have taken advantage of the checking service, which is offered by the University of Wisconsin, using a computer installed at its computer center in Madison. The computer analyzes their diets after they fill out a food record form which contains foods most frequently eaten by Wisconsin residents. The record form is for one day but a person can fill in from one to 30 forms.

Nutrition experts at the University check the computer's findings and recommend, if necessary, changes in the person's diet: food substitutions that can be made to improve their diet.

The computer's calculations are based on recommended daily intake of a dozen nutrients, taking into account the person's age and sex.

Professor Nancy Johnson is the university nutritionist who helped establish the program. The computer has shown that many people eat more meat than they need and could cut down on meat and spend their money on other and less expensive foods.

The program was developed to help Extension Home Economists provide more specific advice to people about their diets. It has been offered to the public in a few areas of Wisconsin as a pilot project.

The computer is a Univac 1108 of Sperry Univac, a division of Sperry Rand Corporation.

## EXCESS OF EXPORTS OVER IMPORTS FOR COMPUTER AND BUSINESS EQUIPMENT CLOSE TO $2 BILLION IN 1974

*Timothy Donovan*
*Computer and Business Equipment Manufacturers Assn.*
*1828 "L" St., N.W.*
*Washington, D.C. 20036*

Beating 1973 by $579 million dollars, the computer and business equipment industry's positive balance of trade hit $1,980 million for 1974.

According to figures compiled from U.S. Department of Commerce data, total exports in '74 were $3,010 million while exports for the same period in 1973 were $2,320 million. Imports for 1974 totaled $1,029 million, compared to $919 million the year before.

## NUMERICAL WIND TUNNEL

*U.S. Air Force Information Office*
*Aeronautical Systems Division*
*Wright Patterson Air Force Base, Ohio 45433*

A wind tunnel project now underway at the Theoretical Aerodynamics Research Laboratory of the Air Force Aerospace Research Laboratories here uses no fans, outlets, or any air flow at all. Known as the "Numerical Wind Tunnel," it is a method of calculating lift, drag, and other "real" wind tunnel test data by using computers.

One factor which gave impetus to this computer project is the increase in costs for wind tunnel testing. For example, wind tunnel tests on the B-29 Bomber of World War II cost $1 million; tests for the cancelled Supersonic Transport cost up to $50 million. Yet the cost of computation units dramatically declined during the same general period: 100,000 multiplications cost $1.26 in 1952 and only one cent today.

Besides saving in cost, the computer offers another major advantage over physical wind tunnels; in conventional testing, several wind tunnels such as subsonic, transonic, and supersonic, are needed. But with computers, only one piece of equipment is necessary.

Research in computer testing to replace wind tunnel testing began early this decade, but according to Dr. W. H. Hankey of the Aerodynamics Laboratory, the efforts today are reaching major proportions because of the astounding growth in power of computers. Dr. Hankey said, "Since 1970, computer capabilities have doubled each year. If this rate continues, by 1980, computer calculation and actual wind tunnel testing should be at a one-to-one ratio."

The major cause of concern for computer testing is accuracy. Dr. Hankey emphasized that now the computer is capable of only "coarse" information, or information accurate to within five to twenty-five percent. This is roughly equivalent to computing information for about every square foot rather than for every half-inch needed for accurate calculations.

However, the accuracy is expected to improve in direct proportion to computer growth. Dr. Hankey said, "If you speculate about the potential uses of the numerical wind tunnel, by the end of this century we might be able to accept or reject aircraft designs, including structural designs, just by computer studies."

## COMPUTER PROGRAM HELPS DESIGN ARTIFICIAL TEETH

*Jean Vandenberg*
*Univ. of Southern Calif.*
*Los Angeles, Calif. 90007*

More than 3,000 years ago, ancient Egyptians tried to replace missing teeth by pounding molars from small cows into their gums. Although their idea was good, the results weren't very lasting. And over the centuries, other people trying other materials similarly had poor results. But now a computer program has measured the stresses and strains of modern dental implants, giving patients a far greater chance of retaining the artificial teeth.

At the Dental School here, Dr. Dale E. Grenoble, associate professor of dentistry, has used an IBM computer to help design dental implants made of vitreous, or glassy, carbon.

"Implants are individual artificial teeth, anchored to the jawbone and not dependent on surrounding teeth for support, as are those in a bridge," said Dr. Grenoble. "Our challenge was to design implants that would neither loosen in the mouth nor fracture."

Since an implant is subjected to all of the grinding forces and stresses that natural teeth face, Dr. Grenoble used a computer to analyze the stress factors for both the implant and its adjacent tissue. Working with him was Albert Knoell, an applied mechanics engineer from the Jet Propulsion Laboratory at the California Institute of Technology, under a grant from Cal Tech.

"As a person chews, he creates constantly changing stress patterns throughout his mouth," Dr. Grenoble said. "We want an implant to match the stress waves of normal teeth as closely as possible. By mathematically measuring the stress factors, our computer enabled us to modify and improve the implant designs without having to build actual models. It saved us significant amounts of time and resulted in better implants."

Once the designs were completed, USC tested them first in animals and then in human volunteers. "In certain situations implants can be more aesthetic, more hygienic and can function better than other dental replacements, but they are not for all people in all situations. The key is selectivity," Dr. Grenoble said.

If, for example, a person loses a tooth in an accident, and the adjacent teeth are healthy, a dentist might consider an implant preferable to a bridge. Or if a patient already has an expensive bridge involving the adjacent teeth, an implant might save it from being sacrificed for a larger bridge.

"Once the need is established, an implant operation can be performed in a regular dentist's office in about a half hour," Dr. Grenoble said. "The dentist cuts through the gum, drills a hole into the jawbone, and taps in the vitreous carbon rod."

After the gum and bone heal, holding the carbon implant firmly in place, a stainless steel post is anchored to the rod and the dental crown is cemented to the steel.

"An implant should last about five years to be considered successful," Dr. Grenoble said. "Our oldest ones have been in place about four years now, and have given their wearers no problems."

*(please turn to page 30)*

# Computers in Use: Analyzed by Standard Industrial Classification: 1974 Compared with 1968 – Part 3, Tables

*Ed Burnett*
*Ed Burnett Consultant, Inc.*
*176 Madison Ave.*
*New York, N.Y. 10016*

*"The distribution of computers on a percentage basis has remained remarkably stable since 1968."*

TABLE II

**COMPUTER PENETRATION RATIOS OF BUSINESS UNIVERSES BY MAJOR SIC CLASSIFICATION –**
**1974 Compared with 1968** *(omitting Computer Services & Service Bureaus)*

| SIC | Classification | Computer Count | | Universe (All Ratings) | Penetration of Universe | | Penetration of Establishments Rated $20,000 Net Worth & Over | | Classification |
|---|---|---|---|---|---|---|---|---|---|
| | | 1974 | 1968 | | 1974 | 1968 | 1974 | 1968 | |
| All | U.S. Total | 24,540 | 17,589 | 3,600,000 | 1/50 | 1/200 | 1/35 | 1/40 | U.S. Total |
| 01-09 | Agriculture, Forestry & Fisheries | 74 | 56 | 21,000 | 1/300 | 1/400 | 1/150 | 1/200 | Agriculture, Forestry & Fisheries |
| 10-14 | Mining Industries | 237 | 170 | 17,000 | 1/80 | 1/100 | 1/40 | 1/50 | Mining Industries |
| 15-17 | Contracting | 246 | 98 | 250,000 | 1/1000 | 1/2500 | 1/250 | 1/700 | Contracting |
| 19-39 | Manufacturing Industries | 9,376 | 6,498 | 246,000 | 1/25 | 1/40 | 1/15 | 1/20 | Manufacturing Industries |
| 19 | Ordnance | 48 | 32 | 180 | 1/4 | 1/6 | 1/1 | 1/2 | Ordnance |
| 20 | Food | 922 | 639 | 25,000 | 1/30 | 1/40 | 1/15 | 1/20 | Food |
| 21 | Tobacco | 26 | 35 | 350 | 1/10 | 1/10 | 1/4 | 1/3 | Tobacco |
| 22 | Textile Mill Products | 302 | 201 | 6,500 | 1/20 | 1/30 | 1/15 | 1/20 | Textile Mill Products |
| 23 | Apparel | 297 | 249 | 16,700 | 1/50 | 1/70 | 1/25 | 1/30 | Apparel |
| 24 | Lumber & Wood Products | 105 | 64 | 16,700 | 1/200 | 1/300 | 1/75 | 1/100 | Lumber & Wood Products |
| 25 | Furniture & Fixtures | 149 | 68 | 11,400 | 1/80 | 1/200 | 1/30 | 1/60 | Furniture & Fixtures |
| 26 | Paper & Allied | 319 | 187 | 5,800 | 1/20 | 1/30 | 1/15 | 1/25 | Paper & Allied |
| 27 | Printing & Publishing | 622 | 521 | 32,400 | 1/50 | 1/60 | 1/20 | 1/25 | Printing & Publishing |
| 28 | Chemical & Allied | 733 | 524 | 12,800 | 1/20 | 1/25 | 1/12 | 1/15 | Chemical & Allied |
| 29 | Petroleum Refining & Allied | 200 | 227 | 1,900 | 1/8 | 1/6 | 1/5 | 1/4 | Petroleum Refining & Allied |
| 30 | Rubber & Plastics | 256 | 141 | 4,300 | 1/15 | 1/30 | 1/10 | 1/20 | Rubber & Plastics |
| 31 | Leather & Leather Products | 90 | 72 | 3,700 | 1/40 | 1/50 | 1/10 | 1/15 | Leather & Leather Products |
| 32 | Stone, Clay & Glass | 225 | 144 | 12,900 | 1/60 | 1/100 | 1/25 | 1/50 | Stone, Clay & Glass |
| 33 | Primary Metal Industries | 493 | 354 | 6,500 | 1/15 | 1/20 | 1/10 | 1/15 | Primary Metal Industries |
| 34 | Fabricated Metal Industry | 651 | 301 | 22,700 | 1/40 | 1/80 | 1/20 | 1/40 | Fabricated Metal Industry |
| 35 | Machinery Except Electrical | 1,290 | 977 | 32,900 | 1/25 | 1/30 | 1/15 | 1/20 | Machinery Except Electrical |
| 36 | Machinery, Electrical | 1,284 | 948 | 8,900 | 1/7 | 1/10 | 1/6 | 1/8 | Machinery, Electrical |
| 37 | Transportation Equipment | 641 | 432 | 5,900 | 1/10 | 1/15 | 1/7 | 1/10 | Transportation Equipment |
| 38 | Prof & Scien & Control Instruments | 324 | 244 | 4,800 | 1/15 | 1/20 | 1/7 | 1/10 | Prof & Scien & Control Instruments |
| 39 | Misc Mfg Industries | 399 | 138 | 13,800 | 1/30 | 1/100 | 1/12 | 1/30 | Misc Mfg Industries |
| 40-49 | Transport Comm & Utilities | 1,538 | 1,172 | 90,000 | 1/60 | 1/80 | 1/15 | 1/20 | Transport Comm & Utilities |
| 50-51 | Wholesale Trade | 2,301 | 1,232 | 230,000 | 1/100 | 1/200 | 1/40 | 1/80 | Wholesale Trade |
| 52-59 | Retailing | 1,118 | 792 | 1,300,000 | 1/1000 | 1/2000 | 1/300 | 1/400 | Retailing |
| 60-67 | Finance | 3,192 | 2,967 | 300,000 | 1/100 | 1/100 | 1/30 | 1/30 | Finance |
| 70-79 | Services, Bus & Pers (omitting Service Bureaus) | 898 | 398 | 250,000 | 1/300 | 1/600 | 1/60 | 1/150 | Services, Bus & Pers |
| 80-99 | Services & Social | 5,324 | 4,206 | 430,000 | 1/70 | 1/100 | | | |
| 82 | Services, Educational | 1,966 | 1,830 | 110,000 | 1/50 | 1/60 | | | |
| 91-94 | Services, Governmental | 2,283 | 1,910 | 40,000 | 1/20 | 1/20 | | | |
| Other | Services, Other | 1,175 | 466 | 280,000 | 1/200 | 1/500 | | | |

For Parts 1 and 2 (including Table 1), see the May and June 1975 issues of *Computers and People.*

TABLE III
**DISTRIBUTION OF COMPUTERS BY MAJOR SIC CLASSIFICATIONS**
**1974 Compared with 1968**
*(omitting Computer Services & Service Bureaus)*

| SIC | Classification | Percentages 1974 | 1968 |
|---|---|---|---|
| All | All | 100.00% | 100.00% |
| 19-39 | Manufacturing | 38.20 | 36.99 |
| 70-99 | Services | 26.36 | 26.17 |
| 60-67 | Finance | 13.00 | 16.86 |
| 50-51 | Wholesale | 9.37 | 7.00 |
| 40-49 | Transport Comm & Util | 6.26 | 6.66 |
| 52-59 | Retail | 4.55 | 4.50 |
| All Other | Contracting, Mining, Agriculture, Forestry, Fisheries | 2.26 | 1.82 |

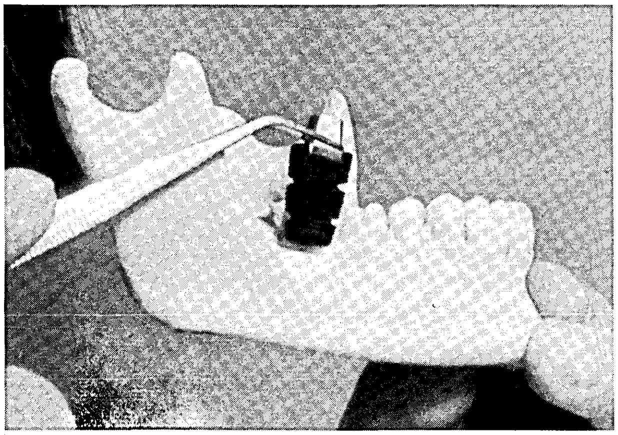
TABLE IV
**PENETRATION RATIOS FOR COMPUTERS IN USE BY MAJOR SIC CLASSIFICATION**
*(omitting Computer Services & Service Bureaus)*

| SIC | Classification | Penetration Ratio 1974 | 1968 |
|---|---|---|---|
| All | All | 1/150 | 1/200 |
| 01-09 | Agriculture, Forestry & Fisheries | 1/300 | 1/400 |
| 10-14 | Mining | 1/80 | 1/100 |
| 15-17 | Contracting | 1/1000 | 1/2500 |
| 19-39 | Manufacturing | 1/25 | 1/40 |
| 40-49 | Transport Communication & Utilities | 1/60 | 1/80 |
| 50-57 | Wholesale Trade | 1/100 | 1/200 |
| 52-59 | Retail Trade | 1/1000 | 1/2000 |
| 60-67 | Financial Services | 1/100 | 1/100 |
| 70-99 | Other Services | 1/180 | 1/250 |

TABLE V
**PERCENTAGE OF COMPUTERS BY MAJOR SIC CLASSIFICATIONS**
**ARRAYED IN DESCENDING ORDER** (No. of Computer Installations)
**WITH PENETRATION RATIOS**
*(omitting Computer Services & Service Bureaus)*

| | | | Penetration Ratios 1974 | | 1968 | |
|---|---|---|---|---|---|---|
| | Percent | No. | Universe | Rated 20M Net Worth+ | Universe | Rated 20M Net Worth+ |
| All | 100.0% | 24,540 | 1/150 | 1/35 | 1/200 | 1/40 |
| Manufacturing | | 6,498 | 1/25 | 1/15 | 1/40 | 1/20 |
| Services | | 6,222 | 1/100 | NA | 1/250 | NA |
| Social | | 5,324 | 1/70 | NA | 1/100 | NA |
| Business (non-Computer) | | 898 | 1/300 | 1/60 | 1/600 | 1/150 |
| Finance | | 3,192 | 1/100 | 1/30 | 1/100 | 1/30 |
| Wholesale | | 2,301 | 1/100 | 1/40 | 1/200 | 1/80 |
| Transportation, Communication & Utilities | | 1,538 | 1/60 | 1/15 | 1/80 | 1/20 |
| Retail | | 1,118 | 1/1000 | 1/300 | 1/2000 | 1/400 |
| Contract | | 246 | 1/1000 | 1/250 | 1/2500 | 1/700 |
| Mining | | 237 | 1/80 | 1/40 | 1/100 | 1/50 |
| Agriculture, Forestry & Fisheries | | 74 | 1/300 | 1/150 | 1/400 | 1/200 |

**Newsletter** — *Continued from page 28*



A computer-designed dental implant is examined. The grooved carbon implant is tapped into a person's jawbone, to anchor a stainless steel post that supports an artificial tooth.

Dr. Grenoble travels throughout the United States instructing dentists in implant procedures. Six other dental schools also are teaching the USC techniques to their students.

## COMPUTER–CONTROLLED IRRIGATION INCREASES CROP YIELDS

*Ralph W. Sheehy*
*Control Data Corp.*
*6003 Executive Blvd.*
*Rockville, Md. 20852*

Computer-controlled irrigation has increased crop yields by an average of 16% in an Idaho study area that is participating in a test project conducted by the Interior Department's Bureau of Reclamation. Supporting this study are 17 other irrigated areas in the western states.

This 16% increase in productivity is important because the irrigated areas of the southwest produce most of the country's winter fruits and vegetables, while the cooler northern areas contribute corn, sugar beets, alfalfa, wheat, barley, and other grains.

The productivity increase is important to the farmers, too; an average farm of 200 acres in the test areas has returned an additional $5,000 to its owner in a year's time.

## TABLE VI
## PENETRATION RATIOS IN MAJOR CLASSIFICATIONS
## (ONE COMPUTER PER* IN UNIVERSE ARRAYED IN DESCENDING ORDER)
*(omitting Computer Services & Service Bureaus)*

| | Penetration of All Firms | | Penetration of Upper Net Worth Grade | |
|---|---|---|---|---|
| | 1974 | 1968 | 1974 | 1968 |
| Manufacturing | 1/25 | 1/40 | 1/15 | 1/20 |
| Transportation, Communication & Utilities | 1/40 | 1/80 | 1/15 | 1/20 |
| Services, Social | 1/70 | 1/100 | NA | NA |
| Mining | 1/80 | 1/100 | 1/40 | 1/50 |
| Finance | 1/100 | 1/100 | 1/30 | 1/30 |
| Wholesaling | 1/100 | 1/200 | 1/40 | 1/80 |
| Agriculture, Forestries, & Fisheries | 1/300 | 1/400 | 1/150 | 1/200 |
| Services, Business | 1/300 | 1/600 | 1/60 | 1/150 |
| Retailing | 1/1000 | 1/2000 | 1/300 | 1/400 |
| Contracting | 1/1000 | 1/2500 | 1/250 | 1/700 |

## TABLE VII
## PENETRATION RATIOS
## MANUFACTURING – BY 2 DIGIT SIC CODES
## ARRAYED IN DESCENDING ORDER
**1974 Compared with 1968**

| | | Penetration of Universe | | Penetration of Firms Rated $20,000 & Over | |
|---|---|---|---|---|---|
| SIC | Classification | 1974 | 1968 | 1974 | 1968 |
| 19 | Ordnance | 1/4 | 1/6 | 1/1 | 1/2 |
| 36 | Machinery Electrical | 1/7 | 1/10 | 1/6 | 1/8 |
| 29 | Petroleum Refining & Allied | 1/8 | 1/6 | 1/5 | 1/4 |
| 21 | Tobacco | 1/10 | 1/10 | 1/4 | 1/3 |
| 37 | Transportation Equip | 1/10 | 1/15 | 1/7 | 1/10 |
| 33 | Primary Metal Industries | 1/15 | 1/20 | 1/10 | 1/15 |
| 38 | Prof & Scientific & Control Instruments | 1/15 | 1/20 | 1/7 | 1/10 |
| 30 | Rubber & Plastics | 1/15 | 1/30 | 1/10 | 1/20 |
| 28 | Chemical & Allied | 1/20 | 1/25 | 1/12 | 1/15 |
| 22 | Textile Mill Products | 1/20 | 1/30 | 1/15 | 1/20 |
| 26 | Paper & Allied | 1/20 | 1/30 | 1/15 | 1/25 |
| 35 | Machinery Except Electrical | 1/25 | 1/30 | 1/15 | 1/20 |
| 20 | Food | 1/30 | 1/40 | 1/15 | 1/20 |
| 39 | Misc Mfg Industries | 1/30 | 1/100 | 1/12 | 1/30 |
| 31 | Leather | 1/40 | 1/50 | 1/10 | 1/15 |
| 34 | Fabricated Metal | 1/40 | 1/80 | 1/20 | 1/40 |
| 27 | Printing & Publishing | 1/50 | 1/60 | 1/20 | 1/25 |
| 23 | Apparel | 1/50 | 1/70 | 1/25 | 1/30 |
| 32 | Stone, Clay & Glass | 1/60 | 1/100 | 1/25 | 1/50 |
| 25 | Furniture | 1/80 | 1/200 | 1/30 | 1/60 |
| 24 | Lumber & Wood | 1/80 | 1/200 | 1/75 | 1/100 |

Not only have crop yields increased under computer control, but about 8% less water has been used by farmers. This helps to conserve water supplies, which are becoming increasingly scarce as more arid land goes into cultivation and more and more water is required to serve growing communities in the "dryland" farming areas.

The Bureau of Reclamation's test project has been under way since 1968, beginning with 22 farms in Idaho and 19 in Arizona. Today, more than 220,000 acres in 14 western states are included in the test program. This program is monitored by a giant Control Data CYBER 74 computer in Denver, Colo., belonging to the Bureau of Reclamation.

"By letting the computer tell the farmer when and how much to irrigate, we are making the first real advance in irrigation techniques in the past 25 years," The Bureau's water use study supervisor in one of the test areas said. "Some farmers have been irrigating by the calendar, others under fixed rotation schedules, and still others irrigate when their neighbor does."

To schedule irrigation by computer, many factors must be considered: water holding capacity of the soil; effective root zone depth; percolation rate; daily climatic conditions; precipitation probability; and the amount of soil moisture depletion; transpiration loss through plant leaves; etc. 90 percent of water absorbed by a plant goes to evaporation into the air.

Then, too, the type of crop must be considered; sugar beets need more water than corn, for instance, and at different times during the growth cycle.

*(please turn to page 33)*

TABLE VIII
**PENETRATION BY 2-DIGIT AND 4-DIGIT SIC**
ONE COMPUTER PER ESTABLISHMENT IN UNIVERSE
TO ONE COMPUTER PER TEN ESTABLISHMENTS IN UNIVERSE

* All but marked classes come from manufacturing
E=Estimated 1968 Detail Data no longer available

| Ratio of Penetration Against Universe | SIC | Classification | No. of Computer Locations 1974 | 1968 |
|---|---|---|---|---|
| 1/1 | | ( Comp. & Acct Machines ( Typewriters, and ( Office Machines | 407 | 418 |
| | 3721 | Aircraft | 106 | 63 |
| | *4511 | Airline Certificated Carriers | 101 | 95E |
| 1/2 | 3021 | Rubber Tires | 93 | 50 |
| | 3661 | Tel & Tel Apparatus | 60 | 93 |
| | 3671 | Radio & TV Tubes | 28 | 20 |
| | 3673 | Transmitting & Spec Tubes | 23 | 13 |
| | 3711 | Motor Vehicles | 164 | 132 |
| | * 63 | Insurance Companies | 998 | 900E |
| 1/3 | 2611 | Pulp Mills | 33 | 20E |
| | 2911 | Petroleum Refining | 174 | 123 |
| | 3312 | Blast Furnaces | 152 | 123 |
| | 3334 | Alum. Prim. Production | 22 | 20 |
| | 3674 | | 72 | 50E |
| 1/4 | 19 | Ordnance | 48 | 32 |
| | 2824 | Synthetic Organic Fibers | 12 | 8E |
| | 2911 | Petroleum Refining | 150 | 123 |
| | 3351 | Rolling - of Copper | 33 | 18E |
| 1/5 | 2082 | Malt Liquors | 39 | 36 |
| | 2085 | Distilled Liquors | 30 | 25E |
| | 2611-31 | Pulp & Paper Mills | 150 | 107 |
| | 2823 | Cellulosic Man Made Fibres | 11 | 8E |
| | 3511 | Steam and Gas Engines | 19 | 15E |
| | 3519 | Internal Combustion Engines | 24 | 32 |
| | 3699 | Electrical Machinery, N.E.C. | 128 | 100E |
| | * 40 | Railroad Transportation | 195 | 128 |
| 1/6 | 206- | Sugars | 31 | 13 |
| | 2812 | Alkalies & Chlorine | 16 | 12 |
| | 3534 | Elevators & Escalators | 17 | 12E |
| | | | 30 | 25E |
| | 3562 | Ball & Roller Bearings | 26 | 25 |
| | 3612 | Power & Specialty Transformers | 41 | 34E |
| | 3631-9 | Household Appliances | 86 | 60E |
| | 3662 | Radio & TV Apparatus | 215 | 185 |
| 1/7 | 36 | Machinery, Electric | 1284 | 948 |
| | 2211 | Cotton | 69 | 48E |
| | 2631 | Paperboard Mills | 35 | 20E |
| | 3221 | Glass Containers | 17 | 12E |
| | 3611 | Electric Measuring & Test Equipment | 66 | 85 |
| | 3621 | Meters & Generators | 45 | 46 |
| | 3629 | Electrical Industrial Apparatus | 25 | 20E |
| | 3722-29 | Aircraft Engines & Parts | 105 | 51 |
| | 3731 | Ship Building & Repair | 34 | 24E |
| 1/8 | 29 | Petroleum Refining & Allied | 200 | 227 |
| | 2044 | Rice Milling | 10 | 13 |
| | 2095 | Animal Fats & Oils | 16 | 6 |
| | 3357 | Drawing & Insulating of Wire | 35 | 25E |
| | 3411 | Metal Cans | 31 | 20 |
| | 3651 | Radio & TV Receivers | 48 | 40 |
| | 3822 | Automatic Temp. Controls | 26 | 21 |
| | 3955 | Carbon Paper & Inked Ribbons | 12 | 11 |
| | *50-51-41 | Groceries, General Line Wholesale | 224 | 120E |
| | *7391 | Research Testing & Development Labs | 364 | 175E |

ation

TABLE VIII *(continued)*

| Ratio of Penetration Against Universe | SIC | Classification | No. of Computer Locations 1974 | 1968 |
|---|---|---|---|---|
| 1/10 | 21 | Tobacco | 26 | 35 |
| | 37 | Transportation Equipment | 641 | 432 |
| | 2043 | General Preparations | 5 | 6 |
| | 2072-3 | Cocoa | 15 | 11 |
| | 2271 | Woven Carpets & Rugs | 12 | 8E |
| | 2284 | Thread Mills | 10 | 5E |
| | 2654 | Sanitary Food Containers | 14 | 10 |
| | 2818-19 | Chemicals, Industrial | 121 | 113 |
| | 2822 | Synthetic Rubbers & Elastomers | 10 | 7E |
| | 2831 | Biological Products | 10 | 7E |
| | 3211-29 | Glass Products | 53 | 55 |
| | 3241 | Cement, Hydraulic | 22 | 17E |
| | 3317 | Steel Pipe & Tubes | 17 | 12E |
| | 3323 | Steel Foundations | 20 | 15E |
| | 3331-57 | Non Ferrous Metals | 146 | 89 |
| | 3352 | Rolling of Aluminum | 20 | 15E |
| | 3452 | Bolts, Nuts, Screws & Washers | 50 | 30E |
| | 3531 | Construction Machinery & Equipment | 50 | 35E |
| | 3613 | Switchgear & Boards | 41 | 38 |
| | 3643 | Current & Carrying Wiring Devices | 30 | 26E |
| | 3714 | Motor Vehicle Parts & Equipment | 162 | 110E |
| | 3811 | Engineering, Laboratory & Scientific Equipment | 57 | 43 |
| | 3861 | Photographic Equipment | 54 | 53 |
| | 3871 | Watches, Clocks & Parts | 15 | 18 |
| | 3955 | Carbon Paper & Inked Ribbons | 12 | 11 |
| | *4911 | Utilities, Electric | 254 | 150 |
| | *6020 | Commercial Banks | 1380 | 1300E |
| | *8932 | Actuaries | 57 | 50E |

**Newsletter** - *Continued from page 31*

The information is fed by telephone into the computer in Denver by the Bureau's field men. Then the computer goes to work, applying complex equations developed from research conducted by the U.S. Department of Agriculture and the Bureau of Reclamation. Within 24 hours, the farmer receives a computer printout, guiding him as to how much water to use and when to use it, over the next 14 days.

Since the computer can also correlate all the water demands for an entire irrigation district, it becomes simple to schedule water usage so as not to exceed capacity, and available supplies are stretched out to meet requirements.

Before the test program was implemented, farmers were wasting between 20 and 40% of the water through surface runoff and deep percolation losses. Careful computer control of irrigation will enable farmers to reduce this water waste to as little as 10 percent. □



## THE INDIVIDUAL: His Privacy, Self-Image, and Obsolescence — Part 2 (Concluded)

*Paul Armer*
*Director, Computation Center*
*Stanford University*
*Stanford, Calif.*

### References (continued)

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# GAMES AND PUZZLES for Nimble Minds – and Computers

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It is fun to use one's mind, and it is fun to use the artificial mind of a computer. We publish here a variety of puzzles and problems, related in one way or another to computer game playing and computer puzzle solving, or to the programming of a computer to understand and use free and unconstrained natural language.

We hope these puzzles will entertain and challenge the readers of *Computers and People.*

## NAYMANDIJ

In this kind of puzzle an array of random or pseudorandom digits ("produced by Nature") has been subjected to a "definite systematic operation" ("chosen by Nature") and the problem ("which Man is faced with") is to figure out what was Nature's operation.

A "definite systematic operation" meets the following requirements: the operation must be performed on all the digits of a definite class which can be designated; the result displays some kind of evident, systematic, rational order and completely removes some kind of randomness; the operation must be expressible in not more than four English words. (But Man can use more words to express it and still win.)

### NAYMANDIJ 757

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 9 | 2 | 6 | 3 | 0 | 8 | 5 | 2 | 0 | 7 | 9 | 3 | 3 | 3 | 0 | 4 | 4 | 4 | 2 |
| 3 | 3 | 7 | 3 | 3 | 5 | 6 | 7 | 0 | 3 | 7 | 1 | 5 | 9 | 3 | 2 | 4 | 9 | 2 | 3 |
| 9 | 7 | 7 | 1 | 5 | 5 | 4 | 2 | 4 | 7 | 1 | 5 | 5 | 5 | 4 | 7 | 3 | 7 | 6 | 3 |
| 9 | 3 | 5 | 3 | 5 | 5 | 7 | 6 | 5 | 4 | 7 | 4 | 4 | 1 | 9 | 0 | 7 | 2 | 7 | 4 |
| 5 | 7 | 6 | 1 | 6 | 3 | 0 | 1 | 3 | 5 | 4 | 8 | 6 | 2 | 0 | 5 | 3 | 0 | 1 | 2 |
| 6 | 8 | 5 | 0 | 8 | 1 | 2 | 2 | 4 | 4 | 5 | 5 | 2 | 9 | 4 | 0 | 9 | 9 | 4 | 5 |
| 6 | 6 | 1 | 6 | 6 | 7 | 4 | 0 | 4 | 9 | 3 | 8 | 0 | 0 | 6 | 6 | 0 | 3 | 9 | 1 |
| 2 | 6 | 3 | 3 | 4 | 2 | 5 | 5 | 8 | 7 | 5 | 5 | 8 | 4 | 3 | 4 | 4 | 3 | 3 | 4 |
| 6 | 8 | 4 | 7 | 4 | 8 | 9 | 8 | 9 | 5 | 2 | 7 | 3 | 5 | 2 | 6 | 6 | 5 | 3 | 6 |
| 4 | 5 | 2 | 3 | 7 | 7 | 7 | 8 | 3 | 8 | 8 | 8 | 7 | 2 | 4 | 3 | 1 | 3 | 3 | 0 |

## MAXIMDIJ

In this kind of puzzle, a maxim (common saying, proverb, some good advice, etc.) using 14 or fewer different letters is enciphered (using a simple substitution cipher) into the 10 decimal digits or equivalent signs for them. To compress any extra letters into the 10 digits, the encipherer may use puns, minor misspellings, equivalents like CS or KS for X or vice versa, etc. But the spaces between words are kept.

### MAXIMDIJ 757

## NUMBLES

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 deliberate (but evident) misspellings, or is otherwise irregular, to discourage cryptanalytic methods of deciphering.

### NUMBLE 757

```
              W I S D O M
            x   S A I L S
            -------------
              S M D W D A
            I S O O L I
          D O H L N S            W = N
        M D D I A M
      S M D W D A
      -------------------
    = L O A M A S W A E A
```

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We invite our readers to send us solutions. Usually the (or "a") solution is published in the next issue.

## SOLUTIONS

**NAYMANDIJ 756:** Make W of 4's.

**MAXIMDIJ 756:** If it is OK do it. If it is not OK do not do it.

**NUMBLE 756:** The thread breaks where it is thinnest.

Our thanks to the following individuals for sending us their solutions to – **NAYMANDIJ 755:** John Waters, Atlanta, Ga. – **NUMBLE 755:** T. P. Finn, Indianapolis, Ind.; Manuel Juan, Oakland, Calif. – **NAYMANDIJ 756, MAXIMDIJ 756 and NUMBLE 756:** Russell Chauvenet, Silver Spring, Md.