computers and people

including *Computer Graphics and Art* — formerly *Computers and Automation*

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The Computer Almanac and Computer Book of Lists — Instalment 45

Neil Macdonald, Assistant Editor

71 TOPICS IN THE COURSE, "4TH AND 5TH GENERATION DATA MANAGEMENT SOFTWARE" (List 860101)

Glossary of Acronyms

DBMS	data base management system
TP	teleprocessing
AI	artificial intelligence
4GL	4th generation language
R & D	research and development
IBM	International Business Machines

1. The Evolution of Integrated Data Management Software -- From the 1st to the 5th Generation.

   DBMS
   Time Sharing Systems
   TP Monitors
   Report Writers
   Query Languages
   Data Dictionary
   Directory
   4th Generation Languages
   Decision Support Systems
   Graphics
   Data Base Designers

2. Information Centers: The True Story

3. Prototyping: How and Where to Use It

4. What are Decision Support Systems?

5. Requirements of a 4GL

   DBMS
   Query
   Reporter
   Procedural Language
   Non-procedural Language
   Screen Painter
   Word Processor
   Migration
   Documentation
   Integrity
   Security

6. Management Implications of Using a 4GL

7. The Different Types of 4GLs

8. The Importance of Data Independence

9. How a DBMS Operates

10. The Different DBMS Logical Views of Data

    Hierarchical
    Network
    Inverted List
    Relational

11. How to Select the Right DBMS for Your Needs

12. How Relational DBMS Will Impact the Data Base Field

    Relational Advantages
    Relational Problems
    Minimal Relational
    Relationally Complete
    Fully Relational
    Relational Performance
    Revised and Updated Systems

13. Normalized Data Structures: How They Work and Why

14. Review and Discussion of Complete Mainframe Systems Development Technologies

15. Review and Discussion of Information Center and Application Generator Software

16. Review and Discussion of Application Development Tools

17. Review and Discussion of Software for Super Mini Systems

18. Review and Discussion of Microcomputer and Personal Computer Software

19. Micro-Mainframe Links: The Reality

20. Review and Discussion of Relational DBMS

21. Review and Discussion of Database Machines

22. IBM's Database Strategies

23. Future Directions

    R & D
    Hardware
    Software

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Computing and Data Processing Newsletter

SHAKESPEARE FOLIO EDITIONS GOING INTO A COMPUTER DATABASE TO PROVIDE INSIGHT FOR ACTORS, DIRECTORS, STUDENTS

Based on a report in the "Montreal Gazette"
250 St. Antoine St.
Montreal, Quebec, Canada

Two York University professors are, "putting the mistakes back into Shakespeare" because they don't believe the so-called mistakes in the original texts were really errors at all. For more than 400 years, Shakespeare's plays have been "corrected" by publishers who standardized the spelling, brought the grammar up to date and "improved" the rhythms of the verses, changing the works with each new edition.

Now actors or directors who need uncorrected original versions of Shakespeare's works need go only as far as their computer terminals. Professors Neil Freeman and Jim McBride have entered the original folio editions of the Bard's plays into computers. They are now devising programs to analyse the texts more thoroughly than has been possible before.

Formed Partnership

Initially, Freeman of the Fine Arts faculty approached McBride, chairman of computer science, to see if a student would be interested in helping out on the project. The computer scientist was so enthusiastic that they formed a partnership.

"The variations of spelling and grammar in the original texts were quite deliberate," Freeman explained. "The Elizabethans allowed their actual thinking process to appear on the page. They allowed themselves extreme freedom of spelling and grammar. This shouldn't be confused with laxity since the form is meant to cue the reader to the meaning of the line. The sentences may have been incomplete because the intention was to express emotion and argument and that was the best way to do it." The York scholars' intention is to put these cues back into their computer texts.

Professor Freeman cites the example of the line "Oh he's a lovely gentleman" from the nurse's speech in "Romeo and Juliet" as an example of variant spelling. The original text was "Oh, hee's a Lovely Gentleman." The original shows the emphasis. Now we might denote the same thing by underlining."

These cues have all been lost in the modern texts, used by actors and read by the public. The modern editions originated long after Shakespeare's death. "Shakespeare never intended his plays to be read so he didn't authorize printing during his lifetime," Freeman said.

"To prevent rival theatre companies from stealing the plays, actors were only given their parts rather than the whole text of a piece. But other groups collected what they remembered from the plays and passed them off as the originals. Some of these unauthorized editions were printed during Shakespeare's lifetime." One of these versions is so inaccurate it has Hamlet ask, "To be or not to be; Ay, that's the point?"

There is a source of the definitive texts available. After Shakespeare died two of his colleagues and shareholders in his company put together the acting versions of the plays and had them printed. Since they were actors who had been Shakespeare's close friends for 20 years, the texts come from the most definitive source possible. Known as the "First Folio," this edition of the 36 plays is the source for the York project.

Restoring Content

"The niceties of literature and poetry have taken the place of the human drama in the original. These editors have destroyed some of the acting moments. We are trying to restore the human content that was in the texts when Shakespeare wrote them," Freeman said.

The Shakespeare scholars have finished entering all the folio texts and they hope to add the quarto editions as well so comparisons can be made. The next step is the writing of analysis programs. The new programs are set up to analyze themes and to determine the relationship of a single charactor to the play he is in and also to all the rest of Shakespeare's work. Their first attempts have already yielded some interesting results.

"A lot has been made about the use of the word 'blood' in "Macbeth." But if you analyze its use in the historical plays you will

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computers and people formerly *Computers and Automation*
including *Computer Graphics and Art*

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.

Announcement

We have to reduce the storage space we are occupying. Back copies of *Computers and People* for 1985, 1984, 1983, and most prior years beginning with 1970 are available. The special price per copy (so long as the excess lasts) will be $1.50 (instead of the usual price $4.70) for each copy, applying to orders received in our office before Wednesday, January 15, 1986. — ECB

Front Cover Picture

The front cover shows dig workers removing a coffin from a tomb in Saqqara, an elaborate cemetery for Egyptian generals and high state officials in ancient Egypt. Workers, scientists, and a microcomputer functioned under adverse weather conditions, and gathered interesting information about the diseases of ancient man. The photograph is courtesy of the Egyptian Exploration Society. For more information, see page 19.

Editorial Note

We invite articles on the subject of computers and nuclear weapons. Computers, and computer people who work to make nuclear weapons work, are an essential ingredient of the nuclear evil.

There will be zero computer field and zero people if the nuclear holocaust and the nuclear winter occur. Every city in the United States and in the Soviet Union is a multiply computerized target. Thought, discussion, and action to prevent this holocaust is an ethical imperative.

Key

[A]	—	**Article**
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Editorial

Zero Common Sense

Edmund C. Berkeley, Editor

We are heading into a most dangerous period of human history due to application of computers and electronic communications to nuclear war, and an immutable law of nature: If it is possible to make a mistake, then sooner or later the mistake will be made.

I quote from a prodigious and magnificent report, "The Button: The Pentagon's Strategic Command and Control System" by Daniel Ford published by Simon and Schuster, New York, NY, 1984, 271 pp:

[Beginning of Quotation, from p. 24]

In the 1980's, there is no longer a guaranteed grace period for hot-line consultations while opposing bombers, at subsonic speeds, approach each other's territory. The technology has changed — today's intercontinental ballistic missiles fly at speeds in excess of 15,000 miles per hour — and this has prompted changes in the kinds of firing mechanisms relied upon to assure retaliation. It must now be recognized that in an actual U.S.-Soviet confrontation, the good sense of leaders on both sides could be overwhelmed by the brute fact that they might have little warning time or opportunity to deliberate, a situation made all the more acute by the vulnerability of the leaders themselves to each other's nuclear weapons.

Common sense demands deliberation and restraint. But the arrangements now in place for assuring retaliation depend on the ability to take speedy action at the first sign — or apparent sign — of an enemy attack.

"We've got to realize the implication of what we have done," Dr. John Steinbruner, the Director of Foreign Policy Studies at the Brookings Institution, said. "I think that like many things one does not want to overdo the set trigger analogy, but to a first approximation that is the way to think about the situation. ..."

[End of Quotation]

A set trigger is a hair trigger, an exceedingly sensitive trigger.

The Reagan administration and the Pentagon look on the Soviet Union as an evil enemy, and regularly cast the USSR as the enemy in war games. They denigrate or keep silent about actions by the Soviet Union that are clearly good. They emphasize and proclaim actions by the Soviet Union that are clearly bad, like the oppression in Poland, the fighting in Afghanistan, and the shooting down of Korean Airlines flight 7. So all the people of the United States become hostages to a Strategic Command and Control System, "the button", which does not work properly, which has zero common sense.

Certainly, the button if used first may kill over 200 million Soviets. But half an hour later retaliation will kill over 200 million Americans. No common sense!

Many clear signs show if a big industrial nation is planning to attack other big industrial nations. The German chancellor Hitler used seven years for military preparations, from 1933 when he became chancellor to 1940 when he conquered France. Warning after warning by observers, travelers, defectors like Albert Einstein, intelligence personnel, came out of the Third Reich, only to be disregarded.

But the Soviet Union is showing no signs of preparation to attack the United States. The Soviets are building 8 more subways in Kiev, Kharkov, Tashkent, Yerevan, Tbilisi, Baku, and Minsk. This is not aggressive. A Soviet spaceship photographed and named the craters on the back side of the moon. This is not aggressive. The Soviet Union suffered more than 30 million dead in this century from two wars. Of all Soviet men born in 1922 only 3 out of 100 survived World War II. That the Soviets desire to fight a nuclear war, desire to commit aggression against the United States, is beyond belief. In the real world the Soviets show no signs of intending military aggression against the United States.

We Americans must apply plain common sense to strategic command and control. We must not be deluded by the will-o'-the-wisps of computers, electronic communications, and irrationality.

Ω

Why Scientists Are Speaking Out Against Star Wars

Herbert Thompson, Lecturer
Dept. of Artificial Intelligence &
Centre for Cognitive Science
University of Edinburgh
Edinburgh, Scotland, U.K.

"When the area of concern was the control of weapons, we became quite literally terrified."

Based on a report in the *New Scientist*, November, 1985, published by IPC Magazines, Ltd., London, England. Reprinted with permission from the author.

Emerging Groups

When the social history of our time is written, one item of interest will be the dramatic increase in the 1980s of pressure groups concerned with science and technology. On a number of fronts, scientists are trying to make themselves heard outside the usual channels of academic debate.

Groups emerging in Britain and elsewhere in the past few years include Physicians for Social Responsibility, International Physicians for the Prevention of Nuclear War, Scientists Against Nuclear Arms, Campaign for Lead-Free Petrol, Computer Professionals for Social Responsibility (CPSR), Electronics for Peace and Computing and Social Responsibility (CSR).

The last three have all been particularly visible lately, attempting to bring to public attention some of the technical problems with President Reagan's Strategic Defense Initiative (SDI, also called Star Wars).

Motivation

Is the explanation for all this a simple hunger among scientists for publicity, or some knee-jerk leftist opposition to the state, or is it part of the general rise in antinuclear sentiment? My personal view, as a computer scientist involved in the beginnings of both CPSR and CSR, is that all of those reasons may have played some part for some people. But the basic motivation for an individual scientist's participation in such groups lies elsewhere.

The initial motivation is personal. People are uncertain about the wider significance of their work and its relationship to social and political issues which concern them. Sharing their concern with others proves beneficial -- talking about it helps clarify what one thinks and how one ought to act.

A Radical Failure of Existing Governmental Organizations

Such groups then turn their attention outwards as their discussions lead to the perception of a radical failure of existing governmental institutions. East and West, European and American, they are all failing to cope with the growth and change in the nature of scientific knowledge during the past 50 years.

It is for others to seek an explanation for this failure. Perhaps it lies in the decline of the scientific civil service as an attractive career for scientists, together with the rapid increase in diversity and specialisation which has taken place in science as a whole. It has become impossible for any one person to cover more than a very small part of the necessary ground. Whatever the cause, the perception among scientists is clear: there is no one in Whitehall who is competent to understand technical arguments about issues of any significant complexity.

The inadequacies of the current set-up could not be better illustrated than by the fact that Michael Heseltine, the Secretary of State for Defence, has recently negotiated the basis for British industrial involvement in the SDI without any governmental forum having addressed the technical feasibility of the programme. Nor has the government considered whether the injection of £1 billion into a narrowly focused area would seriously distort the balance of scientific research in Britain.

Computer Science is Quite Different from Natural Science

The problem seems to be particularly acute for computer science. This is perhaps not too surprising, because the existing governmental mechanisms were designed to cope with the natural sciences. But computer science is not like the natural sciences. In the natural sciences one is investigating, explaining and exploiting what is there in the world. Ordinary experience, coupled with a general scientific education and a good mind, provide a fair basis for planning and evaluation.

Computer science is quite different. At least in part it defines and thereby creates its own new possibilities.

The significance of this distinction in the context of SDI is greater with respect to computer science than mathematics. Matters of policy have never turned on claims about what is or is not susceptible to mathematical analysis.

The self-defining property of computer science perhaps contributes to the apparent impossibility of conveying to a non-specialist the nature of computational complexity. Systems, in the computational sense, are unusual things, and the nature of their complexity is not easily communicated. In particular, the issue of scale is difficult. A large system is not created simply by replicating one small system a number of times, or by joining together a number of disparate small systems. Its behaviour is not necessarily derivable from the behaviour of its components in any straightforward way.

Basic Lack of Understanding by Government

Given all this, it is not surprising that the people making decisions about public policy in areas involving computing technology have done so on the basis of a fundamental lack of understanding of the strengths and weaknesses of that technology.

That lack of understanding has been unfortunate when expressed as unwarranted pessimism, leading to missed opportunities. It is downright dangerous when it is expressed as unwarranted optimism. Some of us were concerned when the people not understanding computing technology came from the schools and the Department of Health and Social Security. We were not sufficiently concerned to organise. But when the area of concern was the control of weapons we became quite literally terrified, and that did produce sufficient motivation to organise.

The responsibility for this unreasonable optimism cannot all be placed at the door of the government. Well meaning optimists and cynical opportunists have all too often combined to overstate the case in their efforts to sell some aspect of computing technology. The proponents of computers in education and artificial intelligence have been particularly guilty. It is not surprising that it is in these areas that groups such as CPSR and CSR are most concerned to redress the balance. Indeed I think some of the motivation for people's involvement in such groups is a feeling of obligation to try to make up for the past excesses of their colleagues.

Starting a Nuclear War Under Fully Automatic, Unsupervised Control?

The nub of the argument is this: as computer scientists, we know what computer systems are like, what they can and cannot be depended on to do. Not one of us, or I am confident any other responsible computer scientists, could ever literally or figuratively turn the switch which placed the means for starting a nuclear war under fully automatic unsupervised control. From that it follows that it would be profoundly intellectually and morally dishonest to connive at the creation of any programme with that as its stated goal.

All the evidence is that decisions with respect to the development and even deployment of major weapons systems are rarely if ever made on purely technical grounds. So, even though the technical impossibility of the computing aspects of the SDI are clear to us, we have no confidence that this is sufficient to stop its development.

As Professor Tony Hoare said with respect to another effort by the Department of Defense in the US: "At first I hoped that such a technically unsound project would collapse, but I soon realised it was doomed to success. Almost anything in software can be implemented, sold, and even used, given enough determination. There is nothing a mere scientist can say that will stand against the flood of a hundred million dollars. But there is one thing that cannot be purchased in this way -- and that is reliability."

(please turn to page 25)

Artificial Intelligence: An Introduction

Dr. Patrick H. Winston
Professor of Computer Science
Director, Artificial Intelligence Laboratory
Massachusetts Institute of Technology
Cambridge, MA 02139

"The perspective of Artificial Intelligence complements the traditional perspectives of psychology, linguistics, and philosophy."

Editorial Note: This article is based on the table of contents, the preface, and the first chapter of *Artificial Intelligence*, second edition, 1984, by Patrick Henry Winston, published by and copyrighted by Addison-Wesley Publishing Co., Reading, MA, 01867, 527 pp; it is reprinted with permission. The article is somewhat abridged. Interested readers are referred to the full text in the book, which is available, fascinating, and important. — ECB

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PREFACE

The field of Artificial Intelligence has changed enormously since the first edition of this book was published. Subjects in Artificial Intelligence are de rigueur for undergraduate computer-science majors, and stories on Artificial Intelligence are regularly featured in most of the reputable news magazines.

Part of the reason for change is that solid results have accumulated. In the early days, most researchers in the field were content with illustrations that showed ideas at work on simple, blocks-world problems, without showing the limits of those ideas. As the field matured, there came to be a gradual shift toward demonstrations, showing that there are ideas that are powerful enough to handle problems of practical interest. Now, having achieved a degree of respectability, more people are building systems for experiments as they hypothesize answers to truly hard problems that defy superficial speculation.

Of course, in this book, the emphasis is on illustrations, often from the blocks world, because the book's purpose is educational. But do not confuse the emphasis in a textbook with the emphasis of the field. Artificial Intelligence is a serious subject, one that inquires into the deepest of the classical problems inherited unsolved from fields like psychology, linguistics, and philosophy.

Changes

The subjects covered in this book are roughly those in the first edition, but this book is stronger in the following ways:

- The focus has moved toward principles and away from case studies.
- I deal explicitly with my view of how Artificial Intelligence work should be done and how it should be judged.
- There are new chapters on logic and learning, inasmuch as readers of "Artificial Intelligence" demanded them. The chapters on programming have emigrated into a new book, "LISP," coordinated with this one.
- There are explicit procedures. The procedure language is English, so as to require no tangential study, but the English is arranged in procedure-like style, so as to offer greater precision than ordinary language.
- Old material has been purged and new material added to bring things up to date. All surviving material has been rewritten and rearranged to improve clarity and coherence. The most radical changes are in the chapters on control, representation, language, vision, and problem solving. The problem-solving chapter, for example, now treats design and analysis systems, providing explanations of representative successes like XCON, THE DIPMETER ADVISOR, MYCIN, and ACRONYM.
- There are more problems. Many introduce important contributions to the field such as Mitchell's version-space learning procedure, Morevec's reduced-images stereo procedure, and the Strips problem solver.

Uses

This book is modular, so that the material can be selected and ordered to resonate with personal preferences and time constraints. Much of the book is suited to individuals wishing to learn about the key ideas on their own.

The book was designed, however, to support classroom instruction. ...

Chapter 1: THE INTELLIGENT COMPUTER

This book is an introduction to the field that has come to be called Artificial Intelligence. The purposes of this first chapter are to explain why knowing about Artificial Intelligence is important, to outline the field, and to give some examples of the progress that has been made.

The Field and the Book

There are many ways to define the field of Artificial Intelligence. Here is one:

- Artificial Intelligence is the study of ideas that enable computers to be intelligent.

But what is intelligence? Is it the ability to reason? Is it the ability to acquire and apply knowledge? Is it the ability to perceive and manipulate things in the physical world? Surely all of these abilities are part of what intelligence is, but they are not the whole of what can be said. A definition in the usual sense seems impossible because intelligence appears to be an amalgam of so many information-representation and information-processing talents. Nevertheless, the goals of the field of Artificial Intelligence can be defined:

- One central goal of Artificial Intelligence is to make computers more useful.
- Another central goal is to understand the principles that make intelligence possible.

The purpose of this book is to serve two groups of people. Computer scientists and engineers need to know about Artificial Intelligence in order to make computers more useful. Psychologists, linguists, and philosophers need to know about Artificial Intelligence in order to understand the principles that make intelligence possible.

Because this book focuses on basic ideas, almost none of it requires special background such as computer programming experience or advanced mathematical training.

Making Computers Intelligent Helps Us Understand Intelligence

The perspective of Artificial Intelligence complements the traditional perspectives of psychology, linguistics, and philosophy. Here are some reasons why:

- Computer metaphors aid thinking. Work with computers has led to a rich new language for talking about how to do things and how to describe things. Metaphorical and analogical use of the concepts involved enables more powerful thinking about thinking.
- Computer models force precision. Implementing a theory uncovers conceptual mistakes and oversights that ordinarily escape even the most meticulous researchers. Major roadblocks often appear that were not recognized as problems at all before beginning the cycle of thinking and experimenting.
- Computer implementations quantify task requirements. Once a program performs a task, upper-bound statements can be made about how much information processing the task requires.
- Computer programs exhibit unlimited patience, they require no feeding, and they do not bite. Moreover, it is usually simple to deprive a computer program of some piece of knowledge in order to test how important that piece really is. It is impossible to work with animal brains with the same precision.

Note that wanting to make computers be intelligent is not the same as wanting to make computers simulate intelligence. Artificial Intelligence excites people who want to uncover principles that all intelligent information processors must exploit, not just those made of wet neural tissue instead of dry electronics. Consequently, there is neither an obsession with mimicking human intelligence nor a prejudice against using methods that seem involved in human intelligence. Instead, there is a new point of view that brings along a new methodology and leads to new theories.

One result of this new point of view may be new ideas about how to help people become more intelligent. Just as psychological knowledge about human information processing can help make computers intelligent, theories derived purely with computers in mind often suggest possibilities about methods to educate people better. Said another way, the methodology involved in making smart programs may transfer to making smart people.

Intelligent Computers Are More Useful Computers

Do we really need to make our computers smarter? It seems so. As the world grows more complex, we must use our energy, food, and human resources wisely, and we must have high-quality help from computers to do it. Computers must help not only by doing ordinary computing, but also by doing computing that exhibits intelligence.

It is easy to think of amazing applications for intelligent computers, many of which seem like science fiction by yesterday's standards. Here are a few:

- In business, computers should suggest financial strategies and give marketing advice. Moreover, computers should schedule people and groups, refer problems to the right people, summarize news, and polish draft documents, freeing them of grammatical errors.
- In engineering, computers should check design rules, recall relevant precedent

designs, offer suggestions, and otherwise help create new products.

- In manufacturing, computers should do the dangerous and boring assembly, inspection, and maintenance jobs.
- In farming, computers should control pests, prune trees, and selectively harvest mixed crops.
- In mining, computers should work where the conditions are too dangerous for people, and they should recover the manganese nodules from the bottom of the sea.
- In schools, computers should understand their students' mistakes, not just react to them. Computers should act as superbooks in which microprocessors display orbiting planets and play musical scores.
- In hospitals, computers should help with diagnosis, monitor patients' conditions, manage treatment, and make beds.
- In households, computers should give advice on cooking and shopping, clean the floors, mow the lawn, do the laundry, and deal with maintenance.

Some of these things are being done now. Others are close. Still others will require a lot more work. All are possible. ...

What Computers Can Do

Having seen the ideas to be examined in this book, let us look at some representative examples of what computers can do once they are programmed using such ideas. Be cautious, however! It is as easy to become a rabid believer as it is to remain dogmatically pessimistic. Much remains to be discovered, and when talking about what computers can do, it is often appropriate to preface claims with, "To some extent ...." In most cases, basic research is only now becoming engineering practice.

Computers Can Solve Difficult Problems

An early program, written by James R. Slagle, operated in the world of integral calculus. Computers can do arithmetic at unbelievable speed, of course. Slagle showed they can do much more, accepting many symbolic integration problems and producing symbolic anwers. Slagle's program is simple enough to serve as a programming example even though it comfortably handles problems from university-level examinations. Subsequent programs, like one by Joel Moses in the MACSYMA system, do even better because they have more and better knowledge. No human can compete with them.

Much more recently, programs have been written that solve mechanical problems. Faced with a spring-loaded reducer valve, a program by Kenneth D. Forbus produces the following explanation for what happens when the pressure rises in the output port:

> When the pressure in the output port rises, the increasing pressure pushes the diaphragm up and closes the auxiliary valve. The pressure in the auxiliary valve's output chamber falls, the pressure in the piston steam port falls, and the piston moves up and closes the main valve. The pressure in the main valve's output chamber falls, causing the pressure in the output port to fall. Note that when the pressure in the output port rises, it causes the system to act so that the pressure in the output port falls. This means the system exhibits negative feedback.

Computers Can Help Experts Analyze and Design

Some programs are intended to help physicians analyze certain kinds of disease. One, MYCIN, by Edward Shortliffe, specializes in certain bacterial infections. Another, CADUCEUS, by Harry E. Pople, Jr. and Jack D. Myers is for internal medicine. The performance of both programs is moving toward the level of human specialists.

Another powerful analysis program, by Gerald J. Sussman and Richard M. Stallman, is for understanding electronic circuits. Their program, EL, reaches conclusions about a circuit diagram using humanlike reasoning, rather than brute-force attack on the network equations. An advantage lies in the system's ability to talk about what it has done in terms human engineers can understand.

Another analysis program, PROSPECTOR, developed by Richard O. Duda, Peter E. Hart, and Rene Reboh, helped to discover a promising new extension to an existing molybdenum deposit near Mount Tolman in Washington.

Programs for analysis are complemented by others for engineering design. An integrated-circuit chip has been designed with help from a program. Another representative design program used in the computer business is XCON, originally called R1, developed cooperatively by John McDermott at Carnegie-Mellon University, Arnold Draft and Dennis O'Connor at the Digital Equipment Corporation, and their associates. XCON decides how to configure the various modules in a computer system.

Computers Can Understand Simple English

There are now several programs that are capable of handling questions expressed in English. One of these, INTELLECT, developed by Larry R. Harris, answers English questions like the following:

- I wonder how actual sales for last month compared to the forecasts for people under quota in New England?

Another program, LIFER, developed by Gary G. Hendrix, was originally specialized to answering questions in the world of ships:

- How many Spruance class ships are there?
- Who is the captain of the Kennedy?
- What is the length of Old Ironsides?

Computers Can Understand Simple Images

Equipped with television cameras, computers can see well enough to deal with certain limited worlds. From drawings of a blocks world, for example, they make conclusions about what kinds of objects are present, what relations exist between them, and what groups they form. A program by David Waltz notes that a certain line drawing depicts eight objects, including three that form an arch in the middle foreground. It further observes that to the left of the arch is a wedge, and to the right is a distorted brick with a hole, and a three-object tower stands in the background.

Unfortunately, it is much harder to work with images from a camera than to work with prepared drawings. Promising progress has been made, nevertheless. ...

Computers Can Help Manufacture Products

It is fortunate that computers will eventually do work that people dislike -- jobs that are dirty, dangerous, demeaning, hopelessly boring, or poorly rewarded. As society advances, such jobs must be done by flexible, intelligent robots or by an armamentarium of special-purpose machines using brute-force methods. So far, the special-purpose machines dominate. Hardly anyone has shoes made to order, even though one person's two feet are rarely the same size. Tailor-made suits have similarly given way to the standard item off the rack.

To move from special-purpose machines to flexible, intelligent robots requires many capabilities. One of these is reasoning about motion in space.

Another requirement is the capability of dealing with force and touch information. A program developed by W. Daniel Hillis can distinguish among screws, washers, cotter pins, and other small objects using information from touch sensors. The touch sensors can be carried by fingers like a tendon-actuated one, developed by Steven Jacobsen and John E. Wood.

Computers Can Learn from Examples and Precedents

Several programs now demonstrate learning talent. One of my programs learns new concepts from sequences of diagrams. Another, INDUCE, by Ryszard S. Michalski, learns to distinguish between the "upper trains" and the "lower trains" shown in a certain diagram. In a practical application, the train-recognition program learned criteria for recognizing more than a dozen soybean diseases, producing results superior to human specialists. Since a considerable fraction of the world's population relies on soybeans for survival, diagnosing soybean diseases is important.

Another kind of learning program, by me, deals with precedents and exercises like those captured by the following brief descriptions:

Macbeth

> This is a story about Macbeth, Lady Macbeth, Duncan, and Macduff. Macbeth is an evil noble. Lady Macbeth is a greedy, ambitious woman. Duncan is a king. Macduff is a noble. Lady Macbeth persuades Macbeth to want to be king because she is greedy. She is able to influence him because he is married to her and because he is weak. MacBeth murders Duncan with a knife. Macbeth murders Duncan because Macbeth wants to be king and because Macbeth is evil. Lady Macbeth kills herself. Macduff is angry. Macduff kills Macbeth because Macbeth murdered Duncan and because Macduff is loyal to Duncan.

(please turn to page 24)

Payment Systems Without Cash

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"The flow of financial benefits among consumers, banks, and retailers should follow an equitable formula based on analyses of costs and benefits."

Based on a presentation at the Retail Forum on Payment Systems, sponsored by the Retail Management Development Program, London, England, Sept. 20, 1985.

Electronic Funds Transfer at the Point of Sale

This presentation is aimed at changing the way a retailer views non-cash payment systems and encouraging retailers to play a different and stronger role than most retailers have taken up to now.

I will use the term EFT-POS, Electronic Funds Transfer at the Point Of Sale, in the broadest possible sense, to mean the payment for goods and services in retail locations by means of electronic technology. By retail locations, I mean all points where consumers can purchase and pay for merchandise or services, whether or not they lie inside a store. Gas stations, restaurants, airline counters, hotel checkout desks, entertainment ticket windows, etc., would all be included. The payment methods used in such systems may include debit or credit techniques, and they will all have one thing in common; they will replace paper-based technologies with electronic technologies. They will also replace cash-based payments in many cases, although cash will never be eliminated altogether.

The Retail Viewpoint

In discussions, meetings, and conferences going on in Europe and other parts of the world, the viewpoints of all participants need to be aired. Consumers, depository institutions, systems and equipment suppliers, government organizations, third party networks or service suppliers, as well as retailers, all have roles to play.

EFT-POS systems can be viewed in two major ways. First, they can be considered as vehicles for delivering payment services to consumers using electronic technology. Depository institutions all over the world certainly view EFT-POS in this way. In most countries, EFT-POS started as a delivery system idea, in which one bank or one group of banks (generally it was the commercial bank group) decided to launch electronic payment services as part of a competitive strategy for consumer business.

In the last two years especially, larger retailers here and there, have also decided to use EFT-POS systems as a vehicle for delivering payment services to their customers, in competition with the banks and other retailers. These retail efforts take two different forms. In some cases (J.C. Penney and Sears Roebuck are usually cited as the prime examples) financial services are coupled with payment services, and are sold to other retailers or to banks, as well as to consumers. In the other cases, retailers are providing electronic debit payment services to their customers, using their own EFT-POS systems not tied to banks.

New National Payment System

The second major way to view EFT-POS systems, is to think in terms of new national electronic payment systems which are more efficient than paper-based and cash-based payment systems. In this view, the various participants try to work together to create a new system that will benefit everyone in an equitable fashion. Government, consumers, depository institutions, retailers, and suppliers would all gain in the long run because the benefits of the new system far outweigh the depreciated costs of implementing it. With this viewpoint, the total surplus between the savings achieved and the new investment cost would be divided up equitably among retailers, consumers, depository institutions, and suppliers. In the long term, there would be an "everyone wins" situation. The problem with this viewpoint is that short term goals and objectives overwhelm long term national objectives, and to date, there is no country in the world where everyone will win in the foreseeable future.

Depository Institution Viewpoints

The depository institutions around the world include commercial or trading banks, savings banks, building societies, savings and loans, cooperative banks, credit unions, and the postal clearing houses (also called giros). I will use the word banks from here on. Banks have taken the first of these two major viewpoints. Even in countries like the U.K., Denmark and Canada, where joint cooperative efforts between retailers and banks have been initiated, the banks still view EFT-POS as a service oriented vehicle with which they are going to supply payment services to retailers and to consumers at points of sale. Retailers are still considered to be customers of the banks, and service fees for EFT-POS transactions are still considered to be appropriate for the retailers. The playing ground of POS payments is considered to be primarily the domain of the banks. The ground rules for systems designs, economic relationships between retailers, consumers and banks, and operational details of what happens at a point of sale are still arrived at by the banks initiating proposals, and attempting to gain approval of the retailers and the consumers.

The Proposed New Retailer Viewpoint

I am now proposing a viewpoint and policy position for retailers everywhere. The viewpoint has nine main points.

- The Point of Sale portion of a nation's consumer payment system is the primary domain of the retailers and consumers.
- Proposals for EFT-POS systems should be initiated by retailers, with responses from the banks and eventually from consumers.
- The retailers, banks and the government must clearly differentiate between a nation's POS payment system and a nation's depository system, which is the primary domain of the banks.
- A line of demarcation should be drawn between the POS payment system and the depository system in a nation. This line will serve as a systems design tool, a legal boundary, and an economic negotiating tool between retailers and banks.
- Retailers should consider themselves as suppliers of a spectrum of POS payment services to consumers, including cash, retail credit, debit, food stamps, barter, checks, money orders, giro transfers, etc. EFT-POS services are to be considered one more new service which will supplement the others, and eventually replace some of them.
- Retailers should insist on a countrywide cost-benefit analysis of the total costs and total savings achievable by replacing paper-based and cash payments by electronic payments. Bank savings are very important in this analysis, and must be arrived at by non bank analysts and data collectors.
- The flow of financial benefits among consumers, banks and retailers should follow an equitable formula based on cost-benefit analyses. If bank net savings nationwide exceed retail net savings, money for the total of electronic POS transactions should flow from banks to retailers in the long term.
- In the short term, retailers should control the design of EFT-POS systems pilots and should negotiate for the banks to pay equitable transaction fees to the retailers. In no case should the retailers settle for anything less than a PAR situation; that is, no fee money would change hands for new electronic payments in the short term.
- Retailers and their associations should view EFT-POS as a national effort, and should combine all of their strengths in building their own line of demarcation/retail debit-credit card networks, to serve all retailers, large and small, of all types.

Precedents

What are the precedents for this retail viewpoint and position?

If we go back in history, the payment systems and methods at the point of sale have always belonged to and have been under the control of retailers. Beginning with barter, and working our way through coins, currency and other cash forms, retailers have controlled the POS payment environment. The only time banks have been involved is when the depository system and the supply of cash have been tapped by consumers and retailers to obtain cash, or when retailers have deposited cash. But these are really two separate systems. The retailer and the consumer are the only ones involved at the point of sale.

Retail credit transactions involve the same separation of the payment and the depository systems. What goes on at the POS doesn't involve the banks. Other forms of POS payments, such as coupons, bottle returns, food stamps, welfare stamps, postal money orders, etc., also do not involve banks at POS. Checks may or may not involve access to bank records at POS. But even if they do, the decision as to whether a check will be accepted, and the determination of whether a check is good or bad, is still up to the retailer. The banks are not really involved. This is even true with a guaranteed check. Although the bank provides the guarantee, the retailer must make the POS decision.

Bank credit cards at POS introduced the first three way overlap among retailers, consumers and banks. But if one analyzes the sources of bank credit card authorizations and the risks taken in accepting bank credit cards, in some countries there are more retailers and non-bank third party authorizors than there are banks. The depository system does not come into play. In supermarkets and discount stores for example, in the U.S., both bank credit card negative files, and check authorization negative files are built up within the retailers' own systems. No linkage to bank networks is used in these cases.

The Debit Card

Perhaps banks would not quarrel with these historical POS payment precedents. But when the bank debit card is introduced, the trouble begins. Banks have coupled debit cards associated with current accounts or savings accounts, to the deposit relationship between consumer and bank, and therefore have also coupled the use of debit cards, whether in Automatic Teller Machines (ATMs) or at POS, with the depository system of the banks.

If retailers and consumers view a debit payment at POS as just one more way to pay for goods and merchandise, in which the customer's depository account is going to be debited, then the debit payment can be treated as an authorization by the customer to permit the retailer to inform his/her bank to debit the account.

Both the agreement between the retailer and the customer, and the systems method for implementing that agreement, can take place in an information mode, with no actual money movement taking place at POS.

Retail Debit Cards

A debit card would not actually be necessary at the POS. All that is needed is a prior agreement between the consumer and the retailer that his or her specific deposit account at a specific bank can be debited for the amount of the sale. This agreement can be implemented in the same way as a preauthorized payment or standing order is implemented in a giro system. Of course, the consumer must be identified and verified at the POS, and the bank number and bank account number added to the transaction either manually or by the retailer's system for transmission to the bank clearing system.

In several countries this type of debit transaction has been accomplished by having the retailer issue customer cards which can be used for either retail credit or bank debit. The customer signs the debit authorization agreement and the retailer's system adds the bank account information automatically, sending it to the customer's bank through the country's bank clearing network. Examples are: GB-Inno-BM in Belgium, Auchan and several other retailers in France, Exxon and Vons Supermarkets in the U.S., and Hudsons Bay and Imperial Oil in Canada.

This technique has been labeled the "Retail Debit Card - Line of Demarcation" system by "Retail Forum". It allows the retailer to separate the actual transfer of money from information about the transfer of money. In effect it is very similar to a giro transfer instruction, which certainly is only information, and not actual money.

Countrywide Retail Networks

The extension of this Line of Demarcation-Retail Debit Card concept to all of the retailers in a nation is the objective of my presentation. Schematically, the system might look like Figure 1. The vertical line of separation in the center keeps money and the depository system on the left, separated from information about POS payments and transfers, on the right. The retailers, of all types, large and small, in a community are tied into a retail information processing center (IPC) and network. The community could be an entire country, or a region, or a state or province. Some retailers would have their own on-line systems with retail data centers, shown in the upper right section of figure 1, connected to the network. Some small to medium retailers would be tied into retail service centers, as shown in the middle right section, and some smaller retailers would have EFT terminals or electronic cash registers (retail style) tied to the IPC. Some retailers might be using their own smart cards used as debit or credit cards. These would be tied off-line into the IPC. Everything on the right hand side of the diagram belongs to, and is controlled by, the retailers. Everything on the left side belongs to the banks. Of course, some of the systems elements on the right could be supplied by third parties.

Negotiations

Given this overall approach, retailers can negotiate as a group with the banks for equitable financial arrangements on EFT-POS payments. The basis for negotiations would be founded on the cost-benefit analysis of the values of whatever information crosses that line of demarcation in both directions. Who pays who how much would no longer depend on the banks providing POS payment services to the retailers that involve installation by the banks of anything on the right side, or on the banks designing any of the systems or service elements on the right hand side.

The Who Pays Who Problem

Most of the fights and arguments between the banks and the retailers in various countries over the economics of EFT-POS, have been based on short term economic considerations and comparisons. For example, in France, where the battle has become very bloody, the retailers, represented by ACME (Association Commerce et Monnaie Electronique), the local chambers of commerce all over France, and the national retail associations, have taken the following position: With respect to electronic money, debit payments at POS using smart cards or standard bank debit cards, there should be no transaction discount or fee, unless additional services are provided. "Zero Services - Zero Cost" is the retailers' slogan. They argue, a 10 franc note is worth 10 francs at the point of sale to both retailer and consumer. A 100 franc check is worth 100 francs. Therefore, a 100 franc electronic payment using a card should be worth 100 francs, not 90 or 99 francs as proposed by the French banks.

This is a good argument, but so far, it seems to be ignored in France, by both the banks and the government. The prime reason seems to be that old first viewpoint I mentioned. The French banks and government consider that the POS payment system belongs to the banks and that service charges or transaction discounts for debit payments are perfectly normal as part of the charges for bank services.

The only way, I believe, to change things in France, or anywhere else for that matter, is for the retailers to adopt the viewpoint and position I'm proposing. It will change the negotiating situation because the banks will not be able to bargain over something they do not own or control.

Cost Benefit Analysis & Long Term Agreements

The best way for retailers to maintain control and to negotiate equitable financial arrangements is to insist on an overall national cost benefit analysis that takes into account all bank and all retail costs and savings. Total Net Savings for the nation of the new system would be equal to the sum of the net bank savings and the net retail savings. Who pays who and how much should be determined by which industry has the highest net savings. The formula would be: payments made by banks to retailers would be proportional to the difference between the net bank savings and the net retail savings. If this figure turns out to be negative, that is retailers save more than banks, then the retailers would pay the banks.

Under the line of demarcation systems approach, it is difficult to see how retailers would have greater net savings than banks. The banks would not have to issue POS debit cards, nor would they have to invest in EFT terminals at POS, since the retailers' own POS terminals and electronic cash registers would be used. The information processing center for the retailers, and their data centers, both individual and shared, would take most of the load off the bank network, so it would be relatively inexpensive. Other communications costs on the bank side would be relatively reduced as well. In effect, all the banks would have to do would be to sit back and watch the POS debits roll in, replacing all those expensive checks, cash

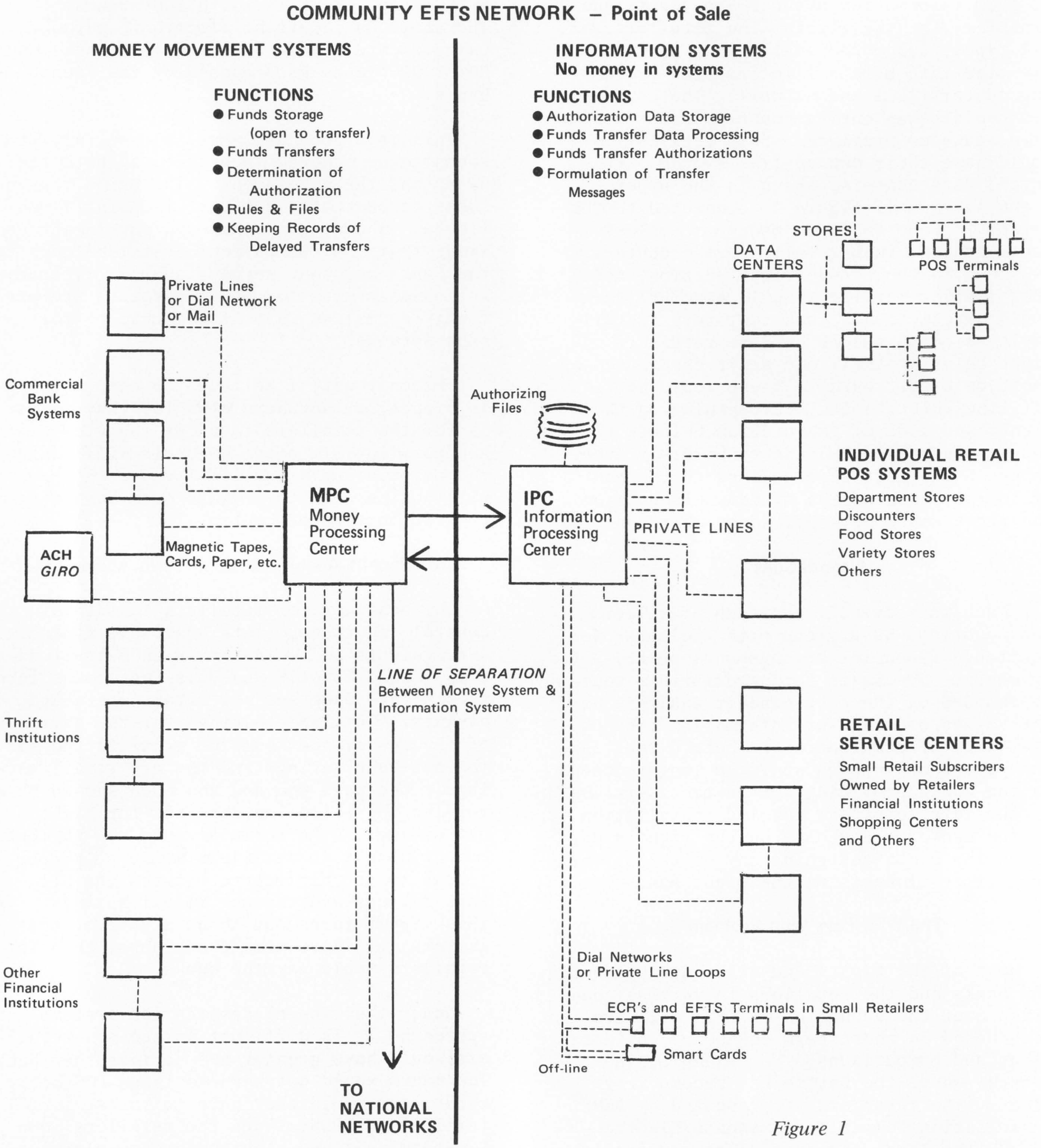

Figure 1

and other paper-based transactions they have had to handle up to now.

Current Status

Are retailers anywhere in the world following this approach or adopting this viewpoint? In France, the U.K., Denmark, Norway, Finland and Canada, at least, the retailers have all joined forces (except for the oil companies) to negotiate with the banks. In the U.S., France, Belgium and Canada, as mentioned earlier, individual large retailers have adopted the line of demarcation - retail debit card approach. State level food retail groups in the U.S. have also begun to build their own line of demarcation - retail debit card systems. But no retail group in any country has as yet undertaken the entire philosophy proposed here. Ω

A Computer and an Archaeologist in Egypt

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"We listed the notes in the computer ... what chamber a body was found in, what position it was buried in, the way the heads were oriented ... We measured dental wear ... The sandstorms made a cup of tea full of grit. But as long as we kept working, the computer worked too."

Winter on the Desert

It was winter on the high desert of Egypt, an hour's drive from Cairo and within sight of the Great Pyramids. Below the shifting sands of the Sahara, in tombs carved from layers of crumbling limestone more than 30 centuries ago, some computer scientists systematically sifted through the brittle, sometimes charred, remains of dozens of ancient Egyptians.

These tombs were not like the tomb of Tutankhamen, though, or those of the pharaohs buried in the Valley of the Kings. No marvelous gold coffins greeted the visitors; no papyrus books told the stories of the dead. Instead, the burial chambers were small and damp, and the walls in some were covered with moist black soot, the result of fires cold for many centuries. But to a "computerized" archaeologist, the find represented a scientific treasure chest full of coffins, mummies, artifacts and hundreds of bones.

To help sort these long-buried treasures, physical anthropologist Roxie Walker used a tool from the modern world of high technology: a Portable Professional Computer made by Texas Instruments (TIPPC). The computer had weathered sub-freezing temperatures and a fall from a luggage carrier in London, plus several sandstorms in Egypt without a hitch. Roxie Walker says: "It came up and ran like a champion in circumstances I didn't expect it to. The computer and I have both been to Egypt, and neither one of us is as beautiful as before we left, but we both still work."

Walker is an independent researcher from Mill Valley, California. She is still using the computer to catalog her findings and to sort through the massive database she compiled to find answers to many questions posed by the winter's dig.

Ancient Religious Center: Saqqara

Walker and her colleagues have been working under the direction of the Egyptian Exploration Society. They were investigating a tomb in Saqqara, a necropolis (an elaborate cemetery) for Egyptian generals and high state officials. Saqqara served the city of Memphis (or Men.nefer, as it was known to the ancient Egyptians), which was founded more than 5,000 years ago. It was the capital of the first pharaoh, Menes, who united Upper and Lower Egypt about 3200 B.C. Memphis was a religious center all through Egypt's history.

The tomb excavated consists of a series of courtyards with many columns and pillars on the surface, and shafts leading to subterranean burial chambers. At this site, archaeologists found two shafts. Work began about two years ago with excavation of the largest shaft, which led to the burial chambers of Princess Tia -- sister of the pharaoh Rameses the Great -- and her husband, also named Tia.

In the winter of 1984, scientists first explored the second shaft, which had a small chapel built around the opening. The shaft itself is about 25 feet deep, and leads to seven different chambers. These were built for Iurudef, a treasury official who died around 1100 B.C. "These are very disappointing when compared to the beautiful pictures of tombs from the Valley of the Kings," says Walker. "They're very, very small. You couldn't stand up in most of them. And there was absolutely nothing on the walls."

Late in the 1983 winter digging season (in the daytime during the summer temperatures of 125 degrees or more limit archaeologists to just six months of work per year), while making their way toward the lower chambers, the scientists made a new discovery: one shaft contained as many as 40 mummified bodies. "People said 'Oh, dear, we didn't want to find this,' but here they are," says Walker, who joined the project for the 1985 season. "Disturbing the bodies is a very sensitive issue." The research team decided to wait until it returned to Egypt in January 1985 to do anything else with the mummies.

Cataloguing the Features of Mummies

When they returned to Saqqara in 1985, the archaeologists planned to take the mummies out one at a time, X-ray them, then rebury them or exhibit them in a museum. Equipped with a portable battery-powered X-ray machine, Walker and the others re-opened the tomb and set about their work. Unfortunately, though, their plan quickly ran aground: "There was so much moisture damage to the mummies that we just had a lot of greasy black rags over loose bones. That increased our workload by a factor of five."

Team members gingerly removed the remains from the top burial chamber to the dig house about a mile-and-a-half from the tomb, where they were examined and catalogued. "Initially, we listed everything on paper, then we transferred these sets of notes to the computer. We had notes on everything -- what chamber a body was found in, what position it was buried in, the way the heads were oriented, what was buried with them. We made 18 measurements of each skull and about 15 of the pelvis. We measured dental wear to use as an indication of age and health status." To keep track of that enormous amount of information, the computer was equipped with a 10 megabyte hard disk and a database management software package.

The system operated under severe conditions. First, Walker carried it on her flight from the United States to Egypt with a brief detour in London, where it was subjected to below freezing temperatures and a fall from a luggage cart. The system was then jostled some more in the airplane baggage compartment. When she got to the site of the dig, Walker didn't plug the computer system in for two days because she feared that it would not work. When she did find the courage to try it, it worked perfectly.

It continued to work during heavy sandstorms. "I just covered up the floppy disk drive and ran it solely off the hard disk. The dust is incredible. We had storms at least once a week. Sometimes it got so bad the power would drop out, and the people (as many as six at any one time) would get crabby because you couldn't even drink a cup of tea because it would be full of grit. But as long as we kept working, the computer worked, too."

Sorting Lists to Make Them Usable

In addition to entering notes, Walker and others used the computer to sort lists of data into a more usable form, comparing different types of information to develop a better understanding of the Egyptians buried in Iurudef's tomb.

Early in the dig, Walker was able to determine some basics about the bodies. First, they were not Iurudef or his family. Instead, they were artisans who usurped Iurudef's tomb for their own burials sometime between 1100 and 500 B.C. Many of the coffins contain beautiful decorations, Walker says, but the inscriptions on them are "utter gibberish. These people were very poor; to them, writing in hieroglyphics was like writing in Latin to people today."

Walker holds a degree in microbiology, and became interested in the Saqqara site because it presented an opportunity to further her work in the area of paleopathology -- the biology and diseases of ancient man. She determined much about the people buried in the tomb.

Probable Tuberculosis and Anemia

"We can look at the bones and give estimates of age, race, sex and obvious pathologies" -- diseases or injuries. Two of the adults suffered from probable tuberculosis; others showed signs of anemia. That's not surprising, but we're looking at why they died -- were these things congenital, or did they come from malnutrition or some other causes? Dental remains can sometimes determine when an individual underwent periods of malnutrition or high fever.

"With work in the first chamber under control, we moved to the second one. Its walls were coated with an inky black goo -- the residue of smoke from an ancient fire, mixed with water that came from rain percolating through the stone walls of the chambers.

"Where did the smoke come from? We were going through the stuff in the second chamber, and we found some burned bone fragments, and I don't know yet how many bodies that represents. We won't know that for a year."

(please turn to page 27)

Problems, Solutions, and Methods of Solving —Part 6

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"Problems play an essential role in the progress and teaching of science."
— George Polya

This series of articles has three main propositions:

- The problems that computers can solve are much fewer than all the problems that human beings encounter;
- The types of solutions that computers can give are much fewer than the types of solutions that human beings can give;
- It is sensible to observe and consider all the problem solving methods that human beings use.

The previous parts of this series appeared:

Part	Issue
1	Sept.-Oct. 1984
2	Nov.-Dec. 1984
3	Mar.-Apr. 1985
4	July-Aug. 1985
5	Nov.-Dec. 1985

A method of problem solving which goes back in history for at least 2400 years is the fable or parable or anecdote which has one or more lessons or morals, sometimes contradictory.

This centuries-old form of literature expresses in a story a principle or principles which apply widely. Also, a good story imprints itself on one's memory far more vividly than a mathematical formula.

The Bear and the Young Calf

Once there was a Bear who was a good carpenter. The Lion hired him to build a new Lion house to replace the cold, smoky, drafty cave which the Lioness refused to live in any more.

The Bear agreed and set to work. One day his helper was a Young Calf.

The Bear said, "See all those shingles? Move them carefully from that heap where they were dropped when they were delivered, to the foot of the ladder, so that I can carry them up with me as I shingle the roof."

The Bear then took half a dozen shingles under his arm, put a handful of roofnails into his mouth, and carrying his hammer climbed up the ladder to the roof, and nailed in the shingles.

As he came down the ladder, he noticed the Young Calf carrying one shingle at a time from the heap to the foot of the ladder.

The Bear growled. "By Gemini," he cried out, "why in the world are you carrying those shingles just one at a time?"

The Young Calf said, "You told me to carry them carefully. You did not say not to carry them one at a time."

The Bear growled again. "Carefully, yes of course, carefully, but that does not mean one at a time. How can I tell you not to do something if I can't imagine what you will do? Take the shingles in reasonable loads and carry them carefully."

Some Maxims

If an order can be misunderstood, it will be misunderstood.

A man must provide himself either with wit to understand, or with a halter to hang himself.
- Antisthenes, c. 400 B.C.

The Corn, the Stag, and the Woodchuck

Once Farmer Jones harvested an outlying corn field. He stacked the corn ears in a crib in a nearby shed, checked that the tin roof of his shed would still keep out the rain, and padlocked the door of the shed.

"There," he said to himself, "I think those ears of corn will be safe until I come in a few days with a truck and take them away."

But the smell of the fresh corn kernels drew scores of hungry animals from the woods. They gathered at the shed and their mouths watered. The Fox sized up the situation, organized a truce, and held a conference.

First the Stag spoke: "I am the biggest and strongest here. I will crash that shed door open, and then we shall all have some corn." So he charged the door again and again. But the door was strong and resisted the Stag's repeated rushes, and the Stag gave up.

There was a long silence.

Then the woodchuck spoke: "I am not big and strong, but I can burrow. I will burrow under the shed and make a tunnel to the corn. Then we shall all have some corn."

So the Woodchuck burrowed and burrowed, and made a tunnel into the crib. Then he brought out ear after ear of corn, and the hungry animals ate until they could eat no more.

Some Maxims

A good strategy is better than a strong force.

There are more ways of killing a cat than choking her with cream.
- Charles Kingsley, 1855

A wise person takes things as they are, and knowing the conditions, proceeds to deal with them in such a manner as to achieve the desired result.
- W. Somerset Maugham, 1948

The Muskrat and His Birthday Gift

The muskrat came into his Nottingham office one morning, looked at the calendar, and said to himself "Aha, today is my good wife's birthday. I must bring her a present -- what will it be? Yes, a box of candy, and I enjoy it too." So at lunch time he went over to a nearby candy store and bought the present.

When five o'clock came, he picked up his briefcase and the box of candy, left the office, went to the bus station, and started home on the Sherwood bus, an hour's ride. He put his briefcase between his feet, and his gift on the empty seat next to him.

It had been a long hot day in the office, working for the Sherwood Forest Life Insurance Co. He read the evening newspaper for a while; then he fell asleep. He waked up suddenly when the bus driver called out "Oak Grove," which was his stop. He grabbed his briefcase and hurried off the bus.

As the bus drove away and continued down the highway in the distance, he suddenly remembered the box of candy -- left on the seat next to him.

Some Maxims

Every memory is at times a forgettery.

An educated person always has pencil and paper at hand.

To try to remember two things at once when you have a habit of remembering only one is an invitation to forgetting the second.

Men are men; the best sometimes forget.
- Shakespeare, 1605

The Young Rabbit, and Day and Night

Once there was a Young Rabbit who was extremely curious. Among many other things that he wondered about was why there was day and night. He decided to ask three wise Rabbits. So he went to the first wise Rabbit, and inquired:

"Why is there day and night?"

"I don't know, Young Rabbit," said the first wise Rabbit. "There is day, and there is night. And that is it. That is good enough for me, and for you, and for all sensible, practical rabbits. It is not necessary to know why."

But the Young Rabbit was not satisfied, and so he went to the second wise Rabbit and inquired:

"Why is there day and night?"

"I can tell you what nearly all rabbits say," said the second wise Rabbit. "The sun goes down under the earth at sunset, and comes up again at sunrise. And the god of the sun drives his shining chariot from east to west all across the sky during the day, and some rabbits call him Apollo."

But the Young Rabbit was still not satisfied, and so he went to the third wise Rabbit and inquired:

"Why is there day and night?"

The third wise Rabbit said, "Because the earth is a large ball and spins in space not very far from the sun, and when sunlight falls on some part of the earth, there it is day, and when sunlight does not fall on some part of the earth, there it is night. And this explanation has been proved over and over."

"Oh!" said the young Rabbit.

Some Maxims

Be prepared to change your mind -- to attain correctness may take days or years or centuries.

Truth often hides in an ugly pool.
— Chinese proverb

God offers to every mind its choice between truth and repose. Take which you please -- you can never have both.
— Ralph Waldo Emerson, 1841

No man prospers so suddenly as by the errors of others.
— Francis Bacon, 1597

Cultivate a tentative viewpoint.

What you think may be true and what is actually true may be far, far apart.

The world is more complicated than most of our explanations and theories make it out to be.

The Cat Who Swore Off Mice

Once there was a cat named Belinda. She used to catch many mice, play with them, and then eat them. One day she caught and ate a feeble little mouse who had eaten some poison. Belinda became very ill and only recovered slowly. She decided that after all it was dangerous to eat mice. Belinda swore off mice.

After a while, remembering that mice were fun to play with, and having decided she would never eat any more mice, she announced her new policy at every mouse hole in the house and in the barn. She begged the mice to come out and play with her. She declared she would be as friendly and gentle a playmate with the mice as she was with the children in the house.

But not a single mouse believed her; and not once did any of the mice come out of a hole and play with Belinda.

Some Maxims

I pay heed to my reputation; it shows what is in my heart.
- Antef, c. 2200 B.C.

Hold fast to your reputation.
- Cato, c. 175 B.C.

Glass, China, and Reputation are easily cracked and never well mended.
- Benjamin Franklin, 1750

A reputation once lost is seldom regained.

The Fifth Squirrel

[Based on an actual occurrence observed by Loren Eiseley, anthropologist]

Once there was a bird feeder on the wide lawn of a hospital. The bird feeder was mounted on a slippery iron pipe about five feet above the ground; on the top of the pipe and under the bird feeder was the inverted half of a large round metal can projecting in every direction beyond the pipe. Fastened on top of the can at the center was a holder of sunflower seeds which would allow the seeds to feed out as birds pecked at them.

A squirrel came along the lawn, surveyed the feeder, and struggled up the pipe to the top; but he could not get around the can. Scolding and complaining, he slipped back down the pipe to the ground and went away.

Three more squirrels, one by one at different times over the next hour, came, wanted to eat the sunflower seeds, saw the same problem and tried the same solution. But none of them could surmount the metal can; each one eventually gave up, and scolding, slid down the pipe, and left.

At last there came another, a fifth squirrel.

He stood a little distance away, with his paws folded in front of him, and looked carefully at the pole and the feeder. Then, with a run and a jump, he whisked himself up the pole, put one paw on the edge of the can, and flung himself swiftly over the barrier with the momentum that he had not yet lost.

There, on top of the can, in a leisurely way, he ate all he wanted of sunflower seeds.

(please turn to page 25)

Winston – *Continued from page 13*

An Exercise

> Let E be an exercise. E is a story about a weak noble and a greedy lady. The lady is married to the noble. Show that the noble may want to be king.

Told by a teacher that Macbeth is to be considered a precedent, the program forms a rule to the effect that the weakness of a nobleman and the greed of his wife can cause him to want to be king. The same program can learn what things look like from functional definitions, some background knowledge, and particular examples.

Still another learning program, by Douglas B. Lenat, one more oriented toward teacher-free discovery, deals with concepts like multiplication, factorization, and prime number. It demonstrates that a program can invent mathematics that even professional mathematicians find interesting and exciting. In particular, Lenat's mathematical discovery program stumbled across the obscure idea of maximally divisible numbers, even though the program's author, and evidently most other mathematicians, had never thought about maximally divisible numbers before. The distinguished mathematician Ramanujan had, however, so Lenat's program is in good company.

Computers Can Model Animal Information Processing

Many psychologists do Artificial Intelligence because they want to understand animal perception and cognition from an information-processing point of view. Programs join animals as test subjects, with behavior differences between programs and animals becoming as interesting as behavior itself. Part of the research focuses on vision, hearing, and touch, and part addresses human problem solving.

Criteria for Success

Any field must have criteria for determining if work has been successful. In some fields, the criteria are firmly established. Criteria for success in Artificial Intelligence are not so firmly established because the field is still young, it is extremely broad, and much of it does not seem susceptible to conventional mathematical treatment.

Still, we need some working criteria for judging results, even if the criteria prove transient. Consequently, let us demand good answers to these questions before we take some particular work in Artificial Intelligence to be successful:

- Is the task clearly defined?
- Is there an implemented procedure performing the defined task? If not, much difficulty may be lying under a rug somewhere.
- Is there a set of identifiable regularities or constraints from which the implemented procedure gets its power? If not, the procedure may be an ad hoc toy, capable perhaps of superficially impressive performance on carefully selected examples, but incapable of deeply impressive performance and incapable of revealing any principles.

All of the examples cited in this article satisfy these criteria: all perform clearly defined tasks; all involve implemented procedures; and all involve indentified regularities or constraints.

Summary

- Artificial Intelligence has tremendous potential for applications in many socially relevant areas. Leaders in a wide variety of fields need to know its ideas.
- As a means for studying intelligence, working with computers and with computer-based metaphors offers certain clear advantages. Results are more likely to be precise, to provide bounds on the amount of information processing required, and to be testable experimentally.
- Intelligent behavior can be displayed along several dimensions. This is made possible by strength in information-processing capability associated with certain basic areas. These areas include matching, goal reduction, constraint exploitation, search, control, problem solving, and logic.
- Finally, computers already can do many things that seem to require intelligence.

Ω

ARTIFICIAL INTELLIGENCE
SECOND EDITION

Patrick Henry Winston

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Thompson – *Continued from page 8*

A Government Cannot Make Sensible Decisions Without Understanding

There is no value-free science but, until recently, in disciplines other than nuclear physics at any rate, scientists have, by and large, been happy to allow their governments to make scientific policy decisions. We no longer believe the government capable of grasping the complexity of the issues involved, or of making sensible decisions in the absence of such understanding.

The Temptation of Arrogance in Making Technical Decisions

As science has become more complex, the temptation to technological hubris on the part of policy makers has grown enormously. Spectacular successes such as the Manhattan project and the space programmes of the US and the Soviet Union, combined with the insistent background of technological-wonderland science fiction, have given rise to a belief that we can achieve any technological goal that can be stated, given enough will and enough cash. The threat that this represents to all our futures is so great that in the end one must, in the old Quaker phrase, "speak truth to power." There is no guarantee one will be heard, or if heard attended to, but in the final analysis that is no reason to keep silent.

So we have moved from the purely private goal, of clarifying for ourselves why the system cannot be built, to the public goal of developing a sufficient popular awareness of this fact to make a political impact on the government.

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Berkeley – *Continued from page 23*

Then, well-fed and comfortable, he swung himself over the edge of the platform, descended the pole, and left.

Some Maxims

Timing, speed, and momentum, may defeat impossibility.

Intelligence consists in recognizing opportunity.
— Chinese proverb

Every now and then a new way is found.

O Man, be not sure you have mastered the world; intelligence is not only yours.

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find that the word is employed just as often in them," says the researcher. "With our programs you can go much further than this sort of word-counting. Our program showed that "Macbeth" is the only play where the word 'screams' is used. That was the clue for us to look at the sound images in "Macbeth." The computer analysis of the sound imagery immediately gives us a very different view of the play."

Looking for unusual words gives the scholars other clues about the themes of the plays. The researchers found that the word "enchantingly" is used only once in Shakespeare's works. In fact he invented the word for "As You Like It." "The word is used by Oliver in talking about his younger brother Orlando. When you use this clue to analyze the younger brother's relationship with the other characters you can see that he quite literally enchants, or casts spells, on everyone he meets. We wouldn't have been led to explore this without the computer analysis and you can easily see how it would change the way an actor would play this character," Freeman said.

In the view of the York scholars, directors will not slavishly follow the restored texts but rather use them as a guide to the meaning of the words they choose to employ. "By giving the modern reader/actor more information we won't start them producing museum pieces. Rather we hope to open up new vistas for performance," McBride said.

Using Texts

Many theatre schools and professional companies have already started using the computer texts. Twelve institutions will be using the York scripts by the end of the year. Freeman has worked with more than 100 actors in classes set up by Actor's Equity in Toronto, and he has advised actors and directors at the Stratford Festival. Freeman used his restored scripts in experimental work with Shakespeare and Company, a Massachusetts-based theatre group, for the last four years.

SOVIET COMPUTERS TO BOOST SOVIET AUTOMATION IN INDUSTRY, RESEARCH

Based on a report in "Soviet News and Views"
1110-400 Stewart St.
Ottawa, Ontario, Canada

Covering groups of machines, production lines, departments and whole enterprises, including design and control, the automation of production is a tremendous task.

For this, it will be necessary drastically to increase the rate of automation and to extend the use of computers and data processors in different fields, particularly to promote research, medicine and services at every level, and to ease household chores.

Approach

We do not yet use efficiently even the relatively small numbers of computers we manufacture for industry, research and development, and science. This is primarily because trained computer users are scarce. It is necessary to organise a network of short-term schools to raise the skill of computer users.

Difficulties

When computers were making their first steps in this country, we ran into difficulties with the training of users because designers and manufacturers produced machines that were incompatible as far as software and peripherals were concerned.

In that period, computers were produced on a small scale. Nowadays the production of computers will require great investments and software will be several times more expensive than hardware.

Mathematical programs and algorithms will probably become an industry in its own right.

It would be absurd to follow the example of western firms which produce incompatible machines to preserve customers who purchased their equipment at least once.

Recently, the US army has spent nearly 13,000 million dollars to replace combat hardware, incompatible mathematically and technologically, that came from different manufacturers.

Reliability

Another important task in the field of science and technology is to develop computers and automation facilities of very high reliability.

Faultless operation should run into years, certainly not less than three years. Accidental interruptions in electricity supply should not lead to the loss of information in automation systems, or to emergencies.

As with space technology, the preparation of computer software should be automated and

(please turn to page 27)

Ketner – *Continued from page 20*

The computer will help determine that number. The types and characteristics of each bone can be stored in the computer, then those characteristics will be compared to help reconstruct complete bodies.

The Rationale of Mummifying

"The bodies may have been burned to make their souls depart from the chamber. The whole rationale of mummifying was that the soul needs to come back to the body from time to time. The greatest curse you could put on someone was to destroy the body -- you condemned his soul. The bodies were probably burned by robbers who wanted to keep their spirits from hurting the robbers, or by people who came in later and who wanted to purify the chamber so they could re-use it.

"We explored three other chambers, but with disappointing results. Sections of the roofs had collapsed, crushing bodies, while moisture had made the remaining bones soft and as fragile as eggshells. When I carefully tried to pick up a skull, it fell apart in my hands.

"When we returned to the United States, our work was just beginning. The stored data had to be analyzed -- a chore made much easier by the computer. We have about 60 burials to go through and sort. You can't keep going through all these pieces of paper to see which ones match a particular characteristic you're looking for."

Walker and others will return to Saqqara in January 1986, and she plans to have the TIPPC in tow. "The more I use it, the more I see things I'd like to do with it," she says. In the meantime, Walker will continue to sort through the data collected in the winter of 1985, using a creation of the modern high-tech world to help solve the ancient mysteries buried beneath the shifting sands of the Sahara.

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CACBOL – *Continued from page 2*

    Computer Markets
    Communications
    5th Generation

24. Artificial Intelligence

    AI Languages
    AI Shells
    Expert Systems
    Knowledge Based Systems
    Data Base Query
    Usefulness of Natural Language
    AI Hardware
    The Future

(Source: catalog of courses by Digital Consulting Associates, Inc., described and presented by Software Inst. of America, Inc. (nonprofit), 8 Windsor St., Andover, MA 01801, (617) 470-3880; catalog of courses Dec. 1985 through Apr. 1986)

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Newsletter – *Continued from page 26*

adapted to automatic error removal. Systems should be developed to protect software from disturbances due to changes in power voltage or frequency, electromagnetic interference, vibration, etc.

Automation in industry, with the exception of sectors operating continuously will at least double productivity, and halve the labor force of enterprises on continuous schedules, boosting Soviet production capacities and making feasible new technology.

In the research field, the automation of experiments reduces the time taken to complete projects to a fraction of what it used to be.

Visual display units will allow designers to communicate, without blueprints, the program for the manufacture of a component and the order for flanks directly to the lathe and the automated storage depot.

Potential

The United States has banned the export of a very wide range of electronic technology to the USSR, hoping to hinder or halt Soviet progress in this important field.

However, the United States apparently does not remember that Soviet science and technology coped, quickly and without outside aid, with tasks that were not less difficult, as was the case with atomic and rocket technology.

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Opportunities for Information Systems

– Instalment 1 (Observation 8601)

Edmund C. Berkeley, Editor

Editorial Note: We publish here a new series of short reports on opportunities for computers and information systems. Comments are invited.

"A robbery of a bank safe deposit vault happened in 1980 in Medford, Massachusetts. The robbers stole more than $1 million worth of cash, jewels and other valuable property. They tunneled through an unguarded floor or wall. The robbers worked with no interruption from policemen, guards, or watchmen, during a long holiday weekend.

"This robbery could have been stopped completely in the first quarter hour by an information system using sensors of movement and of electrical capacity.

"There is undoubtedly a billion dollar market in the United States alone for hightech, inexpensive, complete, smart, intelligent information systems to discourage and prevent burglary."

The above was written about Nov. 27. Then, by an extraordinary coincidence:

On December 9, 1985, four men were arraigned in Middlesex County Superior Court in East Cambridge, Mass., for this burglary. They were ordered held in lieu of $200,000 cash bail by Judge James J. Nixon, and their cases were continued until Dec. 16. These men were:

- G.W. Clemente, 52, of Fulton St., Medford, a former Metropolitan Police Captain;
- T.K. Doherty, 45, a former Medford police lieutenant, now serving an 18-to-20 year sentence for attempted murder;
- K.J. Holmes, 33, of Robert Ford Road, Watertown, Mass.; and
- F.X. O'Leary, 42, of Beach St., Tewksbury, Mass.

First Assistant District Attorney Thomas Reilly said he expected to prove when the case came to trial that these four and one other person conspired to break into the vault of Depositors Trust Co. in Medford, and that while some worked at breaking through the foot-thick ceiling, Clemente and Doherty, watch commanders that weekend in their respective departments, saw to it that they were not disturbed.

Before they began work (testimony showed) someone had bypassed the burglar alarm by hooking a nine-volt battery and a resistor to the wires that led to an alarm panel in the Medford police station, and had then cut the wires near the vault.

It is evident therefore that one should design an intelligent antiburglary information system using many independent sensors that communicate in many directions.

Games and Puzzles for Nimble Minds and Computers

Neil Macdonald
Assistant Editor

NUMBLE

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, expressed in numerical digits, is to be translated (using the same key).

NUMBLE 8601

```
            C L O S E D
      *         F I S T
      -----------------
          E S G Y F Y O
        D T C Y O D L
      F F E S G F C
    L G D D S I E
  ---------------------
  = L C D L C Y S F F O
```

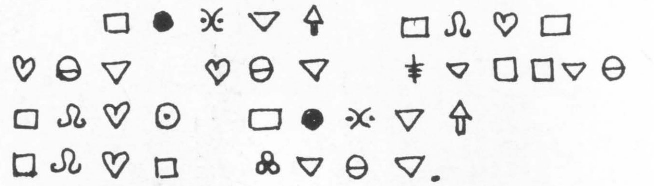
G=O

0043 88603 42414

MAXIMDIDGE

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, plus a few more signs. The spaces between words are kept.

MAXIMDIDGE 8601



Our thanks to the following persons for sending us solutions: T.P. Finn, Indianapolis, IN – Numble 8511, Maximdidge 8511; Herdis Lyngby, Odense, Denmark – Naymandidge 8509, Maximdidge 8509, Numble 8509.

SOLUTIONS

MAXIMDIDGE 8511: He is rich who wishes for nothing.
NUMBLE 8511: Free goats run far.
NAYMANDIDGE 8511: Column 1: 1's, 9's.