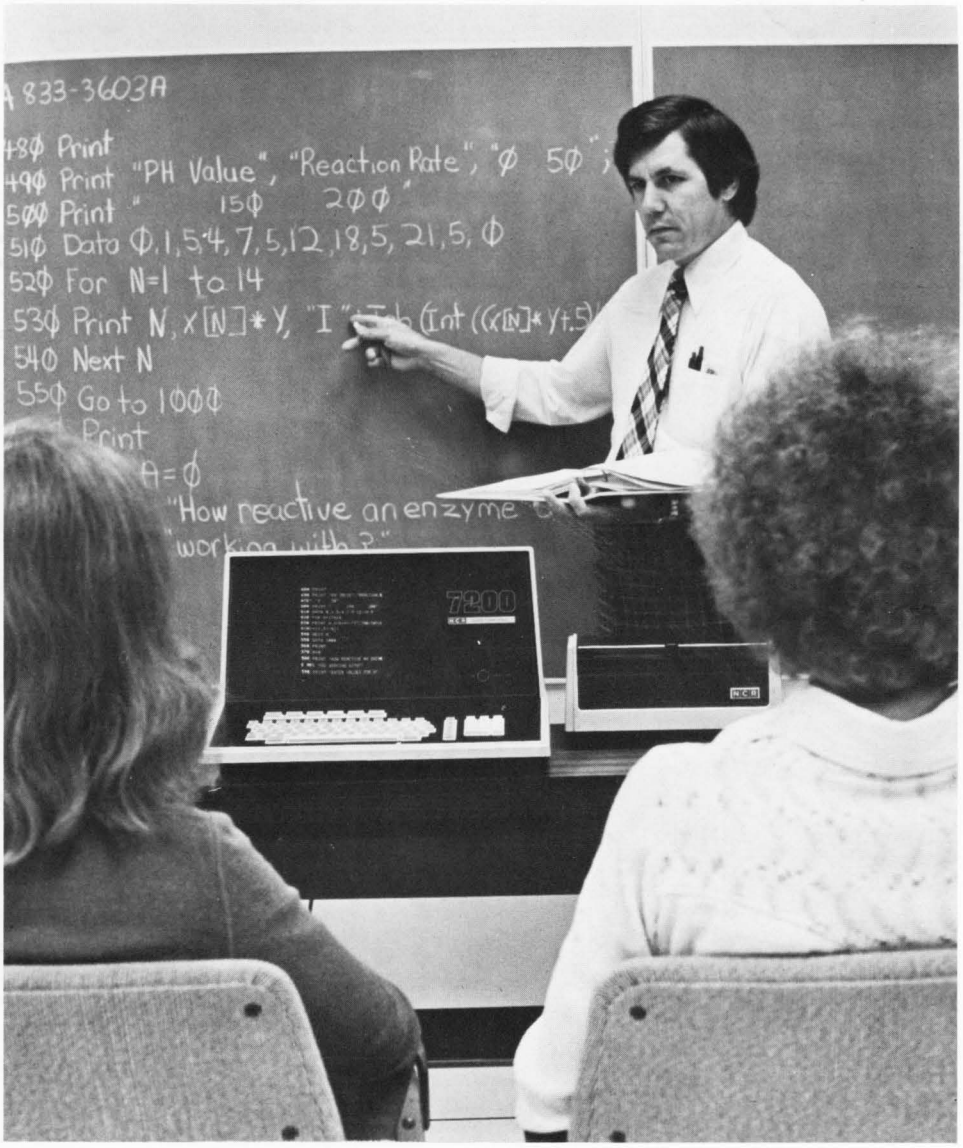
computers and people

Jan. – Feb., 1980

Vol. 29, Nos. 1-2

formerly *Computers and Automation*



INSTRUCTION IN PROGRAMMING USING A MICROCOMPUTER

The Cutting Edge of the Future
Sherwood L. Fawcett

Telecommunication Satellites: Their Future Contribution
Albert D. Wheeldon

Optical Character Readers in the Automated Office
Bruce Bambrough

Writing a Novel by Computer – Part 3: Suspense
Edmund C. Berkeley

The Computer Almanac and Computer Book of Lists
Neil Macdonald

The Frustrating World of Computers
Harry Nelson

The Computer Almanac and Computer Book of Lists — Instalment 11

Neil Macdonald
Assistant Editor

95 SUBJECT AREAS OF THE EXAMINATION FOR THE CERTIFICATE IN DATA PROCESSING (List 800101)

DATA PROCESSING EQUIPMENT
1. Computers and Peripheral Equipment (Hardware/Software)
   - A. Evolution of Electronic Data Processing
   - B. Computer Components and Functions
   - C. Internal Processing
   - D. Computer Characteristics
2. Peripheral Equipment
   - A. Input/Output Media
   - B. Data Transmission
   - C. Special Hardware
   - D. Auxiliary Memory

COMPUTER PROGRAMMING AND SOFTWARE
1. Principles of Programming
   - A. Basic Computer Instructions
   - B. Methods of Addressing
   - C. Loops
   - D. Subroutines
   - E. Program Checking
   - F. Basic Programming Techniques
   - G. Input/Output Considerations
   - H. Advanced Programming Techniques
2. Meta Programming Systems
   - A. Assemblers
   - B. Compilers
   - C. Translators
   - D. Interpreters
   - E. Generators
   - F. Operating Systems
   - G. Utilities
   - H. Data Base Management Systems
3. Programming Languages
   - A. Application, Scope and Usage
   - B. COBOL

PRINCIPLES OF MANAGEMENT
1. Principles of General Management
   - A. Functions of Management
   - B. Organization Principles
   - C. General Management Techniques
   - D. The Art of General Management
   - E. Legal Considerations
2. Data Processing Management
   - A. General
   - B. Systems and Programming Management
   - C. Installation/Operations Management
   - D. Security

QUANTITATIVE METHODS
1. Accounting and Finance
   - A. The Basic Accounting Process
   - B. Cost Accounting
   - C. Internal Control
   - D. Auditing EDP Systems
   - E. Use of Accounting and Financial Information
2. Mathematics
   - A. Mathematical Notation
   - B. Computation Topics
   - C. Operations Research (O.R.)
   - D. Sequences
   - E. Counting or Enumeration
   - F. Relations, Functions, and Graphs
   - G. Mathematics of Finance and Accounting
3. Statistics
   - A. Basic Statistics
   - B. Probability Theory
   - C. Time Series Analysis
   - D. Control Charts

SYSTEMS ANALYSIS AND DESIGN
1. Defining the System Responsibility
   - A. Management and User Roles
   - B. Concepts
   - C. Planning
   - D. Team Organization
   - E. Control
2. Data Processing Systems Analysis
   - A. The Feasibility Study
   - B. Systems Investigation
   - C. Equipment Considerations
3. Data Processing Systems Design
   - A. The Systems Approach
   - B. File Design and Organization
   - C. System Input
   - D. Output in Data Processing Systems
   - E. Other Activities
4. Implementing the System
   - A. Project Planning and Control
   - B. Scheduling the Installation Phase
   - C. Planning the Conversion
   - D. Formulating the Test Cases
   - E. Special Control and Audit Considerations during the Cut-Over Period
   - F. Interim Procedures
   - G. Measuring System Performance Against Specifications
5. System Maintenance and Follow-Up
   - A. Post-Installation Changes
   - B. Periodic Reviews of System Performance
   - C. Collecting and Analyzing Operating Costs

(Source: brochure of the Institute for the Certification of Computer Professionals, October 1979, 35 East Wacker Drive, Chicago Ill, 60601, (312) 782-9437, applying to the Certificate in Data Processing (CDP))

4 ADJECTIVES APPLIED TO IBM'S POLICY OF GRANTING CERTAIN TRADE-IN ALLOWANCES (List 800102)

Monopolistic
Predatory
Anti-competitive
Discriminatory

(Source: a statement of the Computer Lessors Association opposing IBM's new policy of granting trade-in allowances to present users of leased models 3158, 3148, and 3138 on replacement machines not yet announced; the policy does not apply to owners of these machines nor to those users not leasing from IBM; see Computer Dealers Association News, 10/13/79, 5635 West Douglas, Ave., Milwaukee, Wisc. 53218)

18 TOPICS FOR PAPERS AT THE INTERNATIONAL CONFERENCE ON MICROCOMPUTERS, MINICOMPUTERS, MICROPROCESSORS, DATACOMM JUNE 1980, GENEVA, SWITZERLAND (List 800103)

Satellite Communications
Packet Switching Networks
Communications Protocols
Network Control and Measurement Systems
Local Networks - Corporation Communications
Distributed Processing Systems
Corporate Communications - Manager Level Considerations
The Human/Computer Interface
Status of European Commercial Networks
Planning and Implementing a Data Communications System
The Impact of High Level Languages on Micro/Minicomputer Systems
Advances in Low Cost Peripherals in Micro/Minicomputers
Software Development - Tools and Techniques
16 bit vs. 8 bit Devices
VLSI/Bubble/CCD Memories
Microcomputers in Industrial Automation
Parallel/Multiprocessing
Troubleshooting, Tests, Debugging of Microcomputer Systems

(Source: call for papers; abstract due date, 15 February, 1980; Dr. Fred Morritz, Industrial and Scientific Conference Management, Inc., 222 West Adams St., Chicago, Ill. 60606: (212) 263-4866)

THE 42 COMMONEST WORDS OF THREE SYLLABLES IN SEQUENCE BY FREQUENCY PER MILLION WORDS (List 800104)

Frequency	Word	Frequency	Word
693	another	241	position
552	however	225	department
497	general	222	policy
482	united	221	following
417	government	207	century
392	business	206	Washington
382	president	204	evidence
377	several	201	various
375	national	196	personal
373	possible	187	expected
369	important	185	everything
330	interest	180	conditions
312	different	179	attention
292	example	171	including
290	company	171	industry
286	history	170	developed
280	anything	168	committee
273	already	165	religious
267	together	164	beginning
265	period	161	difficult
261	probably	157	similar

(Source: selected from "Computational Analysis of Present-Day American English" by H. Kucera and W. N. Francis, Brown Univ. Press, Providence, RI 02906, 2nd printing, 1970)

THE 36 COMMONEST WORDS OF FOUR SYLLABLES IN SEQUENCE BY FREQUENCY PER MILLION WORDS (List 800105)

Frequency	Word	Frequency	Word
569	American	160	especially
334	development	143	industrial
276	experience	136	population
269	information	135	temperature
258	political	133	literature
245	available	132	generally
243	economic	125	apparently
237	society	121	understanding
231	community	120	additional
222	necessary	116	activity
214	education	115	activities
212	military	114	obviously
196	situation	113	operation
194	America	109	democratic
191	secretary	108	analysis
179	particular	105	interested
174	material	105	professional
166	actually	103	original

(Source: selected from "Computational Analysis of Present-Day American English" by H. Kucera and W. N. Francis, Brown Univ. Press, Providence, RI 02906, 2nd Printing, 1970)

THE 30 COMMONEST WORDS OF FIVE OR MORE SYLLABLES IN SEQUENCE BY FREQUENCY PER MILLION WORDS (List 800106)

Frequency	Word	Frequency	Word
239	individual	66	intellectual
214	university	65	California
196	situation	63	contemporary
161	administration	61	organizations
155	international	54	interpretations
146	particularly	53	administrative
132	association	52	characteristics
127	organization	51	investigation
123	immediately	51	necessarily
121	opportunity	51	opportunities
118	responsibility	50	Philadelphia
96	considerable	48	occasionally
87	possibility	48	personality
73	individuals	47	manufacturers
68	characteristic	47	representative

(Source: selected from "Computational Anlalysis of Present-Day American English" by H. Kucera and W. N. Francis, Brown Univ. Press, Providence, RI 02906, 2nd Printing, 1970) □

Vol. 29, Nos. 1-2
January-February, 1980

computers and people

formerly *Computers and Automation*

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The Publisher
Berkeley Enterprises, Inc.
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Newtonville, MA 02160
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"Computers and People" (ISSN 0361-1442), formerly "Computers and Automation," is published every two months at 815 Washington St., Newtonville, MA 02160, by Berkeley Enterprises, Inc. Printed in U.S.A. Second Class Postage paid at Boston, MA and additional mailing points.

Subscription rates: United States, $14.50 for one year, $28.00 for two years. Elsewhere, add $6.00 per year.

NOTE: The above rates do not include our publication, "The Computer Directory and Buyers' Guide." To receive this, please add $15.00 per year to your subscription rate in the U.S., and $18.00 elsewhere.

NOTE: No organization in Switzerland or Morocco is authorized or permitted by us to solicit subscriptions for, or receive payment for, "Computers and People" or "The Computer Directory and Buyers' Guide." Such subscriptions and payments should be sent directly to us.

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

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

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

The Computer Industry

19 Optical Character Readers in the Automated Office [A]
by Bruce Bambrough, President, Compuscan, Inc., Teterboro, NJ
Optical character reading can make traditional office procedures much faster.

14 Telecommunication Satellites: Their Future Contribution [A]
by Albert D. Wheeldon, Vice President, Space and Communications Group, Hughes Aircraft Co., Los Angeles, Calif.
Third world nations can enter satellite telecommunications at an up-to-date technological level. Shared resources and international leasing can provide great advantages at low cost.

24 New Audio Device Helps Blind Typists Do Their Typing Independently [N]
by Donald H. Reck, IBM Office Products Division, Franklin Lakes, NJ

1, 5 Instruction in Programming Using a Microcomputer [FC]
by NCR, Dayton, Ohio
BASIC being taught using hands-on microcomputers.

Computers and Crime

7 $50 Million Collected from Stealing Banks [F]
by Robert Kahn, Lafayette, Calif., and the Editor
Some banks have placed exorbitant charges against "dormant" accounts, and the face-saving excuse, to prevent depositors from knowing, is (like the New York Telephone Co.'s excuse) "confidential internal company procedures."

Computers and the Future

8 The Cutting Edge of the Future [A]
by Sherwood L. Fawcett, President, Battelle Institute, Columbus, Ohio
How an organization which is both an institution for research and development, and a main contributor to charities, looks at the future – when all manufacture will be regulated by the unyielding limits to growth required by a finite planet.

The Marketing of Computer Peripherals

7 Self-Centered vs. Other-Centered Publicity [F]
by Kathy Stanford, BASF Systems, New York, and the Editor
Should a company boast of itself and its products or find out what a given audience wants to know?

7 Is "Computers and People" a Reasonable Place to Advertise? [F]
by Richard A. McLaughlin, Telecommunications Corp., Marina Del Ray, Calif., and the Editor
McLaughlin: Perhaps? The Editor: Probably not.

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.

Computer Applications

25 World Wide Subscription Activity Handled by Computer [N]
by F. Dixson Brooke, Jr., EBSCO Industries, Inc., Birmingham, Ala.

Computers and Mathematics

6 Computers and Mathematical Objects [E]
by Edmund C. Berkeley, Editor
Interesting mathematical objects, historically recognized, have been numbers, points, lines, directions, angles, infinite series, etc.. Computers are extending mathematics by producing recognition of many more mathematical objects: algorithms, calendar time, calculating languages, etc.

Artificial Intelligence

22 Writing a Novel by Computer – Part 3: Suspense [A]
by Edmund C. Berkeley, Editor, "Computers and People"
The definition, measurement, and calculation of suspense in a story or a novel.

24 Using Sign Language Developed for the Deaf, a Chimpanzee Communicates with Laboratory Scientists and with her Adopted Baby Son [N]
by Paul Bannister, "The National Enquirer," Lantona, Fla.

Errors in Computers and their Human Environment

27 The Frustrating World of Computers [N]
by Harry Nelson, San Jose, Calif.

Lists Related to Information Processing

2, 3 The Computer Almanac and the Computer Book of Lists: Instalment 11 [C]
by Neil Macdonald, Assistant Editor

95 Subject Areas of the Examination for the Certificate in Data Processing / List 800101
4 Adjectives Applied to IBM's Policy of Granting Certain Trade-in Allowances / List 800102
18 Topics for Papers at the International Conference on Microcomputers, Minicomputers, Microprocessors, Datacomm, June 1980, Geneva Switz. / List 800103
The 42 Commonest Words of Three Syllables, in Sequence by Frequency per Million Words / List 800104
The 36 Commonest Words of Four Syllables, in Sequence by Frequency per Million Words / List 800105
The 30 Commonest Words of Five or More Syllables, by Frequency per Million Words / List 800106

Computers, Games, and Puzzles

28 Games and Puzzles for Nimble Minds – and Computers [C]
by Neil Macdonald, Assistant Editor
MAXIMDIJ – Guessing a maxim expressed in digits.
NAYMANDIJ – A systematic pattern among randomness?
NUMBLES – Deciphering unknown digits from arithmetical relations.

Front Cover Picture

The front cover illustrates a common, interesting situation: student instruction using a powerful, accessible microcomputer. The picture shows a desk top microcomputer (NCR 7200, Model VI) with processing unit, memory, visual display screen, alphanumeric and numeric keyboards, etc..

Key

[A]	–	**Article**
[AA]	–	**Abbreviated Article**
[C]	–	**Monthly Column**
[E]	–	**Editorial**
[EN]	–	**Editorial Note**
[F]	–	**Forum**
[FC]	–	**Front Cover**
[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 Editor has been told that in the September, 1979 issue, on pages 18 and 19, the computer art should be attributed to Kerry Jones, artist, and not to Harry Hedelman, artist. Both these artists were working in the same field, mathematical representations of natural forms, and a confusion occurred. We regret this error. A further and more complete correction will be published.

Announcement: For latest news on the Computer Directory and Buyers' Guide, please turn to page 26.

Editorial

Computers and Mathematical Objects

Edmund C. Berkeley
Editor

In 1964, in a book "The Programming Language LISP: Its Operation and Applications", currently published by The MIT Press, Cambridge, Mass. I once wrote:

"There are several comments which it seems to me should be made about LISP from the point of view of a person approaching it for the first time:

"The first comment is that LISP greatly enlarges our conception of the nature of mathematical objects. In prior centuries men became accustomed to noticing as interesting mathematical objects:

- numbers;
- the points and lines of geometry;
- the magnitudes and directions of forces;
- sequences of numbers, usually infinite and usually with fairly simple rules for the construction of successive terms;

and much more.

"Now with the advent of LISP our horizons in mathematics are considerably extended. With LISP we take into mathematics finite sequences of a great variety of structures (lists) and also a mathematical grasp of the processes of effectively computing with them (recursion, the program feature, etc.). This new expansion of mathematical nature, of man's view of mathematical objects, is exciting.

"Second, LISP is not only a mathematical language but also a language for instructing computers. So instead of humanly verifying a symbolic mathematical calculation, if it is expressed in LISP, we can put it on a computer and have the computer verify it."

Since 1964, of course, computers and their applications have continued to evolve rapidly, and many more mathematical objects have come to be recognized. Many important concepts in the real world and in the more specialized world of science have been newly taken into the world of mathematics. There they are studied for their logical and mathematical implications.

One of these concepts is the concept of an Algorithm. This is the concept of an effective calculating procedure. "Effective" means that "it works." If a procedure is to work, it has to be performable in a reasonably finite time. A reasonably finite time changes from decade to decade as mathematicians and computers progress. Consequently, the variable of calendar time enters into mathematics, and MUST enter. (Probably it should always have been there; but no pure mathematician of 50 years ago recognized this; "pure mathematics" was too "perfect" ideally for arithmetic and computation to affect it.)

Another of these concepts is the various kinds of representation of Infinity within a computer. Anybody who has watched Space War played on the cathode ray screen of a terminal has seen "spaceships" disappear from one boundary of the screen and immediately reappear on the opposite boundary — using the wrap-around concept of infinity. Also anybody who has to deal with large numbers in a computer application realizes that within a computer there is a finite largest number that it can deal with. Sometimes this number is .999999-9999999999 times 10 to the 128th power.

Still another of these new concepts is that individual living beings are specified essentially as a sequence of choices in the chain of amino acid proteins of DNA and RNA, the spiral helix of the nucleic acids in a cell. I think the first complete specification of a form of life, a small virus molecule or cell, was a sequence of some 5300 amino acid proteins.

It is inevitable that mathematics will be enriched by computers, and computers will be enriched by mathematics.

Forum

SELF-CENTERED VS. OTHER-CENTERED PUBLICITY

1. *From Kathy Stanford*
BASF Systems, Suite 4520
200 Park Ave.
New York, NY 10017

Could you tell us by answering the questions below, how we in Public Relations can serve you better? Thanks.

1. Are our new releases timely and helpful?/ ???
2. How can we improve our releases? / see below
3. Could you use more material on BASF systems? / NO
4. Would you be interested in news-features on our company, products, people? / ???
5. When you need information and call us, do you get what you need? / doesn't apply
6. Would you like to meet with us? / NO
7. Would you like to visit our plants? / NO
8. Do you feel we are too low-key? / ???
9. What suggestions would you offer for improving our public relations? / see below

2. *From the Editor*

Suggestion 1: Find out what we want and need in our magazine, and would like to have from you.
Suggestion 2: Adjust your publicity to what is useful for us. An enormous amount of publicity that we receive is totally useless to us. Nearly all publicity is self-centered and not you-centered (or other-centered).

$50 MILLION COLLECTED FROM STEALING BANKS

1. *From Robert Kahn*
Robert Kahn and Associates
Business Counselors
P.O. Box 343
Lafayette, Calif. 94549
(415) 254-4434

I was recently reading your March/April issue and came across the story of your experience with the New York Telephone Company and particularly the letter from C. W. Getz in which he made the statement:

> As for the specific questions you raised, these relate to Internal Company Procedures, information about which is considered confidential in nature.

I got a similar reply from a bank some years ago when I was researching an article on How Banks Steal. Howard C. McCrady, senior vice president of First Western Bank, replied:

> We do have standard instructions for the use of our branches in processing savings accounts of the type mentioned in your memo of April 30. It is however against bank policy to distribute such internal documents.

A similar statement was included in the letter subsequently received from Security Pacific National Bank.

As a result of the four articles in my series published in "The Montclarion", Oakland, Calif., the Attorney General of California started an investigation and subsequently won a suit against both the Security National Pacific Bank and Bank of America. Security settled for some $7 million paid to the State Controller. It appears that Bank of America will shortly settle for about $15 million. Other banks have paid without suit and it looks like the Controller will collect on the order of $50 million and, based on their past record, $25 million will be returned to the rightful owners.

It is amazing how much is protected as "confidential procedures". I expect that the ones the New York Telephone Company has that abuse the customer are equally protected.

Keep up the good work.

IS C&P A REASONABLE PLACE TO ADVERTISE?

1. *From Richard A. McLaughlin*
Director of Corporate Information
Telecommunications Corporation
2500 Walnut Ave.
Marina Del Ray, CA 90291

Okay, I give up. If the only way to see a recent issue is to subscribe, I'll subscribe. Your flyer lists numerous articles of interest, and authors of very great stature. While I worked at Datamation, I would have been overjoyed to have some of them write for our book. Have to hand it to you for bringing them aboard.

(please turn to page 25)

The Cutting Edge of the Future

Dr. Sherwood L. Fawcett, President
Battelle Memorial Institute
505 King Ave.
Columbus, Ohio 43201

"Gordon Battelle ... was not a scientist or engineer. He was not an inventor. He didn't discover anything. He held no patents. He wrote no books. Yet his conviction that applied research had practical value has proved to be as important, as influential, and as significant a concept as any in the twentieth century."

(Based on an address before the Newcomen Society, Columbus, Ohio, October, 1979)

Battelle's broad objective is the advancement and utilization of science and education for the benefit of humanity. We seek to fulfill this objective through the various avenues of technological innovation.

Most of our work, in order to benefit humanity, has to be done through a company or government agency we refer to as a sponsor. It is our sponsors who take our knowledge and information and utilize them in such a way that it benefits the public. We serve literally thousands of sponsors in industry and government.

We work for people who utilize the knowledge and the scientific information that we generate. For this reason, I like to think that these people and we share a common interest in Battelle and its objectives. This being the case, Battelle's 50th anniversary seems an appropriate time to look at the Institute's past, present, and future.

THE PAST

When one discusses a business enterprise — and Battelle Memorial Institute is definitely a business enterprise — there are certain basic questions that arise: What is it? How did it get that way? And where is it going? To answer the first two questions, I would like to briefly review the birth and growth of Battelle and capture, as best I can, some sense of the life and times of the Institute. I say this because Battelle is very much a creature of its environment.

Gordon Battelle's Conviction

The history of Battelle Memorial Institute begins, of course, with Gordon Battelle. Gordon was a man who possessed amazing foresight and believed in the usefulness of scientific research. He was not a scientist or engineer. He was not an inventor. He didn't discover anything. He held no patents. He wrote no books. Yet his conviction that applied research had practical value has proved to be as important, as influential, and as significant a concept as any in the twentieth century. The only son of a wealthy Ohio steelmaker, Gordon died on September 21, 1923, leaving a Will which provided that the bulk of his estate be used to create "a Battelle Memorial Institute. . . for the encouragement of creative research . . . and the making of discoveries and inventions." The Institute serves as a memorial to his family.

Battelle's Board of Trustees acquired a ten-acre site in Columbus for the new Institute on King Avenue adjacent to The Ohio State University. The original building was opened for use in October 1929, just as the Great Depression struck. Nonetheless, Battelle was off to a good start, and a year later in 1930, "The Columbus Dispatch" editorialized optimistically — and as it turns out, quite prophetically — on the future of the Institute.

The editorial said in part: "Perhaps few of us appreciate the value to Columbus of the service rendered by the Battelle family in establishing the Battelle Memorial Institute, the scientific work of which was begun about a year ago on completion of the beautiful initial building on West King Avenue. As the end of the first year of operation approaches, its payroll all told has only about 50 names; but in the course of the years to come, it may mean more to the development of Columbus, even from the material point of view, than industries which number their employees by the hundreds or thousands. ."

Men of Stature in Metallurgy

To begin operations, the Board of Trustees chose a director for the Institute — Dr. Horace W. Gillett. When he first came to the attention of the Battelle board as a possible director of the new laboratories, Gillett was Chief of the Metallurgy Division of the National Bureau of Standards. He had once worked for Thomas Edison, and he shared some of the great inventor's remarkable ingenuity. And he had accumlated an extraordinary knowledge of alloys and processes.

Dr. Bertram D. Thomas, who later was to be a president of Battelle, described Dr. Gillett and the people he brought with him to begin the Institute in this way: "These were certainly men of great stature. There was a time in the early days when I used to say that if you named the ten leading metallurgists in the country, Battelle had five of them. And Gillett, who was a scientist, was dean of the metallurgists then."

Dr. Gillett always demanded excellence, from himself as well as others. He brought to Battelle many of the high-caliber scientists he had known at the Bureau of Mines and the Bureau of Standards — competent men, whose work was sound, giving the Institute a strong professional underpinning right at the start. Their own instincts matched Gillett's insistence on integrity.

One of the bright, young men that Dr. Gillett early brought to Battelle was Clyde Williams. Gillett and Williams were fast friends but profoundly different in temperament. Years later — after the two men had retired from Battelle — Williams recalled his early association with Gillett with some good natured humor. "I became very close to Gil," Williams said. "I was not married, and Gil was married to fishing; so every weekend he and I would go out in the lakes around Ithaca and fish and eat the chow that nobody could make as badly as Gil. But we became attached to each other. This is what led to his selecting me to come to Battelle."

Contract Research vs. Apathy

Doubtless, one of the most important events in Battelle's history was Dr. Gillett's decision in 1934 to ask the Board of Trustees to relieve him of administrative duties and to name Clyde Williams as director. If Dr. Gillett placed the stamp of his character on Battelle, it was Clyde Williams, by his aggressive promotion of contract research, who guaranteed that the Institute would grow and flourish. While respected in technical circles, he also had the charm, the zeal, and the appreciation of economics to convince company presidents and board chairmen that they needed Battelle.

He was faced with an industrial world that was, at best, apathetic to the potentialities of applied science. Dr. Williams resolved that if industry would not come to science, he would take science to industry. With missionary zeal he traveled the length and breadth of the country when trains, rather than planes, were the primary mode of transportation.

Under Dr. Williams' leadership, the Institute's capabilities and interests were extended far beyond materials technology to include expertise in chemistry, physics, engineering, and economics. And with the advent of World War II, Battelle, for the first time, had the United States government as a sponsor of its research. The war years brought a great challenge to Institute scientists. Battelle, for example, became involved in the development of atomic energy through its participation in the Manhattan Project of World War II — this because of its international reputation in metallurgy.

Chester Carlson and Xerox

During this period, Battelle people met an independent inventor — Chester Carlson — and in 1944, Battelle agreed to assist him in the development of his invention — xerography. In 1946, Battelle signed the first of a series of agreements with the Haloid Company leading to the Company's commercialization of Carlson's xerography process. The Haloid Company subsequently became the Xerox Corporation, and the story of its success became a legend in the business world.

In the postwar period, Battelle continued its expansion and diversification. It was in the early 50's that the Institute built research centers in Geneva, Switzerland, and Frankfurt, Germany. Establishing the Geneva Centre and Battelle-Institut eingetragener Verein in Frankfurt was, in itself, a daring experiment, but both quickly took root, bringing to Europe the concept of sponsored research.

Science as the Greatest of the Humanities

Dr. Williams' title was changed to President in 1952; but he was known almost universally throughout the Battelle organization as Clyde — even though the staff had grown to 3100 at the time of his retirement in 1957.

Dr. Bertram D. Thomas, who succeeded Dr. Williams as Battelle's third chief executive, worked closely for many years with Dr. Williams, serving as his assistant and as Acting Director. Years later, Dr. Thomas recalled his arrival at Battelle in this way: "In May of 1934 I got a telegram from Battelle offering me a job at $150 a month. So I came to Columbus and started work. I was told subsequently that things were not too lush at Battelle then; there were 50 or 60 people on the entire staff and they weren't doing very much hiring. But Clyde Williams justified me on the basis that they wanted a chemist. If I didn't work out as a chemist, they could use me as a metallurgist; if I didn't work out as a metallurgist, they could use me as a bookkeeper."

Despite their close working relationship over the years, Dr. Williams and Dr. Thomas were quite different in style and philosophy. Bert Thomas saw science as "the greatest of the humanities," and under his leadership, the Institute moved further in the direction of what he called the need for "social interaction" between the scientist and the world in which he lives. With his usual modesty, commenting on this role, Dr. Thomas said in retrospect, "I would be subject, I am sure, to criticism if I said that I took Battelle into social science. I don't think of it that way. I thought that if science has its interactions, Battelle ought to know what they are and ought to be prepared to do something about them."

Dr. Thomas assumed the presidency at a time when the Institute — through its endowment and the commercialization of xerography — had the financial resources to greatly expand its efforts to pursue the objective of Gordon Battelle's Will. Under Dr. Thomas' leadership, the Institute continued to expand and diversify its research activities, moving into such areas as oceanography, regional planning, health care, ecology, pollution control, and urban problems, to mention a few.

Branching Out

But extending its contract research efforts in the 60's was only a part of Dr. Thomas' strategy. There was the acquisition of an 18-acre wooded site near the University of Washington that was transformed into the Battelle Seattle Research Center — a cluster of quietly handsome buildings to house conferences and offices and provide living quarters for visiting scientists and scholars. And there was the creation of the Battelle Institute Program, which provided support for a cadre of Fellows appointed from sources outside Battelle as well as from existing Battelle staff to conduct work of a basic or scholarly character.

In the fall of 1964, the Institute assumed responsibility for the management and operation of the William F. Clapp Laboratories in Duxbury, Massachusetts. Long noted as a world center for the study

of marine biological attack on materials, the Clapp Laboratories complemented the Institute's Florida Marine Research Facility which Battelle had established near Daytona Beach in 1946.

In 1964, Battelle was selected by the U.S. Atomic Energy Commission to operate the former Hanford Laboratory in Richland, Washington. With the stroke of a pen, as the transfer was made, the Institute acquired 1,959 new staff members, at what was designated Battelle's Pacific Northwest Laboratories — bringing the total to a new all-time high of 5,500. As a further extension of its interests in the Northwest, the Institute purchased a 120-acre site at the mouth of Sequim Bay in the state of Washington, for a marine research facility.

With respect to Battelle in the Pacific Northwest, it is at about this point that I become a part of the history of Battelle — as the first Director of the Pacific Northwest Laboratories — an assignment that was to round out my "education" in Battelle management. Strictly speaking, I became a part of the history of Battelle, as do all of our staff members, when I joined the Institute. For me, that was in 1950, shortly after completing my doctorate at Case Institute.

Reinterpretation by Court of Battelle's Will

Four years after going to Richland to head up the Pacific Northwest Laboratories — when Bert Thomas retired — the Board of Trustees selected me as President of the Institute. During my tenure as President, one of the most significant milestones in the life of Battelle has been the litigation concerning the Will of Gordon Battelle and the scope and sphere of the Institute's activities. The legal actions, begun in March of 1969, were not closed until May of 1975, with a declaratory judgment and decree that included a detailed interpretation of the Will of Gordon Battelle.

To satisfy the financial requirements of the decree, the Institute's portfolio was substantially reduced. But on the positive side, Battelle's purpose was clarified and given a contemporary interpretation.

At about the time the court decree was handed down, Battelle also concluded lengthy negotiations with the U.S. Internal Revenue Service. As a result of these negotiations, the Institute agreed to pay taxes for several years past and to become a federal income tax paying organization.

Despite these problems, I believe we have made substantial progress toward some of the goals I set when I became president. I am convinced, for example, that we have drawn much more closely together the various Battelle components and instilled in them a stronger sense of cooperation and common purpose. And by foresight and planning, Battelle, as an organization, has continued to grow. Because of good planning, we were in an excellent position to undertake a much-expanded research effort in those areas where present research needs are greatest — for example, in energy and environmental work and in the life sciences.

In this broad brush history of Battelle, I want to conclude with one other event that, in itself, is important and that also points up one of the major thrusts of the Institute. In 1978, the U.S. Department of Energy authorized Battelle to manage a large program on commercial nuclear waste isolation. This program prompted Battelle to create a new operating division — our fifth — for this and other subsequent development programs. The new division, known as the Project Management Division, is indicative of Battelle's intent to formalize and expand efforts in the management of large development-type programs. The emphasis in these programs is on demonstration of new technology, as opposed to the research and development that precedes demonstration.

THE PRESENT

This history of Battelle is, of course, a very abbreviated one. We could spend a lot more time recalling people and events, but the Institute, by its very nature, is uniquely future-oriented, so I want to move along to the present and future. But before I do, there are several observations I would like to make.

As I have indicated, Battelle was literally born as the idea of one man — Gordon Battelle, who staked the family fortunes on the viability of his idea. This idea had to do with the usefulness and importance of the making of discoveries and inventions to better people's lives. One way or another, this idea has been accepted, modified, strengthened, and nurtured by everyone who has worked for Battelle Memorial Institute.

Thus the Institute has been built through the efforts and the dedication of well-trained, creative people convinced that science, when properly applied, can make a considerable improvement in the lot of humanity. Each staff member has built on what others have done in the past, but each has also brought and given something of himself, for it is impossible to perform scientific research without contributing something of yourself in the process.

Individual Staff Member: Drive and Zeal

Here, I'd like to say something about the importance of staff members as individuals. Perhaps the most important hallmark of the Institute has been its dependence upon and support of individual effort. The really significant developments in the life of the Institute, without exception, have come about because one person or a small group has been convinced that a particular activity was vital to Battelle. The Institute's entry into new research fields, the directions its research effort has taken, the growth of particular fields of work — all of these can be traced to the drive and zeal of one staff member or, at most, a small group of staff members, and to Battelle management support of these individual efforts. We, at Battelle, try to be ever mindful of the vital role of the individual, as an individual, in the affairs of Battelle.

Giving Up Half the Net Worth of Battelle

One further observation concerning the past: Battelle has had its share of successes and failures as it proceeded through depression, wars, and economic upheavals in the course of its 50-year

existence. Certainly the legal and tax problems I alluded to earlier have been and continue to be a real test of the strength of the organization. The Trustees' interpretation of the objectives of Battelle and how they should be pursued could not qualify for a tax exemption under the IRS definitions of charitable activities. Furthermore, the court-approved interpretation of the Will of Gordon Battelle required that a considerable amount of Battelle's assets be distributed to other charities. These two situations resulted in Battelle giving up approximately one-half of its net worth. I think it is safe to say that almost no business enterprise can have half of its net worth taken away within a two-month period of time without undergoing considerable trauma. Battelle is no exception in this regard. But, now to the present state of the Institute.

Where Are We Now?

After fity years, where are we now? In numbers and statistics, we are some 7100 people, doing over $300,000,000's worth of research and development work annually on about 3000 individual contracts, with nearly 2000 companies and government agencies. Our net worth is about $150,000,000 — most of it in buildings and facilities, including some of the most sophisticated scientific research equipment in the world. About 40 percent of our staff are graduate engineers and scientists; the remainder include some of the most skilled technicians in the world.

Legally, we remain a non-profit charitable trust. We are probably the only non-profit charitable trust in the world that pays all the taxes of a commercial enterprise and that distributes money by formula to other charities, under some conditions even when it doesn't earn the money. This peculiar set of circumstances notwithstanding, we still consider ourselves very fortunate indeed.

We Solve Problems

Scientific research and development is a very noble and high-sounding activity, but just what does Battelle do? In general, we generate and use scientific and technical knowledge and teach others how to use it. Mostly we solve problems that other organizations need to have solved badly enough that they are willing to pay for the solution. What kind of problems and in what areas? Battelle areas of work are a microcosm of the problems of the world.

In terms of size of effort, the largest single area has to do with energy — new or alternative sources of energy, new or more efficient ways of using energy, environmental and other impacts that energy usage makes on human and other life. We utilize all of the physical, life, social, and engineering sciences in this area.

Probably the second largest area of activity for Battelle is research and development for military defense. The ratio of our military R&D to all other R&D is probably comparable to the national ratio for the United States. Interestingly, most of the military research eventually ends up being applied in the civilian sector — new materials, new methods of fabricating materials, new techniques for organizing and performing complex tests, and new methods for quality assurance, just to name a few.

Research on Potential Toxins

Of about equal size, and growing in importance over the past decade, has been our research in the life sciences — research generally concerned with the effects of potentially toxic materials and atmospheres on living organisms, mostly human.

From its beginning, Battelle has been heavily involved in the development of materials and industrial processes, and it continues to be active in metallurgy, ceramics, and chemistry.

Over the past decade there has been a growing awareness of the interaction between science and society — of the physical and life sciences and their social impact. Battelle has pioneered in building multidisciplinary research capabilities to be able to interpret this interaction for the benefit of our sponsors.

Other Research

Finally, a review of our research subjects must include a growing number of social topics, such as studies of white collar crime, population, world economics, and urban planning.

Explicit in Battelle's objectives is the education of men and women for employment. Thus far, this objective has been pursued primarily in efforts to improve the science of education itself and in the better utilization of science. We pursue this educational objective primarily through seminars, by publishing papers and books, and by having individuals visit our laboratories and learn from our people specialized techniques of research and of research management.

Thus far, I have spoken of our work in research and development and in education. Another area of activity that is growing in significance is concerned with the development of ways to commercialize the intellectual property created and owned by Battelle. Generally, these activities are conducted through Battelle's subsidiaries, the Battelle Development Corporation and Scientific Advances, Inc., but the technology underlying this activity comes mainly from the Battelle laboratories. Historically, the most striking example of this innovation process was, of course, xerography, which was invented by Chester Carlson, further developed by Battelle, and finally commercialized by the Xerox Corporation. This was a stunning success, but I suspect that many people do not understand the real importance of what was done to bring this technology into widespread use.

Technical Invention PLUS Commercialization

We at Battelle believe that every significant invention really has two parts. One is the technical invention itself, and the second part is the commercialization of that invention for the benefit of the public. With many inventions, it is not at all clear how the invention should be commercialized and how it should be marketed to the public. In many cases, a successful technical development will be completely lost because no one is able to devise a profitable way to bring it to the marketplace.

The development and commercialization of xerography was a great success in both parts of the in-

novation process. First was the invention and development of xerography. Second was the innovative marketing techniques by the Xerox Corporation that made it possible for a wide segment of business and industry to obtain Xerox machines on a rental basis at affordable prices.

There are other more recent examples of Battelle's efforts to bring new technological developments in the form of products to the marketplace. Some of these are interesting because they point up the need at times for new enterprises to properly market these developments.

This year, for example, has seen the sale of Nortec Corporation, a small company initiated by Battelle's subsidiary, Scientific Advances, to manufacture and market new types of non-destructive testing equipment. The year has also seen the initiation of a new company, the Trans-Met Corporation, for the production and marketing of new forms and applications of what we call "directly formed metal" material.

All in all, we believe our founder would be surprised but pleased with what the Trustees and staff of Battelle have done with his idea over the past 50 years.

THE FUTURE

So much for the past and the present of Battelle Memorial Institute. Research and new knowledge and discoveries and inventions are by their very nature future-oriented. It is well established, and Battelle has found in its own experience, that it takes an average of about 12 years from the time an invention is made to the point where there is substantial acceptance by the public. When fundamental research is involved, an even longer period of time is required for useful application. Thus, when we think about Battelle, we must think in terms of decades, rather than in terms of months or even years.

Unmet Human Needs

Battelle works in the forefront of applied research and development, and, overwhelmingly, applied research is a response to an unmet human need. Accordingly, any consideration of Battelle's future must take into account the unmet needs of society.

As a part of the Institute's 50th anniversary observances, the management of Battelle reviewed and revised its strategic plans. In doing so, we identified a number of unmet needs of the world and related them to research and development requirements. Let me spell out these needs, for I believe it is vital for you, as part of the leadership of the free world, to recognize the importance of doing something about these needs.

To Reduce the Need for Energy

The one need of overwhelming importance that we are particularly aware of now, and that will be with us for years to come, is the need to increase the supply of energy resources and to reduce energy requirements. Related to this is the need to identify the shortages or approaching shortages of other natural resources and to learn how to cope with them. Hopefully, in this way we can head off other shortages before they grow to the magnitude of our energy shortage.

To Decrease Hunger, ...

There is the crying need to decrease hunger and malnutrition and to improve the food supply and distribution. A closely related need, of course, is to decrease the overpopulation and control the rate of population growth.

We need to reduce the incidence of crime and terrorism, and we need to assist developing countries to improve the status of their citizens and reduce poverty and unemployment. Broadly speaking, there is a need to improve the quality of life everywhere.

We must identify the causes and effects of environmental impacts and devise practical control measures. We must also improve the education of people to enable them to cope better with the situation in which they live. There is also a need to minimize imbalances in international economics and trade, and we must improve the assimilation of the disadvantaged into society.

These needs I've cited are very broadly stated, but there are others less general in nature that are nevertheless important and must be classed as world needs that will have an important influence on future society and industry.

Let me run through these quickly:

- To enlarge our scientific and technological knowledge so that institutions like Battelle can better satisfy the needs of man;
- To improve the security of nations;
- To help avoid the socio-political consequences of biased or manipulated communicators among nations;
- To conserve resources, including human resources;
- To control disease;
- To avoid the failure of machines and structures and eliminate the wastefulness of avoiding failure by over-design;
- To devise more efficient and adequately convenient modes of transportation;
- To provide better, more economical housing;
- To find ways to plan urban redevelopment in a more farsighted way.

To Improve Complex Decision Making

There is one other need I want to mention, because it is one that is often overlooked and it is of overriding importance. We need to improve the presently inadequate methods for decision-making in complex situations. Many of our other needs would be far less pressing today if proper decisions had been made before the problems reached crisis proportions.

It takes little imagination to recognize that these needs represent great challenges and opportunities for organizations like Battelle and for business and industry generally.

THE SECOND INDUSTRIAL REVOLUTION

Now I'd like to take a different tack in assessing the future and what it portends for industry and thus for Battelle. Let me begin by saying that I believe that the developed world is moving from the final stages of the first industrial revolution to a new, or what I think of as the second, industrial revolution.

The first industrial revolution, as you know, began in Europe and America almost simultaneously in the early 19th century with the invention and utilization of the steam engine. In its final stages, now going on, we see the use of artificial intelligence, communications, and computer systems to enhance the quality of life.

One of the dominant features of the first industrial revolution — the real importance of which is only now becoming apparent — is that it was based and economically optimized on the concept that many things were free or essentially free. That is, we had free air, free water, free — or almost free — energy and land. We were free to make noise and to blight the landscape. Not only did we optimize our industrial system on these concepts — we developed our whole technology, and trained our management, engineers, scientists, and economists to think in these terms.

The Realization that NOTHING IS FREE

It is only in the past decade that we have come to realize that in the further evolution of use of the planet earth, nothing is free. There is no more free air, water, energy, or land. Each system generating materials, goods, and services for man's use has to be a closed one. The inputs and outputs must be essentially identical, or at least inert and non-invasive to the surroundings.

In the coming second industrial revolution, which we are just now entering, business enterprises will have to live by and economically optimize on the ground rules of the new game. And governments, in all their functions and services, will be bound by the same rules as well. The situation calls for dramatic change — even the way we think has to be changed.

Doubtless there will be much reluctance to move in this direction, and this is certainly understandable. Vast capital investment has been made in the existing industrial system.

... And We Have No Choice ...

We may question the high risk investment that must be made in the new technology which, if successful, will obsolete our existing finely tuned industrial system. The situation and events of our generation, however, ultimately leave us no choice. We must begin adapting to the demands of a new age. The automobile, electrical machinery, electronics, plastics, and computers each, in its turn, made various industries obsolete. Now the emergence of the closed system and the "Age of Conservation" may be expected to make obsolete presently established processes in our time.

But the Opportunities are Breathtaking

On the positive side, the era now emerging will present exciting and almost breathtaking opportunities for successful new enterprises, a new generation of entrepreneurs, and, most important, substantial contributions to human progress. In almost every direction one looks there are challenges to create and introduce new products and processes to meet the needs of the times. From this viewpoint, the problem is to sort out and time-phase these opportunities and to capitalize on them with a minimum of risk.

Now in this recitation of unmet needs for humanity and the outline of the coming second industrial revolution for industry, what is Battelle's role?

First, of course, as we have done in our past 50 years, we must dedicate ourselves to helping industry and government agencies as they proceed into the future. This comes in the form of sound applied research to help them accomplish their stated missions.

Leading the Way in Beneficial Technological Change

The second role for Battelle is in what our founder called "the making of discoveries and inventions," and, I would add, finding practical ways to bring these to the marketplace for the benefit of the public when they might otherwise not make it.

Battelle must lead the way in beneficial technological change — at times down paths which others cannot or will not go. To do this, we will need all the money we can possibly earn. Battelle, throughout its history, has never sought charitable gifts to provide support for its work, and it never intends to do so. Thus, to fulfill our role, we must earn our way, and we must do this through the creation, development and capitalization of our own intellectual property.

Innovation is a Long Chain with Many Links

Battelle's future lies clearly in technological innovation — serving our sponsors and serving society. We, at Battelle, see the technological innovation process as a long chain. The links of the chain include definition of need, knowledge, research, invention and innovation, development, capital investment, marketing investment, and finally, commercialization to provide new products and services for the public. Unless every link is strong and meets the demand placed on it, the chain is nonfunctional and not one link can be considered successful.

As Battelle passes the half-way mark in its first century of service, we — as individuals and as an organization — are dedicated to making our links in the chain of technological innovation as strong as possible. Clearly, for us, this is the best way to insure the Institute's future success in contributing to human progress, and that, of course, is Battelle's purpose in being. □

Telecommunication Satellites: Their Future Contribution

Dr. Albert D. Wheeldon
Vice President, Space and Communications Group
Hughes Aircraft Co.
Los Angeles, Calif.

"A nation new to telecommunications need not repeat all the steps in development that have been taken in the past. A nation can now enter the process at the latest stage of evolution."

(Based on an address at the World Telecommunication Forum, Geneva, Switzerland, September, 1979)

Extraordinary Change Coming

We are living in a decade of extraordinary change. This change is driven by rapid advancements in the technology of computers and communications. I believe that this decade will set the direction and pace for the next century. It will probably have a fundamental effect on every nation. I believe that modern telecommunications is a necessary ingredient of national development.

In the United States today, major telecommunication changes are occurring continually. Computers and information are coming together in a way that demands new communication capabilities. Demand for new and more powerful communication service is accelerating. Vigorous, new entrants are on the American communication scene. Evolving public attitudes toward television and telecommunications are beginning to influence national policy in important, new ways. Competition is being tried on an increasingly wide scale, and is questioning the presumptive role of telecommunications monopolies.

Economy of Scale vs. Leverage of Specialization

The classic assumption of economy of scale is being challenged by the leverage of specialization. Leasing of communication facilities is developing as an important alternative to purchase. Sharing of facilities is increasing in place of exclusive ownership. Innovative financing of large telecommunications systems is beginning. Technology is creating opportunities for new services faster than public policy can be established to guide them comfortably. Let us look more carefully at these developments.

Competition

The Bell system provides the United States with an integrated telecommunications system of unusual capacity and quality. Ten years ago competition with this nationwide system of long lines facilities and local loops was not seriously considered. Yet today it is happening on an increasing scale. The first to compete were specialized microwave carriers. They attempted to duplicate the terrestrial links of the Bell system on a selective basis. They soon found the capital requirements too large and the rewards too small. The next step was a new public policy requiring Bell to make its facilities available to competitive services. Opening the network to other users has produced a considerable amount of service innovation and has stimulated Bell itself in interesting ways. Its Advanced Communication Service is an example of Bell's response to the challenge of others.

The real agent of competition proved to be the communication satellite. With a satellite investment of one or two hundred million dollars, a company could duplicate the long lines capacity of the terrestrial network. And this capacity could be operational in two or three years. With such a system, a competitor could provide service to as many points as desired with low cost earth stations. Public policy in the United States allowed, even tacitly encouraged, private companies to establish satellite systems at their own risk.

Open Skies Policy

These systems have emerged since the United States government proclaimed its Open Skies Policy for domestic satellite communications in 1972. Their effect is already pronounced. A rich fare of television programming is becoming available through a combination of satellites and cable TV systems. Communication services are being tailored to the users' needs. The prospect of inexpensive, wide-band data communications service is allowing the computer and office copier industry to take the next major steps in those technologies. Large companies are entering the communication equipment market in forceful and diversified ways. The time scale for introducing new services is shortening dramatically under the press of competition.

Rate Averaging or Cross Subsidy

There is another side to this competition. It is generally understood that a substantial amount of rate-averaging or cross-subsidy occurs in a monopoly network. Profitable long distance and business services generally support the not-so-profitable rural telecommunication systems. This is done as a matter of public policy.

When a specialized carrier caters to the data needs of large industrial users, as SBS and Xerox propose to do, it may undercut the financial basis for public message service. On the other hand, if the specialized carrier provides new services that were not available for purchase from the monopoly network, they will not detract from the public message service. Both viewpoints have been argued, sometimes in disguised form.

Communication Specialization

This issue has a counterpart in satellite communications. Intelsat now provides major path and primary service with the same spacecraft at the same rates. It is widely recognized that Intelsat could provide the high density major path service between Europe and the United States with special purpose spot-beam satellites. It could probably do so at rates below the present structure and probably well below those charged for undersea cables. But that would imply costs of a different kind - opportunity costs for cable layers and possibly rate increases for the smaller users of Intelsat. On the other hand, to ignore the opportunity for such specialization is to place a different - and possibly greater - burden on the system.

Another kind of satellite specialization is being considered by Intelsat. It is based on the dissimilar geographical features and traffic demands of the three ocean basins. Thus far, they have used identical satellites in the three locations because they have defined the characteristics of all three satellites by the requirements of the Atlantic basin. Serious consideration is now being given to individualized and more appropriate satellites for each ocean basin. This new approach provides an interesting example of the leverage of specialization, in contrast to the economy of scale.

Satellite technology clearly provides the basis for communication specialization. However, it also supports the traditional economy of scale procedures for very important applications. For example, a spacecraft designed to provide standard coverage becomes progressively more efficient as more transponders are included. The new Hughes Syncom IV widebody spacecraft can accommodate as many as 48 transponders. It can do so at a much lower cost per transponder than the older 12 and 24 transponder satellites. Using appropriate financing arrangements, a satellite leasing company could allot three, six, or twelve transponders to a small country, permitting them to realize the same low cost per transponder as a country that utilized all 48 transponders. By specializing its use of those transponders, the leasing nation could custom-tailor a satellite communications system fully responsive to its own requirements.

More Economical Methods

It is more economical to provide an additional unit of service with a network that already furnishes similar service, than it is to establish a new network. This practice forms the basis of incremental pricing. However, a new kind of service can be set up more cheaply as an independent module rather than as an increment to an existing network using common facilities. Recent experiments in the United States support this conclusion.

The leverage of specialization is competing favorably with the economy of scale in the satellite era. It is a simple matter to specialize communication satellites, both in configuration and in service. Each satellite can be deployed in space as a module. Because of these technical advances, our economic theorems are changing. Those who cling to the economy of scale with common facilities may find themselves in increasingly awkward positions as the influence of satellites spreads. Whatever one's persuasion on the question of monopoly versus competition, I believe that no one can afford to ignore the leverage of specialization.

Costs

If one accepts the proposition that communication satellites are a major element in the emerging telecommunications model, it is important to understand where their technology and economics are leading. It is difficult to get one's bearings here because space technology has been glamorized by manned spaceflight and scientific expeditions to other planets. These ventures have colored the space industry with considerable romance. They have also invoked a high level of national prestige-consciousness. We must look at satellites in a different light. We must realize that satellite systems can either frustrate or facilitate the provision of new services. They can provide more - or less - economical solutions to communication problems. They influence the price of communications both through their own costs and through the burden they place on ground stations.

Let us examine the costs of establishing satellite communication services in more detail. The direct cost of a satellite is composed of 1) the spacecraft itself, 2) its launch into geosynchronous orbit, and 3) insurance of the launch. The three elements invite careful attention.

Cost 1: Spacecraft

Spacecraft for telecommunications today cost $20 to $30 million. They are generally procured on a firm fixed-price contractual basis. A substantial portion of the total price is paid only if the spacecraft perform satisfactorily in space for seven years or more. Financial penalties are usually incurred for late delivery. About half of the world's communication satellites have been procured by open competition and about half by negotiation. Most of the negotiated contracts were for standard spacecraft or modifications thereof. However, some operating companies have been unwilling to commit their communication traffic and revenue to a satellite chosen by the lowest bid price, and have retained their right to choose the best mixture of price and quality to meet their operational needs. For the most part, open competitions and price auctions prevail and they have driven spacecraft prices to very attractive levels. This price reduction does not allow much international sharing of spacecraft development. There is considerable pressure to distribute satellite construction responsibilities, as is done in ESA scientific programs. However, the relentless pressure of price competition has eliminated this practice except for a few international programs that are willing and able to pay a surcharge for group comity.

Cost 2: Launch Vehicle

The second important element of satellite system cost is the launch vehicle. All commercial communication satellites to date have been placed in orbit by either of two expendable United States rockets - the Delta and the Atlas Centaur. The Titan 3 series has been used for United States military communication satellites. The Soviet Union has employed its own rockets for launching Russian spacecraft. In 1970 the unit prices for Delta and Atlas

Centaur rockets were $5 and $14 million, respectively. The prices will increase to $26 million for a Delta 3910-PAM and $40 million for an Atlas Centaur for launches in 1980. The rise reflects both the pressure of inflation and the approaching phase-out of these vehicles.

Three new launch systems are about to become operational: the United States Space Transportation System or Shuttle, the Japanese N-rocket, and the European Ariane. The N-rocket is similar to the United States Thor Delta and is built under license in Japan. It has already flown from Tanegashima Island in Southern Japan, and takes a 300 pound payload into synchronous orbit for a reported cost of $75 million. The Ariane is similar to the Atlas Centaur and can place about 2200 pounds in geostationary orbit from a near-equatorial launch site in French Guiana. The first Ariane will be launched early in 1980 and the ESA launch price is $15 million. Space Shuttle will also make its initial flight early in 1980. It will be launched from Florida and will place 65,000 pounds into a low altitude earth orbit. To raise a communication satellite to geosynchronous orbit, one of four payload assist modules must be used: (1) the PAM-D with an orbital payload of roughly 1240 pounds (2) the PAM-A with a payload of 2290 pounds (3) the Inertial Upper Stage (IUS) with a payload of 5000 pounds, or (4) the integral propulsion system of Syncom IV which allows a payload of about 3000 pounds to be placed in geostationary orbit.

The cost of launching a 1240 pound payload with the Shuttle and PAM-D in 1982 will be roughly $11 million. The cost of launching a larger satellite with integral propulsion, such as the 3000 pound LEASAT, will be about $13 million in 1982.

The important point is that launch costs will soon drop significantly. This decrease is due primarily to the reusable feature of the Shuttle and the opportunity for ride-sharing offered by its large capacity. Ariane launches will be priced competitively with Shuttle launches to attract their share of the business. Again we see the benefit of competition, a benefit that flows to the communication system owner.

Cost 3: Launch Insurance

Launch insurance is the third important element of satellite system cost. The threat of a launch loss is a financial burden that many system operators are unwilling to bear. To minimize this financial exposure, the London insurance market has offered launch insurance for over ten years.

The forms of available coverage have kept pace with the changes in technology. For the early Intelsat launches, it was possible to obtain insurance only on the basis of large deductible losses. Moreover, the available insurance capacity for the early policies was less than $10 million: so only limited indemnifications could be provided. By comparison, full coverage of launch vehicle and satellite costs is readily available today with insurance capacity in excess of $50 million per launch. The current rate for expendable launch vehicles is less than 10 percent of the value insured, reflecting the 90 percent reliability of existing rockets. The corresponding rate for the Shuttle is expected to be significantly lower, because of the improved reliability (98 percent) demanded by a vehicle transporting astronauts. The underwriters have yet to establish insurance rates for Ariane and the N-rockets.

A more recent development in the space insurance market is the variety of insurance for satellites' operational life. Owners of satellite systems can now protect themselves against partial failures or a total loss of communication capacity in orbit. The evolution of launch insurance and on-orbit life insurance has greatly reduced the financial risks of satellite ownership. These developments have all but removed the threat of major financial loss. They permit potential owners of satellite systems to concentrate their implementation decisions on known cost factors and societal benefits, rather than launch and operating risks.

Space Segment

The communication satellite exerts another major influence on the economics of telecommunications because its performance has direct impact on the ground segment. If the satellite is small and radiates a weak signal, the ground stations must be large and expensive. In a system with many ground stations, the total system cost can be increased disproportionately by economizing on the spacecraft. The opposite problem occurs if a very large, multipurpose satellite with high launch costs is chosen to operate with small, inexpensive earth stations. The apparent economy of scale associated with sharing the housekeeping functions on a large spacecraft can be easily over-ridden by the cost of completely replacing a complex satellite when only a few of its transponders have failed.

The system architect has the important responsibility of balancing the functions of the ground and space segments to reduce the total system costs. A number of qualified consulting concerns offer system architectural service to potential system owners. COMSAT is supporting the Arab League and Colombia, COMSAT and ESA helped India, and Teleconsult advised Indonesia. Such counsel can also help a nation avoid uneconomical solutions to its telecommunication problems. The user can expect to feel considerable pressure from alliances of industries and nations committed to particular launch systems or satellite designs. The systems may or may not provide economic communications.

Comparison of Airplanes

We can best illustrate this point by comparing the Boeing 747 and Concorde airplanes. The first was developed with private funds in response to airline needs. The other was magnificent technology developed with Government funding as a matter of national policy. As a technologist and frequent airline passenger, I am delighted that we have both aircraft. Air France and British Airways, who have operated the two aircraft, report profits on one and losses on the other.

The communication satellite field has had its economic disappointments. The Aerosat program was largely conceived in an industrial and political context. It began as an expensive experiment in international space technology. The intended beneficiary, the airline community, took a dim view of

the project. They expressed their opposition forcefully, and the program ended. Intrinsic economic viability is a requirement for communication satellites, just as it is for transport aircraft.

Satellite design should be driven by telecommunication needs, not the other way around. In the growing environment of service competition, the communication user that chooses an uneconomical solution runs a considerable risk. High purchase, operating, and replacement costs leave a communication system open to criticism, vulnerable to challenge, and in danger of displacement. Truly economical solutions are widely available using the most modern technology. They should be chosen competitively in preference to political solutions. The time necessary to explore the economic effects of alternate solutions is time well spent for the prospective system user.

System Growth

Another important consideration for the prospective satellite user is system growth. Satellites have a finite lifetime. Batteries and tubes wear out in about seven years, just as the station-keeping propellant is eventually exhausted. A replacement satellite, probably ordered three years before, must be ready to launch at that point. Usually the traffic will have grown significantly in seven years and additional new services will be required. This means that the new satellite will need more capability than its predecessor. Experience has shown that the technical and contractual definition of a second generation satellite is usually more difficult than that of its predecessor. The satellite must meet a more complicated mixture of communication needs. It can be chosen from a richer array of space technology options. Like an airline, a communication entity must look to the future in choosing a satellite system supplier to ensure that the company will be vigorous and available for the next step in system growth.

New Financing Forces

New financing forces are appearing on the telecommunication scene. Large sources of private capital in New York and Europe have become interested in satellite communications. For many years, these capital sources have financed transportation and other development projects. In the last two years, the world's large venture and investment capital managers have become comfortable with space technology. They are now convinced that telecommunications services via satellite present attractive investment opportunities.

One of the most interesting developments in the financing of satellite communications is the introduction of leasing. The application is similar to the aircraft industry and airlines. The titles to about half the world's commercial aircraft are held by groups of banks and investors. The airplanes are leased to the operating airline. Satellite leasing works the same way. The difference is that the spacecraft is 22,000 miles above the earth. The legal question of title to the hardware that operates at such a great distance is a new but important issue. Legal title has no effect on the telecommunication operator who provides service, or the investor/owners who provide the financing. A more significant issue is the title to orbital position and frequency allocation bestowed by the IFRB and ITU and held by the operating nation. A general policy on allocating such resources will be discussed by the WARC in the next few weeks.

Leasing

Leasing has the very significant advantage for the operator of not requiring a large capital investment prior to start of service. That investment can now be made by the financial community. The operator pays for the service as it becomes available, and can usually cover this expense with operating revenues. The latter point may be an important advantage for developing nations. Leasing has other advantages. While most contracts for purchasing satellites assign a fraction of the selling price to in-orbit performance, the majority of the financial risk is borne by the purchaser/operator. In the leasing arrangement, all the risk is borne by the seller/owner. The operator pays nothing until the satellite is operating in orbit according to contractual specification.

Leasing has a further advantage for the operator. It equalizes the outlay of investment capital. Satellite purchase requires a large amount of capital every five to ten years for replacement costs, with only small operating expenses in the meantime. The operator that leases service can budget a steady, predictable amount each year and thus avoid large capital appropriation swings. This plan has proved attractive to Government agencies in the United States. It accounts for the satellite leasing programs of the United States Navy with Hughes and COMSAT and of NASA with Western Union. It is likely that PTT administrations that depend on parliamentary appropriations will find leasing an interesting alternative to purchase/ownership.

A close coupling exists between leasing and technology. Because the lessors bear the full risk of in-orbit performance, they usually insist on the most reliable technology available. When COMSAT leased the Comstar satellite system to Bell, they reserved the right to choose their own satellite supplier (Hughes) without competition, and to influence the spacecraft design significantly.

Domestic Leasing

Leasing is proving popular for providing domestic satellite communication service also. Intelsat is leasing transponders to its member nations at increasingly attractive rates. They provide this capacity with channels not immediately needed for international service. Individual members like Brazil and Nigeria use this leased capacity to establish domestic communications within their countries. Sixteen countries now lease transponders under this program, providing revenue to Intelsat of $16 million per year. Intelsat is considering the provision of backup capacity for these domestic channels, so that lessees can be sure that their service will not be interrupted by other demands on the Intelsat system. This program has substantial advantages and a small problem. Because Intelsat is a respected international organization, it is in a favorable position to provide such service in an evenhanded way. It can furnish the service on an incremental basis and thereby provide the economy of scale to its member/users. It clearly has the financial resources and opera-

tional experience to do so. Its present limitation is that it provides domestic service through satellites that were designed for global service and are located over the ocean centers. As a result, Intelsat delivers a substantially weaker signal (22 dBw) than the domestic satellites currently operated by Canada, the United States, and Indonesia (33 dBw). This power difference is significant and causes the earth stations to be approximately three times larger than those used with the domestic systems. Intelsat is therefore considering the purchase of suitably modified international spacecraft or special satellites which can provide the higher signal level.

This discussion leads us to consider another innovation in the era of satellite communications: facility sharing. Undersea cable capacity has been shared, for many years, both in its ownership and its use. The Indefeasible Right of Use concept was developed by ATT to allow the United States International Record Carriers to participate in the benefits of partial cable ownership. Two of the three major satellite leasing programs in the United States are based on facilities sharing - carrying two different kinds of communication transponders on the same spacecraft. Sharing of satellite facilities by two or more countries is technically feasible and economically attractive. Indonesia has shared the use of the Palapa satellite with its neighbors in Southeast Asia on a lease basis. Interests of national prestige and priority of use in the event of satellite malfunction are questions that require careful consideration. However, the sharing of space facilities makes such good economic sense that it is sure to expand rapidly in the years ahead.

Ownership

If leasing or sharing communication satellite facilities is not attractive, what are the opportunities for outright ownership? They are excellent. Private loans from established sources are available in the United States, Europe, and Canada. The United States Export-Import Bank has been active in arranging loans for satellite systems in foreign countries. They provided 45 percent of the financing for Indonesia's satellite system and guaranteed the 55 percent supplied by commercial banks. Export-Import loans usually carry a requirement that the funds be spent for United States equipment, as do other development banks. They also insist that a positive evaluation of economic feasibility be provided in advance and that a consultant monitor the evolution of the system.

The counterparts of Exim in other countries provide similar financing with attractive interest rates and "grace" periods for repayment. The World Bank has not yet expressed interest in these programs, but may change its priorities in the future. For countries with heavy financial commitments or general credit problems, the United States Agency for International Development (AID) and its counterparts in other countries are logical sources of support. AID has already stated its willingness to support satellite projects that provide rural telephone service in developing nations. The agency has made a specific offer to UNESCO based on matching fund arrangements.

User in the Driver's Seat

This article has sought to suggest some of the dimensions of the new flexibility of financing and the richness afforded by modern communications technology. It is gratifying to see that the user of communications, rather than the supplier, is in the driver's seat. A complexity of choices is available today to the user, but he must choose wisely from this array. Our company feels that we have a special obligation to the user. In the past we have worked with large, technologically sophisticated buyers of communications satellites. In the future we will be working with new customers who want to integrate satellites, earth stations, and other technologies into systems to provide suitable communications at the lowest possible price. We recognize the need to cooperate with our customers on financing so that the benefits of satellite technology are readily available to them. A nation new to telecommunications need not repeat all the steps in the development of telecommunications that have been taken in the past. A nation can now enter the process at the latest stage of evolution, and install a powerful, new satellite system suited to its own social and economic needs - and matched to its resources.

Small Cost vs. Great Capacity

There are several overriding advantages of communication satellite systems. First, their cost in relation to capability is very small and affordable compared with the substantial cost of installing microwave plants throughout a country. Second, they can be installed in two to three years. There is a variety of attractive ways to finance their purchase or lease. Reliable satellites are available competitively from several qualified suppliers around the world. They lend themselves both to economy of scale and to leverage of specialization, depending on design and system use. They can be procured on a fixed price basis. They provide communication solutions that can stand the test of long term economic viability. In the century to come we shall see a proliferation of specially tailored domestic and regional systems.

A Future of Competition

I believe that the next one hundred years will be a century of competition. It will be a century of specialization. It will be the century of the satellite. And it will be a century of the most extraordinary expansion of telecommunications services.

Acknowledgments

I should like to thank C. T. Whitehead, P. S. Visher, and P. J. Jordan for important contributions to this article and to M. K. Golob for her help in bringing it to final form.

□

Optical Character Readers in the Automated Office

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"Any communication which at either or both ends involves a person and a message on paper can be made easier by an optical character reader."

The Traditional Office Is Vulnerable

The traditional office, one of the last remaining employers of craft skills, is under attack by every segment of the computer industry. All the traditional methods of doing things are equally vulnerable. From the file clerk to the corporation president, everyone who works in an office is being asked in the name of efficiency, to change his work methods and habits, to accommodate new equipment, new categories of work, and even new tables of organization.

Even the functions of the office are subject to change. During the past thirty years, many of these functions have been increasingly preempted by the data processing center. Most of the record keeping, most of the file management, most of the data analysis is now done in the data processing center. The "office," (except for the executive suite), exists largely to feed the computer and accept its output.

But Some Reverse Trends Are Appearing

Now, most recently, we see some reverse trends as the computer, greatly reduced in size and incorporated in a new array of equipment, invades the office instead of stealing its functions. Office personnel, using word processors, communication terminals, time-shared terminals, small business computers, etc., can perform many functions, almost forgotten by the office.

But all this new equipment imposes its own demands. It requires people to do things in new ways, to be more orderly and disciplined, to follow more structured procedures, to give up a lot of comfortable habitual ways of doing things in order to gain advantages in efficiency and control. Will office personnel learn to fit more procedures into the highly structured form required by data processing equipment? Or will electronics become increasingly adapted to the complex way that people presently work? Certainly, there will be some of both.

In this article I will discuss how one of the evolving new technologies, Optical Character Readers, OCR, can be used to make computers serve people less disruptively; how OCR can provide the means to gain the benefits of computer efficiency while preserving to a large extent the traditional methods of office work.

For the purposes of this discussion the work done in the office can be divided into certain broad categories:

Broad Categories of Office Work: Document Preparation

Documents ranging from short informal memos to business letters, to publications of complete books are increasingly prepared on computer based equipment. OCR plays a major role currently in such activity and will continue to do so. More about this later.

File Management

Almost everything worked on in an office comes out of or goes into a file. Files range from the most disorderly paper files organized under vague subject headings and containing everything from hand written notes to newspaper clippings, to highly structured data files kept on large computer disks. Almost all file input can be, and often is accomplished via OCR.

Communication

Any communication which at either or both ends involves a person and a message on paper can be made easier by an optical character reader. This is true whether it involves internal dissemination of informal memos, national or international mail postal service, telegraphic communications such as Telex or TWX, or man-computer interfaces.

The Technology of Optical Character Reading

Let me now briefly describe the OCR technology of the near term future. By near term I mean devices that either currently exist and whose application is currently being implemented, or those whose design exists and need only be reduced to practice.

The OCR Page Reader will be a relatively unobtrusive part of a computer based work station. The work station may be a word processor, a communication terminal, a small business computer. It may, in fact, be all three at the same time. The user will see only a slot into which he may enter a page and a slot out of which the page emerges. Alternately, there may be the tray of a multiple page feeder for input. But in any case, OCR is

only one of several ways to enter data into the workstation. The OCR will typically reside in a desk drawer and will be used for input in the same way that a magnetic card on a floppy disk is used.

The OCR reader accurately reads a large number of typed and printed fonts. It reads handwritten data and marks. It reads carbon and xerographic copies, pages typed on ordinary typewriters with ordinary fabric ribbons on ordinary paper. It reads all manner of forms, responding intelligently to the fielded variable data on the form while ignoring the pre-printed data. Intelligent response to the data on the form may include means for editing non-readable text. It also may include validation of every field on the form according to any programmable criteria and on-line interactive editing using the keyboard and display of the work station.

An OCR Page Reader consists of a scanner whose function is to produce an electronic image of the page, followed by electronic hardware to recognize predetermined characters. The scanner, in principle, can be used by itself without the recognition hardware to input or transmit the image directly. Thus, the OCR Reader equipped with a telephone interface, is also a facsimile transmitter. High resolution matrix printers, xerographic or facsimile receivers which are a part of the work station complete the loop allowing either text images of pages or combinations of both to be received.

The Usefulness of Paper

Much has been said about the need for reduction of paperwork, the advent of the checkless society via electronic funds transfer, the elimination of paper via "soft" copy on electronic screens and so forth. File storage on magnetic media or microfilm is very widespread and offers many advantages in convenience, speed of access and compatability with the computer. Will paper disappear?

We believe that paper will not disappear in the foreseeable future. The usefulness of paper is so immense, its adaptation to human work habits is so close that no existing or foreseeable substitute can take its place. Paper is incredibly cheap. It can be copied, written upon, folded, and mailed. It is extremely permanent, yet very easily destroyed. It can be signed by anyone and a signature on it makes it a legal document. A single piece of paper can easily hold 20,000 characters with high contrast and definition. A person can read paper pages for hours without fatigue.

The Disadvantages of Electronic Screens

In contrast, electronic screens, even the most expensive, can display only a few thousand characters and with much poorer contrast and definition. Nobody can read them continously and only one such screenful per work station is feasible. The average office worker needs dozens of pages of text simultaneously to be effective. Paper books and directories will not be surpassed by computer files in the foreseeable future. Nothing like a telephone directory with its millions of entries, accessible in a few seconds by anyone without any additional equipment, and produced for a few dollars each by the hundreds of thousands will be encroached on by computer hardware. Executives will continue to tuck a few folders, a report or two, and one or two books into their attache cases and take them home for additional work. No, paper will not disappear. It will be supplemented by other means, but it is here to stay.

The Concept of the "Wireless Input Terminal Cluster"

Before discussing some specific large scale applications of OCR in the automated office, it would be useful to describe, in an architectural manner, the kind of work flow structure made possible by OCR. We call this the Wireless, Input Terminal Cluster.

An OCR is an input port into which flows work from many work stations. These work stations are usually typewriters which are separated in time and space from the OCR. Separation in time means that the work may have been prepared at any time in the past. Separation in space means that the work stations can by anywhere in the world and not in the vicinity of the processor. Wireless is an important distinction since no direct connection is needed between the work station and the OCR. We have a cluster because many work stations can feed a single OCR.

Yet for all its apparent informality and its flexibility the Wireless Input Terminal Cluster achievable via OCR is closely analagous to the hard wired Terminal Cluster. In both systems each individual keystroke results in a character input to the processor with no additional attention. In the off-line cluster, through the use of preprinted forms, the operator can be prompted through a data entry task in a manner analagous to an on-line terminal. The work, buffered on paper, is accessible for humans to read in the interim. And lastly, via the downstream validation and editing features of modern OCR systems, errors are detected and corrected. The overall result is an efficient, very flexible but structured system for data input with many of the attributes of hard wired data entry clustered but much easier to set up. Usually it requires nothing more than the OCR alone.

The Preparation of Original Documents

OCR is widely used to allow existing office typewriters to talk directly to word processors for the input of original documents. The rationale for this use is simple. In most cases, about two-thirds of the time spent preparing original text is required for composition and only one-third of the time for editing. Typewriters are just as useful for composition as are electronic keyboards. Therefore, why not use typewriters for input and word processors only for editing? This division of labor lets one word processor do the work of three and lets every typewriter in the organization become a Wireless Input Terminal to the word processor.

Existing Methods of Work

In a typical situation an office has installed three single station display word processors whose price today is about $15,000 and has found them to be extremely productive. On multipage documents

requiring many revisions, they quickly become essential, but even for single page letters they are very efficient. So naturally every secretary and typist in the organization vies for their use and queues up waiting for a turn. It becomes apparent that more units are necessary. In such a situation, the office manager may choose to install an OCR machine instead at a price of about $20,000, depending on its features. Now the existing word processors are used only for editing, making them three times as productive. Secretaries remain at their desks for their other duties. And one OCR machine at $20,000 has improved productivity as much as six additional word processors which would have cost $90,000.

This is an impressive return on investment. It becomes even more impressive when it is realized that a single OCR machine is productive enough to keep at least ten word processors busy on editing alone. But even if there were only a single word processor present, it would be better to install an OCR at $20,000 rather than two more word processors at $30,000.

Perhaps equally important is the fact that OCR helps to preserve the structure and methods of work of the existing organization while permitting the full utilization of electronic aids to productivity.

Electronic Messages

There is no doubt that electronic mail in many different varieties is on the way. Whether supplied by the United States Postal Service, by the common carriers or by the new satellite based data communications services, large scale electronic transmission of hard copy messages is inevitable. The reasons are well known. The explosive advance of communication technology makes electronic transmission ever more economical while at the same time, the volume of communications grows rapidly, and physical delivery becomes more expensive and slower.

Regardless of whose electronic channel it is, whether supplied by the U.S.P.S. or by the Bell System or by others, the messages that are to be transmitted must be composed and edited in exactly the same manner as any other documents. File management of message files, sorting for batch transmission, and sorting for distribution is no different than similar procedures on other documents. The need for hard copy at various stages of message preparation and at the receiving end by the ultimate recipient is the same as for any other document.

Consequently, wherein the terminal hardware and software are concerned, there are almost no major differences between a communicating and a non-communicating terminal device. The same input considerations, the same local storage for buffering, sorting and retrieval, and the same editing and validation methods apply.

Switching of Electronic Messages

Let's take a closer look at how such a system might work in an electronic mail application.

Our hypothetical network is based upon the switching capability of the Bell dial-up telephone network. Each terminal is identified by a telephone number unique to it and which provides the sole means whereby it is addressed. To add a terminal to the network, it is simply necessary to connect it to any dial-up telephone.

In addition to transmitting and receiving messages, terminals may also perform some useful storage and sorting functions. Messages may be accumulated for a period of time, sorted by destination and transmitted by batch. Incoming messages may be stored for presentation on demand by individual recipients. The individual recipients can conveniently be identified simply by a three or four digit telephone extension number.

Networks such as these are currently being implemented via communicating word processors. But these networks are constructed of like terminals with the same Baud rates, the same communication protocol, etc. Large scale hard copy electronic mail will require the ability to interconnect many different terminals by different manufacturers and configured for widely different amounts and kinds of traffic. Of course, an industry standard to which all manufacturers conform is useful. But even this is not absolutely necessary and its absence will not prevent or even greatly slow down the growth of such networks. The incredible proliferation of distributed intelligence via microprocessors will allow unlike ternimals to communicate using many different protocols. Even today inexpensive translating devices are being offered to permit unlike terminals to communicate.

Fitting of Optical Character Recognition

How does an OCR capability fit into this picture? In one mode the OCR is used as an input to a communication terminal. In this case, it simply allows the implementation of our Wireless Cluster with the terminal as the concentrator. Every typewriter in the house becomes an input terminal and anyone can prepare messages for transmission just as he prepares any other documents. In this mode all of the economic and work flow considerations previously described for original document preparation are directly applicable.

In a simple, more direct mode, an OCR may itself be used directly for communication and is itself the communication terminal. It is presumed that text scanned by the OCR is correct and needs no editing, perhaps having been produced on a word processor originally.

Facsimile Transmission by Itself

There is one other capability available via the OCR that is worth mentioning and that is its ability to serve as a facsimile transmitter. Facsimile transmission, in spite of its substantial disadvantages, has had considerable success in recent years. The reasons for its success are twofold. First is its ability to accept almost any input. Handwritten memos, photos, newspaper clippings, etc., can all be accommodated along with typewritten pages. Second is the great simplicity of installation. All that is needed is a telephone.

A major disadvantage of FAX has been its very slow speed. Most FAX equipment requires four minutes per page. More recently, FAX equipment with

(please turn to page 26)

Writing a Novel by Computer - Part 3: Suspense

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"Without conflict there can be no suspense (unanswered questions about important puzzles) ... but it is easy to present conflict without suspense."

Outline

31. Synopsis of the First Two Parts
32. Topic 2: Suspense
33. Suspense and Conflict
34. Suspense and the Storyteller's Art
35. The Measurement of Suspense: Suspense in the First Draft (of a passage from "Gurnard Castle")
36. Suspense in the Second Draft
37. Algorithm for Revising, in Regard to Suspense

31. Synopsis of the First Two Parts

This Part 3 of "Writing a Novel by Computer" considers some more of the aspects of writing a good novel making use of the resources of a computer to the extent that this is "probably" possible or "reasonably" conceivable.

In Part 1 we compared writing a good novel with playing a good game of chess. They have many points of resemblance. And our thesis is that it ought to be possible for a computer (or a computer guided by a human being) to write a good novel. See Part 1, in "Computers and People", Mar.-Apr., 1979, p 28 ..., and Part 2, May-June, p 18 ...

In Table 1 is a synopsis (based on the centered headings, in some cases amplified) of the prior subjects discussed. The centered headings in this Part 3 are numbered in a continued sequence with those in prior parts.

32. Topic 2: Suspense

Suspense = unanswered questions about important puzzles.

A "good story", the way to "keep a reader turning the pages", the way to sell a book, is suspense, stimulating the curiosity of the reader to find out "what happens next." In the world-famous "Arabian Nights Entertainments", Queen Scheherazahde prevented herself day after day from being beheaded by making the Sultan curious for 1001 nights about "what happened next" in her stories. Naturally she told them verbally, so that he could not "look ahead" in the book to find out!

A good story is regularly based on a sympathetic character, usually a hero or heroine, and

Table 1

WRITING A NOVEL BY COMPUTER

Part 1

1. Writing a Novel Compared with Playing a Good Game of Chess
2. The Definition of a Novel
3. The Length of a Novel
4. The Elements of a Novel: A Story
5. Programming a Computer to Tell a Story
6. Some More Elements of a Novel (Characters; Problem; Solution; Complications and Plot; Suspense; Setting; Details)
7. The Mathematical Structure of a Novel
8. Ideas
9. Events
10. Scenes, and Chapters, and Novel (counting words, ideas, events, scenes, chapters, etc.)
11. Tempo
12. Programming a Computer to Tell a Story: Verifying details against a knowledge data bank.
13. Vocabularies (choice of words and ideas for describing characters, events, and scenes in the novel)
14. Consistency of the Characters (verifying details of behavior against the nature or personality of the character)

Part 2

15. Synopsis of Part 1
16. Creation of Life-Like Characters
17. A Theory of Personality
18. Real Persons and Imaginary Persons
19. Personality Inside a Computer: Eliza
20. Personality Inside a Computer: A Pattern of Behavior
21. A Computer Program to Write Good Novels
22. Computer Games from "Space War" to "Dungeon"
23. An Actual Example of "First Draft to be Revised"
24. First Draft: Input
25. Second Draft: Output
26. Modifications from First Draft, and Algorithms to Produce Them: TOPICS
27. Topic 1: Conflict
28. Conflict, in the Second Draft
29. Algorithm for Revising, in Regard to Conflict
30. From Words and Phrases into Ideas

his or her efforts to solve a problem. All their efforts during most of the story fail or fall short, while the problem becomes more and more mountainous; but at last the climax arrives, the problem becomes solved by an unforeseen but logical turn of events, and the heroic characters regularly "live happily ever after."

A reader feels cheated:

(1) if he can see the solution coming;
(2) if he can guess the solution;
(3) if the problem is solved too soon;
(4) if the problem is never solved but just abandoned;
(5) if the problem has an obvious practical solution, such as "not becoming involved" (this phenomenon is called a "paper dragon");
(6) if the plot is too simple or too complex, requiring too much effort to keep track of all the details;
(7) if the threats of disaster are too mild to be challenging, or so numerous as to become funny;
(8) if he is delayed by excursions and diversions that are not related to the main thread of the story (maximum tolerance of delay is about 400 words);
(9) if the solution is essentially impossible (this phenomenon is called a "deus ex machina");
(10) if the solution does not flow logically out of the circumstances of the situation and the nature of the characters;
etc., etc.

33. Suspense and Conflict

What is the relation between suspense and conflict?

Without conflict there can be no suspense, no important puzzles, only unimportant ones such as "what is going on? who is acting? what seems to be the essence?" Personally, I find it hard to read as much as ten pages of the start of a novel without finding out an important conflict affecting a sympathetic hero or heroine.

But it is easy to present conflict without suspense, the contribution of the art of the storyteller. This form of presentation is the contribution of the newspaper reporter, who seeks to put the essence of the story in the first one or two sentences: "On Nov. 28 a jumbo jet crashed into Mt. Erebus in the Antarctic, killing all 257 crew and sightseeing passengers. The probable cause was low altitude, gale winds, and pilot error."

An excellent story could be produced from this real life tragedy. Suppose two or three persons survive, and due to the knowledge, training, and common sense of one of them (the hero), they succeed in living until rescued. Insert a series of problems, much suspense, and final victory. Tell artfully, and use from 160 to 300 pages. Of course, knowledge of the Antarctic is a sine qua non. And many editors will decline the novel, because it is "Robinson Crusoe" in a modern dress.

34. Suspense and the Storyteller's Art

It is much easier to tell a story to a group of listeners than it is to write a story for an imagined audience. You can look up as you read the story, or better still, tell the story from memory, and watch the expressions on the faces of your listeners, and deduce whether or not to slow down or speed up, say over again in other words or proceed down the trail of the story. The sweetest reward is "And so -- tell me some more, please don't stop." I believe the minstrel and troubadour have been welcome all through history until the printed word and reading became common.

It is not easy to build an appropriate amount of suspense into a written story. Furthermore, what is appropriate in one period of history or culture may be inappropriate in another. For example, compare suspense in "David Copperfield" by Charles Dickens written about 1860 with suspense in "Frenchman's Creek" by Daphne Du Maurier written in 1937. Also, what is appropriate for one class of readers, say poetry lovers, is inappropriate for another.

There is probably no good solution for this problem of appropriateness until the story telling choices can be "tuned" by changing a command in a computer program, so that the story can alter in many ways, and not be told the same way each time, but become suited to the unique, individual listener.

35. The Measurement of Suspense: Suspense in the First Draft

Let us now take another look at the suspense in the sample first draft of part of "Gurnard Castle" which is quoted in Part 2 of "Writing a Novel by Computer" (see the May-June 1979 issue of "C&P"). In that passage is there any unanswered question about any important puzzle?

Yes, there is. There is one single faint indication: Rowena says that "today" her father (who regularly refuses to let her do something that is "unseemly") will "let me ride astride." Why? The passage does not say why. Presumably the story will later unfold the reason.

In order to measure suspense, let us adopt a scale of weights 1, 2, 4, 8, 16 ranging from "least important" to "most important", recognizing five stages of importance, to attempt to assess the importance of a puzzlement. This is like real life: we probably think enormously more about problems that are important to us than we think about problems that are minuscule.

Let us assign a weight of 2, and compute the score as 1 puzzle of weight 2, or a total of 2. The computer of course can multiply by a weight, but we have not yet provided an algorithm for detecting an unanswered question about an important puzzle!

36. Suspense in the Second Draft

Now let us take a look at the proposed second draft, and ask the same questions about the indications of suspense. The indications are shown in Table 2.

(please turn to page 26)

Computing and Data Processing Newsletter

NEW AUDIO DEVICE HELPS BLIND TYPISTS DO THEIR TYPING INDEPENDENTLY

Donald H. Reck
IBM Office Products Division
Parson's Pond Drive
Franklin Lakes, NJ 07417
(201) 848-3454

A peripheral device for a typewriter that can "speak" typed information has been designed for use by blind typists. It produces synthetic speech with an unlimited vocabulary. It is called an Audio Typing Unit; it can be attached to any of four models of magnetic media typewriters.

A blind operator will now be better able to edit and revise documents, producing error-free copy, without calling upon a person who has sight, thus aiding blind typists to become self-sufficient and increase their employment opportunities.

As the typist transcribes dictation contained in the typewriter memory, the device allows the typist to review and proofread the material by listening to what has been typed or stored in the magnetic memory.

The device consists of an audio key pad, an audio console, and an optional headset. The device makes use of the technology of voice synthesis and produces sounds that correspond to the typewriter keys that the typist has tounched. Responses are created by combining a stored set of basic speech sounds (called phonemes - there are some 43 in English) in accordance with stored pronunciation rules expressed in electronic memory circuits. The phonemes are "spoken" by a voice synthesizer which produces and blends the phonemes to form continuous speech. This is how the device gives flexibility and an unlimited vocabulary.

Buttons on the audio keypad enable the typist to choose to:

- pronounce any individual character
- spell a word
- spell a full line of text
- pronounce a word
- pronounce a full line of text
- spell or name punctuation
- say "capital" or "lower case"
- distinguish words that are pronounced alike by listening to the spelling.

The device can be used without a dictation device, but normally would be used with it.

The Audio Typing Unit contains a microprocessor using 44,000 bytes of memory, and includes 16,000 bytes of read-only control program, 4000 bytes of random access memory, and 24,000 bytes of read-only language program.

USING SIGN LANGUAGE DEVELOPED FOR THE DEAF, A CHIMPANZEE COMMUNICATES WITH LABORATORY SCIENTISTS AND WITH HER ADOPTED BABY SON

Paul Bannister
"The National Enquirer"
Lantona, Florida
(November 13, 1979)

"My baby — I want my baby. Where is my baby?" pleaded the young mother. Gently, the doctor explained "Your baby is dead."

The mother's whole body sagged in dejection. Her head drooped in misery. But she didn't cry — she couldn't. She's a chimpanzee.

In an astonishing world first, an animal has shown the ability to communicate her emotions — using the same hand-sign language developed for use by human beings.

Washoe, a 14 year old chimpanzee, was taught the sign language by university researchers who worked with her for a dozen years, molding her hands into the signs they wanted her to learn, and rewarding progress with food. And now Washoe seems to be teaching the 1-year-old son she "adopted" to communicate, using some of the 200 signs she knows.

When Washoe's own baby, 2-month-old son Sequoyah died of pneumonia last March, the 4-foot 8-inch chimpanzee daily met researchers at the door of her cage, pleading with them in sign language for news of her son.

"I had to tell Washoe, 'Your baby is dead,' but she seemed to keep hoping," said psychologist Dr. Roger Fouts, 36, who heads the chimpanzee learning program at the Institute for Primate Studies at the Universty of Oklahoma.

"Every day she would meet me at the door of the cage, making the hand signs for baby and a

question — like this." Dr. Fouts cradled his arms as if holding an infant. "Her eyebrows would go up in a questioning manner — her sign language to say, 'Where is my baby?'"

"She was very much like a human, showing depression." Saddened, the scientists soon found another baby for Washoe — Loulis, a lively 20-inch-tall bundle of fur. "I went alone into Washoe's cage to prepare her," Dr. Fouts said, "I told her simply 'Baby'. She got so excited, dancing and chattering. I could swear her eyes lit up. Her whole expression beamed. I went out, got Loulis, and brought him in. But the moment she saw it wasn't Sequoyah, she turned her back on him. Loulis saw it wasn't his mother and he clung tightly to me. We left them together in the cage. They both just stared out at us, ignoring each other."

After about half an hour, Washoe's heart softened and she began trying to get Loulis' attention, Dr. Fouts said. "But little Loulis determinedly ignored her." Dr. Fouts' associate, Dr. George Kimball, spent the night observing them. "Washoe just could not stand it," he said. "By 4 a.m., she approached Loulis. She gave a sign for 'Come hug'. That did it. Loulis jumped into her arms. They hugged — and slept curled together in a chair."

Since then Washoe has become almost an adoptive mother to the little chimp, teaching him games she'd learned as a young chimp herself. And in a surprising display of intelligence, she is apparently teaching him to make the signs scientists have taught her.

"We have observed what could be teaching," said Dr. Fouts. "For example, Washoe was signaling to us for food. Then she took Loulis' little pink hands and tried to mold them into the food sign. We have seen Loulis using some signs in communications with Dr. Kimball. He has used three signs in context and we've observed eight others and these are signs he has learned only from Washoe."

WORLD WIDE SUBSCRIPTION ACTIVITY HANDLED BY COMPUTER

F. Dixson Brooke, Jr., Vice President
EBSCO Industries, Inc.
1st Ave. N & 13th St.
Birmingham, Ala. 35203
(205) 252-1212

It takes a computer to compete with some of our toughest competition: our own customers. We ask our customers to let us do for them what they can do for themselves, and so we have to offer services that make it pay for them, for us to handle their magazine and periodical subscriptions. We remit 85 percent of the received payments to the publishers, who are also well served in many ways.

Many of the services originate here in Biringham where the computer helps sales and customer service representatives in eleven regional offices and in locations in Canada, the Netherlands, and Brazil. We help keep almost 35,000 school, public, university, and institutional library customers up-to-date on changes in their subscriptions.

Our computer data base has over 160,000 different periodicals published by 45,000 different publishers. We add almost 15,000 new titles every year to that file. Our system becomes a single source of information for our customers. They are saved the time, trouble, and expense of keeping current on information from a variety of publishers who have different publication dates, payment plans, business forms, and methods of operation.

Between 2000 and 3000 price, name or other changes take place each week in the publications we handle. The computer makes the changes available and known at once.

Changes in the value of the dollar also affect us and our customers. Almost one half the titles offered are foreign publications and many demand payment in other than U.S. currency. With the aid of a local bank, we keep the latest currency values stored in the computer, and we are able to quote and bill customers at current prices, saving our customers the cost of issuing checks for rebilling.

We also offer an ombudsman service: if there is a problem with a subscription ordered through us, we act as an intermediary between the customer and the publisher. The problem is noted in the customer's computer file, and unresolved problems are reported. At a glance our customers know the status of all their publications. In fact, only through the assistance of a computer, can we thus help and anticipate the needs of all our customers.

The computer is an IBM System 370 Model 148. □

McLaughlin – *Continued from page 7*

And, yes, I would love to see a rate card or whatever else you have for advertisers. If the book is of sufficient interest to keep you involved in its publication and of sufficient prominence to attract the authors you list, then it may well be a reasonable spot for us to advertise. My budget for ads is not large, and it's already largely spoken for, but I don't wish to admit to being closed-minded -- whether that's true or not.

2. From the Editor

Thank you for your subscription to "Computers and People". If at any time you feel it is not worth the money, just tell us and we will refund the unmailed portion of your subscription. In this letter I send you a copy of the Nov.-Dec. issue, to begin your subscription, and I hope you like it. We have felt that our circulation now is so small that it would never interest advertisers any more. The cost of a full page ad would be about $200 now, or you could choose your own rate, really: we simply do not like to charge people what is an unreasonable price for what they would get.

I am pleased that you think what we are aiming to publish is interesting and worthwhile. □

Berkeley – *Continued from page 23*

Table 2

INDICATIONS OF SUSPENSE

No. of Indication	Description and Unanswered Question	Assigned Weight
(1)	will let me ride astride ... and I know the reason / what reason?	4
(2)	in the guise of a page to his lordship — with a name, Alfred Redruth / why?	4
(3)	Merrybelle, my little darling / who is she?	1
(4)	dear Mary / who is she?	1
(5)	proposal for marriage from Lord Carburton / will Rowena eventually say yes?	4
(6)	The Carburtons do not relinquish what they want / a substantial threat - what will happen?	8
(7)	she would never give up trying to convince her father / a substantial trouble - what will happen?	8

In other words, there are now seven indications of suspense. The reader will be drawing on his imagination, and such questions as the following will pass through his mind: Will the party be held up by highwaymen? Will Lord Carburton ensnare Rowena? Will Rowena win her freedom from her father?

We can compute a score for the suspense in the second draft: 7 indications, total score 30. There is no doubt that the amount and intensity of suspense has been increased.

37. Algorithm for Revising, in Regard to Suspense

What algorithm can we specify for the Reviser Program in regard to the factor of suspense?

The first statement of the algorithm is "Increase and intensify suspense." Again, this is a vague statement, and below is a more practical way of expressing the algorithm:

1) Pinpoint (note, identify) each of the several puzzles, both important and unimportant, placed in front of the reader
2) Assign a weight to the importance of each puzzle
3) Total the weights of the puzzles to give a score
4) This number is a basis for evaluating and comparing different versions of the story in regard to suspense.

The next subject we need to consider is Topics 3, 4, and 5: actions, conversations, and thoughts — the "events" of the narrative.

(To be continued in a forthcoming issue)

Bambrough – *Continued from page 21*

data compression features have become available with speeds of less than one minute per page. This can be compared to costs for coded text transmission at say 4800 Baud. Serial asynchronous transmission at 4800 Baud would take about four seconds to transmit a fully typed page containing 2000 characters. OCR coded pages may be regarded as very highly conpressed FAX with approximately 50 times the speed.

There are additional disadvantages of FAX communications. Most systems require manual dial-up at the sending end and manual interconnection at the receiving end. It produces hard copy only for human use. It cannot be connected directly to a computer or a word processor. Reentry of text must be accomplished by rekeying. Storage of messages consumes enormous volumes of memory.

Facsimile Transmission Plus Optical Character Recognition

By combining OCR with FAX all the advantage of both systems can be attained. OCR readable text can be transmitted many times faster than FAX, but non-readable material can still be transmitted. All the advantages of message switching, storage, sorting are available along with the simplicity and universality of FAX.

Perhaps not the least of the advantages of such an electronic mail system is the fact that the network and the message switching means is already there. Nobody's permission is needed to interconnect. Everybody's terminal can be reached. All necessary technology exists.

The Office Compared with Other Work Places

It is possible to draw some broad parallels between the office and other work places in American society. According to Dr. Charles E. Reed, Senior Vice President, Corporate Technology, General Electric Company, Fairfield, Connecticut, there is less than a $2,000 capital investment per office worker. In contrast there is over $35,000 invested per farm worker and $24,000 per production worker. It has been estimated by Peter J. Schuyten of Quantum Science Corporation that by 1982, only three years from now, expenditures for equipmemt going directly to the office environment will be $15 billion annually.

We think the OCR will play a major role in this office revolution. OCR will provide the means whereby everyone can reach the computer from his desk anywhere and at any time. □

THE COMPUTER DIRECTORY AND BUYERS' GUIDE – NEWS: DEC. 15, 1979

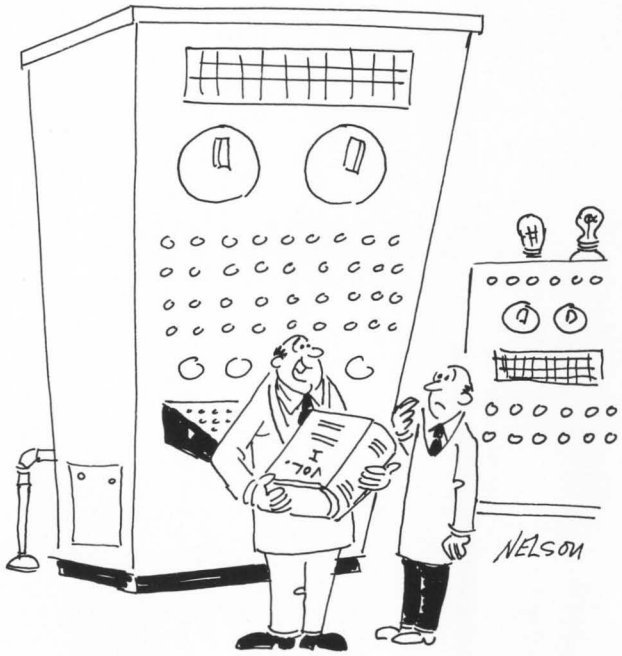
The Computer Directory and Buyers' Guide for 1978-79 will contain a Roster of Organizations of more than 1500 entries, far more than last time. It will also contain a Buyers' Guide to Products and Services, under some 30 categories, including Computer Dealers; etc.

The data is 99% gathered. The hardware is 100% gathered. The software, under contract, is late by more than 10 months, and is still unsatisfactory.

THE FRUSTRATING WORLD OF COMPUTERS

by Harry Nelson
1135 Jonesport Ct.
San Jose, CA 95131

I don't care how important your problem is, Dr. von Neumann – only operators, salesmen, and scrubladies can work here at night ...



It's very simple to operate; here's the brochure explaining how ...

This is the third time you've complained about this same computer error – and I'm sick and tired of it ...

I tried to convince the judge that the computer just misplaced one little decimal point ...

Games and Puzzles for Nimble Minds – and Computers

Neil Macdonald
Assistant Editor

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 programming 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"). 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 must display some kind of evident, systematic, rational order and completely remove some kind of randomness; the operation must be expressible in not more than four English words. (But Man can use more words to express the solution and still win.)

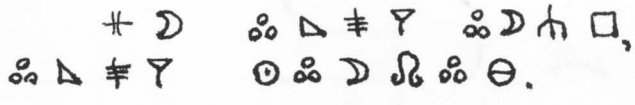
NAYMANDIJ 8001

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

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, plus a few more signs. To compress any extra letters into the set of signs, the encipherer may use puns, minor misspellings, equivalents (like CS or KS for X), etc. But the spaces between words are kept.

MAXIMDIJ 8001



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, ex-expressed in numerical digits, is to be translated (using the same key) into letters so that it may be read; but the spelling may use puns, or deliberate (but evident) misspellings, or may be otherwise irregular, to discourage cryptanalytic methods of deciphering.

NUMBLE 8001

```
        T H I N G S
    *       T A K E
    -----------------
        A E H A G G
      H G K E S E A
    H T A E T S S
    G T H I M A
    -----------------
=   N A T K M G S I G

    2 0 0 9 9 3
```

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

SOLUTIONS

NAYMANDIJ 7911: Rows: difference 5th 6th

NUMBLE 7911: An old cloth cleans well.

MAXIMDIJ 7911: The only perfect people: those we know not.

Our thanks to Karen Hoh, Oakland, CA, for sending us the solution to Numble 7907.