computers and people

May—June, 1981

Vol. 30, Nos. 5-6

formerly *Computers and Automation*

222 MIRRORS CONTROLLED BY COMPUTER COLLECTING SUNLIGHT

The Computer Almanac and Computer Book of Lists — Instalment 19

Neil Macdonald
Assistant Editor

7 OBJECTIVES FOR COMPUTER LITERACY REGARDING HARDWARE (List 810501)

Identify the five major components of a computer:
- input equipment; memory unit; control unit; arithmetic unit; output equipment

Identify the basic operation of a computer system:
- input of data or information; processing of data or information; output of data or information

Distinguish between hardware and software
Identify how a person can access a computer, such as via a keyboard terminal at site of a computer or any distance via a telephone line, or via punched or marked cards, or via magnetic media such as tape or diskette
Recognize the rapid growth of computer hardware since the 1940's
Determine that the basic components function as an interconnected system under the control of a stored program developed by a person
Compare computer processing and storage to the human brain listing some general likenesses and differences

(Source: Minnesota Educational Computing Consortium, 2520 Broadway Drive, St. Paul, Minn. 55113, 1979)

7 OBJECTIVES FOR COMPUTER LITERACY REGARDING PROGRAMMING AND ALGORITHMS (List 810502)

Recognize the definition of "algorithm"
Follow and give the correct output for a simple algorithm
Given a simple algorithm explain what it accomplishes (that is, interpret and generalize)
Modify a simple algorithm to accomplish a new but related task
Detect logic errors in an improperly functioning algorithm
Develop an algorithm for solving a specific problem
Develop an algorithm which can be used to solve a set of similar problems

Note: The student should be able to accomplish these objectives when the algorithm is expressed as a set of English language instructions and in the form of a computer program.

(Source: Minnesota Educational Computing Consortium, 2520 Broadway Drive, St. Paul, Minn. 55113, 1979)

13 COMPUTER LITERACY OBJECTIVES REGARDING SOFTWARE AND DATA PROCESSING (List 810503)

Identify the fact that we communicate with computers through a binary code
Identify the need for data to be organized if it is to be useful
Identify the fact that information is data that has been given meaning
Identify that data is a coded mechanism for communication
Identify the fact that communication is the transmission of information via coded messages
Identify the fact that data processing involves the transformation of data by means of a set of predefined rules
Recognize that a computer needs instructions to operate
Recognize that a computer gets instructions from a program written in a programming language
Recognize that a computer is able to store a program and data
Recognize that computers process data by searching, sorting, updating, summarizing, moving, etc.
Select an appropriate attribute for ordering of data for a particular task
Design an elementary data structure for a given application (that is, provide order for the data)
Design an elementary coding system for a given application

(Source: Minnesota Educational Computing Consortium, 2520 Broadway Drive, St. Paul, Minn. 55113, 1979)

10 COMPUTER LITERACY OBJECTIVES REGARDING APPLICATIONS (List 810504)

Recognize specific uses of computers in some of the following fields: medicine / law enforcement / education / engineering / business / transportation / military defense systems / weather prediction / recreation / government / the library / creative arts
Identify the fact that there are many programming languages suitable for a particular application for business or science
Recognize that the following activities are among the major types of applications of the computer: information storage and retrieval / simulation and modeling / process control: decision-making / computation / data processing
Recognize that computers are generally good at information processing tasks that benefit from: speed / accuracy / repetitiveness
Recognize that some limiting considerations for

using computers are: cost / software availability / storage capacity
Recognize the basic features of a computerized information system
Determine how computers can assist the consumer
Determine how computers can assist in a decision-making process
Assess the feasibility of potential applications
Develop a new application

(Source: Minnesota Educational Computing Consortium, 2520 Broadway Drive, St. Paul, Minn. 55113, 1979)

16 COMPUTER LITERACY OBJECTIVES REGARDING THE SOCIAL IMPACT OF COMPUTERS (List 810505)

Distinguish among the following careers: keypuncher (or key operator) / computer operator / computer programmer / systems analyst / computer scientist
Recognize that computers are used to commit a wide variety of serious crimes; especially stealing money, stealing information
Recognize that identification codes (numbers) and passwords are a primary means for restricting use of: computer systems / computer programs / data files
Recognize that procedures for detecting computer-based crimes are not well developed
Identify some advantages or disadvantages of a data base containing personal information on a large number of people (for example, research value, potential privacy invasion)
Recognize several regulatory rules (for example, right to review one's own files, no universal personal identifiers)
Recognize that most privacy problems exist whether or not files are computerized
Recognize that computerization decreases some employment, increases other employment
Recognize that computerization personalizes some education (and other fields) and depersonalizes other education (etc.)
Recognize that computerization can lead to both greater independence of and greater dependence on one's tools
Recognize that computers can modify their own instruction set, display much "artificial intelligence", and learn
Recognize that many alleged "computer mistakes" are mistakes made by people
Plan a strategy for tracing and correcting a computer-related error (example, in billing)
Explain how computers make surveillance of the public more feasible
Recognize that every person is being affected indirectly in many sectors of social behavior by computerization
Explain how computers can be used to affect the distribution and use of economic and political power

(Source: Minnesota Educational Computing Consortium, 2520 Broadway Drive, St. Paul, Minn. 55113 1979)

9 COMPUTER LITERACY OBJECTIVES REGARDING ATTITUDES, VALUES, MOTIVATION (List 810506)

Does not feel fear, anxiety, or intimidation from computer experiences
Feels confident about his or her ability to use and control computers
Values efficient information processing, provided that it does not neglect accuracy, the protection of individual rights, and social needs
Values computerization of routine tasks, so long as it frees people to engage in other activities, and is not done as an end in itself
Values more communication and more availability of information possible through computers, provided it does not violate personal rights to privacy or the accuracy of personal data
Values economic benefits of computerization for a society
Likes and wants work or play with computers, especially computer-assisted learning
Describes past experiences with computers with positive-affect words like fun, exciting, challenging, etc.
Spends some free time using a computer, if given an opportunity

(Source: Minnesota Educational Computing Consortium, 2520 Broadway Drive, St. Paul, Minn. 55113, 1979)

9 IMPORTANT TYPES OF HUMAN LANGUAGE (List 810507)

The language of gesture and behavior / begins about age of 2 months
The language of one spoken word / begins about age 1 and 1/2
The language of 2 spoken words / begins about age 2
The language of many spoken words and many sentences / begins about age 4
The language of over 5000 spoken words / begins about age 5
The language of reading for fun / begins about age 8
The language of reading and writing for work and fun / begins about age 12
The language of watching and imitating / begins about age of 9 months
The language of deeds and interpretation of them / begins before age of 1 month

(Source: Neil Macdonald's notes.)

24 DIRECTORS OF THE SOCIETY FOR COMPUTER SIMULATION (List 810508)

Ronald Maslo
W. G. Cunningham
Carl Malstrom
Donald Martin
Eugene W. Henry
William Grierson
Robert Brennan
Walter Karplus
Stefan S. Kruc
A. Ben Clymer
Ralph Huntsinger
Wayne Ingalls
Brian Unger
Roy Crosbie
Bill Billiness
Jim Davis
Dick Dodds
Stewart Schlesinger
Ragnar Nilsen

(please turn to page 26)

Vol. 30, Nos. 5-6
May-June, 1981

Editorial Offices	**Berkeley Enterprises, Inc.** 815 Washington St. Newtonville, MA 02160 (617) 332-5453
Advertising Contact	**The Publisher** **Berkeley Enterprises, Inc.** 815 Washington St. Newtonville, MA 02160 (617) 332-5453

"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.

computers and people

formerly *Computers and Automation*

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

Corrections: *Please see page 20.*

Front Cover Picture

The front cover shows an experimental "solar power tower" at Sandia National Laboratories, Albuquerque, N.M. It is called a "molten salt receiver" of energy from the sun reflected by 222 computer-controlled mirrors (heliostats). See the story on page 25.

Key

[A]	–	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.

Notice to Our *D Subscribers

The 1979-80 *Computer Directory and Buyers' Guide* is expected to be printed by mid-1981. In the meantime, the 1978-79 *Directory* may be consulted. Copies are available.

Editorial

The Number of Words to Say Something

Edmund C. Berkeley
Editor

"One of the problems which future computers will solve is the problem of reading to determine meaning and to answer questions."

2 Words

NO NUKES

- bumper sticker common on motor cars, 1981

6 Words

"God fashioned hell for the inquisitive."
- Saint Augustine, who lived 354 to 430, churchfather, bishop of Hippo

15 Words

"We would do many more things if we did not think of them as impossible."
- Francois de Malherbe, 1555 to 1628, French poet

55 Words

"I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."
- the words, when dying, of Sir Isaac Newton, who lived 1642 to 1727, English mathematician, natural philosopher, inventor of the calculus and Newtonian mechanics

90 Words

More than 200 celebrities recently signed an ad in the New York Times protesting US policy in El Salvador. The signers, many of liberal bent, included baby doctor Benjamin Spock, the writers Erica Jong, Allen Ginsberg, I.F. Stone, and Kurt Vonnegut; the television star Ed Asner; the civil rights figures Jesse Jackson and Coretta Scott King; former UN Ambassador Andrew Young; political figures such as former US Rep. Bella Abzug and Georgia State Sen. Julian Bond; and scientists such as Nobel Prize winner Dr. Linus Pauling and Harvard professor George Wald.
- entire report from the "Boston Globe", March 24, 1981

Re 500,000 Words

One of the problems which future computers will solve is the problem of reading to determine meaning and to answer questions. Right now sitting on my desk is a two-volume work entitled "Adolf Hitler", written by John Toland, 1102 pages long, published by Doubleday & Co., Garden City, N.Y., copyright 1976. The questions I want to answer by reference to this book are:

1) How many people did Hitler, as chancellor and führer of the German Reich from 1933 to 1945, kill or destroy directly or indirectly?
2) If Hitler had had nuclear weapons such as the United States or the Soviet Union each have today, would he have used them?

The book is so fascinating that every time I try to answer my two questions, I fall in -- as if I were walking on ice too thin and fall through the ice. I become distracted by the drama.

Curiously there seems to be in these 1100 pages no answer to Question 1: How many people did Hitler destroy? It astonishes me that John Toland did not think that this question was worth answering prominently.

As for Question 2: any answer has to be an induction. The information reported by Toland should be relevant. I need a computer program which can take in 500,000 words, understand them, and apply reasonable operations upon them.

Why do I want to answer these questions? Because I am terrified. The prospect is that my children, my children's children, and their descendants face a world that either quickly (by war) or slowly (through nuclear reactors, nuclear accidents, the "disposal" of radioactive waste, ...) will produce an environment that is literally cancerous for human beings. It is also figuratively cancerous for society, which will learn attitudes that tolerate and encourage megadeath, juggernauts, and genocide. □

Computer-Based Education in New Areas, and Partnership in Productivity

William C. Norris, Chairman
Control Data Corp.
8100 34th Ave., South
Minneapolis, MN 55440

"All of these enabling technologies support a major effort to better utilize the human resources in Control Data."

Based on a talk at the conference of the American Institute of Industrial Engineers, December, 1980.

The subject of this article is ANSWERS, answers to the questions and issues of:

- lagging productivity growth
- the Japanese competitive threat
- the revitalization of American industry, and so on.

These answers are not theoretical responses because I will be reviewing the activities of Control Data for improving productivity. Furthermore, almost all of these answers are activities applicable to any company.

Before describing them I should speak briefly about the declining rate of growth of national productivity. Here we see a complex and consensus-lacking situation. Experts have been unable to agree on an overriding explanation for the decline, nor have they been able to agree on the degree of impact of individual factors. However, there is a consensus that a number of causes are important: lagging innovation, lagging capital investment, the increased cost of energy, underutilized resources (both human and physical), excessive government regulation, and an unresponsive educational system.

Restoring Adequate Productivity Growth

Restoring an adequate rate of national productivity growth is an awesome challenge. Every underlying cause must be aggressively attacked both at the national level and within individual companies. While attention is being given to all causes by Control Data, most emphasis has been placed on:

- Innovation, and
- more efficient utilization of human resources.

Essentially, I will be describing a massive and creative effort to enhance human resources within Control Data.

Human resources command priority because Control Data is at the forefront of the rapid trend in the United States from an industrial society to an information society. Only some 20% of U.S. workers are now engaged in manufacturing. Therefore, attitudes and behavior are becoming increasingly important, which calls for an even greater effort in responding to personal needs and aspirations in an equitable and humanistic manner.

Innovation

A keystone in Control Data's human resources enhancement program is innovation, especially innovation to enrich the lives of individuals. Such innovations are vital, because they are enablers in the enhancement effort; said another way, they provide many of the basic tools needed to implement the program.

Computer-Based Education

The first and foremost enabler is Plato computer-based education. Control Data has been engaged in developing Plato for 18 years. The Plato System is an educational delivery system of the first rank, using many media and many structures. The system offers infinite patience and extreme personalization. It is nearly limitless in its versatility. It is also limitless in its delivery of more accessible, less costly, and uniformly high quality education and training.

The Plato System is a complete teaching system which assists and manages the learning process. The Plato System relates to the student's needs in a way not possible with books alone or in a classroom. It diagnoses student needs, it teaches, drills, tests, and grades in an individualized, self-pace, easy-to-use manner. When the student touches the screen or the keyboard, the Plato terminal responds immediately. There is a continuous interaction -- a give and take -- on a personal, one-to-one basis.

It is able to update, flashback, review, explain and animate, virtually any activity that can be simulated on the Plato terminal. It creates a learning experience difficult to achieve by any other method. Also, the system can accommodate students with varied knowledge levels, or students studying different subjects, all at the same time.

Homework

Plato is central to another enabling human technology called homework. The objective of homework is to provide training and employment alternatives to the severely-disabled homebound population. At the present time, homeworkers are engaged in programming computers, preparing data and designing educational courseware. Other types of job opportunities are being investigated.

Homework also provides training, education and communication for the disabled persons. A counselor participates in the computer network along with the other employees. It is truly a network of disabled individuals, learning different skills at different rates but sharing the learning experience.

Work-at-Home

The use of Plato to facilitate working at home is not limited to the disabled. It is also available to a growing number of able-bodied workers who save gasoline and time and lessen frustration by working at home, two, three or four days a week. This program is called Work-at-Home. It not only saves energy but enables individual productivity improvements.

Employee Skills

One most important enabler is a broad range of Plato training courses to improve employee job-related skills.

Concerned Others

Another enabler, a Plato course, is called Concerned Others. This is computer-based education and training for those who are trying to deal with alcohol and drug related problems within their families. Concerned Others recognizes the tremendous trauma that chemical dependency problems cause within a family. This program educates participants about the basic facts of alcohol or drug abuse, how to determine if there is a problem in the family, and where to get help and how. The privacy and immediate availability, along with the depth of learning that can be achieved at low cost through the use of computer-based education, are all critical in successfully dealing with chemical dependency problems.

Helping Relationship and Parenting

Two more Plato offerings are called the Helping Relationship and Parenting. The Helping Relationship course teaches communications and helping skills for special interpersonal situations. It's based on two beliefs: first, that little problems, left untended, often become bigger, more serious problems. And, second, that peer counseling can be extremely effective in helping people to face and to overcome minor problems and emotional setbacks.

Parenting, very simply, helps parents rear children. When we were young, we grew up on the myth that parenting comes naturally: now we recognize that good parenting is a learned skill. The parenting course is a skills-oriented resource for parents to deal with the uncertainty, lack of knowledge and fear often associated with their new role, especially if they grew up in a home where there was not an acceptable role model.

EAR: Employee Advisory Resource

Still another enabler is EAR, the acronym for Employee Advisory Resource. Any troubled employee or family member can call a toll free number at Control Data that establishes contact with a counselor who can help diagnose the problem and provide a solution. EAR serves the whole range of personal, family and work-related problems.

Behind that simple description lies human technology that copes with complex human issues. Most of the problems are so personal, or the opportunity for reprisal and the fear of it, so real in the employee's mind, that absolute anonymity must be maintianed initially for the employee. Only with that confidence thereby gained is there willingness to proceed with the process of seeking solutions.

It is not sufficient that the counselor receiving telephone calls is simply a well-meaning individual. The employee with a problem is often unable to articulate the causes of the problem. Each counselor is therefore trained in crisis intervention, a human technology that is especially effective in bridging the distance between the counselor and the calling individual.

The employee is helped by an EAR advocate to make contact with the appropriate community service for help or treatment if necessary. In the case of work related problems, the advocate's task is to assist both managers and the employee to seek and interpret the relevant facts until a just conclusion is reached for the employee and the company.

Staywell

A final enabling technology to be mentioned is Staywell. This program includes health assessment and health education with emphasis on any individual lifestyle changes that are needed to help employees, their spouses and their children stay well. Most of the education is delivered through our Plato computer-based education courseware. The Plato System makes it economically feasible to offer high quality training at times and places convenient to the participants.

Better Utilization of Human Resources

All of these enabling technologies support the major effort to better utilize the human resource in Control Data. We have given it the title of "Fair Exchange -- a Partnership for Excellence" -- and indeed, it is a partnership -- a shared commitment that Control Data will help each employee achieve personal goals at the same time the employee strives to help Control Data achieve corporate goals.

The premise is that we all perform best in an environment of caring, where there is a sincere effort to use available resources in an equitable, consistent and humanistic manner as among employees, company and other constituencies. For many years, Control Data has been making changes in traditional types of employee benefits and developing new ones to help achieve our goals. While there is more work ahead of us, substantial progress has been made. So much so that what we are doing is seen as a new culture building within Control Data -- a culture that is distinct from that of other organizations following more traditional practices.

Another basic premise of our commitment to excellence is that the lack of education and training, both in job skills and in understanding the adverse implications of sub-standard products, harms employees, employer, customers, and business, and society. I am sure that each of you can easily recall examples of automobile or home appliance repairs that were far from satisfactory. And if you checked into the reasons, you no doubt found that the work had been performed by someone lacking adequate training.

The same situation is found everywhere and is prevalent in any company and in my company. Substandard performance equates closely with lack of education and training. Inadequacy in skills necessary to do a good job leads to despair. Despair leads to apathy. Apathy engenders shoddy workmanship. Closing the skill gap in each company and in our country requires education and training on an unprecedented scale by industry.

In Control Data, we are gearing up to provide whatever amount it takes, possibly on average as much as a tenfold increase over the traditional level of training. The major method of delivery is Plato CBE. Such a massive offering would be neither feasible nor affordable with traditional education and training. It is a substantial part of the company's investment in the partnership for excellence.

One comment on productivity: it is difficult to measure productivity in services. Hence, as our economy shifts to service, we are less able to measure productivity changes. Also, many employees are turned off by the word because it has the connotation of just working harder or the connotation of reduction in the number of workers required, all of more benefit to the employer than the employee.

Company Contribution

What is the company investment in the partnership? Of course, there are the conventional elements such as compensation. life insurance and retirement. These are highly important but widely used and well known.

What are the company's innovative employee benefits? There are severe strains on the American work force today caused by pressures on the family, in part due to a growing segment of American society becoming increasingly mobile. Either by choice or because of frequent transfers, families are leaving behind many of their traditional support systems -- relatives, childhood friends, churches, and so on. This lack of support becomes especially crucial in times of unusual stress. Pressures that can't be shared with traditional support systems overload the family's capacity to cope. Tragic evidence emerges in the form of alcohol, drug abuse, suicide, and an unprecedented number of divorces.

Hence, for this reason and that society has become much more complex, there is an unprecedented need for a spectrum of support services for employees. In Control Data, EAR, Concerned Others, Helping Relationship and Parenting, Staywell, flexible hours, homework programs and work-at-home described earlier provide direct support. Indirect support is provided by recreational and employee gardens programs. In total, the company is striving to do what it can do and ought to do by way of support services which is part of the company's efforts to provide an environment of fair dealing.

Skills Development for Managers

Next, I will review skills development programs and start with those for managers because the single, most important means for improving company performance is better management. One primary area which managers need to influence for improved performance is human resources. Most managers are adept at getting things done. The prevailing system of management guarantees that because those managers who don't get things done don't enjoy a long tenure.

What the system doesn't assure is the most efficient process in the long term in getting things done, in part, because too much emphasis is placed on short term goals. This results in most managers being much better at controlling and directing the non-human side of the enterprise such as assets, design effort, production methods, than in managing human beings.

An adequate amount of human technology is now available on how to best respond to the wide varieties of attitudes, needs, interests, and motivations of individuals. The deficiency is simply that most managers are not using it. Considering that nearly 80% of today's work force are professionals, managers, technicians, salespersons and clerical, attitudes and behavior are crucial to performance improvement.

A second glaring weakness in managers is the inability to effectively adapt to matrix management. Shifting back and forth in being a boss in one role, participation in peer interaction in another, and being a follower in still another -- all occurring within one afternoon at work requires a lot of skills -- interpersonal as well as managerial and organizational skills.

Clearly, a vast increase in training for all levels of management is required, and it must be comprehensive, of high quality, easily accessible and affordable. Plato CBE is the only approach which can offer all these.

Skills Development for Non-Manager Personnel

For non-manager personnel, a huge increase is being made in functional training in all categories including purchasing, personnel, accounting, marketing, clerical and so on. Each employee will be reached. To accomplish this, Plato learning facilities are made available within easy walking distance. Again, as previously mentioned, this would be neither feasible nor affordable with traditional education. Not feasible because traditional types of education are not readily accessible at times convenient to the individual, not affordable because of the high cost, in part due to travel and excessive time away from the job.

Also, the mere presence of convenient accessibility to education and training provides stimulation. People get worn out doing the same tasks day after day. Therefore, frequent and brief periods of training will provide stimulation in addition to the improvement of skills.

Inflation Fighting

The last innovative employee benefit that I will mention is "Inflation Fighting." This is a wide spectrum of company activities to help employees better cope with the devastating impact of persistent inflation by making better use of their incomes.

Employee surveys rank taxes as the number one problem, followed by costs of transportation, food, housing, health care and education. In response, we're providing the following assistance to our employees:

- Extensive Plato training courses in such subjects as creating a tax-oriented budget, money management, proper use of credit, investment and insurance planning and comparison shopping.
- Free home energy audits
- Car pooling, busing
- Staywell (previously mentioned)
- Information on obtaining educational loans for family members
- Gardens
- Volume discounts in food purchasing

There are others, besides. The major thrust is to equitably apply the existing resources of a large company to help employees help themselves.

Arbitration

We have been working on arbitration for quite some time. We are very close to implementing a program that will guarantee our employees full arbitration before a panel of other employees -- in any and all disputes within the company. We believe this program will introduce the greatest sense of justice, and we hope our employees have come to expect that of us. Furthermore, we believe that substantial savings will be realized due to fewer lawsuits and an improved company position when lawsuits are filed.

Security

The second program under our development is concerned with maintaining employment. Job security is uppermost in all employees' minds, especially these days in the wake of extensive plant closings by corporate giants in the steel and automobile industries. The traditional scenario for adjusting to a severe turndown in a large company is for the division managers to proceed on their own in an effort to maintain budgeted profits. That often means reducing inventories, laying off employees, and closing selected plants if necessary.

This is no longer a responsible, equitable or acceptable procedure in our society. Therefore, every company should establish a policy on the maintenance of employment. A maintenance of employment policy must take into account such issues as:

- Extent and length of time employment levels should be maintained beyond those required for maximum efficiency.

- Closing selected plants or spreading the work to share adversity.

- Amount of severance pay to those laid off.

- Extent of retraining and supplemental unemployment assistance.

- Long term effort to create sources of new jobs.

In considering these and other issues, I am not suggesting an unlimited or unilateral commitment to Control Data. I'm calling for a cooperative approach involving Control Data, the government and communities. The approach is too complex to describe in detail in this article, but I would like to outline the essence of the approach. It is based on the values of a job to the federal government, the community and the company. These values differ. Surprisingly, they have never been established, perhaps because of the complexities involved; but they can be arrived at accurately enough for all practical purposes. For example, studies made by Control Data and an independent consulting company show that on average the value of a job to the federal government is approximately $30,000 a year because of reduction in government payments and the economic gains caused by higher levels of employment. In addition to that figure, the investment required to create a job must also be considered. Of course, the investment varies depending upon the industry and the nature of the job, but the data is generally available.

Use of Job Values

The essence of a cooperative approach to maintaining employment based on job value can be explained. Federal and state tax credits would be allowed to a company commensurate with the investment required to create jobs in any given plant and the number of years the jobs would exist. Tax credits would then be accumulated in a reserve to be used when the time arrives to replace some or all of the jobs; the fund could be used to create new jobs or to retrain employees for existing jobs. Another source of funds would be provided by the community in which the plant is located in a reserve built from local taxes commensurate with the value of the same jobs to the community.

Small business would be the source of most of the new jobs needed by displaced workers. Therefore, the community would also establish the necessary organizations required for a cooperative effort to foster the startup and profitable growth of small businesses on a continuing basis.

Obviously, changes in the tax laws will be required to create the necessary incentives and reserves to implement the system I'm describing. Legislation should also be enacted which requires a social impact analysis for any contemplated plant closing or major employment cutback. The format would be similar to Control Data's premerger analysis. It would include a financial statement for the local community which clearly sets forth the operating profit and loss, and balance sheet for the plant. In the case of a plant closing, the statement would help the community understand the legitimate business reasons for the action and would also enable the community to consider alternatives, including keeping the plant in operation.

We are actively pursuing the concept of maintaining employment with government leaders at all levels. Control Data is moving ahead with implementation to the fullest extent possible. For example, facilities are being established in or near each Control Data plant to help foster the startup and growth of small business. Discussions are also underway with leaders in several communities regarding the actions that they need to take in consonance with Control Data.

Finally, the program that I have outlined is fair. Why? Because it is a dedicated, innovative and cooperative effort to deal with maintaining employment.

Employee's Contribution

Having reviewed Control Data's investment in the partnership, let us look at the employee side of the partnership equation. Foremost, of course, is the employee commitment to performance improvement through enhancement of job skills by acquiring necessary education and training. Also important is training in human relations and awareness of the implications of performance to the individual employee, the company, community and country. Unfortunately, most individuals do not fully grasp the grave consequences of substandard achievements. This can be taught, however, through the use of case studies illustrating the adverse effects of remissions in performance for every type of job. In other words, each employee studies cases involving his or her own position.

Every employee is expected to devote at least a specified minimum amount of time to education and training to acquire needed jobs skills. Degree of participation and level of achievement in training is a major criteria in determining increases in pay. Every person knows the gaps to be bridged to improve his or her own performance. Therefore, employees are expected to take the initiative to identify education and training in addition to that recommended by the company which may be most useful.

Commitment to Performance Improvement

In addition to acquiring needed education and training, each employee is expected to participate to the fullest practicable extent in performance improvement activities such as involvement teams. Involvement teams are small groups of people voluntarily meeting regularly to identify and analyze causes of problems, recommend their solutions to management and, where possible, implement the solutions themselves. This method of operation is similar to the one developed in Japan. Wide usage of the involvement team is being made in Control Data not only in manufacturing, but there are a growing number of professional and clerical teams.

Commitment to Long Term Employment

Another aim is a long-term employment commitment to the company. In other words, we want and expect each employee to stay with us, and we make sure that each employee knows that. Yet, it is not the intent to categorically equate the interests of an individual against those of a large company. When a mismatch of interest occurs in spite of best efforts, then an employee decision to resign is a positive event with the door left open to rejoin the company. In fact, the company will provide reasonable assistance, if needed, in making a change. One example is where an employee wishes to start a small company. Control Data will provide consulting assistance including help in developing a business plan. As an aside, I should mention that this policy has been highly rewarding in a number of respects. Some of our most valued employees are those who once left the company and returned. With respect to starting small businesses, there are an average of about 15 employees per month seeking assistance. Only about 1 or 2 actually do it, the others deciding it's not for me, thus resolving a nagging uncertainty about leaving to start one's own business.

One more point needs mentioning on the employee side before moving on to another aspect of performance improvement. This is to emphasize that there is no inference in anything said thus far that Control Data employees are reluctant to participate. Quite the contrary, surveys show that our employees assess themselves as being less productive than they are capable of being or want to be. They identify some of the reasons and the actions they see that would be helpful in improving their performance. The degree of motivation to improve performance isn't quantifiable, but it is present.

A recent conference board survey confirms that eighty percent of the workers, in the 5,000 households contacted, expressed satisfaction with their jobs and indicated dedication to their jobs.

Motivation

At this point, I should emphasize that the major source of motivation in the approach I am talking about is to be derived from the satisfaction of having the required skills and in doing a good job, whatever that job is. Required skills, of course, are provided by the necessary education and training.

Further, that good performance is primarily rewarded through merit pay increases and promotions -- all in a caring environment. Hence, the company is helping each employee to have a rewarding life that is matched by a conscientious employee response.

(please turn to page 24)

Natural Human Languages Automatically Translated by Computer: the SYSTRAN II System

David Burden
Senior Vice President
World Translation Co. of Canada, Ltd.
220 Laurier Ave. West, Suite 740
Ottawa, Ontario, Canada K1P 5Z9

"The Apollo-Soyuz joint Russian and American space mission in 1975 provided the required impetus (and funds) to develop the logic of the analysis of English."

The use of computers for the translation of natural human languages has long been considered a possibility. Despite early enthusiasm, effective computer translation has taken far longer to develop than originally expected.

Computer Assisted Translation Now Works ...

At least one such system does now exist, and is used by some of the world's largest organizations. The technology, however, is still in the initial stages and much remains to be done. But the first commercial users, the first few years of operational use and the first tens of millions of words processed have shown that computer-assisted translation works, and have served to clearly define the work that remains to be done.

The system described here, SYSTRAN II, is primarily used for the translation of large-volume technical text, usually documentation for equipment being exported to non-English-speaking countries. Among the major users are Xerox Corporation, the United States Air Force, General Motors Canada, and the Commission of the European Communities.

... But It Is Not Yet Perfect

It should be stated immediately that SYSTRAN II does not produce a perfect translation; in fact, it is unlikely that "perfect" machine translation is possible -- at least in the immediate future. The system does, however, produce a text which can be rapidly revised to a final form. This revision of the text at many times the speed of a human translator, combined with qualitative advantages such as consistency of terminology and accuracy of technical data, establish the basic economic advantages of using SYSTRAN II.

The Complexity of "Understanding"

The fundamental difficulty of Computer Translation is related to the extreme complexity of the translation function. The performance of any translating mechanism is directly related to the degree to which the source text is "understood" by the mechanism. While highly technical text often creates difficulties of this kind for the non-specialist translator, computer translation systems have frequently been blocked by an inadequate "understanding" of any kind of text. This is due to the sheer variety of natural languages and the large amount of information required to successfully "understand" them.

The solution adopted in SYSTRAN II is that of large dictionaries and extremely large and complex software programs to analyse grammatical structures. The dictionaries must be large in order to carry sufficient numbers of words and expressions and also to store enough information about each particular word and expression. Unfortunately, until approximately 1970, computer systems capable of storing the necessary information and of carrying out the necessary logic were not widely available. This constraint has now been effectively removed and it seems certain that within the next three years, SYSTRAN II will be implemented on small office-environment units and perhaps even on portable hardware.

The Need for Other Technologies Now Available

The second problem was that of the surrounding technology. As long as technical writing and publishing was essentially a manual process, and the electric typewriter was the prime tool, the possibilities for computer translation were extremely limited. The jet engine is essential to modern air transportation; however, without parallel development in air-frame design, metallurgy, communications, navigation techniques, etc., its applications would be extremely limited. As long as text had to be retyped on a data entry system, just for machine translation, and as long as the printed output from the computer had to be retyped for editing, the economics of Machine Translation did not make sense. The wide-spread use of word processing systems and computer type-setting and photocomposition have eliminated these difficulties and have in fact, generated additional economic advantages.

As is frequently the case, the basic technology (computational linguistics) developed independently and in parallel with the technology required to make it work (word-processing and computerized publications).

The History of SYSTRAN II

SYSTRAN is the brainchild and lifework of Dr. Peter Toma. Dr. Toma, who himself speaks a dozen languages, became interested in computational linguistics in the 1950's and was instrumental in the development of the SERNA system at Georgetown University. This system was demonstrated at the Pentagon on June 6, 1959, when it was applied to the translation into English of more than 100,000 words of previously unseen Russian text.

The SERNA system demonstrated the need for much more detailed and sophisticated linguistic analysis and it is still true that the SYSTRAN II system is itself the essential tool involved in improving its own performance. It is only with large dictionaries, sophisticated linguistic analysis programs and large volumes of text that the computational linguist can make significant progress.

The report in 1965 of the Automatic Language Processing Advisory Committee headed by Dr. J. R. Pierce substantially reduced machine translation research in the United States. But Dr. Toma continued his work in West Germany. The need for Computer Translation was growing however; and in 1969, the first version of the SYSTRAN system was installed for the United States Air Force. In 1979, this installation, at the Wright Patterson Air Force Base, processed more than 25 million words of Russian to English translation in a single year.

The Complexity of English

Translation from Russian to English does not of course have widespread commercial potential; at the same time, the analysis of English, the essential component of translation from English to other languages, is extremely difficult. The lack of precise structure and particularly the absence of inflexions (word-endings and agreement) make English by far the most difficult of the source language systems developed for SYSTRAN (Russian, English, French, German, and Japanese).

The Apollo-Soyuz joint Russian and American space mission in 1975 provided the required impetus (and funds) to develop the English Analysis logic. After the successful use of the resulting English to Russian system for this project, other SYSTRAN target language systems were quickly developed. Subsequently, with expansion into Canada, Europe and Japan, new source language systems were built.

SYSTRAN II: Present Status

We express the degree of development of SYSTRAN II in terms "operational" and "developed" language pairs. An operational language-pair is one that has been installed and in use by a customer organization for at least six months. A developed language-pair is one for which linguistic analysis systems have been developed, together with basic dictionaries.

Implementation

The SYSTRAN II system is implemented on IBM 360/370 compatible computer systems operating under MVT or MVS. Recent developments permit portability across operating systems and to hardware which is not IBM plug-compatible. The SYSTRAN system is, for example, running on a small Siemens computer in Munich.

While the programs are extremely large and complex (approaching 500,000 machine instructions) the computer resources required are relatively limited. One CPU hour (IBM 370/168) is sufficient for one million words of translation processing, and the entire system (load libraries, dictionaries, text files) fits comfortably on a single 3330 drive (100 million characters).

Table 1
Development of SYSTRAN II

A. Operational Language Pairs

RUSSIAN TO ENGLISH	ENGLISH TO RUSSIAN
ENGLISH TO FRENCH	ENGLISH TO SPANISH
ENGLISH TO PORTUGUESE	ENGLISH TO ITALIAN
FRENCH TO ENGLISH	GERMAN TO ENGLISH

B. Developed Language Pairs

ENGLISH TO GERMAN	GERMAN TO FRENCH
GERMAN TO SPANISH	ENGLISH TO ARABIC

C. Language Pairs Under Development

JAPANESE TO ENGLISH	ENGLISH TO JAPANESE

SYSTRAN Components

The basic linguistic processing, the translation from Source Language to Target Language, is carried out by a sub-system with three major components:

- A dictionary which contains the source language and target language terms, together with grammatical and semantic information. The dictionary contains both individual words and multi-word expressions;
- A system which 'analyses' the source language text and creates a mathematical representation of the source language sentence structure;
- A system which "synthesized" the target language text, using the mathematical representation created by the Analysis, together with information from the dictionary.

The Dictionary

The dictionary is being continually expanded, and this is mostly done by the SYSTRAN II users themselves. In designing a computer translation system, one must take into account the trade off between information and cost. Ideally, one would like the dictionary to be easy to update. However, the process of 'understanding' (that is, successfully analyzing) the source language depends on having a great deal of structured information about each word in the language. Not only must elementary facts such as the part of speech (noun, verb, adjective, etc.) be specified but also syntactic and semantic information such as animate /inanimate, preposition government, countable/uncountable, etc.. As yet one cannot store as much information on each word as the human brain has, and uses, when understanding speech. The extent of the information in the dictionary sets limits to the linguistic analysis and synthesis.

The dictionary contains stem words, idioms, and several kinds of multiword expressions.

On average, the SYSTRAN dictionaries contain 150 bytes for each word; in some cases, for complex words with many different uses and meanings, more than 1,000 bytes are stored.

A complete set of maintenance and access programs has been developed to support the dictionary-building process. The English-French dictionary now has more than 120,000 entries, while the Russian to English has more than 500,000.

The Analysis

The Source Language Analysis programs are by far the most difficult and complex part of the system, particularly for the English language. These programs are heuristic and reflect the sheer complexity and variety of a natural language.

The Analysis programs build a representation of the sentence structure in the form of a directed graph (implemented in the computer as a matrix, known as the Analysis Area). Homographs are resolved and the relationships defining the sentence's meaning are established. Clause structure, subjects and predicates, adjectival and adverbial qualifiers, verb tense, verb mood, and the other key elements are defined and stored in the Analysis Area.

The Synthesis

Once the Analysis Area has been completed, the process of translation (synthesis of the target language) can begin. Correct meanings are selected, words are placed in the correct order and word-endings are chosen to reflect appropriate agreement between verbs and subjects, between nouns and adjectives, etc.

In some cases, the system will carry out sophisticated transformations, such as passive to reflexive:

For example:	This word is translated differently
becomes	Ce mot se traduit autrement

The Linguistic Programming Language

A significant early development in SYSTRAN was the definition of a specialized language for linguistic programming known as the Linguistic Programming Language; this allowed computational linguists with little programming experience to contribute to the development of the system without intermediate programmers.

Another significant development was the realization that linguistic rules can be divided into two general groups:

- -Basic grammatical rules which are general in application for a specific language; these are built into the Linguistic Programs.
- -Specific rules applying to the usage of specific words and phrases.

The Usage of Specific Words

This second category is extremely numerous and would be prohibitively expensive to implement in the linguistic programs themselves. Accordingly, a mechanism was created to allow this kind of rule to be implemented in the dictionary -- in the form of an "interpreted" logic language. A good example of this kind of rule is the treatment of the verb "to go out".

English	*French*
-the man goes out	(sortir)
-the light goes out	(s'éteindre)
-the brake system goes out	(tomber en panne)

We can see that the distinction here lies in the source language different uses of the verb. A rule was placed in the dictionary to select the correct meaning according to the semantic category of the subject of the verb.

Knowledge of the Real World

It should be noted that this kind of rule depends on the linguistic analysis of the source language. Unless the system can correctly identify the subject of the verb (which need not be the noun phrase immediately preceding it), the rule cannot work.

The linguistic processing system allows analysis of most grammatical structures and the resolution of most ambiguities and questions of usage. The limits of SYSTRAN II occur where extensive structural knowledge of the real world is necessary to 'analyze' a sentence.

For example, the sentences:

The man paddles down the river in the canoe.
The man paddles down the river in the West of Canada.

can only be successfully analyzed with some notion of the relative sizes of rivers, canoes and countries.

SYSTRAN II thus, does not attempt to perform a perfect translation, either in terms of a perfect analysis of the source language or in terms of a perfect stylistic usage of the target language. It does however produce correct, well-formed sentences in the majority of cases and a text which can be revised at a speed between three and six times faster than the speed of a human translator working alone on the same original text.

Examples of Behavior of SYSTRAN II

An example of SYSTRAN II output, unrevised, is shown in Tables 2 and 3.

Table 2

SYSTRAN – Sample Translations

14 English Statements

The cat sits on the mat.
The black cat sat on the green mat.
The engine sits on the mounting brackets.
This will make a delay necessary.
Ship sinks today.
This makes many changes necessary.
The lamp goes out.
The lamp will go out.
The lamp went out.
The mechanic goes out.
The brake system goes out.
The brake system should go out.
The sound was heard immediately.
The word is translated differently.

14 Corresponding French Statements

Le chat s'assied sur le tapis.
Le chat noir s'est assis sur le tapis vert.
Le moteur repose sur les supports de montage.
Ceci imposera un retard.
Le vaisseau coule aujourd'hui.
Ceci impose plusieurs changements.
La lampe s'éteint.
La lampe s'éteindra.
La lampe s'est éteinte.
Le mécanicien sort.
Le système de freins tombe en panne.
Le système de freins devrait tomber en panne.
On a entendu immédiatement le bruit.
Le mot se traduit autrement.

Table 3

SYSTRAN – English Passage

Steering

The machine is articulated and steering is accomplished by hydraulic power which pivots the main frames at the center hinge. Turn the steering wheel until reaching the desired angle of turn. Hydraulic power holds the angle of turn until the steering wheel is turned again.

Ground Driven Steering (If Supported)

If there is a drop in hydraulic pressure, the ground driven steering warning light on the instrument panel will flash on and off. While the light is flashing the ground driven pumps are supplying the steering hydraulic pressure.

Corresponding French Passage

Direction

La machine est articulée et la direction est accomplie par la puissance hydraulique qui pivote les unités centrales à la charnière centrale. Tourner le volant jusqu'à atteindre l'angle désiré du tour. La puissance hydraulique immobilise l'angle du tour jusqu'à ce que le volant soit tourné de nouveau.

Servo-direction actionnée par la motion du véhicule (si supporté)

S'il y a une baisse dans la pression hydraulique, la lampe-témoin de servo-direction actionnée par la motion du véhicule sur le tableau de bord clignotera de façon intermittente. Pendant que le témoin clignote, les pompes actionnées par la motion du véhicule fournissent la pression hydraulique de direction.

Computer Translation Systems Other than SYSTRAN II

This article is not intended to be a comprehensive report on the state of the art in computational linguistics. One can, however, draw the reader's attention to the excellent theoretical work being carried out at l'Université de Montréal, Brigham Young University and l'Université de Grenoble. In the commercial field one should note the successful fusion of word processing techniques, mini-computer technology and computational linguistics by Weidner Communications Inc., and the LOGOS system developed originally for English to Vietnamese.

One unfortunate concept introduced into the field of machine translation is that of "Generations". This term has been borrowed by some writers from the computer hardware industry. It attempts to classify the various systems according to the approach used. It ignores the essential flexibility of software and the basic fact that a system is improved only from practical experience, the elimination of problems, and the search for new solutions. The so-called "first generation systems", many of which have been redesigned and rewritten several times have, from sheer experience, become sophisticated and very complex, frequently incorporating new linguistic advances with each release.

There does not appear to be a "magic solution" to the problem of computer translation -- no new theory or algorithm which will resolve the problem at a stroke. The answer is hard, painstaking work; gradually building up systems which take into account the flexibility, the variety and the illogic of natural human languages.

Future Developments

The variety of existing language pairs makes it likely that the SYSTRAN II design will be effective for most languages. New target languages will be added relatively quickly, with new source languages being developed when major funding is available. Dictionaries for operating language pairs will grow and become progressively more comprehensive.

An average of 3000 machine instructions are executed for each word translated -- real-time machine translation is thus clearly feasible on small hardware, and, perhaps more significantly, SYSTRAN II could be implemented on a small office system incorporating word-processing, optical character scanning and high quality printing.

While it is difficult to see immediate commercial value, SYSTRAN II output can be fed into available voice synthesis equipment, thus producing an automatic, spoken translation of the printed input text.

(please turn to page 24)

Year One of the Future Bell Telephone System: 1980

C. L. Brown
Chairman of the Board
American Telephone and Telegraph Co.
195 Broadway
New York, NY 10007

"We shall be changing our business on a scale unmatched in any business I know of."

Based on the annual report to the stockholders of AT&T.

The Shape of the Future

What was it that made 1980 unique? In the course of 1980 we crossed the threshold of a new era in Bell System history. It is an era that gives us challenges -- opportunities. I believe that 1980 was in a number of significant ways Year One of the Bell System's future. In 1980 the shape of that future in broad outline became clear.

We started the first steps toward a restructuring of the Bell System. Once that has been accomplished it will make our organization vastly different from the one we know today.

We redefined the scope of our business and raised our marketing horizons. Our business no longer will be limited to telephony or, for that matter, telecommunications. Ours is the business of information handling, the knowledge business. And the market we seek to serve is global.

A Gathering Consensus on National Policy in Telecommunications

What spurred these developments was a gathering consensus on national telecommunications policy. Regrettably, legislation that would remove many of the remaining uncertainties fell short of enactment. Nonetheless, from the bills Congress considered and from the Federal Communications Commission's landmark decision in its Computer Inquiry II, it is possible to see the main outline of emerging public policy.

First of all, it now seems clear that public policy will look to the marketplace as the most efficient regulator of telecommunications services, to regulation only to the extent that it is necessary to assure the continued universal availability of affordable service and the manageability of the nationwide telecommunications network.

Second, it appears to be widely if not universally agreed that -- in an era of intensifying competition -- it no longer makes sense to deny the Bell System the opportunity to compete in unregulated markets.

Separation between Regulated and Unregulated Markets

And third, it appears to be agreed as well that -- because if its size, because of its presumed market power -- there should be a separation between the Bell System's regulated operations and those that serve deregulated markets.

In 1980, then, it became apparent that in the future we shall be operating in two modes. Basic local and long distance service we shall continue to provide under regulation. At the same time, we will be allowed expanding opportunities to compete in unregulated markets. Our aim is to combine the service ethic that inspired the accomplishments of the Bell System's first century with the spirit of venturesomeness which is the key to success in its second. In 1980 we took the first steps toward a restructuring to accomplish this aim.

Setting the Stage for Restructuring

On August 20, the Board of Directors approved a realignment of AT&T's General Departments that separates those departments whose responsibilities relate mainly to regulated activities from those dealing with prospectively deregulated markets. At the same time, we moved toward establishment of a relatively small corporate staff to provide overall strategic and financial direction to the enterprise as a whole.

What needs to be understood about this realignment is that it does not in itself represent the radical restructuring that is in prospect for our business. Rather does it set the stage for that restructuring. Its aim is to assure two things: first, that we think our way into the future carefully, systematically, comprehensively; and second, that as we do so, we mind our current business well.

In short, we are approaching this undertaking with care and deliberation. At the same time, we intend to see that our service and earnings performance is in no way compromised along the way.

We shall be changing our business on a scale unmatched in any industry I know of. Work relationships, proven over generations and by now virtually instinctive, are going to be disrupted and new patterns established. Highly integrated operations systems are going to have to be disaggregated and redesigned to fit the dual mode in which the future requires that we operate.

We shall be transforming a business that for more than 60 years has been structured to meet the requirements of a highly regulated environment. We move to a business that matches a day and age that looks mainly to the marketplace to decide which products and services the public will be supplied, who will supply them and at what price. That means that not only must we change our business' structure; we must change many cherished policies and practices -- ways of doing business -- that, while proven over generations of Bell System management, no longer fit today's circumstances.

Innovation at Competitive Pressure Points

Traditionally the Bell System has directed its research and development activities to system optimization, the balanced improvement of our service capabilities for the entire public we serve. Competition by contrast spurs innovation at competitive pressure points. One is strategic, the other tactical. Our aim is to combine the best of both.

Traditionally we have depreciated our plant over decades to minimize the cost burden on the general public. Competition and the faster product obsolescence it brings with it will force us to faster depreciation and thus -- for a time -- higher prices.

Local Service Costing More; Long Distance Costing Less

Traditionally we have priced our services to support the goal of universal service. No longer is this policy tenable. More and more, we must relate rates to costs -- service by service, even customer by customer. That means, among other things, that as they are relieved of the burden of contributing to the support of local service, long distance rates will come down. Deprived of that contribution, local rates will go up. No aspect of the transition we face is more crucial than sound management of this basic change.

Varying Degrees of Risk

But what will most distinguish the management of the future from that of the past is the varying degrees of risk we will confront. Consequently, one of our first priorities as we go about reshaping our business is the development of criteria to help guide resource allocation between and within its principal sectors. Certainly as we are permitted to venture in unregulated markets, it will be our aim to seek returns to investors commensurate with the risks involved. In this connection, it appears to be widely recognized that it would not be fair to investors to permit regulators to use profits earned in unregulated markets as an offset to revenue requirements in regulated markets.

Anticipated Change is Opportunity

Why -- in view of the complexities it confronts -- has the Bell System chosen to anticipate change rather than await it?

The answer in one word is opportunity.

What creates that opportunity is the scope of the market and the unique resources and skills the Bell System can bring to bear on meeting its needs.

Bell Laboratories

The technology of the Information Age is ours. Indeed it was Bell System technology that largely brought it into being. And it is Bell System technology that positions us to fulfill its opportunities.

The transistor, invented in Bell Laboratories more than 30 years ago opened the way to the convergence of communications technology and computer technology. The transistor still promises a dramatic increase in the productivity of our economy and in man's ability to manage complex undertakings on a global scale.

Ours, too, is a facility which is unmatched in the world. It is at the core of this country's ability to move information. It is the nationwide switched network.

Endowing the Network with Intelligence

With each passing year we are transforming that network, endowing it with "intelligence". Not so long ago it provided a more or less uniform service to all its customers. Before long it will serve no two of them alike.

The People of the Bell System

But we have even greater strength than our technology: Bell System people. It is not only their skills but their spirit that makes our business great -- and will keep it great.

As our business changes, so too does the nature of our share owner's investment. Understandably, along with more opportunity, we confront more risk. However, I hope that in some measure share owners might feel my sense of anticipation of the prospect ahead. Simply put, new markets mean new opportunities to improve earnings -- opportunities we do not intend to neglect.

As this is written, discussions are continuing with the Justice Department looking toward a settlement of the antitrust suit that it brought against AT&T in 1974. What the outcome of these discussions will be I can't predict. Clearly, we are hopeful of reaching a sensible conclusion to a proceeding that, so long as it remains pending, casts a cloud of uncertainty over our business. Its removal would be another element contributing to the sense of a new beginning.

Adhering to the Standard of Excellence

What further changes the future will bring is beyond knowing. Indeed, how the Bell System will be configured ten years from now I can't predict. But the standard we mean to apply to the new decisions we'll be called upon to make is the standard of excellence. Our purpose is to seek -- at every point of decision -- the highest and best use of the organizations and resources we call the Bell System. The highest and best. With that as our standard, I have not the least doubt that, unknowable as the future is, it will be a great future.

Some Financial Notes

Operating revenues in 1980 -- $50.8 billion -- improved 11.9 per cent and net income -- $6.1 billion -- 7.1 per cent. Earnings per share were $8.19 compared to $8.04 in 1979.

The Bell System continued to invest significant amounts of capital in order to improve, expand and sustain service. Construction expenditures rose $1.5 billion, from $15.8 billion in 1979 to $17.3 billion in 1980. In constant dollars, however, construction expenditures remained at about the same level as the previous year.

To help finance its construction program the Bell System had to raise some $7 billion in 1980 -- the highest new money requirement in its history. The cost of new Bell System debt in 1980 averaged 12.5 per cent, bringing the System's embedded cost of long and intermediate term debt to 8.0 per cent.

We intensified our efforts during the year to employ our resources as productively as possible. These efforts are being enhanced by new technology, in both long distance and local transmission systems, that dramatically increases the capacity of existing facilities with minimum additional investment. As a result of new technoloy and better operating methods, Bell System total factor productivity -- which has grown at a rate four times that of the economy as a whole over the past five years -- continued to grow rapidly.

Highlights	1980	1979
Earnings per share	$ 8.19	$ 8.04
Dividends declared per common share	$ 5.00	$ 5.00
Revenues including other income (millions)	$51,680	$46,183
Expenses including taxes and interest (millions)	$45,600	$40,509
Net income (millions)	$ 6,080	$ 5,674
Rate of return on average total capital	9.9%	9.8%

Overall, service quality remained high in 1980. That we were able to sustain high levels of service and improve earnings -- despite a sluggish economy and still rampant inflation -- is testimony to the rigorous management by the Bell companies.

The Information Age

The Information Age is here. It is an age in which new capabilities offered by data processing and communications technology are profoundly altering the way individuals and institutions -- government, business, education -- conduct their affairs. These two powerful technologies mated, and in many cases indistinguishable, are vastly expanding man's capacity to manage complex undertakings on a continental -- indeed a global -- scale.

The synergistic combination of computers and communications offers the prospect of resumed productivity improvement for an economy whose operations more and more depend on the generation and distribution of information.

At the same time, the Information Age offers a large and growing market for suppliers of information and communications services. Today, just the business sector of the information market -- business telecommunications, data processing, business travel, word processing and handling of mail -- stands at $200 billion and is expected to triple by the end of the decade.

The Bell System is strategically positioned to meet the needs of that market by virtue of its leadership in the technology of telecommunications. But we are not alone. Regulatory policies of the past decade have opened virtually every sector of telecommunications to competition. Today not only telephone companies but also a wide variety of vendors are offering telecommunications products and services -- telephones, office communications systems and long distance services.

Room for Many Suppliers

The fact of competition -- and the prospect of more -- by no means signals diminished opportunity. The dimensions of the market are so vast -- and its expected growth so rapid -- that there certainly will be room for many. More than that, we are confident we have the technical resources to meet the growing demands for new and sophisticated services. We have the marketing skills to match our technology to customers' needs. And we look forward to the opportunity to apply these skills in "detariffed" markets in line with the Federal Communications Commission's Computer Inquiry II decision.

The Network Becoming "Intelligent"

The nationwide telecommunications network enables customers anywhere, at any time, to communicate with each other and, in addition, provides connection with telephone systems around the world. This network can handle swiftly and accurately communication in any form -- voice, data, video, graphics.

Today the network is fast becoming an "intelligent" network with a degree of versatility -- adaptability to the unique needs of customers -- that was virtually inconceivable just a few years ago.

The network's intelligence stems, in large measure, from the electronic switching systems that we are installing -- computerized switching systems that can be programmed to provide specialized services in addition to completing routine telephone calls swiftly and economically. In 1980, we installed more than 300 local and 18 long distance electronic switching centers.

(to be continued in next issue)

The Japanese Economic Challenge: Understanding It and Meeting It — Part 2

William S. Anderson
Chairman
NCR Corporation
Dayton, OH 45479

"The productivity problem in the United States can be attributed to structural deficiencies in our economic system rather than to any pronounced change in the traditional American work ethic."

This article is continued from the March-April, 1981 issue, page 29. It is the second part of the text of an address given at the University of Notre Dame on September 25, 1980, as one of the ITT Key Issues Lecture Series.

Third, current tax laws should be amended so as to stimulate personal savings instead of personal consumption. The United States stands unique among industrial nations in penalizing the thrifty and rewarding those who live beyond their means. With an inflation rate twice that of the allowable interest on savings accounts, and with dividends and most other investments subject to double taxation, it is remarkable that Americans save anything at all. The effect of this is further dilution of the capital available for economic growth.

In correcting these glaring deficiencies in the current tax structure, we need only to look to our international competitors for guidance. Japan, for example, offers special depreciation allowances for new technology investments. Canada provides a 10 percent investment tax credit for all research and development expenditures. Germany, France, and the United Kingdom permit accelerated depreciation for both plant and equipment used in scientific and technical research. Comparable incentives are offered by those countries to encourage plant modernization and the growth of personal savings.

Just as we need to generate more capital for investment, so we need to reduce the flow of capital into non-productive areas. Few would quarrel with the good intentions of most of the regulatory legislation of recent years. Protecting the environment, eliminating on-the-job health and safety hazards, and ensuring equal opportunity employment are as justifiable from a business viewpoint as they are from a social or humanitarian viewpoint.

Waste, Inefficiency, and Inconsistency of Government Regulations

What cannot be justified — or tolerated if the United States is to remain a strong international competitor — is the tragic waste, inefficiency, and inconsistency which characterize so many government regulations today.

It is indeed an Alice-In-Wonderland world when one arm of government is constantly pushing for greater use of pesticides at the same time another agency is restricting their use; or when one branch of the federal bureaucracy is demanding weight-adding safety features for automobiles even as another agency is promoting lighter-weight cars to reduce gasoline consumption. A visitor from another planet might well conclude that we have all gone mad.

Not long ago the Business Roundtable sponsored a study of costs incurred by 48 companies in complying with the regulations of only six federal agencies. Those costs amounted to 16 percent of the companies' net income and 43 percent of their expenditures for research and development.

Clearly, it is time for government to begin weighing the merits of many existing regulations and all proposed new regulations against the drain they cause on the capital needed to rejuvenate the national economy.

Impatience for Quick Returns

Rebuilding America's economy will also test the ability of business managers to develop better policies and practices than those that were followed in the 1970s. In the 1980s we need to raise our sights beyond this month's sales report and this year's financial performance. We need to be more interested in where our companies will be five years from now than where they are today. And we must begin measuring our own performances as business managers, and the performances of our subordinates, in terms of contributions to long-term growth and increased market penetration as well as short-term profits.

And that will be difficult. To quote philosopher Paul Valery, "The trouble with our times is that the future is not what it used to be."

I, for one, hope that the future truly will not be what it used to be, insofar as the traditional adversary relationship of business and labor is concerned. If American products are to regain the preeminence they once enjoyed in the international marketplace, we shall have to develop new approaches to that relationship — approaches that will help refurbish this country's reputation for technologically-advanced, high-quality products manufactured with pride and efficiency.

Warning from Japanese Auto Manufacturer to American Parts Suppliers: Improve Quality or No More Orders

Earlier this month a Japanese trade delegation flew to Detroit, ostensibly to buy auto parts from U.S. manufacturers, but also to pour oil on the troubled waters caused by record exports of Japanese-made cars to this country. The delegation brought along a statement from the managing director of Japan's largest auto manufacturer. It warned the American parts suppliers that they had better improve the quality of their products or face the loss of any future business from Japan.

The fact that this could, and did happen — in what Americans have always regarded as the auto capital of the world — points up the magnitude of the task confronting American management and labor in the 1980s. It was a classic case of role reversal, with the once-vaunted U.S. auto industry and its suppliers reduced to the status one might give a fledgling industry in some remote banana republic.

I find it difficult to believe that either American management or American labor will be willing to accept that kind of secondary economic role in the world economy of the 1980s. I don't think anyone in government wants it either. Yet there is a clear and present danger that this could happen in many other industries as well. It seems to me that is the real essence of the economic challenge that faces this country.

Can the trend be reversed? In my judgment it can be.

Can the Trend Be Reversed? Does Japan Have No More Problems?

It is true that Japan, to use today's vernacular, seemingly "has it made." But is the Japanese position in tomorrow's economic world really that secure?

- More than any other industrial country, Japan is highly vulnerable to future disruptions in the supply of oil and other basic resources, as global political tensions continue to mount.

- Japan today is also a high-labor-cost country. It, too, must convert its present industrial base into one that is more heavily weighted toward higher-technology, higher-valued-added products. As the Ministry of International Trade and Industry recently noted, "The period when Japan made progress by applying and improving existing ideas has already come to an end, and a period of creativity and initiative is beginning."

- Also, increasing trade friction has raised the spectre of anti-Japanese protectionism in both the United States and Europe, which are Japan's principal markets. And even if international trade remains relatively free, Japan will have to vastly increase its direct investment abroad to remain competitive in many markets. Doing so will require huge amounts of capital. Also, it raises the question of how transplantable the Japanese success formula will be in other countries.

- In addition, Japan's own internal house is not in the best of order. Rising inflation, substandard housing, growing consumerism, and the need to streamline an unwieldy state bureaucracy are problems which the Japanese have not yet solved.

- Finally, there are signs that the Japanese people themselves, having achieved a level of affluence that once was only dreamed about, are moving toward a somewhat different life style. It is a life style that envisions more leisure time, greater emphasis on culture, and — Heaven forbid — perhaps even doing nothing at all productive once in a while!

The Sleeping United States Giant

The fact that Japan is entering the 1980s with its own agenda of difficult problems offers scant solace to the United States. Momentum still favors the Japanese.

But it's now apparent that the United States — which in recent years has often appeared to be the sleeping giant of the world's industrial nations — is beginning to wake up at last. And although the scoreboard at the moment may read 35 to 14, the home team still has time to revise its game plan, beef up its offense, and win the big one after all.

It should be an interesting second half.

□

CORRECTIONS

March-April issue: On pages 1, 4, 14, 30, please replace author's name "Jerome L. Dwyer" by "Jerome L. Dreyer".

March-April issue: On page 16, right hand column, bottom line: please replace "31" by "30".

November-December, 1980 issue: On page 2, left hand column, line 15 from bottom: please replace "List 808802" by "List 801102".

These human (not computer) errors are much regretted.

Ideas and Their Handling by a Computer:
All the Language of Thought Becoming Calculable Like Mathematics

Edmund C. Berkeley
Editor
Computers and People

"A wasp making a mud nest in the rafters of an attic displays understanding."

Taken from Chapter 9 of "The Computer Revolution" by Edmund C. Berkeley, published by Doubleday and Co., Garden City, NY, 1962, 249 pp.

1. Discussing Ideas of All Kinds

In the last two chapters we considered an example of a computer handling ideas in a conversation about the weather. We listed about 90 or 100 ideas occurring in the samples of conversation between an elevator man (the computer) and a passenger.

But what about all the ideas in ordinary conversation? and in teaching and lecturing? and in all the books in libraries? How are we to program a computer to discuss, analyze, and "think" about ideas of all kinds?

This problem at first glance looks insuperable; a solution seems even beyond the bounds of possibility. But this is not so. In the first place, human beings, acquiring language as they grow up, learn how to deal with ideas. Even a five-year-old can say meaningful long sentences, answer questions, and ask questions, showing that he can handle ideas. Any intelligent operation which a human being can perform and which can be explained or taught, a computer can perform also, and quite often the computer can do it better. Second, in some puzzling situations a computer can be programmed to react saying, "I don't know", "I am not sure what that means", etc., just as in similar situations a human being appropriately makes such remarks. This would take care of such situations for the computer, just as it does for the human being. Third, there are some branches of human language, in particular mathematics and logic, which are thoroughly understood in regard to the structure of their ideas; these are the languages in which computers already have been programmed to operate. It is reasonable therefore to expect many more branches of human language to become programmable for computers. Fourth, the experience in programming computers to translate from one language to another, say from Russian to English, producing correct and smooth translations, is a direct guide and tutor to the programmers who will program computers to discuss. Finally, the problem does not have to be solved as a whole all at once. Instead it can be solved gradually, in bits and pieces, as more and more fields of ideas, branches of knowledge, become programmable for discussion and analysis by computers.

2. The Nature of Understanding

Let us begin, not with an examination of "idea", but with an examination of "understanding". Understanding is observable, because an organism can display understanding; but an idea (in any organism other than one's self) is something deduced.

If we look up "understanding" in the dictionary, we find many synonyms for it, such as "capability of comprehending and judging", "grasping mentally", "thorough familiarity with the underlying nature of", and so on. These definitions by means of synonyms are inadequate; they define in terms of unobservable properties. But we do find among the definitions an operational one, a definition based on operations which can be observed; this definition of "understanding" is "the power to distinguish truth from falsehood and to adapt means to ends." We can actually check this description against the behavior of an organism that we are observing; we can actually see if this property is present in its behavior.

For example, a wasp making a mud nest in the rafters of an attic displays understanding. She can choose a place for a nest, go and get mud, find her nest over and over again, use the mud to build the nest, find caterpillars, anesthetize them with her sting, store them away, lay eggs next to them, and seal up the nest. She is adapting means to ends.

Much of this behavior of hers is, of course, instinctive. The term "instinctive" refers to behavior inherited and unlearned, attached to signals that the organism has no choice but to respond to. Such behavior expresses only a low level of understanding, since it involves no acquistion of understanding as a result of the experience of the individual.

But some of the wasp's behavior is not inherited but individually acquired, individually learned. In particular, she navigates in reference to the landmarks of her particular environment; she learns these bearings. After gathering a pellet of mud in a nearby mudhole, or after catching a caterpillar in neighboring bushes, she returns and finds again the nest she is building. Wasps succeed in this navigation often enough to keep their species alive. This behavior expresses a higher level of understanding.

An automatic oil-heating system that heats an ordinary house also displays understanding. A thermostat fastened to the wall of the living room transmits electrical signals from time to time to the furnace in the cellar. The temperature falls two degrees, a temperature-sensitive element closes a relay, the thermostat signals "more heat", the fire in the furnace lights and burns, the radiators warm up. Then the temperature rises two degrees, the temperature-sensitive element opens the relay, the thermostat signals "no more heat", the burner in the furnace is turned off, and the radiators slowly cool off. The robot system is more wide-awake and punctual than the old-fashioned human furnace-man, who was supposed to call at the house twice a day, if he wasn't sick and didn't forget, and then when he did come, made either too big a fire or too small a fire. The automatic oil-heating system in fact understands the situation better than the furnace-man, because its simple, restricted "spark of consciousness" is always alert, and contains only one two-sided bit of information, "too cold", or "not too cold".

3. A Computer's Understanding

A big computer if elaborately programmed can display a great deal of understanding. For, most certainly, the computer can "distinguish truth from falsehood and adapt means to ends", on a vast scale. It may be argued that the computer's understanding comes from the mathematicians who programmed it; but this argument is open to the rebuttal that these mathematicians have themselves been programmed by their education. More than 99% of all they learn and understand is the result of a social and racial culture of global extent and more than 5000 years' duration.

The power to distinguish truth from falsehood and to adapt means to ends rests on the possession by an organism - animal or machine - of certain equipment. This equipment must be able to take in information, carry out reasonable operations with it, and produce information, directing other parts of the organism to act. As a result the organism has a degree of control over itself and over the outside world. In other words, the organism has a degree of understanding.

The main requirement for an organism to understand a situation is that its physical equipment for taking in, operating on, and storing information must have a capacity adequate for the situation. What does this mean? In the case of a computer, suppose that if it is to solve a certain mathematical problem, it must have at least 500 registers where information can be stored. But suppose that the particular computer has only 50 registers. Then there is no possibility whatever that this problem can be solved by that computer, for the problem is beyond its capacity for "understanding".

4. The Nature of an Idea

It seems reasonable to explain ideas in terms of understanding. For our purposes, an idea is something which an organism understands, a unit of what is understood. For example, as the wasp finds its way back to its nest, presumably it has in its brain records of the appearance of certain features of the environment, such as trees or windows or the end of the attic within which it has its nest. The Dutch naturalist Tinbergen in his book "Curious Naturalists" reports interesting experiments revealing the landmarks wasps actually use for making their navigation decisions.

We can say that an idea is the unit of understanding (or meaning) common to various unit pieces of information about which the organism behaves as if they were interchangeable. For example, the wasp behaves interchangeably in regard to different optical views of the end of the attic, as seen from different distances and directions. It seems evident that only by unifying these different views into a single unit of understanding is she able to use the end of the attic as a landmark from various distances and directions during an approach to her nest. For another example, in the computer's conversation about the weather, described in Chapter 7, the vocabulary of the computer in regard to quality 13 degree 2 was "abate, decrease, diminish, subside"; in other words, in regard to each of these four different English words, the computer was instructed to behave interchangeably: the computer had been programmed to substitute for any of these words the idea-label 13,2.

5. Meaning

In the case of human beings, the unit of understanding is also idea or meaning. In fact, we can say that an idea is the meaning common to various pieces of information that have the same meaning. For example, the idea of two is what is common to "zwei, duo, deux, II, 2, pair, two", etc. The idea of "banana" is the meaning common to "banana, banane, Banane, platano" in English, French, German, and Spanish. Such ideas are terms, the names of things.

The statements:

two and three are five;
two plus three equals five;
deux et trois font cinq (French);
duo et tres quinque sunt (Latin);
zwei und drei sind funf (German);
2 + 3 = 5

all make the same assertion, have the same meaning, are said to be expressions of the same proposition, indicate the same idea. Such an idea is a relation rather than a term.

6. The Social Reality of Ideas

In human society people agree widely and uniformly about thousands of ideas. People operate with many ideas as if they were real. People believe that the ideas they have in their minds fit together neatly with facts about the real world. A person usually assumes that other people have ideas in their heads as he has in his own head; and for some ideas, like "two", this is very likely to be true, and for other ideas like "democracy" this is very likely to be false. People living in society find ideas to be indispensable for handling the real world surrounding them. Ideas in fact possess a social reality. V. Gordon Childe, a well-known British anthropologist, says in his book "What Happened in History":

In society men make names for and talk about ideas which cannot in fact be seen, smelt, handled, or tasted...ideas such as two-headed eagles, electricity, cause. All these are social products like the words that express them. Societies behave as if they stood for real things ... Socially approved and sustained ideas that inspire strenuous and sustained action must be treated by history as just as real as the ideas which stand for the substantial objects of archeological study. In practice, ideas form as effective an element in the environment of human society as do mountains, trees, animals, the weather, and the rest of external nature.

7. The Physical Form of an Idea

However, in human brains as well as in computers, any actual physical form for an idea is simply the storing of some information in a register, like the pair of numbers 13, 2. The importance and significance of ideas consist in their structural relations to other ideas, and the effect of this stored structure of information upon the observable behavior of the organism.

As more and more programs are developed for computers, it becomes highly desirable in order to save exhausting work that programs made by one computing center should be capable of running on machines at other computing centers, whether of the same manufacture or not. So common programming languages are developing, such as ALGOL (ALGebra Oriented Language), language for programming computers to solve algebraic or mathematical problems, and COBOL (Common Business-oriented programming Language), for programming computers to solve business problems. Of course, the idea of "two" will be available in each computer, even if in one computer it may be represented decimally and in another computer it is represented in binary notation. And also, many other ideas will be common between different computers. The parallel to the common ideas shared in human society is likely to develop increasingly among computer "society".

8. The Relevant Details of an Idea

In order to use any idea, we do have to decide about some details, features, or properties, and we don't have to decide about certain other details. Take for example the idea referred to in the phrase "the Statue of Liberty"; the meaning of the words is a certain physical object in New York Harbor, a large statue which represents a woman who is crowned and holds a torch.

But even the idea of a single, definite, concrete, specific object is always a great deal fuzzier and more immaterial than we would at first expect. Do we or don't we include in the idea of the Statue of Liberty the visitors climbing up and down the spiral stairs inside the statue? Do we or don't we include in the idea small particles of rusted metal swept out from day to day that may actually have been part of the physical statue for many years? We can think of many possible details of the physical object called the Statue of Liberty, and for many of these details we cannot with confidence say whether or not they are included in the idea of the Statue of Liberty.

The idea of the Statue of Liberty -- and any idea, in fact -- is essentially a conventionally agreed specification of certain properties and relations, and an agreed specification that certain other properties and relations are irrelevant, make no difference. Every idea requires that we drop out of attention a great many features, "irrelevant details" possessed by the "real" referents of an idea.

In fact, we arrive at an idea by disregarding details, by thinking of a quality or qualities apart from a particular object, by abstracting. That is where ideas come from. According to the dictionary, the verb "abstract" means to "think of something apart from any particular object or real thing"; the adjective "abstract" means "thought of apart from any particular object or real thing." The word "abstract" comes from two Latin words, "ab" meaning "away", and "tract" meaning "drawn, pulled"; so "abstract" means "pulled away" -- The derivation gives a good, vivid picture.

No matter how concretely we try to think of some specific object that actually exists in the real world, in dealing with it we are compelled to select only some, not all, of its properties; and so we think of that object as a construct, an edifice, of selected properties. When we disregard details, the thing we think of, the concept, the idea, necessarily becomes abstract, "thought of apart from a particular object".

Actually, by abstracting, ideas become counters for operations of reasoning. By disregarding more and more details, ideas develop into counters for playing mental games. Ideas are pieces for the game of reasoning; and abstraction is one of the most important steps in the reasoning process.

9. A Computer Programmed to Operate with Ideas

For a computer, words, meanings, and the properties and relations of meanings, will be a structure or system correlating stored information, instructions, and programs. This was true for the conversation about the weather between the computer and the human being, and this will be true generally.

In most cases a computer will be programmed to act as if there were two or more ideas corresponding to each word, or piece of information, and two or more words, or pieces of information, corresponding to each idea. We can think of many pieces of information itemized in one long list, and many labels for ideas itemized in another long list, and in between these two lists, a complicated network of lines showing associations, like an intricate spider web.

We can imagine a computer storing this structure. It would have three sections in its memory. In Section A it would store expressions, pieces of information, "words". In Section B it would store labels for ideas, meanings, usually a preferred expression selected from among many expressions. In Section C it would store links, cross references, correlated addresses of registers, something like "re 301, see 614", meaning "When Register No. 301 is referred to, consult Register No. 614." Then whenever the "attention" of the machine came to Register 301 containing a piece of information, it would also consult Register 614 containing the tentative label for an idea.

Suppose: Register 301 contains "twelve"; Register 302 contains "dozen"; Register 614 contains "12"; and the machine also contained reference notes "301 to 614" and "302 to 614". Then the reference notes "301 to 614" and "302 to 614", could be used to instruct the machine to act in regard to a piece of information in Register 301 or 302 as if that piece of information stood for the idea-label in 614.

10. Computer Operating with Ideas

How would the computer pay attention to and operate with ideas? Every time it came upon a piece of information, it would have a puzzle to solve, to find out what idea was being referred to. Suppose a string of half a dozen expressions came into the machine. The machine would have a standard routine for looking up all the ideas associated with each expression, and checking to see what selection of ideas -- the second one here, the first one there, the fifth one at the next place -- gave a consistent meaning to the whole string. If there were no reasonable selection, the machine would report "apparently nonsense". If there were two or more reasonable selections, the machine would report "ambiguous". If there were just one reasonable selection, the machine would be "satisfied", and would be ready to go ahead. If the ideas could be operated with reasonably, then the idea-labels could be calculated with, and a mechanical brain would be able to perform reasonable operations.

There would be a one-to-one correspondence between ideas and idea-labels that occur in the "idea" section of the machine; and to these idea-labels reasonable behavior by the mechanical brain would be associated. If Register No. 614 contains "12", and if the machine is able to act about the idea-label 12, then the machine acts as if it were storing in this register the "idea of 12" even though all that is actually there is the idea-label. The behavior of the machine, the capacity of the machine to operate reasonably, endows the idea-label with the properties of a reasonable idea.

11. Human Brain Operating with Ideas

It seems quite possible that the brains of human beings are much like the computer behavior just described. We know there are definite places in human brains that store our recollections of sights, sounds, other sense impressions, and other pieces of information that we take in -- like Section A of the computer. It would be reasonable to believe that there are other places in our brains where we store labels for ideas, for the meanings common to a group of expressions -- like Section B of the computer. All that would be necessary is that one preferred expression should be selected as a keynote -- just as "12" is the keynote for "twelve, dozen, 12". Our brains certainly contain millions of links, connections, neurons, running between areas of the brain; these connections could very well run between stored pieces of information and stored idea-labels.

A human being can listen to a sentence of half a dozen words, and with remarkable facility select the right one of many possible meanings for each word, so that the whole sentence "hangs together", "makes sense". This is the parallel of one of the operations we have just described for the computer. Sometimes we even notice the lag while our mind hunts for the right selection of meanings which will explain a set of words; suddenly we deduce it, and then the meaning of the whole sentence fits together like the parts of a puzzle clicking into place.

It is easy to enter English words and expressions into a computer by typing on a keyboard. But how shall we specifically program the computer to recognize the ideas referred to and discuss and argue with them? This we shall discuss in the next chapter. □

Burden – *Continued from page 15*

A word of caution, however. We re-iterate the limits of the technology as mentioned at the beginning of this article: SYSTRAN II will not produce a "perfect" machine translation. Very significant advances in our understanding of speech and of intelligence will be required even to obtain a 100% reliable, factual translation. The finer points of style and cross-cultural transfer,it seems, will always remain the domain of the human translator.

The present system does, nevertheless, make translation of large volume technical documentation economically feasible. In a world where acceptance of foreign language (i.e. English) documentation is diminishing, and where some countries, notably Japan, are ready to provide technical information in the customer's language, SYSTRAN II is of significant interest to export industries.

□

Norris – *Continued from page 11*

Special recognition programs are not built into the approach and long term success does not depend upon them, in part, because the values people place on specific results vary widely. Job security is of foremost importance to some, money is paramount to others, and then again, there are those who equate success at work with social acceptance. Given those differences, it isn't practical to design an effective company-wide method of recognition. This does not preclude special programs from time-to-time; in fact, they are encouraged whenever there is an appropriate occasion such as an extraordinarily severe competitive problem or quality problems with a product.

□

Computing and Data Processing Newsletter

222 COMPUTER-CONTROLLED MIRRORS (HELIOSTATS) FOCUSING THE SUN ON A "SOLAR POWER TOWER"

Bob Gall
Public Information Division
Sandia National Laboratories
Albuquerque, New Mexico 87115
(505) 844-1253

In the New Mexico desert, 89,000 square feet of mirror surface is concentrating the equivalent of 2000 suns on a "receiver" in a "solar power tower". It produces up to 2000 megawatts of solar thermal energy. The receiver is a panel of black tubing 11 by 18 feet, using a mixture of molten salt, 60 percent sodium nitrate and 40 percent potassium nitrate. This is a "heat transport fluid". This experiment is testing the concept of a solar power tower adjacent to a fossil-fuel generating plant or an industrial factory.

The name of this experiment is the CRTF (Central Receiver Testing Facility). It was designed and built by Martin Marietta Corporation for the Department of Energy. The system under which it operates is the MCS (Master Control System). It provides coordinated control of operating, data, and testing systems, for all the elements including the heliostats.

In an electric generating plant, the hot salt, heated to 1050 degrees Fahrenheit, would be used to generate steam. There are a number of potential advantages over conventional water-to-steam technology: higher system efficiency; lower working pressures; lower pumping costs; and higher heat-transfer rates.

COMPUTERIZED DISHONESTY: "OPPORTUNISTIC" AND "ACADEMIC"

"The Financial Times"
10 Cannon St.
London, EC4, England

"The computer, electronics, and the microchip mean that earning a dishonest living is conveniently simple for the skilled technologist."

This is the claim of two computer consultants who plan to educate folk in anti-fraud techniques. According to Roger Turvey and Brian Hitchen of Sheerbridge, Ltd., no less than £1300 per minute found its way into the pockets of computer fraudsters in 1979, a total for the year of 680 million pounds.

4/5 of computer swindles are "opportunistic" according to Sheerbridge, occurring when staff come upon a flaw in the system on which they can capitalize. The remainder are premeditated, including what are known as "academic" frauds, where the perpetrator is a user of the system whose job it is to build in the safeguards which he systematically breaches. "This more cerebral character", says Turvey, "sets himself an intellectual exercise on how to commit the perfect crime."

ARABIC LETTER CHARACTERS IN FULL FORM PRODUCED BY COMPUTER

Stephen Strauss
"Globe and Mail"
444 Front St. West
Toronto, Ont., Canada N5V 2S9

(Based on an article Jan., 1981)

For the first time ever in printed form, Arabic is being generated with all of the 140 separate word shapes and 13 possible accents that the language is capable of.

The ability to express by a computer the five shapes that some letters are written in was the result of a discovery of a subtle linguistic relationship in Arabic script. This discovery was made by a Montreal professor, in a ten-year effort to preserve the usage of Arabic in a technologically changing world. The professor is Richard Blackburn, a professor of Middle Eastern studies at the University of Toronto.

The previous solution to the problem was to truncate the language. An English keyboard with its 26 letter keys was adapted, allowing between one and three forms (upper and lower case shifts in English) for each of the 28 letters used in Arabic. However this is not enough, because if you write ABC in Arabic, the form of the letters will be different from the form of the letters in a word written CBA or BCA.

The abbreviated but legible Arabic resulting is however unpleasing and culturally antagonistic to Arabs, particularly the conservative ones. Arabic cursive writing has become an important form of art to Arabs.

Blackburn says "We have had hundreds of years to get used to all the typefaces that we see in books. But the Arab hasn't. Maybe even he doesn't want to. Why not help him?" Arabic script is used in writing 51 non-Arab languages and dialects (some with up to 35 characters in them). These are spoken by an estimated 550 million people in Iran, parts of India, Pakistan and China.

Syed Hyder, a computer science professor at the University of Montreal, born in Kashmir, was interested in using technology to preserve things and improve what was available in Arabic. He discovered that for 16 groups of Arabic letter shapes, linkages with other letters can be expressed in an algorithm. Blackburn says he knows of no standard set of rules by which a student of Arabic learns how to make the letter changes when learning the language - they simply learn by doing.

The Hyder algorithm was written onto a computer chip and inserted into a $1600 Olympia typewriter whose disc typing unit contains all the forms of Arabic letters. The computerized linguistic memory takes over when you type an Arabic ABC, deciding in milliseconds what letter forms are needed. The computer memory will automatically change the letters to other forms if you type CBA or BAC, etc.

Prof. Hyder, in conjunction with the Quebec manufacturer Comterm, has already sold $12 million worth of computer display devices to the Saudis. The Saudis are ecstatic with the breakthrough.

COMPUTERS IN MANAGEMENT: USA/USSR JOINT PROJECT

Helen Tackett
News and Information Service
University of Texas at Austin
Box Z, Univ. Station
Austin, Texas 78712
(512) 471-3151

Unlike in the United States, if you ignore signals from the marketplace and produce 300,000 copies of a necktie, you may be left with a "clinker" on your shelves. That happens in the Soviet Union.

Unlike in the Soviet Union, if you lack a proper way of keeping track of a nation's rail cars, you may find about one fourth of those cars "lost" on some siding at any one time. That happens in the United States.

Though problems in a planned economy such as the Soviet Union differ from those in a market-oriented economy such as the U.S., each nation can learn something from the other about management. How such widely differing systems use computers in management is the subject of a cooperative project between the Soviet Union and the U.S.. The Univ. of Texas has a significant role in that project. UT scholars are studying Soviet application of computers to large systems and Soviet scholars are studying the same things about the United States. Included also as a subject is the Soviet development of computer data bases.

Subtopics include: nationwide rail transportation; energy; management information systems; regional planning; processing large masses of territorial economic statistical data; chemical catalysis; electrometallurgy; forestry; metrology (weights and measures); microbiology; physics; science policy; water resources.

The cooperative project, which began in 1972 as part of the Bilateral Agreement on Exchange of Science and Technology between the U.S. and the U.S.S.R., has yielded several fruits. For the first time, UT researchers have been able to obtain a five-volume report on Soviet economic planning methods, "of which only 400 copies have been published." Also, there was published in Russian and English a joint, first "Dictionary of Data Base Terminology", 1980.

THE COMPUTER IMPACT ON TRADE UNIONS AND EMPLOYMENT

John Lloyd
"The Financial Times"
10 Cannon St.
London, EC4, England

(Based on an article in March 2, 1981)

Two issues are of special importance in the complex debate on the impact of computers (by which we mean automation of all kinds) on employment. The issues are first, what computers will do to employment, and second, employment in computers.

The first of these has received the most discussion. See the writings of Mr. Clive Jenkins, general secretary of the white-collar union ASTMS. See also the writings of Mr. Barrie Sherman, director of research for that union. "The Collapse of Work" is their most popular statement. Jenkins and Sherman assume a swathe cut through the world of employment by the adoption of automated systems in manufacturing, service industries, and the office. They argue that the "computer revolution" will not replace one type of work with another (as the advent of steam power did). So the central task for policy planners is to displace work as the central ethic of advanced societies, and plan for greatly increased leisure.

Others have been much more cautious. The TUC's employment and technology group, for example, eschewed any attempt to quantify job losses, though it spoke of the job-destroying potential of automation. A government report in 1979 said that employment effects in manufacturing would be "negligible"; service industry job losses would be balanced by "offsetting opportunities"; and general change would be "gradual rather than revolutionary".

There are clear signs that unions will sharpen their responses to employers' demands for change. "Technology bargaining" is emerging as a skill in contract negotiation. "Technology agreements" are now a feature in the landscape of industrial relations. □

CACBOL – *Continued from page 3*

R. Vichnevetsky
George Marr
John Gardenier
Roland Gagné
Martin Dost

(Source: Society for Computer Simulation, March 1981, P.O. Box 2228, La Jolla, Calif. 92038) □

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.)

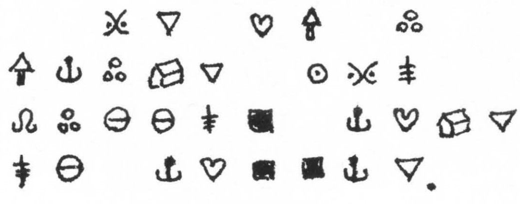
NAYMANDIJ 8105

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

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 8105



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, 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 8105

```
            G O D
  *   C U R S E S
  ---------------
          A O H S
        U H R T
      A O H S
    A G S H
    G O D
  U R E G
  ---------------
= U E O R R H A E S

      4 4 1 5 3 7
```

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

SOLUTIONS

NAYMANDIJ 8103: Make diagonal of 2's.
MAXIMDIJ 8103: To live long, it is good to live slowly.
NUMBLE 8103: There is no fool like an old fool.

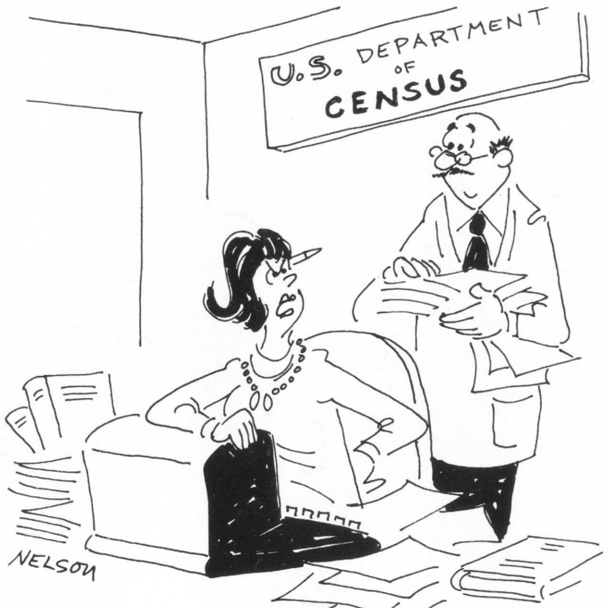
Our thanks to the following people for sending us solutions: T.P. Finn, Indianapolis, IN – Numble 8103, Maximdij 8103; Patty Morrison, Tulsa, OK – Maximdij 8101; Steven Shulman, Edison, NJ – Numble 8103, Maximdij 8103, Naymandij 8103; Steve Werdenschlag, Livingston, NJ – Numble 8103, Maximdij 8103.

The Frustrating World of Computers

by Harry Nelson
1135 Jonesport Court
San Jose, CA 95131

I'M NOT MS. OCCUPANT, MISS OCCUPANT, MRS. OCCUPANT, RESIDENT, LADY IN RESIDENCE, MADAM OF THE RESIDENCE OR ———

YOU MAY BE ONLY GOING TO BOSTON BUT YOUR RESERVATIONS ARE BOOKED THRU TO BUENOS AIRES ———



BEFORE I CAN START ON THE 1980 CENSUS CORRECTIONS I HAVE TO FINISH THE 1970 CENSUS CORRECTIONS ———

SIR, — IT'S REPLY IS, "— TO FORGIVE IS DIVINE —"