June, 1972

Vol. 21, No. 6

computers and automation

Computerized Scheduling of Tree Care

Pictures of Mars by Mariner and by Computer — *W. E. Shufelt*
Personal Rapid Transit — *S. E. G. Elias, and others*
A Computer Laboratory for Elementary Schools — *Seymour Papert*
The Computer and the Intellectual Frontier — *R. W. Hamming*

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

Who's Who in Computers

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

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

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

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

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

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

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

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

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

Abbreviations include:

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

Main Interests:

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

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

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

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

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

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computers and automation

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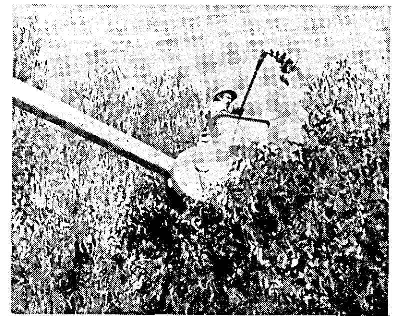

Front Cover Picture

Lifted skyward by a "cherry picker," Francisco Gaeta of Davey Tree Surgery Co., Livermore, Calif., clears eucalyptus branches from a power company right-of-way. A computer schedules the crews and equipment necessary to keep up with tree care and landscaping activities from the Rocky Mountains to Hawaii.
(For more information, see page 44.)

NOTICE

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Departments

Key

[A] – **Article**
[E] – **Editorial**
[F] – **Forum**
[G] – **The Golden Trumpet**
[NT] – **Not Technical**
[T] – **Technical**

c.a **EDITORIAL**

The Shortage of Good Typists — and the JJ Command

One of the conditions that nowadays confronts any person who needs to write and who does not type well is finding somebody who does type well and who can type for him or her. Typically, the person needing the typing is an "executive" and, typically, the person to do the typing is a "good secretary".

In our area, the suburbs of Boston, in spite of an unofficial unemployment rate of over 7%, good secretaries and good typists are apparently not to be had for love or money. The Job Central Control Bank here has, according to report, over 1000 positions calling for good secretaries open and unfilled week after week.

Undoubtedly, part of the reason for the failure to fill these jobs is the widespread refusal of young women to train to become secretaries. They wish to become executives, writers, editors, reporters, etc., in their own right – and more power to them! As for young men, they refused long ago. It seems clear that "good secretaries" are becoming extinct like the dodo and the great auk.

As a result, many persons who have been accustomed in the past to secretaries have begun typing for themselves, and give only a portion of their writing to be finally typed by good typists – often persons not in the office but who do typing part time, at home, to earn extra income, at college, to supplement allowances for education, etc.

Therefore, a new condition is developing with new problems, and new solutions to the new problems are needed. Perhaps we can even take advantage of the pressure to change, in order to take a step forward in efficiency. For it is obviously not efficient (even if it is prestigious) for an "executive" to transmit his writing through a "good secretary" in order to get it typed.

One solution is for you yourself to learn to type, and to type well. This works rather well for a great many young people. But many older people find this solution rather difficult. It is true that people in their thirties and much older still can learn to type faster than they can write by hand; a good handwriting speed is 20 words a minute, while an easily attainable typing speed is 30 words a minute. But non-expert typists make many mistakes; the mistakes take time to correct neatly; and there is a widespread, rather irrational, compulsion in the business world which requires much typing to be with no mistakes ("What will people think, if my letter goes out with five ink corrections?"); and this compulsion makes for sand in the gears. Mistakes often do not need to be erased, however, because you can obtain chalky strips ("correctype") which you can use to just strike over a wrong character, and also sticky white tape ("correction tape"), which you can use to cover up mistakes and then type over them.

A second solution was just announced in April. It is an electric typewriter, offered by a manufacturer in the computer field, which stores the characters typed on a magnetic card and allows unlimited adjustments or corrections – so that what is finally typed in any spot is the most recent character typed for that spot. The major trouble with this machine is that its price is over $200 monthly rental, or something like half of the wages of a "good secretary". It is easy to deduce that the price is related to what the traffic will bear rather than the cost of the equipment!

A third solution is open to anyone who has access to a computer, and that is to make use of a computer program with which he can edit his typing, and so produce easily any text that he wants. Probably over 98% of people in the computer field have access to a computer; and so it seems likely that this form of typing can be a very practical solution for a great many persons in the computer field – and also a number of persons not in the computer field but who have access to computer terminals.

On-line editing is a considerable help in efficiency and directness in producing final text. But even off-line editing is a help, especially when you use some commands contained in the stream of text that you are typing. The command which is most useful to me in this operation (which I have tried) is what I like to call "the jj command".

When jj occurs in a stream of characters, it tells the computer program:

1. Search backwards along the string of characters until you find a match for the four characters immediately following the jj.
2. When you find the match, delete all the characters from the beginning of the match up to and including the jj, and then pick up all the characters following the jj.

This command enables you to change any error, as soon as you notice it, in almost the easiest possible way; and it implies that you can type in the same way that you talk, for you often interrupt yourself to change what you are saying into something else. In all cases, the editing program will thus "know what you mean", and be able to do it.

For example, John Jones typing can type like this:

> The other day I was talking to the managerof the jj manager of the industir jj industrial actuarial depare

Real-Time Pictures of Mars By Mariner and By Computer

Wayne E. Shufelt
Sperry Rand Univac
2121 Wisconsin Ave. N.W.
Washington D.C. 20007

The following sequence of three photographs illustrates the real-time image processing being performed in connection with the Mariner 9 spacecraft's visit to Mars.

The raw picture is transmitted to earth at approximately 16 thousand bits per second and requires approximately 5 minutes, 42 seconds to transmit. These pictures are received in digital format at the Jet Propulsion Laboratory in Pasadena, California, by a UNIVAC 1230 Mission & Test Computer.

Once in the computer, the data are formatted for processing and the first raw picture (Figure 1) is generated through the computer system in approximately two minutes.

The first enhancement process performed is described as shading correction; the result appears in Figure 2. This process compensates for the nonlinearity of the spacecraft imaging system, and converts the output scale factors to provide appropriate film exposure and contrast to the generated negative. This process is complete approximately one minute following the raw picture output.

The contrast gradient over the shading-corrected picture shows areas of over and under exposure, and these will obscure certain features. The shading-corrected picture is then processed once more to increase contrast and to provide a relatively constant background.

The result of this second enhancement step is seen in Figure 3, where features not evident or clear on any of the previous pictures are brought out for increased visibility and study. This process requires approximately one minute to complete.

While this processing is being done, the next picture is being received by the computer system, and vehicle telemetry is simultaneously being received and displayed to provide for effective real-time evaluation and control of the Mariner 9 spacecraft as it orbits Mars.

Since the onboard TV cameras were turned on in November 1971, the real-time computer enhancement system has processed over 6,000 pictures sent back from outer space. Real-time enhancement allows investigators at JPL a quick look, and has been a key factor in making decisions on changes in the original orbiting and picture-mapping schedule.

The area shown in the photographs is located in Tithonius Lacus, 300 miles south of the equator of Mars. The picture was taken by Mariner 9's wide angle TV camera on Orbit 119 from 1225 miles (1977 kilometers) and covers an area 235 miles by 300 miles (376 by 480 kilometers).

Editorial — *Continued from page 6*

> jj department, D. G. Park jj ment, H. B. Park. And he said that there was a great deal of waste jj deal of slackness in many departments of the company jj of the organization. And he wanted to set up procedurs jj procedures to decrease thos practices jj those bad habits.

The editing program in the computer takes in this string of characters as typed, and outputs:

> The other day I was talking to the manager of the industrial actuarial department, H. B. Park. And he said there was a great deal of slackness in many departments of the organization and he wanted to set up procedures to decrease those bad habits.

This result would be very easy for a computer program — even as it might be very hard for a human typist — and would save a great deal of time and effort for the person writing. In fact, with only a few more commands, symbolized as pairs of letters set off by spaces or carriage returns and never occurring as two-letter words, one would have a powerful computerized system for immediately converting rather poor typists into excellent ones, either off-line or on-line.

Edmund C. Berkeley, Editor

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

NOTICE

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

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

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

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

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

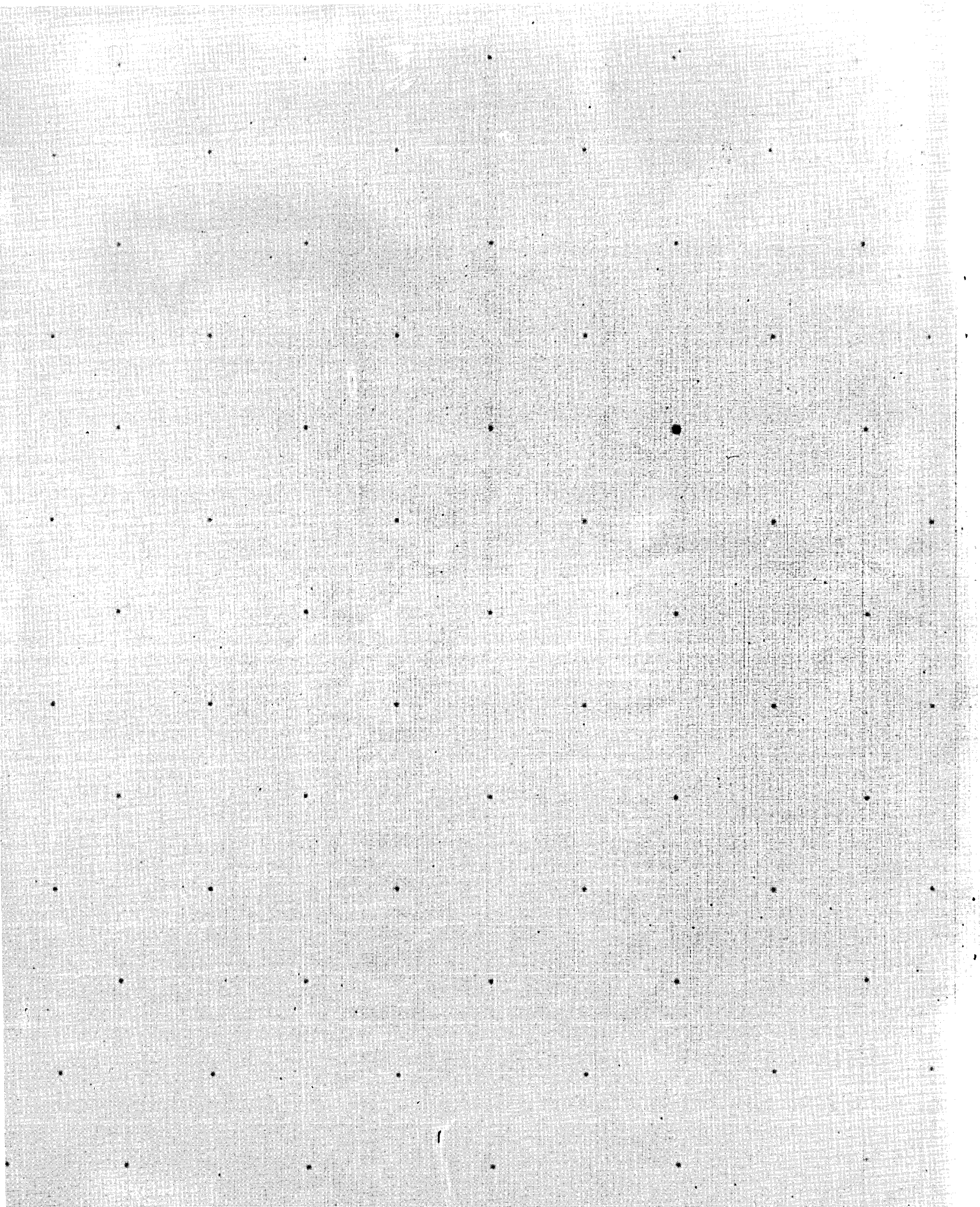


Figure 1 — Raw picture

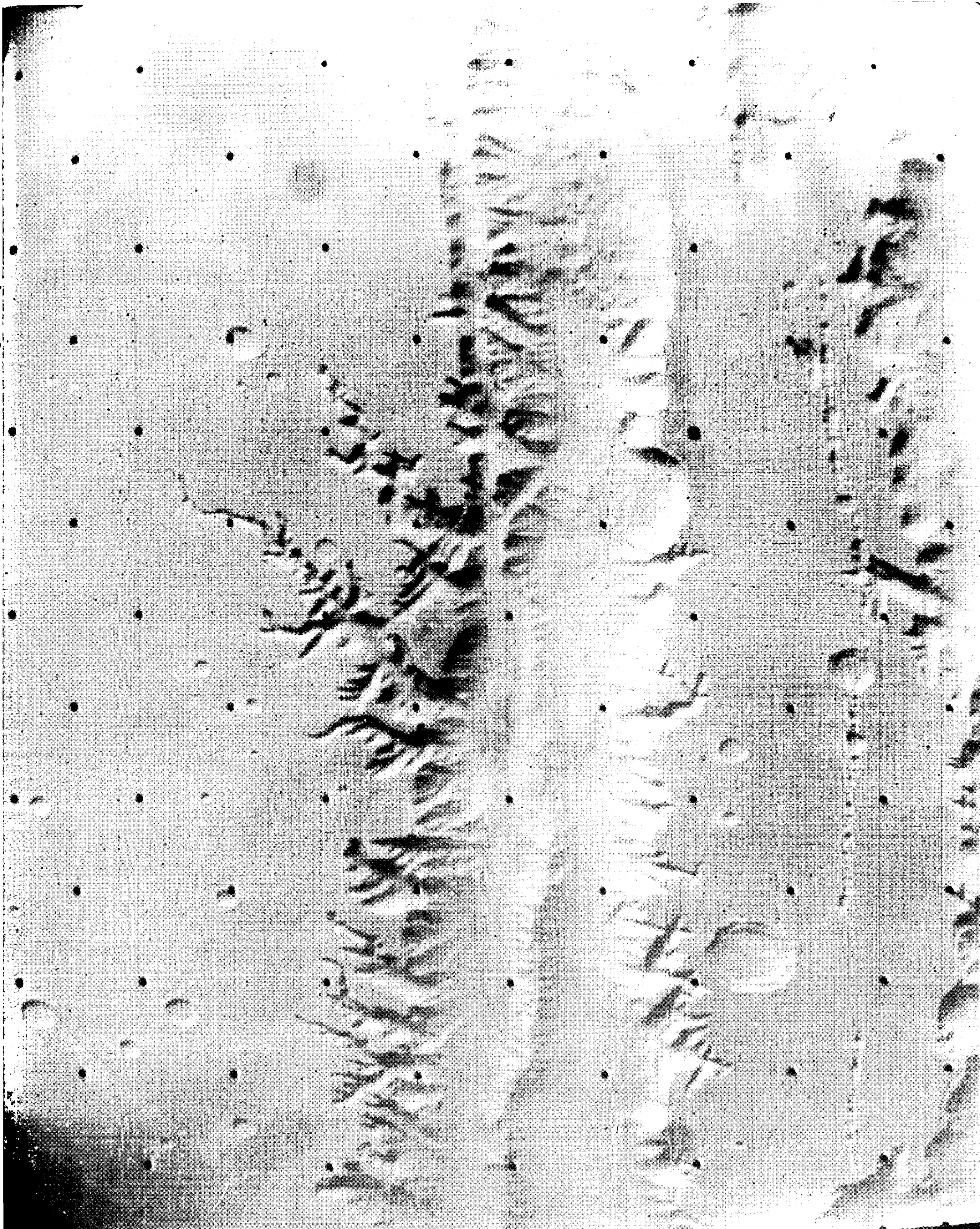


Figure 2 — First enhancement, shading correction

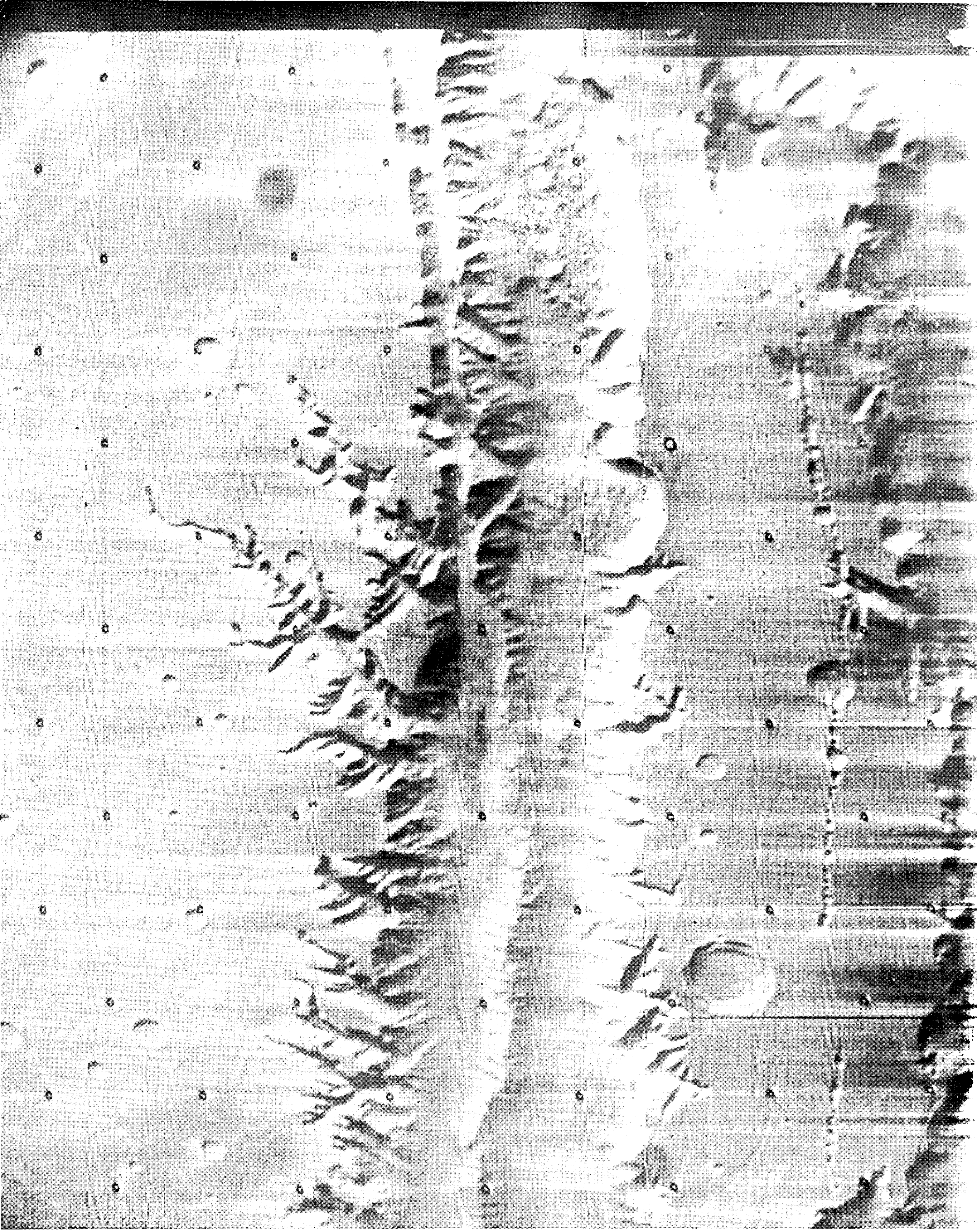


Figure 3 — Second enhancement, increased contrast

Personal Rapid Transit, Computerized, in Morgantown, West Virginia

PART I: THE PLAN

William W. Aston
West Virginia Univ.
Morgantown, West Va.

PART II: THE COMPUTER AS THE HEART OF PERSONAL RAPID TRANSIT

Dr. Samy E. G. Elias, R. E. Ward, and Michael Wilson
West Virginia Univ.
Morgantown, West Va.

"A major breakthrough is taking place in the field of urban transportation at Morgantown, West Virginia."

I. THE PLAN

Two of the nation's leading aerospace organizations are coming down to earth in Morgantown, W. Va. Boeing Company in Seattle and Bendix Corporation in Ann Arbor, Michigan, are now working together to make West Virginia University's Personal Rapid Transit (PRT) System a reality.

Boeing, in overall charge of the design and construction of the system, is also developing the vehicles. Bendix will develop the control and communication equipment. In addition, Frederic R. Harris, Inc., in Stamford, Connecticut, will do the architectural and engineering design work, and Alden Self-Transit System Corporation in Boston will serve as principal subcontractor under Boeing in developing the vehicles. Alden is builder of the "staRRcar," which was used in some of the preliminary evaluations of the system.

"Fifty years ago you could travel in downtown Manhattan at about 11 miles an hour with a horse and buggy. Today you are lucky to average 7 miles an hour in a car," observed Dr. Samy E. G. Elias, chairman of West Virginia University's Department of Industrial Engineering and initiator of the WVU-Morgantown Personal Rapid Transit (PRT) System.

Such traffic problems also exist in small cities, and in both large and small cities they are getting worse. In the mid 1960s, engineers and traffic experts began meeting and talking about new transit systems that could alleviate these problems. Their meetings were made possible under the federal Urban Mass Transit Act of 1966, which funded a series of seminars for top management officials of rail and bus systems. Two of the seminars were held at WVU in the summer of 1967 and attracted transportation experts from throughout the country.

"The most important thing we did was talk," Dr. Elias recalled. "And it soon became clear that most of us were interested in transit systems for large metropolitan areas or even on a national scale. The idea of a rapid transit system for small cities was discussed, but there wasn't much enthusiasm.

"Later, some of us at the WVU College of Engineering decided that a rapid transit system was going to be built in some small city sometime in the future—and that it might as well be Morgantown, and it might as well be now. So we drafted a proposal and, through the efforts of Congressman Harley Staggers of West Virignia, we were able to present it personally to Transportation Secretary John Volpe."

AUTHORS

Samy E. G. Elias is Chairman of the Industrial Engineering Department at West Virginia University and Special Assistant to the University's President. The concept of the Personal Rapid Transit system in Morgantown is his and the project is being directed under his supervision.

Dr. Elias came to WVU from Kansas State University, where he was a member of the I.E. Faculty. He is a senior member of AIIE. Dr. Elias received his bachelor's degree in aerospace engineering from Cairo University, his master's degree from Texas A & M and his doctorate from Oklahoma State University.

R. E. Ward is a Research Engineer at West Virginia University. He has been an instructor at WVU and has held positions with Olmsted AFB, American Can Co., and the New York City Transit Authority. He holds a BSIE from Penn State, an MSIE from WVU, and is currently working towards his Ph.D. Mr. Ward is a senior member of AIIE.

Michael Wilson is a Research Engineer in the IE Department at West Virginia University. He has a BS degree from Georgia Institute of Technology and an MS and Ph.D. in electrical engineering from West Virginia University.

The proposal was approved in July, 1969. WVU was granted $100,900 by the U. S. Department of Transportation to study the feasibility of constructing a rapid transit system in Morgantown. The university contributed $32,600 of its own funds to make the study.

In September, 1970, Secretary Volpe visited Morgantown and made an additional grant of $90,000 for a preliminary design study. This commitment was strengthened in December when a $1.3 million contract was awarded to the Jet Propulsion Laboratory of Pasadena, California, for research and engineering on the system. In April, 1971, about $4 million in contracts were awarded to Boeing, Bendix, and the other companies to develop the system.

Purpose of PRT is twofold—to serve 16,000 WVU students, the university faculty and staff, and the people of Morgantown, and to serve as a demonstration-research project for other small cities of the nation. WVU is spread over three distinct campuses—they are not too far apart, but far enough so that a student isn't allowed to schedule two successive classes on two different campuses. PRT should alleviate this problem and thus greatly increase the choices of classes for many students.

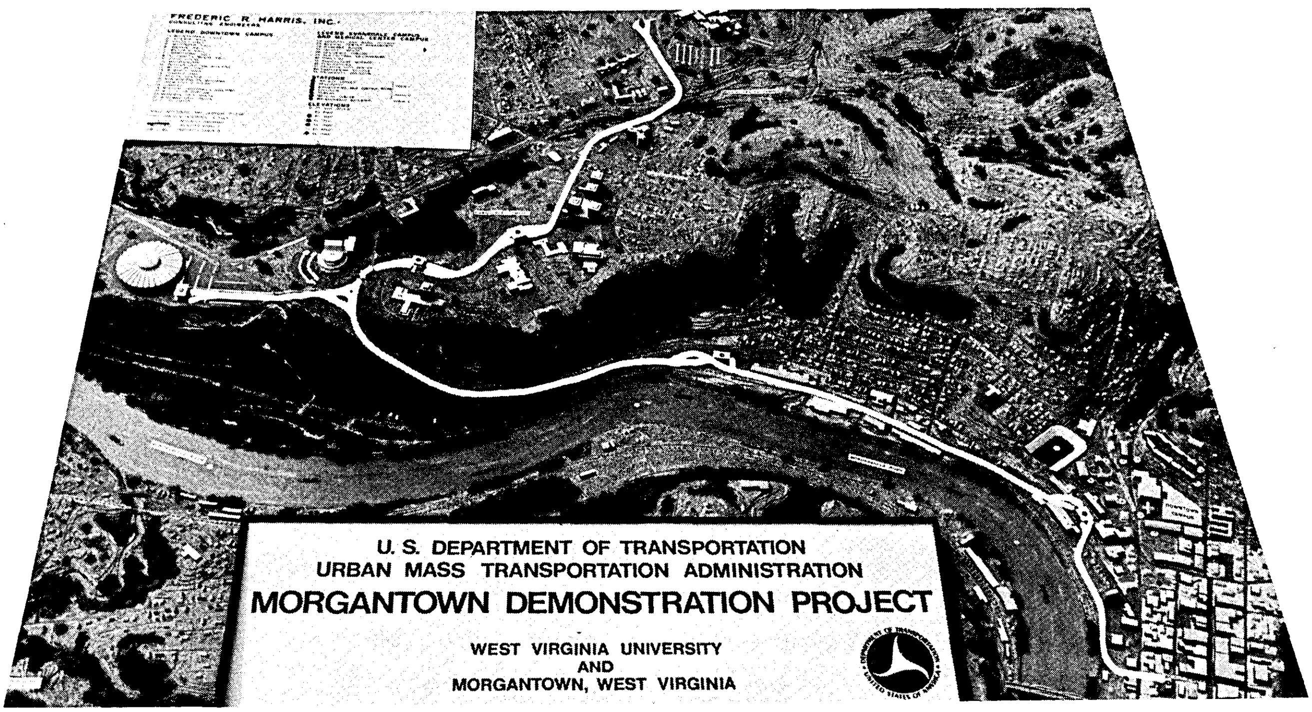
Another advantage, from the demonstration point-of-view, is the varied climate of the city, which has ice, snow, rain, fog and sunshine.

Initially PRT will have six stations, 3.2 miles of elevated track, and about 100 vehicles.

Each vehicle is currently expected to carry eight seated and seven standing passengers and to travel at speeds up to capacity of 1,100 people every 20 minutes. The vehicles will operate in two modes—on a scheduled basis during peak hours and on a demand basis (just like an elevator) 30 miles an hour. The entire system will have a peak during off hours. The movement and spacing between cars will be controlled by a system of computers.

The vehicles will run on four rubber-tired wheels and be propelled by electric motors. The elevated dual guideways, one for each direction of travel, will facilitate movement and increase the safety of the system. The safety factors built into the system are expected to eliminate fatalities and the collision of vehicles.

PRT was initiated as a joint venture of federal, state, and local units. The Monongalia County Court, the City of Morgantown, and West Virginia University are supplying the land needed for the 3.2-mile guideway, while the U. S.



Model of PRT System shows its route from downtown Morgantown (right) to WVU Downtown Campus, Creative Arts-Engineering, Coliseum, Towers and Medical Center.

As a demonstration-research project for other small cities, the choice of Morgantown (population 29,000) was advantageous for several reasons. Because of students changing classes, there will be at least five peak demands for transporation a day. (Normally, non-university cities only have morning and evening peak demands.) This means that researchers will have more data and a greater variety of transportation demands.

The hills of Morgantown provide another advantage. If a rapid transit system can work on the Morgantown terrain, it can work in almost every other city in the country.

Urban Mass Transporation Administration is constructing the system under its research and development program.

Because the system probably will be the most advanced of its kind in the world, it is very difficult, and too early, to predict final construction costs. The cost of research and development for the system, which will not recur if the system is duplicated in other communities, may be as much as 25 per cent of the total costs.

Yearly or semester passes and a central office to sell individual tokens are expected to reduce operating costs of the system. This will save on manpower by eliminating ticket offices at each station and will speed up service, as well as eliminate problems of handling large amounts of change. For football games and other large events, special token sellers will be placed at each station.

The present WVU inter-campus bus system, which is the second largest university-operated system in the country, is financed by fees collected from all students. It has been proposed that this method be extended to PRT.

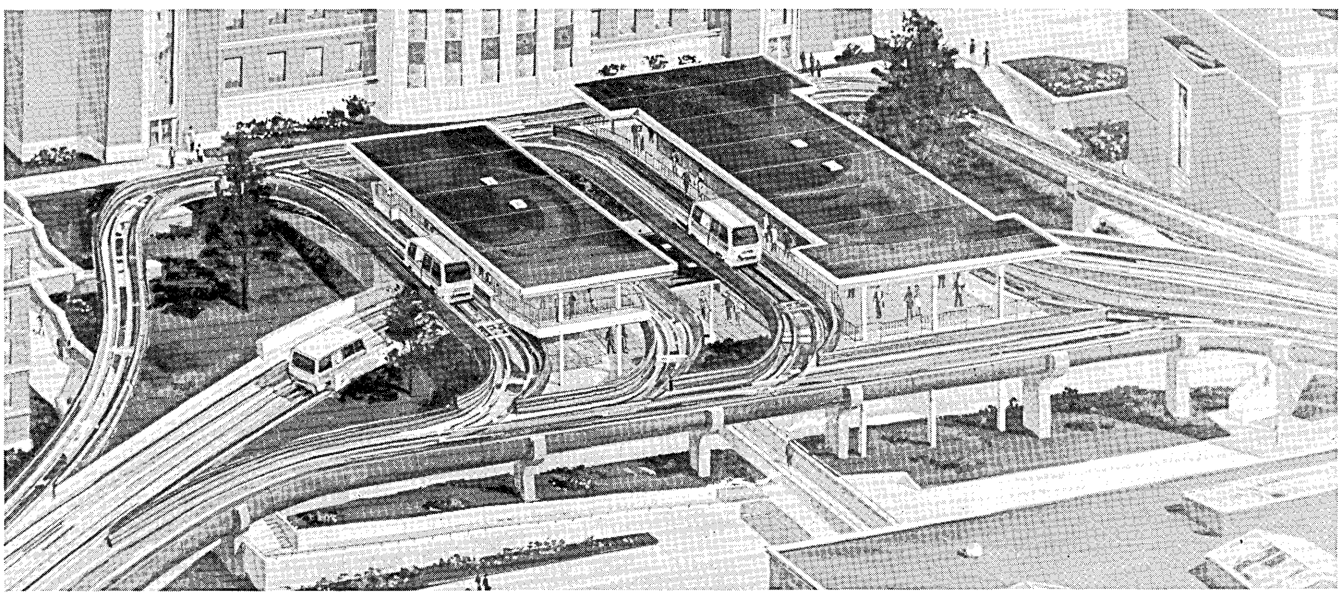
It will cost students less than 10 cents a day to ride as many times as they want to under a proposal now being studied. The same yearly or semester fee would be charged townspeople and university personnel. Tokens for occasional riders would cost slightly more.

Based on an estimated 20,000 regular students and 6,000 summer students by the time construction of the system is finished, these fees would amount to between $600,000 and $700,000 a year. This and the other revenues should be adequate to cover operating expenses. Another advantage of the set-fee method of financing operations is that it allows for better planning because a definite amount of income is assured each year.

The first phase of construction will be to build the guideways from the downtown station on Walnut Street to the Engineering Sciences Building—Creative Arts Center station on the Evansdale Campus. This work is scheduled to be completed by October, 1972, and testing of vehicles will begin at that time. The first regular passengers should begin riding in the fall of 1974.

The second phase of construction, which will begin as soon as the first phase is completed, will extend the guideways to the Coliseum and the Medical Center. This work should be finished in the spring of 1974.

PRT is being designed so that future spurs and links could be added with little disruption of its operation.



PRT Station (artist's drawing)

II. THE COMPUTER AS THE HEART OF PERSONAL RAPID TRANSIT

A major breakthrough is taking place in the field of urban transportation at Morgantown, West Virginia. Following the recommendations which resulted from studies initiated and conducted by West Virginia University's Department of Industrial Engineering, the U.S. Department of Transportation, together with the University, the Boeing and Bendix Aerospace Companies and Frederic R. Harris, Inc., are currently in the process of design and construction of a new mode of public transportation referred to generically as the Personal Rapid Transit system or PRT. The system involves new engineering concepts applied for the first time to transportation. This system will be unique and the first of its kind, not only in the United States, but throughout the world.

Although the project's history dates back to 1966, including the phases of planning, feasibility testing, and preliminary design, the ground-breaking ceremonies took place as recently as October 9, 1971. Prototype operations are scheduled to begin during the summer of 1972.

Major Innovations

Major innovations of the Morgantown PRT, and those which distinguish it from other operational transit systems, include:

- A Computer Control
- Demand-Activated Service
- Small, Personalized Vehicles
- On-Board Switching
- Short Headways
- Off-Line Stations
- Non-stop Trips from Origin to Destination

The PRT is a computer-controlled, fully automated collection and distribution transportation system. It is characterized by two types of service. The first service will be demand-activated or on-call, whereby a passenger selects his destination at the origin station in tbe same manner as he would call an elevator in an office building. A single vehicle will respond to the demand and provide the passenger(s) with non-stop transportation to the selected destination. The second form of service will be a prescheduled service for peak traffic periods. In the scheduled mode, each link in the network will have its own schedule of vehicles moving between predetermined station pairs.

The computer system for the demonstration project will be capable of controlling an initial fleet of up to 128 vehicles with the additional capability of controlling 256 vehicles in the future.

Vehicles

Each vehicle is air conditioned and heated and presently designed to carry eight seated and thirteen standing passengers. The vehicles are electrically powered, receiving power from a third rail and control instructions from an inductive loop embedded in the guideway.

The vehicles run on headways of from 7.5 to 15 seconds at a maximum speed of 30 miles per hour, although the theoretical minimum headway is 3.5 seconds. Right-of-way for the vehicles is in the form of an exclusive guideway. For the demonstration system in Morgantown, the guideway will be maintained at three grades: at grade, above grade, and a very short section in a cut-and-cover tunnel. The network in Morgantown will consist of approximately 3.5 miles of double guideway, allowing vehicle movement in both directions. The guideway will connect six off-line stations. The network will be in the form of a "Y" with the stations at the three extremities offering station-side parking for all who choose to ride the PRT.

What the Computer System Controls

The use of a computer in the control function of a transit system is of course not a new phenomenon. However, almost without exception, its current applications have been limited to on-board systems for regulation of velocity profile. Isolated exceptions have made use of the computer for headway monitoring using the traditional block scheme of railroad control. Yet, in every instance, vehicle motormen or operators are still utilized.

The Morgantown PRT breaks away from present experience with several notable innovations.

First, control is achieved in part by way of a centralized computer, whose jurisdiction spans all six stations and the entire 3.5 miles of double guideway.

Second, there are no vehicle operators at all. Aside from the control aspect, this latter characteristic yields a transit system which is capital intensive rather than labor intensive, and the result is a transit system which is more economically viable.

Third, the computer is used to provide automatic operation of the entire transit system, and not just control of speed or headway. However, even in these elements the implemented control concept is a major breakthrough from tradition and represents a combined effort of innovative thinking and new transit technology.

Three major elements are under the control of the computer system; the vehicles, the guideway, and the passengers.

Scenario of a Passenger

A scenario of events taking place for each person who arrives at a station highlights many of the computing functions.

Each passenger arrives at a particular station with a destination in mind. At the time the passenger pays his fare, he also records his desired destination by depressing a numbered button, much the same as he would call for an elevator in an office building. The Central Computer receives the demand and begins a sequence of searches. If it finds a vehicle at the origin station (viz., a dedicated vehicle) already loading other passengers for the same destination, and it is not yet full, the vehicle is instructed to wait for the new passenger. The passenger in turn is directed by dynamic displays in the station area to the appropriate platform. If a dedicated vehicle cannot be found in the station, but there is one or more empty vehicles idling in the station, one of the vehicles will be dedicated to the same destination as the passenger's: the passenger will be directed to the vehicle as before. If there are no available vehicles in the station, approaching vehicles on the guideway, which are due into the station, are interrogated as to their next dedication status. The first available vehicle due in is rededicated to the waiting passenger. If no undedicated vehicles are due in, the entire network of stations is searched for an empty vehicle. If one is found, it will be dispatched to the station demanding it at its first available opportunity.

Once on board a vehicle the passenger will wait until one of two events occurs: either the vehicle fills up or it dwells in the station a maximum amount of time. At this point, the vehicle becomes eligible for scheduling onto the guideway. The vehicle will be scheduled for departure at a given time if it can make the desired trip without experiencing conflicts at merge points along the route. Once the passenger's vehicle is launched the remainder of his trip is essentially determined; the travel time between any two stations is fixed, and the passenger disembarks from the vehicle upon arrival at his destination.

Vehicle Accounting

Clearly, the computer system must keep track of all vehicles in the system and monitor their status. Furthermore, the computer system must initiate signals for: door openings, door closings, launch conformation, acceleration, deceleration, position control, and steering bias. The vehicle steering function is an outgrowth of another major transit system innovation which is also being implemented for the first time in Morgantown. The guideway is passive in that articulation is not required for branching maneuvers. Using lateral guide wheels, the vehicle is instructed by the computer to bias tracking from one side of the guideway to the other. In addition to simplifying guideway construction, on-board branching control has its greatest effect in permitting vehicle headways to theoretically approach a bumper to bumper state.

Initial headways in Morgantown will be at from 7.5 to 15 seconds. In contrast, the San Francisco Bay Area Rapid Transit System will operate at a nominal headway of around 2 minutes.

The computer system will pay very close attention to the guideway. In order to make vehicle launch decisions, the computer must have both real-time knowledge about the present state of the guideway and its expected future state. For example, suppose a vehicle at station i, wishing to travel to station j, must pass through a merge point enroute to its destination. The computer must know whether or not that merge point will be occupied by the time the vehicle reaches it. If it will be occupied, launching is either deferred to a later time, or an alternate route is investigated. If the merge point in question will not be occupied, the computer in effect, makes a future reservation at that point in the guideway for the vehicle awaiting launch from station i. This and other guideway control functions are achieved by a computer generated guideway image within core. Obviously, software becomes a critical element in the implementation of a computer controlled transit system.

A controlling function which is not so obvious is that of directing passengers within the station complex to the proper vehicle. From the time a passenger enters the origin station, the only part of the system aware of his presence is the computer. The passenger, by way of computer-activated dynamic displays, must be directed to the proper platform, the correct loading dock and finally to the vehicle which has been reserved to service his demand. Of all the functions in the system, this may prove the most difficult to implement. The human element introduces a certain amount of uncertainty into a system which up to now has been structured to function as nearly deterministically as possible.

Indirect control functions include the continual execution of algorithms and/or mathematical models for the purpose of achieving near-optimal utilization of the system while still maintaining a high level of service. Service is generally thought of in terms of the amount of time a passenger must wait before he departs from his origin station in a vehicle. System utilization may be thought of in terms of loaded vehicle miles, operating costs, vehicle load versus capacity, dead-head vehicle miles, guideway capacity and several other measures. At least two key operating policies will be under control of the computer. The first involves the positioning and storing of empty vehicles in anticipation of demand (dynamic scheduling). The second involves the strategy for dispatching all vehicles from stations.

The Computer System

Control over the operation is executed not by a single computer but by a hierarchy of computers interfaced by communication links. The computer system configuration is illustrated in Figure 1, and consists of a central control computer, seven station computers and a special purpose processor on board each vehicle.

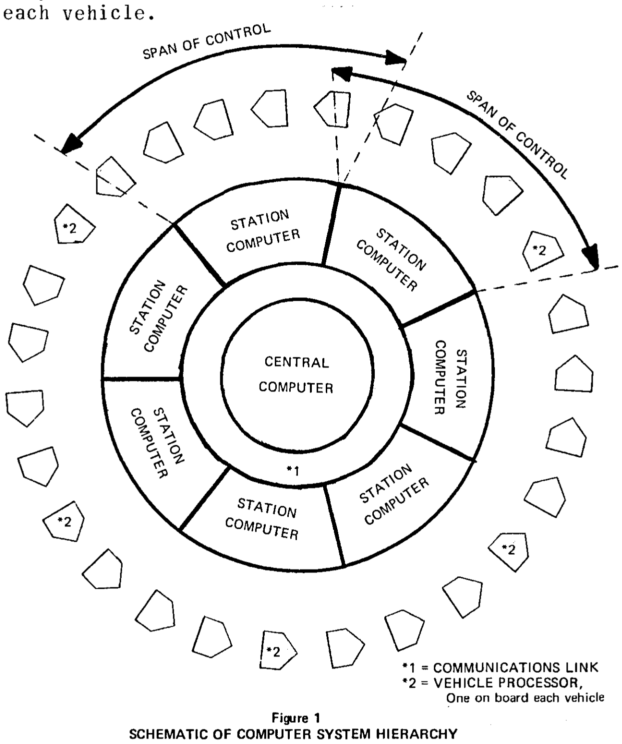


Figure 1
SCHEMATIC OF COMPUTER SYSTEM HIERARCHY

The central control computer is located in a control center approximately at mid-point in the guideway network; its function is to supervise overall transit operations. The station computers, one of which is located at the Maintenance Center, control vehicle and transit operations within fixed local control zones on the main guideway and over sections of guideway in the stations such as acceleration and deceleration ramps and docking channels. The special purpose processors on board the vehicles control the vehicle motion and status based on instructions generated by the local station computer which has jurisdiction over the vehicle at that moment. The command and telemetry link between the Central Computer and the Station Computer is a hardwired transmission cable carrying both video signals and digital data. The link between the vehicle processor and the station computer is dependent on an inductive communication loop which transmits critical signals by tones and non-critical signals by low data rate, FSK digital transmission.

Synchronous Control System: Slots

The principal feature of the Morgantown PRT upon which the software units of both the station and central computers depend and operate is the primary speed control and vehicle separation control system; this is referred to in the literature as the Synchronous Control System. It is this feature which facilitates a better understanding of the relationship of the tasks of each computer. The Synchronous Control System conceptually consists of moving slots on the guideway. Each slot represents a possible vehicle location and is separated by a fixed time interval or headway. Essentially, the slots are created, a vehicle is assigned to a slot and the vehicle maintains its position in the slot during its trip. The central computer software generates the slots and keeps track of their status (e.g. occupied, unoccupied, location) so that vehicle launches may be scheduled according to specific real-time passenger demands and vehicle traffic conditions existing on the main guideway. The station computer software actually commands the launches which have been scheduled by the central computer, and monitors and corrects each vehicle's synchronism with its slot.

Central Control Computer

The Central Control and Communications Subsystem has four primary tasks. There are systems management, vehicle flow management, provision for operator interface, and communications with the stations. The system management function roughly describes a large number of special purpose programs. Examples of these types of programs are the system start function, emergency operations, manual mode operations, data collection and system diagnosis. If the system is in a power-off condition, when power is restored, the Central Computer is loaded with the system start program. This program will load each of the station computers with their operational programs, locate each car in the system, then load the Central Computer with its operational program and start the system.

The emergency operation activities are divided between the three major parts of the Control and Communications system. The task of the Central Computer is to provide the system operator with the information that he needs to evaluate and correct the emergency and to manage the flow and the unaffected portion of the system in a manner so as to minimize the impact of the emergency.

The manual mode operations provide the system operator with the ability to attempt to correct problems on the guideway from the Central Control and Communications facility. In this mode, the system operator addresses commands directly to a single vehicle out on the guideway.

The data collection program collects data reporting origin, destination and time of day for each passenger in the system. It also compiles data on the vehicle movements within the system. This data will permit the programmers to develop more advantageous algorithms and provide a data base for the detailed implementation of the scheduling program. In addition, the Central Computer will collect other data related to the maintenance function. The result of all data collection activities will be a broad base for a Management Information System.

Vehicle flow management implies a certain amount of control over the movement and location of each vehicle. The vehicle control task includes scheduling and routing of vehicles, as well as the allocation of each vehicle to a unique conceptual slot moving over the guideway. The overall problem which must be solved by the Central Computer is the assurance that vehicles are available where they are needed and that optimum use is made of the guideway so as to get the maximum system capacity possible. One vehicle management algorithm will allocate and shuttle empty vehicles. Such vehicle management algorithms will constitute a large part of the vehicle flow management package.

The Central Computer is a DEC PDP-11 with a 36K extended core memory utilizing the standard peripheral devices; disk and tape units for mass storage and card reader and line printer for input-output. The operator interface is provided by CRT display and keyboard. The communications basically consists of telephone lines over which digital data is transmitted at a 1,800 baud rate. There is a line to each station and one to the maintenance facility (as far as Control and Communications is concerned, the maintenance facility is equivalent to a station). There, seven lines are interfaced with a computer. The telephone is connected to a handset in each station. Passengers who have problems interfacing with the system can call the systems operator and request assistance. The right-hand portion of the console has a display showing the current condition of the power system, and provides a number of push buttons by which the power system can be controlled by the operator or by the computer. It is expected that a "mimic board" will be added to this console to display the position of each car in the system.

Station Control Computer and Communications

The basic tasks achieved by the Station Control and Communications system are fare control, destination selection, station graphics, detailed vehicle flow, collision avoidance, and communications. Figure 2 shows the destination selection terminal. This terminal will be mounted with the fare collection equipment so that as one puts in his fare, he is given an opportunity to select a destination. When he selects the destination by pressing one of the six buttons shown, the station computer will check to see if it has a car within the station which is already going to that destination. If there is, it will simply turn on the graphics to tell that person to go to that berth. If not, the station computer will request the Central Computer to assign a car to carry that passenger. When that assignment is made, the graphics in the destination selection equipment and at the platform level will be energized to guide the passenger.

Additional duties of each station computer include door open and close commands and vehicle launching. Non-vital communications such as vehicle diagnostics are also monitored by the station computer, as are such operational activities as platform allocation of the vehicles as well as passengers.

Collision Avoidance

Figure 3 is an operational sketch of the Collision Avoidance system. The Collision Avoidance system consists of the present sensors which are mounted in the guideway and hardwired to the Collision Avoidance logic. The Collision Avoidance logic is in the same location as the station computer, but is a separate set of special purpose logic utilizing redundancy and fail-safe design. This logic, in turn, drives the tone loops reporting "safe" which are distributed along the guideway. The condition shown in the figure is that vehicle number 1 has activated present sensor A but has not yet arrived at present sensor B. The Collision Avoidance logic will, therefore, turn off safe tone loops 1, 2 and 3. Safe tone loop 4 will be turned on. If the separation between the vehicles is greater than 4L, then vehicle number 1 will arrive at present sensor A and turn on safe tone loop 3 before vehicle number 2 passes to that loop. Thus, vehicle number 2 will always find a safe tone loop and will proceed without hesitation. If the separation is less than 4L, vehicle number 2 will arrive at safe tone loop 3 before vehicle number 1 arrives at present sensor A. In this condition, the tone loop 3 is turned off, the emergency brakes are applied and vehicle number 2 is brought to a stop. Once applied, the emergency brakes cannot be released except by human intervention.

The computing system analyzes the position information generated by the Collision Avoidance System to monitor the flow of the vehicles throughout the system. In addition to locating the vehicles, the

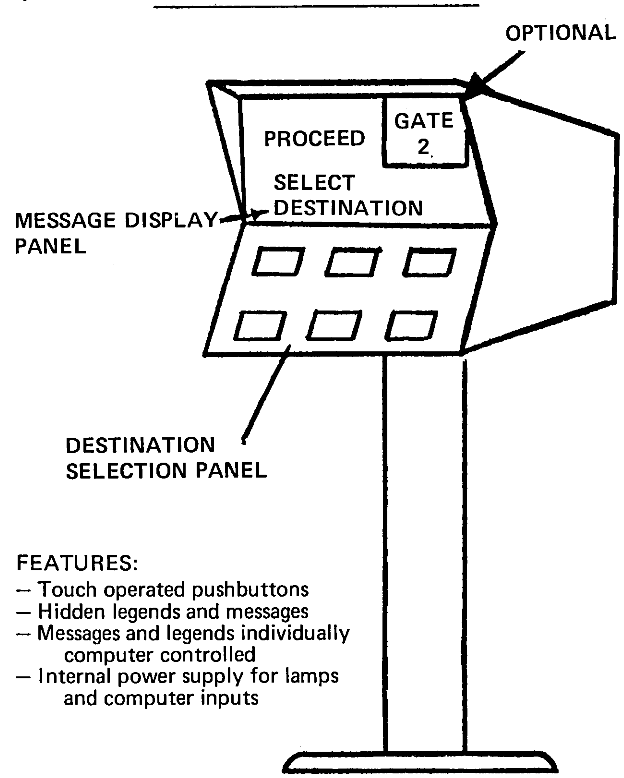
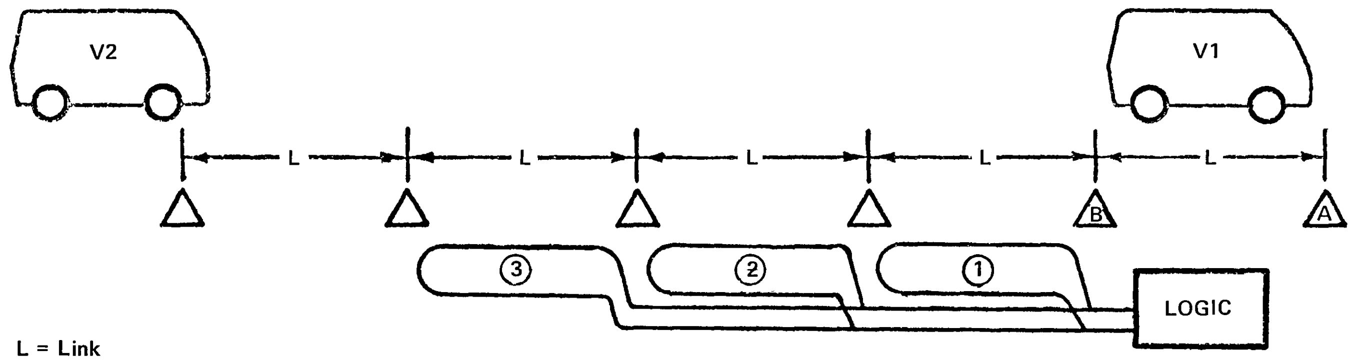


Figure 2
DESTINATION SELECTION TERMINAL



L = Link

CONDITION:

Presence Sensor A — not activated
Presence Sensor B — activated

LOGIC:

Vehicle between B and A
Safe tone removed from wires 1, 2, and 3

RESULT:

If separation less than 3L, Vehicle V2 immediately commanded to stop
If separation less than 4L, Vehicle V2 soon commanded to stop

Figure 3
COLLISION AVOIDANCE SYSTEM OPERATIONAL SKETCH

computer can use this information to detect and correct overspeed and underspeed conditions prior to activation of the Collision Avoidance System. This is achieved by transmitting to the vehicle a required performance level utilizing the FSK data link.

Vehicle Processor and Control

The vehicle processor is a command and control interface between the guideway signals generated by the station computers and the vehicle activators such as the propulsion subsystem, braking subsystem, and the steering subsystem. The processor receives FSK data from the communications unit. The data is decoded if and only if an address tag compares with the address of the vehicle. Once decoded, the processor may also generate a return message to the station computer, if a sensed fault is detected. Present requirements call for up to 32 fault conditions. The processor will assign each detected condition into one of eight failure classes, which in turn dictates the action required by the Central Computer.

The vehicle steering subsystem is a curb following system. Basically it follows either a right hand curb or a left hand curb at the command of the computer. The switching function is simply the change from the right hand curb following to the left hand curb following. In order to follow the curb, it is necessary to sense the position of the curb. This is achieved by a horizontal guidewheel. The guidewheel is pressed against the curb by the force from a bias cylinder. The bias switch cylinder allows this bias force to be applied to either the right or left hand curb. The remainder of the steering subsystem simply senses the relative position of the vehicle and the guidewheel axle and steers so as to keep this relative position zero. This is achieved through the power steering control valve and a power steering cylinder. Utilizing this curb following steering system, the computer can control the path of the vehicle through the network by changing from switch (bias) left to switch (bias) right at appropriate places.

The velocity control function is provided by the braking subsystem and the propulsion subsystem under the management of the point follower control loop. The propulsion subsystem is powered by a 3 phase, 575 volt, AC, third rail mounted in the curb stone. The torque output is regulated by a standard SCR variable phase angle power control unit. The propulsion motor is a 65 HP DC series motor providing torque to the rear wheels through an automotive rear end. This subsystem is one of the critical safety items in the vehicle; so a considerable effort has been expended to provide redundant fail-safe operation. The subsystem actually consists of 3 completely separate braking systems.

The point follower control loop follows the velocity profile which is hardwired into the guideway as a set of speed tones. The velocity profile can be modified by the computing system. Utilizing the vehicle performance parameter, the computer can slow the operation of the entire system by adjusting the parameter of each car or it can correct the improper operation of an individual car by continuously adjusting the performance perameter in order to achieve the desired operation. The vehicle speed control is an open loop with respect to the velocity profile. The Vehicle Processor and Communications system utilizes the speed profile and the output of an onboard odometer to generate motor and brake commands. These commands together with the disturbances represented by the variations in slope and change in wind direction result in a distance travelled. The distance traveled is measured by the odometer and fed back to the Vehicle Processor and Communications system. The requirement of the point follower control loop is to maintain the position of the vehicle within 10 feet of the nominal position. Since the average trip is on the order of 10,000 feet, the resultant odometer accuracy requirement is 0.1 percent. The variations in the odometer gain caused by changes in drag, slope and variations in the passenger load (which changes the effective radius of the tires) are greater than permissible by this accuracy limit. Therefore, each 1,000 feet of guideway has a 200 foot calibration tone loop. The Vehicle Processor and Communications system utilizes this tone to zero out the accumulated position error in the odometer and to correct the odometer gain. □

Who's Who in Computers and Data Processing

A SUBSCRIPTION PUBLICATION

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a. If yes, what kind of computer? Manufacturer?__________ Model?__________

b. Where is it installed: Organization?__________

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A Computer Laboratory for Elementary Schools

Dr. Seymour Papert
Artificial Intelligence Laboratory
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"Three new roles for the computer in education are:
- *mathematical technology for children*
- *a model for learning about learning and other cognitive skills*
- *the use of theoretical computer science as a source for research in elementary education*

The methods being developed in this project add new dimensions to the possibilities of reform of the curriculum in mathematics, physics, biology, and other conventional school subjects. They allow us to remove artificial barriers between "subjects", and in this way to integrate mathematics with the other sciences, to integrate science with linguistics and other academic areas, and even to establish significant links between "academic" work and freer activities such as music and gymnastics. Partly through removing these barriers, partly independently, we are able to achieve a much more involved and personal participation of children in their work.

The key to achieving all this is recognizing three new roles for the computer in education. These are:
- mathematical technologies for children;
- a model for learning about learning and other cognitive skills;
- the use of theoretical computer science as a source for research in elementary education.

Mathematical Technologies for Children

We find that the intention behind this computer role is most effectively conveyed by a fantasy. One might dream of having children learn mathematics by giving them a ship to sail the ocean, a sextant to fix their position, and a cargo to trade with distant peoples. A large part of our work is directed at trying to make this dream come true (at least in principle) by creating mathematical instruments more manageable than ships and sextants, but which still allow the child to develop and exercise mathematical arts in the course of meaningful, challenging, and personally motivated projects.

In our context the computer is not merely a device for manipulating symbols. It actually controls real, physical processes: motors that turn, trucks that move, boxes that emit sounds. By programming it, the child is able to produce an endless variety of actions in a completely intelligible, controlled way. New mathematical concepts translate directly into new power for action. Self-generated projects induce an immediate and practical need to understand the mathematics of movements, the physics of moving bodies, and the formal structure of sound patterns.[1]

A Model for Learning about Learning and Other Cognitive Skills

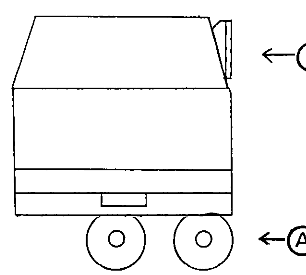
Because "children learn by doing," research in education has the task of inventing better things for children to do. We see our technologies as a particularly good example that is completely justified on this score alone: one can do infinitely more with our machines than with the rods and blocks and shiny but passive laboratory apparatus of the curriculum reform of the previous two decades.

(Based on a proposal to the National Science Foundation for support of research on children's thinking and elementary education.)

We are also influenced by another dimension of educational philosophy indicated by an addition to the slogan: "Children learn by doing, and by thinking about what they do." So, another dimension of the task facing research in education is to give children better ways and means to think about what they do; and this includes looking for activities whose structure might allow the child a particularly clear view of his own intellectual activity and so help him achieve a more articulate understanding of "doing."

Programming a "Turtle"

To see how computer-controlled devices excel in this function, consider a simple task of the kind we assign during the first week of an elementary school course using a device known as a turtle (see Figure 1).



A. Three wheels, on which it rolls; the wheels support it, steer it, and drive it

B. Light or photosensitive cell

Figure 1 — A "Turtle", schematically

(This work was supported by the National Science Foundation under grant number GJ-1049 and conducted at the Artificial Intelligence Laboratory, an M.I.T. research program supported in part by the Advanced Research Projects Agency of the Department of Defense and monitored by the Office of Naval Research under Contract Number N00014-70-A-0362-0002.)

The turtle "understands" simple commands (typed at the computer terminal) such as:

FORWARD 73	Which makes it advance 73 units
RIGHT 90	Which makes it rotate around its center through a 90° angle
PENDOWN	Which makes the turtle lower its pen and leave a trace of its path
PENUP	

To make the turtle do anything more complex, the child must write a procedure. For example, the child might want to "teach the turtle" the command "BOX", whose effect is intended to make the turtle move around a square. To define it, the child must "tell the computer how to BOX." So he types:

TO BOX	The word "TO" indicates that we are defining. So the turtle does
1 FORWARD 100	not go forward and turn right when the next lines are typed.
2 RIGHT 90	Instead, it "remembers" these directions until it is given the
3 BOX	command BOX. Notice the use of recursion in line 3 to set up a self-perpetuating process.
END	

The last line says the definition is finished. The child now has only to type:

BOX	This command causes the turtle to go round and round and round ... a square whose side is 100 units long. For this example we do not need to know how to make the turtle stop.

Drawing a Triangle

Suppose, now, to develop our example, that the child wants to make the turtle draw a triangle. He writes:

TO TRI

1 FORWARD 100

2 RIGHT 60

3 TRI

END

But when the command TRI is given, instead of drawing a triangle, the turtle draws the hexagon in Figure 2.

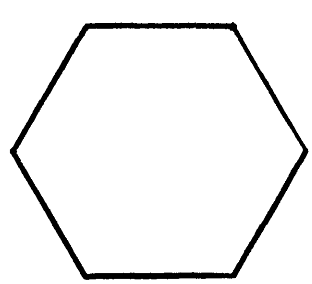


Figure 2

When a child makes mistakes in an arithmetic class, he (and, alas, often his teacher) might conclude, "I'm dumb" or "I'm not mathematically minded" or "I never could understand that" or "to hell with it." The child rarely engages in constructive thinking about how and why the mistake happened and what can be done about it. But when the turtle draws a hexagon instead of a triangle, the reaction is much more constructive (or at least easily becomes so with a little encouragement). Children almost unanimously see the turtle (rather than themselves) as doing the "wrong thing." And, of course, we strongly encourage this, for the child is then much more ready to be objective about what happened. Moreover, we are able to urge them to understand exactly why the turtle did what it did ... rather than merely make it do the "right thing." The diagram (in Figure 3) will help the reader understand what did happen. An elementary school child with a past history of unbroken failure in math needs a longer time. Often it comes to him as a revelation that it is ever possible to understand anything "exactly."

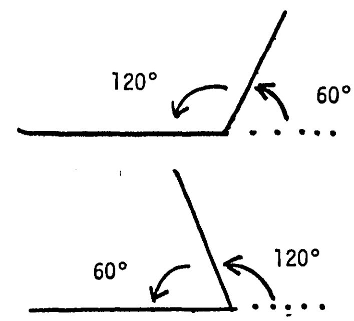


Figure 3

Debugging His Own Mistakes

We have observed many children gradually transfer the objectivity and skill acquired in debugging the turtle to "debugging" their own mistakes and thus a acquire a more constructive approach to their own learning.[2] So, in a sense, they are learning something about the practical psychology of learning as well as about programming and geometry.

They are also learning something about the nature of thinking by seeing an objective, externalized example of that curious process called "formal" or "rigorous" thinking, a process which remains deeply mysterious to most people who pass through school without ever understanding what mathematical thinking is, or why it should exist.

Finally, under this heading, we mention for completeness a further area of our work with children. This is research on how people learn — and can become better at learning — physical skills such as juggling, balancing feats, and other "circus arts." Our conjecture, (for which we are gradually collecting confirmation) is that these skills can be learned with special ease by persons who have acquired sophistication in the "debugging model of learning" and in a number of similar concepts related to computation.

Theoretical Computer Science as a Source For Research on Elementary Education

There has been very little interaction so far between the elementary curriculum reform movement and the conceptual, theoretical wings of computer science. We believe that by starting this interaction we may be unleashing an intellectual force of great power; for education might prove to be the area of research and application needed for certain germinating ideas in the theory of computation to acquire purpose and maturity.

Artificial intelligence is an area of computer science that should interact with education. But, there are other, less obvious, examples with a greater potential for immediate impact. One of these, which we shall use to illustrate our thesis, is computational geometry.

Computational Geometry

This is an essentially new branch of mathematics that derives from such sources as automata theory, pattern recognition, and computational complexity. From these diverse origins, it has gradually moved towards a coherent concept. The Artificial Intelligence Laboratory at M.I.T. is a focal point of development of computational geometry and of the thinking about education embodied in its development. One of the best developed pieces of mathematics in our new curriculum is "turtle geometry," which is firmly rooted in both areas.

Enough other examples are germinating in our laboratory to convince us (as we suspected from general ideas) that many branches of computational mathematics will come into being and that many of these will prove to have pedagogic advantages. Turtle geometry is apparently a rare innovation in mathematical curricula in actually being a new piece of mathematics, created for children. This is very different from the general character of what is called the "New Math". The creators of that movement did not create very much (if any!) new mathematics, but rather seem to have scratched about in the mathematician's cupboard for fragments of already existing (and generally rather old!) mathematics that seemed suitable for children.

Computer scientists have so far not been imaginative in developing mathematical ideas for teaching their subject at any level. The traditional Boolean-Algebra-Finite-State-Machine-Lambda-Calculus course is offered as uninspired and uninspiring fare for young computer scientists. We would rather teach turtle geometry — and other topics like it — at all levels, whether in fifth grade or in graduate school.[3]

We have scarcely begun to tap the three sources of educational innovation mentioned above. We find however that some of our illustrations of new technologies are sufficiently compelling to attract considerable interest from research groups and educators, including some who had become disenchanted with curriculum reform and computers. We hope this interest may start a wave of more research strong enough to deflect the national view of the role of computers in education.

A New Curriculum

We have set ourselves for the present the goal of developing enough material in the form of technology (like turtles) and ideas (like turtle geometry) to include the major part of a full elementary school curriculum in mathematics, science, music, circus arts, formal linguistics, and some new subjects one could call "cybernetic models" — all for use on the elementary school level.

On the technological side, this task is less formidable than it might seem at first glance. Our engineering work no longer has the form of developing particular devices such as turtles; instead we have gained enough experience to shift over to developing modular kits, out of which many different kinds of devices can be constructed.

To this end we have already built a first model of a universal controller to allow extremely easy interfacing (of motors, relays, sensing devices, and so on) to the computer. We shall soon be able to install one of these in our elementary school computer laboratory, and the children will then be able to motorize under computer control any construction they care to make, say with an erector set.

Developing theoretical ideas and teaching methods has become a strain on our present computational resources. We have exciting ideas for a full physics course and a biology course. We have a strong group working on teaching and studying music. We have an increasing pool of mathematical talent eager to develop new ideas. For these ideas to flourish, we need more access for our research staff and students to computers and to children. We need a computer facility of our own, with real-time interactive facilities designed for our needs.

We are therefore designing a system that we need for our own work, but we have kept in mind the possibility that the system might serve as a model for general use in schools and other educational environments (colleges, museums, vocational training, etc.). We have designed it (we believe without compromising our own needs) to facilitate this. The system will, it is expected, be very much ahead of the "state of the art" for mini-computers, in power of language, in real-time facilities, and in displays. On the other hand, its cost (excluding the once-only costs of engineering and programming) will be comparable to currently available systems. So, it will almost inevitably be used much more widely than just in our laboratory.

Technical Features of Computer System

The important technical features of the system are:

(i) Language. The system will be dedicated to a version of the programming language LOGO, extended to provide full list structure, algebraic infix notation, and floating-point arithmetic.

(ii) Users. The system is designed for 10 users, but will probably be extendable to 16. The design takes advantage of the fact that many users will be children working with very small programs.

(iii) Real Time. The system will allow users to declare priorities for response time. The intention of the design is that the top priority program should be able to provide for some experiments a response in less than 30 milliseconds.

(iv) Displays. The system will have five display tubes of adequate quality for turtle geometry and similar graphics, but of considerably lower quality (and cost) than the standards usually considered necessary by the computer industry. (If suitable plasma storage tubes become available in time, we might switch to them.)

(v) Autonomy. The system will be able to operate autonomously, but will be connected by a single high-speed line to a central computer facility to allow more convenient back-up storage, monitoring of programs for research purposes, etc.

Examples of What a Future School Computer-Laboratory Might Contain

We foresee a number of kinds of new devices in a future school laboratory. We shall try here to convey some images that guide our present thinking. But we are firmly committed to the need for flexibility in this kind of research, and we will certainly not stick to a pre-conceived idea when better ideas appear.

Build-An-Animal Kit

We imagine an environment in which children's study of biology is augmented and deepened by embodying various biological functions and mechanisms in cybernetic model animals. The idea of studying biology by building models is not, of course, new. Our contribution is to show how it can be done easily and "cleanly" by a child. By "clean" we mean that the child should not be frustrated by having to work to great mechanical precision, and the process of debugging sub-systems of the model should not be confused by bugs due to mechanical accidents.

A good example of a biological function suitable for study in this way (and perhaps in no other way at an elementary school level) is balance. To understand its mechanisms in any real sense one needs to have mastered a small set of very powerful concepts such as feedback, stability, momentum and a few others. In an abstract setting these concepts are difficult. Concretized in suitable projects in our kind of laboratory these ideas are perfectly accessible.

To illustrate the way in which one might start children off on understanding them, one project is to program a turtle to balance an inverted pendulum.

A Lesson Unit on "Physics in the Finger-Tips": Balancing a Broom

The problem is to find out what objects are easy to balance ... and why. We begin with some crude experiments on balancing objects ourselves. See Figure 4. Then we try to generalize to related situations: can a child or a giant walk more easily on a tight-rope? What length of stilts is best? Etc.)

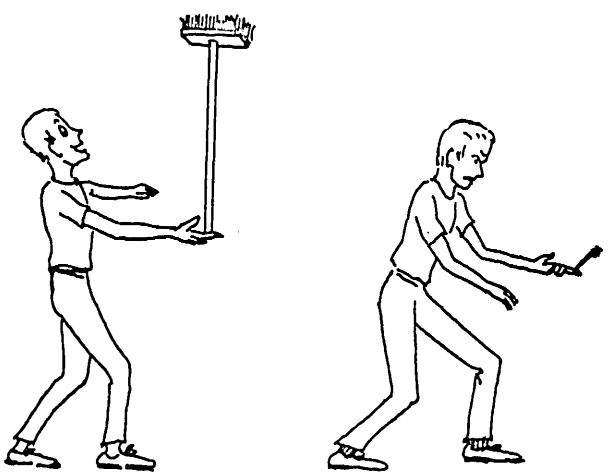


Figure 4

The next two figures show stages in the construction of "models" of this balancing problem ... (making models is often a good way to understand things!). What kind of program can make the turtle balance the rod? It is remarkable (but very typical of this kind of work) that a very simple procedure will work under restricted but realistic conditions. This procedure (believe it or not!) is simply:

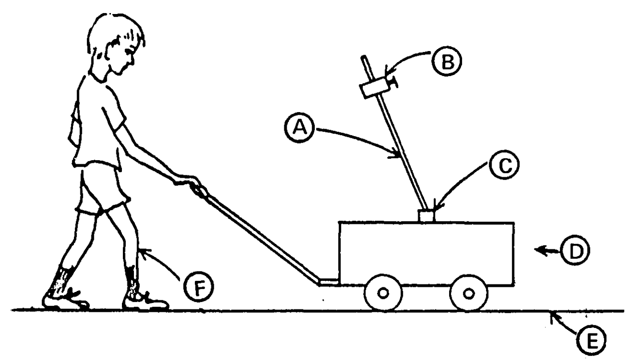
```
TO BALANCE
1 FORWARD ANGLE
2 BALANCE
END
```

The procedure uses a sub-procedure:

```
TO ANGLE
1 OUTPUT PORT 5
END
```

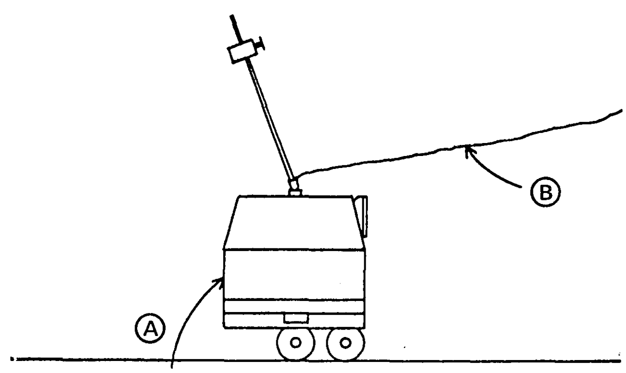
This sub-procedure causes the information from "PORT 5" to become the "value" or "output" of the procedure ANGLE. We guess that the child must have selected the fifth port as the inlet for his wire from the potentiometer (see Figure 5) and that this provides a number between -180 and 180. We also see that he decided that the state of the system would be represented by this angle. State is one of the prime concepts in our fifth grade courses — whether or not we mean to use it in physical contexts. We see this as a good example of a fundamental concept that would appear very abstract in the context of traditional schools and curricula, but which becomes simple, concrete, and powerful in ours.

The next sub-project for the child is to understand exactly when this will "work." The reader will easily see that it will work only for certain lengths of rod, and for sufficiently gentle perturbing forces. He will less easily see that the procedure allows a drift in the turtle that will eventually bring it to the end of its permitted travel. Each of these observations leads to a modification or extension of the procedure. When it is eventually debugged it may work too well, i.e., much better than the boy in the original problem! The final step will be to degrade its performance — perhaps by limiting its reaction time to the human range.



A. Light rigid rod
B. Weight clamp; variable mass and position
C. Hinge with 1 degree of freedom
D. Truck
E. Rail to make problem 1 - dimensional
F. Child keeps rod from falling by pushing truck back and and forth

Figure 5A



A. Turtle keeps rod from falling by moving forward and back. Potentiometer in hinge provides information for feedback.
B. Wire to computer.

Figure 5B

An Extension to Postural Balance

People can stand without moving their feet ... so they have a different balancing method. But its principles are the same. A project directed at finding out how this works should be accessible to a student who has understood the previous experiment, provided that he has suitable components. A set of components we propose for our kit includes a joint that looks like two bars hinged together, but which has, hidden in the bars, a "muscle" in the form of an electrically driven actuator, and a sense organ. Information and power signals would be passed internally in the bars. These joints connect together easily, in the manner of standard "construction kits." The kit also contains passive bars, and bars with other sense organs, such as accelerometers, and possibly other kinds of actuators. See Figure 6. Project: Design a program to balance this device. The letter A marks two places at which accelerometers are attached.

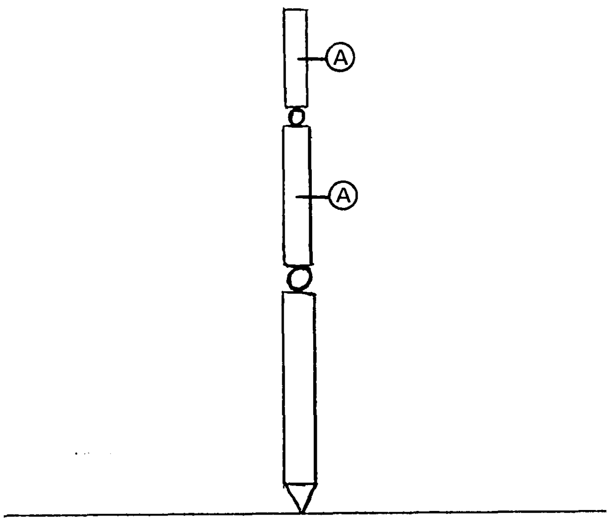


Figure 6

Visually Controlled Balance

The kit would contain simple light-sensitive devices and could balance by using these as a source of information. An excellent experiment for children who are aware of these issues is to study whether people balance by vision. Clue: People can balance with their eyes closed, even on the ball of one foot. But often fall over when placed in this situation while looking through right-left inverting spectacles.

These topics are obviously open-ended ....

Make a Radio-Controlled Motorcycle

We leave the reader to work this one out all on his own. The only clue we give him is that the control theory of balancing bicycles is much easier than popular beliefs (even those of physicists and psychologists) would lead one to suppose. □

NOTES

1. A less lyrical, more technical account of some of the actions we have already made accessible, can be found in the paper, "Twenty Things To Do With A Computer." Available from the author.

2. Other examples can be found in the papers "Teaching Children Thinking" and "Teaching Children To Be Mathematicians." Available from the author.

3. A monograph by Marvin Minsky and Seymour Papert developing ideas of this sort will soon be published by the American Mathematical Society.

NUMBLES

Neil Macdonald
Assistant Editor
Computers and Automation

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away and a second one in the digit cipher. The problem is to solve for the digits.

Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, which is expressed in numerical digits, is to be translated (using the same key) into letters so that it may be read; but the spelling uses puns or is otherwise irregular, to discourage cryptanalytic methods of deciphering.

We invite our readers to send us solutions, together with human programs or computer programs which will produce the solutions. This month's Numble was contributed by:

Andrew M. Langer
Newton High School
Newton, Mass.

NUMBLE 726

```
      T H E
  N I G H T          FR = GS
  ---------
  N N H I O
      x I S
  ---------
E N R M E H
H G I M T
-----------
T U G U O H     86159  86149  78690  7684
```

Solution to Numble 725

In Numble 725 in the May issue, the digits 0 through 9 are represented by letters as follows:

U = 0	D = 5
N = 1	G, H = 6
T = 2	R, S = 7
A = 3	V = 8
I = 4	E = 9

The message is: Naught is never in danger.

Our thanks to the following individuals for submitting their solutions — **to Numble 725:** Herbert Harvey, Morrisville, Pa.; and Don L. Richards, Chicago, Ill. — **to Numble 724:** A. Sanford Brown, El Paso, Texas; and (Mrs.) Pat Tischhauser, Manchester, Conn.

CORRECTION: In the May 1972 issue of *Computers and Automation,* the following correction should be made:

Page 49, "Numbles": In Numble 725, replace the letter U in line 4 by the letter V; line 4 will then read D T T H I V.

We thank our readers who called this error to our attention.

The Computer and the Intellectual Frontier

Dr. Richard W. Hamming
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Murray Hill, NJ 07974

"Perhaps the ultimate game is programming a computing machine. Here again, all the rules are known in advance, but unlike other games, the object, producing a particular working program, changes from game to game. Thus programming offers the devotee an almost infinite number of variations on the basic game."

Outline

1. The Computer as an Experimental Tool
2. Music
3. Computer-Made Music
4. The Use of a Computer Before an Experiment
5. Synthetic Worlds
6. Philosophy
7. What is Meant by Artificial Intelligence?
8. The Need for Machine Intelligence
9. Game Playing
10. Schools of Artificial Intelligence
11. Creativity

The Computer as an Experimental Tool

This chapter examines the use of the computer

1. Before doing an experiment
2. During an experiment
3. After an experiment
4. In place of an experiment
5. As a source of new types of experiments

The first three are fairly straightforward, not very exciting, and will be disposed of rapidly. Only the last two are of major intellectual interest. But before examining these we need to make a digression on the topic of how digital computers handle information in the form of signals and data from the real world, and the consequences of how this is done. ...

In spite of the great flood of publication of books about computers, only rarely does a computer book appear which is thoroughly interesting and stimulating both to persons in the computer field and to persons not in that field at all. Such a book is "Computers and Society" by Dr. Richard W. Hamming of Bell Telephone Laboratories, Murray Hill, N.J. He is an Adjunct Professor in the Department of Computer Sciences of The City College of New York, New York, N.Y., a former president of the Association for Computing Machinery, and for many years a member of its Council.

We are fortunate to have received permission from the author and from the publisher, McGraw Hill Book Co., 330 West 42nd St., New York, N.Y., to publish some excerpts.

The book itself is full of ideas and is highly recommended to all our readers — and is much more satisfying than just the excerpts published here.

The following article is largely based on two chapters, Chapter 9, "The Computer as an Experimental Tool", and Chapter 14, "Artificial Intelligence".

Music

Production of music has received a great deal of attention from people who are interested in computers. Their efforts may be divided, mainly, into two approaches: programming a computer to compose music, and simulating musical sounds by computer. (Analysis of music has also been done to some extent.)

Probably the first composed music to achieve national attention was a composition, based in part on the use of random numbers, called Push-Button Bertha (1956) and played briefly on radio stations on the West Coast.

Much more serious were the efforts by Hiller and Isaacson of the University of Illinois to compose music on a computer. Their efforts resulted in the "Illiac Suite" (from "Experimental Music", Hiller and Isaacson, McGraw-Hill, 1959). What they did, briefly, was to write programs that described the rules of composition of various musical forms, and let the machine see if the next note chosen at random met the required rules. If it did, the note was accepted, and if not, the note was rejected and another trial was made. If enough failures occurred in a row, the program backed up and re-did one or more of the previous notes.

Some of their results were organized into the "Illiac Suite" (named after the Illiac computer on which the computing was done) and was played by a local musical group. Later it was played by the University band.

Composing by, or more accurately, with the aid of, a computer is popular in some circles. The possibility of random composition is especially attractive to many modern composers, John Cage being perhaps the leading exponent of the use of random effects in music composition.

Computer-Made Music

Computer-made music should be distinguished from computer-composed music. Further, it is necessary to distinguish various forms of making music (sounds). Two approaches to using the new electronic capabilities that we now have for making sounds are the French School of "Musique Concrete", which uses natural sounds recorded on a tape recorder as a basis but alters and regroups and selects various parts by electronic technique, and a German group, which uses electronic sounds that are not originally natural. Still other people use specially made electronic equipment to form the sounds, such as the Moog instrument.

The computer-made music we shall discuss is produced directly from the computer in the following manner. The computer calculates a stream of numbers and these are converted via a digital-to-analog converter (plus a simple smoothing filter) to a sound track that is later played on a tape recorder.

To understand how complex sounds can be produced by such a system, consider what happens at the opening of your ear during a concert. These is at any instant effectively a single air pressure at each one of the two ear openings. This air pressure varies with time and is the sum of sounds made by all the musical instruments, the echos of the concert hall, the coughs of your neighbors, etc. All the sounds are added together (except at very loud sound levels) to produce a specific air pressure at any single instant. Whether you hear this directly or whether it is converted by a microphone to an electrical voltage and then recorded on a tape to be played later, it is a single, time-varying function (one such function for each ear). Thus on the magnetic tape of a tape recorder there is a magnetic signal which varies from place to place along the tape and is in some sense equivalent to the air pressure. Running the tape past the playing head of a tape recorder produces a time-varying voltage very much like the original time-varying air pressure. This voltage activates the loud speaker which produces the variations in the air pressure you finally hear.

If we produce numbers in the computer that correspond to the samples of the amplitude of the voltage that corresponds to the sound, we can make a sound track directly without using any musical instruments at all. To do this a program is written for the computer that includes a musical score for one or more instruments, and descriptions of the characteristics of musical instruments (attack, overtone, and vibrato pattern). This single program, written only once, then computes numbers which are put on a digital tape. This digital tape, when passed through a digital-to-analog converter, makes the magnetic tape that is played on a standard tape recorder to produce the "music" you hear.

With this technique for producing sounds the composer has at his command any sound that can theoretically exist, and not merely those that natural instruments can make. And if we distinguish between the composer and the conductor, then the conductor can go over a passage as often as he wants and precisely control the changes until he has exactly what he wants. Thus in some sense we have reached the ultimate in the matter of technically producing music. We have in a very real sense reached perfect control over any sound that can possibly exist.

For example, to produce a pure tone we would write a program that computed the values of the sine function at a very small spacing. The pitch of the pure tone you heard would depend on the spacing of the angles used in the samples of the sine function.

The rate of computing the numbers is not important (except for the cost) since we can take as long as we please to compute them. But when it comes to running the digital tape through the digital-to-analog converter, it is necessary to do this at a fixed rate, preferably at the rate that the final music is to occur (though obviously we can do it at half the rate and later play the tape at twice the speed if we please). Thus only the digital-to-analog converter needs to function at a rapid rate.

Where we lack control is in determining what sounds to make to have the desired effect. The sudden opening of the new world of all possible sounds leaves us in doubt about which ones to choose.

Most of the people who have responded to this new step forward (backward so far as some people are concerned, to be sure) have been engineers who are not basically musicians, and what they have done with the new tool is about what you would expect from them.

Therefore, before criticising the new "music" (if you will pardon the word), remember:

1. The composing was probably done by an amateur musician and not a great composer. How well would music that you composed sound?

2. Most of the currently classical music was regarded as a "scandal" when it first appeared, and it was often a generation or two before people learned to appreciate and like it.

3. When you hear Oriental music, you realize that a different form of music requires experience and perhaps training to appreciate. Electronic music also probably falls in this category.

At present (1970), the most frequent occurrence of computer-made music and sounds is in TV commercials. ...

The Use of a Computer before an Experiment

The use of a computer before an experiment is coming into more use. Perhaps a good illustration of this is my first experience with large-scale computation, the calculation of what a proposed design of an atomic bomb could be expected to produce when it was actually tried. From the calculated results of one trial design the experts could make judgments as to how to design the next try. In this fashion they gradually came to a design that worked. The results, at least to me, were surprisingly accurate when compared with the actual field trial at Almagordo — however disturbing the whole aim and application.

In this situation there is no possibility of doing small-scale experiments. Either you try out a full-sized bomb or you don't try one at all. Sometimes before an experiment it is possible to do the traditional laboratory or pilot experiment, but these have been found to be costly in time and money. Thus the computer is used instead to simulate the experiment. The computer serves as a basis for the pilot study. For instance, in the current space shots there are extensive simulations of the situation long before an actual field trial is made. Indeed, the use of computers before an experiment to simulate what will happen is so widespread and successful that the very technique of experimentation has been altered. Simulation plays a prominent role in almost all large-scale experiments in which there is a sufficient body of knowledge to provide even a poor model.

The possibilities of this approach have not yet been exhausted, and we are still learning new things about how to carry on the art of simulation. However, we shall leave the subject here, merely noting that this use consumes a large part of the capacity of many machines.

The use of the computer as a control device during the experiment is gradually coming into more prominence. At first the computer was used merely to gather the data from an experiment. Gradually it was also used to direct the set up, and check out the equipment before the experiment was run. Sometimes it was used to cycle the equipment through a series of repetitive experiments and to supply the input pulses. We will examine such uses in more detail later.

Synthetic Worlds

I have now started down a path that I expect most readers will not wish to follow to the end, but will prefer to drop off at some point along the way. Indeed, I am not sure how far I believe in it myself, but let me present the vision. There are three distinct questions to be asked about the path:

1. How far can we go?
2. How far will we go?
3. How far should we go?

Let me introduce the idea of a "synthetic world." By this I shall mean a world that finds its main inspiration not in the real world but in the mental world. Games are good examples of synthetic worlds. As a first example, consider the game of chess. No one really pretends that it is a model of warfare. It is a game that is amusing to play. The characteristics that I am interested in are

1. The rules are explicitly known and are inherently simple.
2. The object of the game is also clearly known.
3. How to combine the elementary rules to achieve the stated goal is not known; rather, it is so complex as to defy (up to now) any reasonable analysis.

Bridge is another game that is really a synthetic world. In addition to the stated rules there is a random element whose characteristic (uniform distribution over all possible hands) is supposed to be closely achieved by a moderate amount of shuffling. (We will examine more of the details of machines playing games in Chapter 14).

Indeed, almost all games fall in the class I am calling a synthetic world, and I should like to dwell for a moment on the powerful attraction such synthetic worlds have for many people. They can be very attractive indeed, and for some people can occupy a major part of their lives.

Perhaps the ultimate game is programming a computing machine. Here, again, all the rules are known in advance, but unlike other games, the object, producing a particular working program, changes from game to game. Thus programming offers the devotee an almost infinite number of variations on the basic game. The rules stay the same, but the objective of the game is constantly being changed from problem to problem. If you have any doubt of the truth of my remarks you have only to watch or talk to a professional programmer for a while to find that often he really has only the slightest interest in the use of the program that he writes. All he cares about is being given a clearly stated goal and then being let alone to work out how, using the moves allowed by the machine, to get from the stated problem to the working program. When the program works, his interest usually vanishes. While there is some ultimate reality both in the machine and the paper he uses, as well as in the use the program is to be put, his major activity has only the most tenuous connection with the real world: it is a genuine example of activity in a synthetic world.

Whether we choose to view theoretical physics as a game or not is not of importance here. Suffice it to say that some people regard it as a game and some do not. Much the same can be said in other fields of science.

Having made clear, I hope, the main characteristics of what I mean by a synthetic world, as well as its enormous attraction for many people, let me get back to the path I wish to take you down. Obviously, it is the path to synthetic worlds, but let us recall how far we have already gone. Evidently the two experiments, acoustic and visual, I cited before are a start toward the synthetic world. In both cases the stimuli used were not naturally occurring ones. They were highly artificial, and their possibility rested very much on the existence of computers. Furthermore, the possibility of imagining the experiments rested heavily on an acquaintance with computers and their capabilities. The example ...

The next example I wish to take up involves the same psychologist. One day I said to him that if he would define a tribe of Martians, with every one being identical or else having statistically distributed characteristics, whichever he chose, I would simulate the Martians' behavior on a computer and we could then study the basic problem of "how characteristics of the individual are transformed through group interactions into different, group characteristics." Suppose we had studied this for 5 years or so, with an increasingly larger group, until we felt that we had a grasp on the basic question of How group interactions transform individual characteristics into group characteristics. I claim, and you may not care to go along with me this far, that we would know much more than we now do about such problems as the behavior of committees, mob psychology, corporate behavior, etc., where it is clear that the group behavior often does not resemble what any one individual would do alone. In short, I am claiming that having studied a completely synthetic world of interactions between fictitious Martians we would be better off than spending the same effort studying real people in real situations. It is not that we have no need of real data, but rather that we already have a lot of data, and in complex situations real data can often lead to more confusion than clarity.

Philosophy

This raises the awkward question of how much more real data we need to gather. If we want to continue on the classical path of science and to control the exterior world (which is the path science has been following), then I believe that we will still need to gather new, real data, though perhaps not in the quantity that we have in the past. But there are other paths we can follow, ones that do not require the gathering of lots of real data. There are paths that are more closely related to our interior lives, where we already have all too much data.

Before you dismiss the concept of ignoring the external world, stop to reflect the role that music has played in the human life. It is not based primarily on the real world. Tone poems and similar material are not closely connected with reality in spite of what is claimed. No, music is mainly engaged in for the private internal pleasure of humans, and there is no pretense that is is related in any serious way with the external world.

Remember the three questions: How far can we go into synthetic worlds and simply ignore reality? How far will we go? How far should we go? We already have a lot of control over the external world, and even if we gradually shift our major attention in the future to synthetic internal worlds, we need not completely abandon the real world. It is not an all-or-nothing, it is a question of degree.

Well, how far can we go? I say we can go very far, so far that the major attention of almost everyone could be involved in synthetic worlds that give him pleasure (just as some of us are now deeply involved with music, games, etc.) After all, what limits us? With computers providing vast, as yet unimagined synthetic worlds of pleasures to explore, why engage in the already marginal exploration of this all too unsatisfactory real world? I believe there is potentially no limit on how far we can go if we wish.

How far will we go? Again, recall how far many of us have already gone into music, games, and programming for the love of programming with only the slightest regard for utility. Recall the attractiveness of a world in which all the basic rules are known, where the goals may be set arbitrarily and cleanly, and where the whole challenge is in the very complexity of the problem of getting from the start to the finish. Don't sell the human too short in his willingness to enjoy life. With the ability to make synthetic worlds to fit his desires, far beyond what amateur daydreaming can do, worlds where there is a real intellectual challenge and a sense of accomplishment that transcends any reward that mere daydreaming can offer — think of how far many people will choose to go.

Lastly, how far should we go? Here we are on moral and ethical grounds. I, with my strong Puritan training that so often gets in the way of enjoying life, naturally believed at first that we should shun the path of pleasures, of enjoyment for its own sake, just as many of us believe that the path of drugs used for pleasure should be avoided. But remember, these beliefs were appropriate for the world when there was a lack of control over the external forces. Is it so appropriate now? And even if it is appropriate now, will it be in the future? I can only wonder at and speculate on how much previous conditioning has produced my instinctive judgment that warns of danger. I can say, however, that every time I rethink the question I go a bit further down the pleasure path than I did the previous time.

What has all this to do with the topic of this chapter, the use of the computer as an experimental tool? Simply this: at first, one naturally has a very limited vision of what the computer can do as an experimental tool. I took you rapidly through the obvious uses, before, during, and after an experiment. I went more slowly through the region where the computer provides a new tool for doing new experiments in the more or less classical fields of experimentation. Finally, I ventured some speculation as to the use of the computer to explore unconventional worlds, worlds that are more internally oriented than the usual externally objective world. In the past we have demanded external verification. Even in introspection we rarely venture far in psychology without trying to gain some external evidence for the reported internal states.

But there are human activities that have to a great extent remained outside the main stream of science. Art, music, and literature come readily to mind. Such activities have always attracted human attention because of the inherent internal pleasure they give. Another example is "logical pleasure" in, among other places, mathematics. It seems to me that we will find that the computer provides us with a tool to explore our personal pleasures by allowing us to create what I have called, for lack of better words, synthetic worlds. When I say that computers may provide a major tool for creating and exploring synthetic worlds of pleasure, remember that curiosity, both about others and about oneself, is one of the major human characteristics. We have traditionally honored those who have pursued their strong drive of curiosity about how things operate, we have honored those who have been capable of creating new music, paintings, poetry, and literature even when it has had no economic contribution to make in the form of control of the external world. Are you now so sure that computers cannot, will not, or should not be used to create and explore private worlds of pleasure? ...

What Is Meant By Artificial Intelligence?

The idea of intelligence is a general concept, and it is hard to define intelligence satisfactorily. Sooner or later in almost any extended discussion of computing machines, the question comes up of whether or not computing machines can act intelligently. Put more simply, "Can a machine think?" is a question that is commonly asked. How is such a question to be answered? Clearly we need a definition of intelligence or else a test to see if some process can produce results that require the use of intelligence. Many people will give a definition of intelligence such as "Something like Newton or Einstein did." By this definition (if it can be considered to be a definition), most people are not intelligent. This tends to make the proposed test rather inappropriate since a definition of intelligence that excludes most of us is hardly satisfactory.

If we are to proceed along the lines of testing whether or not a machine can think, it is necessary to frame a definition of the least act, or else something close to the least act, which, if done by a machine, would persuade you to accept the idea that machines have intelligence. How else could it be demonstrated fairly? But the more you consider the least act of intelligence, the more you are apt to become disenchanted with the idea, for the very approach seems to contain a contradiction. Either you have framed a task that is not minimal, or else so simple a task cannot be showing intelligence.

Let us be clear about it. If we are going to decide whether machines are capable of intelligence by judging only the output of a machine, then it appears to be necessary to have a statement that describes in sufficient detail what will be an acceptable proof so that we can examine the output of a machine. If the result is as agreed, we will say that machines can act intelligently.

There are, of course, other approaches to the question. One can say that intelligence is not to be judged by the output, but by the way it is done ("It ain't what you do, it's the way that you do it"). In this approach, a child may be using intelligence when he is multiplying two numbers together, while a machine which produces the same result is not using intelligence.

There is still another approach, which is to frame the definition so that the effect is to have thinking and intelligence a property of humans (and possibly a few other animals, depending on how charitable you feel at the moment) and not a property of machines. Of course, that settles the question the way you want it settled. This approach is widely used, and often some care is taken to disguise the intention behind the definition. But when analyzed the proposal amounts to prejudging the situation.

Without debating the rightness or wrongness of such a definition, it is easy to see that such a definition is apt to be rather sterile, while the opposite assumption, that machines can think and act in intelligent ways, is apt to be more fruitful. The latter approach immediately sets the task of producing programs that think.

Years ago there existed a somewhat similar situation in chemistry. It was then believed that only life could create "organic" compounds. Unfortunately for the theory, a number of organic compounds (including urea) were synthesized in a laboratory. Although up to now chemists have not yet created life in a test tube (let alone a full-scale human) most people have abandoned the "vitalistic" theory that chemistry in living materials has a fundamental difference from chemistry in the laboratory.

What is clear, and we shall later give a number of examples, is that many acts that were once thought to require thinking (whatever that is and whatever relation that has to intelligent behavior) are now being done by computing machines, and it seems very likely that as time goes on many more such acts will be done by machines.

Thus as a practical matter, we shall simply assume that of course machines can think and act intelligently, and then examine a few of the ways we have to go about trying to give actual demonstrations. We shall reject a vitalistic approach to thinking and intelligence.

The Need For Machine Intelligence

The need for complex behavior by machines is quite apparent in many cases. To take one simple example, consider the problems that will face those who will try to explore the surface of Mars. They will want to send machines to do the work, but the machines will inevitably face situations that were not foreseen by the planners back on Earth, and the round trip signaling time from Mars to Earth and back to Mars will run into quite a few minutes, during which disaster may face the exploring equipment. Thus it will be necessary to any sophisticated machine exploration to have a program in the local (on Mars) computer that is directing the equipment, a program which has the ability to take choices and call for actions in situations that have not all been carefully examined beforehand. We will want at least a low level of intelligence for the machines we send to Mars to explore and relay back their measured results.

Indeed, this is almost our definition of intelligent behavior: the ability to act in suitable ways when presented with a class of situations that have not been exhaustively analyzed in advance, but which require rather different combinations of responses if the result in many specific cases is to be acceptable.

While the example of the exploration of Mars may be rather dramatic, in increasingly many situations there are so many alternatives that we simply cannot program what to do in each case. There are also many situations in which for one reason or another there is not time for man to intervene. Missile interception is an example. Or it may be that the situation is under control much of the time during which no intervention by humans is needed, but when the occasional emergency occurs suddenly, it requires such fast response that it is impractical to keep a human on standby duty. Perhaps supersonic airplane flight falls in this pattern (it has a lot of automatic control equipment built in).

There is also the further humane reason, namely, a job may be so dull that it is cruel to require humans to monitor what is going on (Charlie Chaplin's Modern Times dramatized the evils of dull routine work). One hopes and expects that many of the dull jobs of society will in time be taken over by machines.

Game Playing

One of the easiest fields to which machine programs are applied, and which at the same time seems to require intelligence, is that of game playing. For our purposes there are two types of games, those like tic-tac-toe which have a known strategy that can be followed, and those like checkers and chess, which at present have no known, practical strategy of exactly what move to make next in every situation. The first type are hardly worth considering in examining the question of whether machines can or cannot think. The second is far more interesting, and quite early in the history of computing there were papers written about how to program a machine to play chess. The early attempts were not very successful, and only recently have there been reasonably effective programs. A. L. Samuels, formerly of IBM, now of Stanford Univ., tried a serious attack on checkers, and managed to produce a program that at times has beaten some checker experts, and in any case certainly plays a better game than Samuels himself can.

(please turn to page 43)

The Alaska Pipeline Reading Lesson

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> The Department of Interior feels that another public hearing at this time is not necessary ... It is the Secretary's view that this complex report [on the trans-Alaska pipeline] needs to be read; needs to be understood; that a public hearing would be a *circus* in comparison to the kind of thoughtful, substantial comment that might come in to the Council on Environmental Quality or other offices.
>
> Public hearings ... would interfere with a more thoughtful and rational analysis of this complex document.
>
> Statement of William T. Pecora, Under Secretary of the Interior, March 20, 1972.

Done any reading lately? Well, hold your spectacles. Because the Interior Department has just given you the reading assignment of your life.

You have until May 4* to:

- Lay your hands on a copy of the nine-volume environmental impact statement on the proposed trans-Alaska pipeline. (Only 600 were printed.)
- Read its 3,550 pages.
- Render a "thoughtful, substantial comment." (See above.)

This is what the Interior Department considers public involvement in the decision-making process.

We hope you *will* be able to read the statement and render comments, but you should know the following:

1. There are exactly *seven* copies available for public inspection in the "lower 48" states. They can be seen during office hours in certain government agencies in Washington, D.C., Los Angeles, San Francisco, Portland and Seattle. (See addresses on back page.)
2. Sets can be purchased through the mail, but they cost $42.50, and delivery time is unknown.
3. The statement is not well organized or indexed, and finding what you're looking for may require days of tedious searching.
4. Secretary of the Interior Rogers C.B. Morton has said he may issue a pipeline permit on or after May 4.*

Is it any wonder that conservationists are asking for more time and for public hearings to evaluate this "complex report"?

**If you don't see this until after May 4, there may still be time to act. Write to the author.*

Whose Government Is This?

No doubt the seven oil companies which own the Alyeska Pipeline Service Co. are anxious to go ahead and impatient with what they view as delays. But we believe it's time they learned that the government of the United States isn't some third-level subsidiary which they can order around. And the public lands of the United States are not their private domain.

Two years ago they were shocked and outraged that conservationists could force the government to comply with the National Environmental Policy Act. Last year they were offended by the adverse public reaction to the first, abortive environmental impact statement, which had been submitted to them for editing before it was released to the public.

And now, though the new impact statement reveals strong reasons for building the pipeline through Canada rather than south to the Alaskan port of Valdez, they are anxiously awaiting a permit to go ahead with their original plans, using the pipe and equipment already placed presumptuously along the proposed route.

As a person concerned about the environment, *you* ought to blow the whistle on this whole charade of sanctifying previously-arrived-at conclusions. Why should the American people be frozen out of this critical environmental decision? Why, as we asked in an earlier alert, must "the public be damned"?

Note the words of Under Secretary Pecora, above: a public hearing would be a "circus." And note, too, the implication: hearings involving the public are not particularly thoughtful or rational.

Why Public Hearings Are Needed

Actually, the impact statement itself is one of the best arguments for public hearings. One of the strongest impressions one gets reading through it is of the number of unsolved problems which still exist – problems that the statement openly recognizes and for which it has no answers. These problems relate to untried and untested engineering methods, incomplete environmental research, deficient land-use control and planning, and other matters of critical importance.

Many important aspects of the proposed Prudhoe Bay-to-Valdez pipeline are described for the *first time* in the statement. Without hearings, the many interested scientists not involved in government or oil company research will have no meaningful opportunity to comment on this new material. Or, if they do, their communications can be safely filed away and ignored.

Here are some other reasons why public hearings are needed:

Gas transportation systems

The department says "it seems clear that a single gas line will be built through Canada to the United States markets." (Economic Analysis, Vol. I, p. C-22.) It says such a transportation system is an "essential" element (Vol. 1, p. 50) of any oil pipeline system and states that "less environmental cost would result from a *single* [gas and oil] transport corridor than from two separate corridors" (Vol. 1, p. 273). But no effort has been made to evaluate these savings in environmental cost, and on March 20 a department spokesman said, "We are completing such an analysis from the economic point of view only." Further, impact analysis is limited (Vol. 1, p. 176) because the "absence of any firm gas transportation proposal by the owner companies limits the amount of descriptive information available." (Vol. 1, p. 74.) Apparently Interior didn't even ask the oil companies for information on Canadian pipeline plans – despite the intensive studies going on in Canada.

Congressman Les Aspin of Wisconsin points out *why* the Interior Department hasn't received an application for an Alaska - Canada pipeline. "The same oil companies which dominate the Alyeska (trans-Alaska pipeline) consortium also dominate the Mackenzie Valley Pipe Line Co., and they are hardly likely to submit an application in competition with themselves." However, it's important to note that as recently as March 29 the Canadian government reiterated its long-standing interest in having the oil pipeline go through Canada rather than having tankers carrying oil from Valdez past and through Canadian coastal waters to the west coast of the United States

Alternative oil pipeline through Canada

Acknowledging that potential *gas* pipeline routes through Canada are also attractive *oil* pipeline routes, the report notes that the Canadian routes avoid the maximum earthquake threats, eliminate impacts and hazards to *west coast marine areas*, and have no greater terrestrial impact in many significant respects in spite of their greater overland lengths. (Vol. 5, p. 238.)

The report states that an oil pipeline through the Mackenzie Valley of Canada would be "an equally efficient [economic] alternative" to the trans-Alaska route (Economic Analysis, Vol. I, p. 1) *but also admits it did not consider the additional economies of building an oil pipeline through the same corridor as the gas line*. (Economic Analysis, Vol. I, p. C-23.) Obviously, with such economies considered, the Mackenzie alternative would not be "equally" but "more" efficient. This gross error must not be allowed to stand!

Marine transportation system

Volume 3 (449 pages) contains extensive descriptive material on the marine environment and tanker transport of oil between Alaska and west coast ports. The evaluation of oil tanker traffic indicates unavoidable adverse effects from chronic oil pollution in port areas, from intentional ballast treatment discharge at Port Valdez, and from accidental discharge by collision or by negligence. Estimates of accidental discharge are as high as 140,000 barrels a year, but "the impacts of oil upon the various biological systems cannot be predicted in a quantitative manner." (Vol. 4, p. 196.)

Elsewhere the report (Vol. 4, p. 608) says an "irreversible commitment of some marine biotic resources would occur in Valdez Arm as a result of chronic oil pollution." But the actual area or extent can't be predicted. Even so, "permanent and far-reaching effects upon certain forms of plankton would occur," causing a "general decrease in primary productivity, which would in turn affect other organisms of the ecosystem, such as salmon, herring, razor clams, murres, auklets and other species of birds, fish and shellfish."

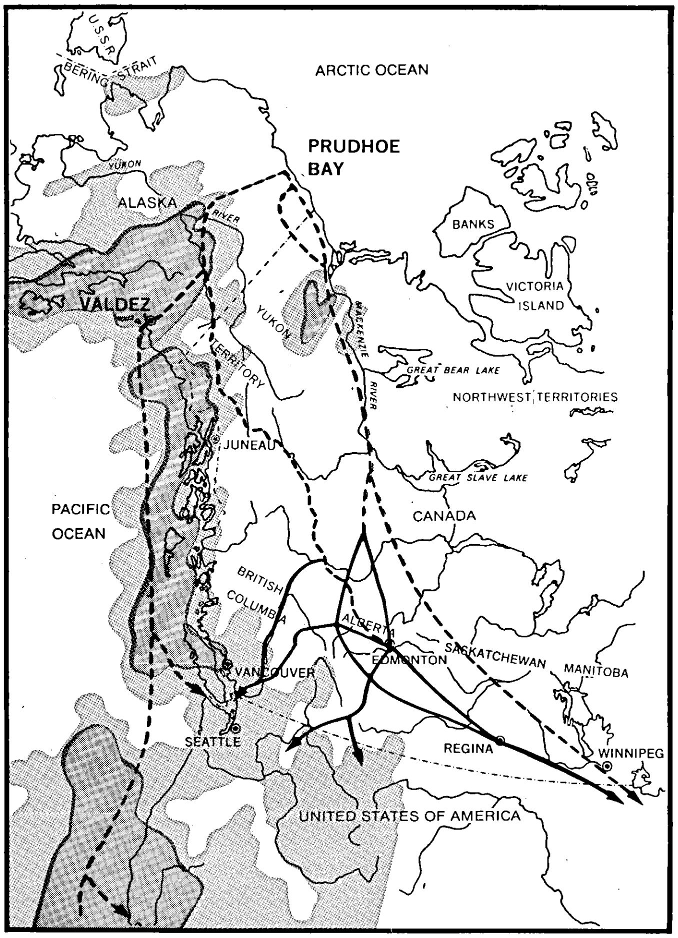
But all this was known before the statement was written. Is this the kind of solid, substantial and detailed information on which decision-makers can render a sober and objective judgment? With no more than this to go on, how could they know we would gain more than we lost by proceeding with the pipeline-tanker transportation system?

Pipeline breaks and contingency plans

The statement acknowledges that a "no-spill performance" would be "unlikely." (Vol. 1, Summary.) It goes on to say that even under emergency shutdown procedures as much as 64,000 barrels (2.6 million gallons) of oil could escape from a pipeline break (Vol. 1, p. 23); and that "minor leaks are practically undetectable" (Vol. 4, p. 11). A "minor leak" turns out to be anything less than 750 barrels (31,500 gallons) a day (Vol. 4, p. 135). In spite of this, the effectiveness of surveillance, monitoring and cleanup procedures has not been fully discussed.

What effect would a pipeline break have on the environment and ecology? Throughout the report there is an unwillingness to quantify the damage. But occasionally one stumbles on a shocker like this: "For example, a significant spill into the upper Gulkana River during the peak of the salmon run would likely cause fishery damages of catastrophic proportions." (Vol. 4, p. 135.) And this is only part of the story, for as one can find in Volume 3, page 311, the Gulkana flows into the Copper River, which supports one of the greatest birdlife concentrations on earth. (Here lies one of the more irritating aspects of the impact statement; you have to search through the massive text and piece together many of its implications – one of the reasons public hearings are so necessary.)

Despite all these dire implications, the recently announced Interior Department engineering stipulations fail to require Alyeska to submit its contingency plans to the government before the construction permit is granted!



ALTERNATE ROUTES – Shown are the proposed trans-Alaska pipeline route from Prudhoe Bay to Valdez and alternate routes through Canada, including route through the Mackenzie River Valley which avoids major earthquake zones (shown in overlays, the darkest areas showing greatest risk). Solid lines are existing pipelines.

The alternative of deferral

Much of this voluminous statement consists of advocacy rather than a careful weighing of alternatives open to the U.S. government. Excluding Volume 6 (comments and attachments) and the three-volume economic and security statement, some 1,850 pages – 77 percent of the first five volumes – are devoted to the environmental impact of *granting* the permit. Fewer than five pages – two-tenths of one percent – deal with the alternative of *deferring* the project. (Vol. 1, p. 258; Vol. 5, p. 1 and pp. 8-10.)

Yet the paragraphs devoted to deferral note these advantages: (a) an opportunity for studies of "innovative pipeline technology," (b) "operation of a pilot plant for ballast treatment," (c) "installation and operation of a large-scale hot oil pipeline experiment" in relation to permafrost terrain, (d) "pipeline leak detection research," (e) "more exact definition of the gas transportation system that would be proposed," and (f) more definitive studies of marine and arctic ecosystems.

Environmental Dangers Confirmed

Until the Interior Department released this statement it was still possible for pipeline advocates to say that conservationists were "extreme," "far out" and "fright-peddlers" when they warned of damage that could be inflicted by the trans-Alaska pipeline. But no longer. Here is what the Interior Department itself has to say about these environmental dangers:

- "It is almost a certainty that one or more large earthquakes will occur in the vicinity" of the southern two-thirds of the pipeline. (Vol. 1, p. 97.)
- "Construction scars would be visible for the life of the project and for years after the pipeline had been removed." (Vol. 1, p. 211.) These scars would occur at 12 pumping stations, seven airstrips, 26 permanent steel towers for microwave transmission, the main haul road and numerous access roads to the 234 gravel sites and 54 quarries; and 12 construction camps, as well as the pipeline itself. Excluding the Prudhoe Bay field, these would occupy an estimated 40,000 acres (Vol. 4, p. 257) and require nearly 70 million cubic yards of gravel (Vol. 4, p. 68).
- In spite of oil industry claims to the contrary, including newspaper and television ads, experiments on revegetating the tundra that will be torn up by pipeline construction have not worked. (Vol. 4, pp. 102-3.)
- A year ago conservationists were ridiculed for suggesting that buried pipe carrying hot oil would melt the permafrost, causing the pipe to collapse. Belatedly, Alyeska now plans to elevate 354 miles (44 percent) of the 789-mile pipeline (Vol. 4, p. 16) – compared to its original plan for only 40 miles (5 percent) of elevated pipe. But there is still no definite determination of how many miles of pipe will be buried. And there is an additional, unsolved problem: Wherever protective vegetation is destroyed on the tundra, the underlying permafrost will thaw, bringing drainage and erosion problems for years to come – at supports, construction pads, ditching, roads, buildings, etc.
- As wildlife authorities have been saying all along, the report acknowledges that caribou and other animals will die needlessly from loss of habitat, the spilling of toxic substances on forage, and disruption of migration patterns. (Vol. 4, pp. 152, 171, 154-5.)

  The report further acknowledges the possibility of catastrophic salmon losses (Vol. 4, pp. 135-36); the likelihood of "pronounced reductions" of grizzly bear populations (Vol. 4, p. 534); the certainty of "considerable" siltation of three rivers noted for their fish resources (Vol. 4, p. 527); the threat of "both locally and internationally significant losses to water-related birds due to oil" (Vol. 4, p. 538); the possibility of increased mortality rates among young moose, mountain sheep and caribou because of aircraft disturbance (Vol. 4, p. 149); the threat of "illegal and wanton shooting of peregrine falcons and the robbing of the young for falconry" arising from access to habitat (Vol. 1, p. 204); and the killing of indeterminate numbers of sea otters and fur seals, which are sensitive to even small amounts of oil. (Vol. 1, pp. 207-8.)

National Security and Oil Economics

The final three volumes of the report deal with "An Analysis of the Economic and Security Aspects of the

Trans-Alaska Pipeline." Congressman Aspin, a former member of the staff of the Council of Economic Advisers, has called the study "pseudo-economics, a sham and a hoax."

As noted above, the economic study fails to take into account the most obvious economy of all: constructing the gas line and oil line in the same corridor instead of separate corridors.

In addition, we note the following:

National Security

The contention is made that the United States can't afford to be dependent on oil from the Middle East. Yet the report admits that North Slope oil (2 million barrels a day) would supply only 9 percent of our projected oil needs in 1980 (22 million barrels per day, according to Economic Analysis Vol. I, p. B-1). Depending on the amount which Canada and South America might be able to supply by that time, we would still need 5 to 6 million barrels a day from the Middle East. (Vol. I, p. B-12.)

Last year conservationists were ridiculed by the president of Alyeska and officials of the Interior Department when they suggested that some of the Prudhoe Bay oil, allegedly needed for "national security," would end up in Japan. Now we find in the Economic Analysis an admission that some of the Alaskan oil would indeed go to Japan and that British Petroleum (which owns about 50 percent of the Prudhoe Bay reserves) has signed an agreement with Japanese oil companies for marketing Prudhoe Bay crude oil in Japan. What is more, the Interior Department, having professed interest in the "national security" need for Prudhoe Bay oil, has not deigned even to ask British Petroleum how much North Slope oil it has already committed to Japan. (Economic Analysis, Vol. I, p. F-20.)

Can they really have it both ways? Surely the public should have a right to comment on these glaring inconsistencies.

Profitability

North Slope oil is low-cost oil. If delivered to the West Coast by tanker, it would reduce prices theoretically by 70 cents per barrel, saving consumers about $800 million per year. If delivered to Chicago by pipeline, prices could be reduced 40 cents per barrel, with similar savings to consumers. That's what the economic study says (Vol. I, pp. H-3, H-6).

But there's one catch to that argument. As the report itself points out, "Mechanisms of the oil import quota system would keep supply and demand in balance at current price, so that prices would not fall and there would be no consumer saving."

Who, then, gets the benefit? The fog of figures is hard to analyze, but the answer is not. If the trans-Alaska route is approved, the profit will go to the oil companies. (Vol. I, p. H-5.)

Who Favors Public Hearings?

For all its weight and girth, the impact statement fails to give deserved emphasis to the tremendous wilderness and wildlife values of Alaska and the menace to these values posed by the unprecedented pipeline project. For this and other reasons most of this country's major conservation organizations have joined in calling on the President to schedule public hearings on the pipeline impact statement. These organizations include: Boy Scouts of America, Citizens' Committee for Natural Resources, Defenders of Wildlife, Environmental Action, Environmental Defense Fund, Federation of Western Outdoor Clubs, Friends of the Earth, Izaak Walton League of America, John Muir Institute for Environmental Studies, National Audubon Society, North American Wildlife Foundation, National Parks and Conservation Association, National Rifle Association, Sierra Club, Sport Fishing Institute, The Conservation Foundation, The Wilderness Society, The Wildlife Society, Trout Unlimited, Wildlife Management Institute and Zero Population Growth.

Similarly, 82 members of the U.S. House of Representatives have joined in signing a letter to the President calling on him to hold pipeline hearings before a decision is reached. And on the other side of the Capitol 23 Senators have made the same request.

Finally, the three plaintiffs in *Wilderness Society et al vs. Morton* – the Alaska pipeline lawsuit – wired the President on March 20 renewing their request for public hearings. Besides The Wilderness Society, the plaintiffs are Environmental Defense Fund, Inc. and Friends of the Earth.

What YOU Can Do

In spite of this imposing array of conservationists, Congress members and private citizens, the Nixon Administration appears determined to bow to the demands of the oil industry and issue the pipeline permit. Your help is needed, and it's needed now.

Unless this decision is reversed and hearings are held, Secretary Morton could ask the federal court on or after May 4 to lift the pipeline injunction and allow him to grant a permit to Alyeska.

We urge you to act today. Send a letter – or a telegram – to the President asking for 90 days to review the statement followed by full public hearings to bring the knowledge and wisdom of the American people into this important decision-making process. Write or wire:

President Richard M. Nixon
The White House
Washington, D.C. 20500

But don't stop there. Send information copies to your congressman and senators. Enlist your friends, neighbors, local clubs and organizations. And inform your local news media – including editorial writers – what you're doing. If you can use more copies of this flyer, ask for them. Get started today!

Copies of the Environmental Impact Statement available for public inspection in the "lower 48" states can be examined during office hours in the following government agencies: Department of the Interior library and U.S. Geological Survey library, both in Washington, D.C.; Service Center, Bureau of Land Management, 710 N.E. Holladay St., Portland, Oregon; Regional Office, Bureau of Outdoor Recreation, 1000 Second Avenue, Seattle, Washington; Field Office, Pacific Southwest Region, Department of the Interior, 450 Golden Gate Avenue, San Francisco, California; Field Office, Pacific Northwest Region, Interior Department, 1002 N.E. Holladay St., Portland, Oregon; and Regional Office, U.S. Geological Survey, 7744 Federal Building, 300 North Los Angeles St., Los Angeles, California.

DALLAS: WHO, HOW, WHY? — Part IV: Conclusion

Mikhail Sagatelyan
Moscow, USSR

"Objectivity and justice demand from all who attempt to explore the origin of the assassination that they ask a very precise question:
'Did the former Vice President know in advance what was supposed to happen on November 22, 1963?'"

How the President Was Killed

Seven people took an active part in the assassination. They were Cuban counter-revolutionaries and Americans from the ranks of semi-legal, armed "ultra" groups. They fired from three points, including the window of the schoolbook depository where Oswald worked. Three snipers fired. Beside them were three assistants whose job it was to pick up the spent cartrides which, along with the guns, were hidden in a van which was driven away hours later from a side street leading off the Dealey Plaza. As is known, once the Dallas police caught Oswald, they stopped looking for anyone or anything else. The seventh member of the ambush, dressed in green combat fatigues, had the job of creating a diversion. A few seconds before the motorcade arrived at the ambush point, he shrieked wildly and fell to the ground, simulating an attack of epilepsy, thus attracting attention to himself and away from the snipers who were in position. The coordination between the seven was precise because they kept in contact by radio.

Two of the seven were picked up by the police following the assassination but were released almost immediately, after which they disappeared from view. Their whereabouts are unknown, though Garrison has their names.

Why Was John Kennedy Killed and Who Organised the Plot?

The seven killers were controlled by Clay Shaw through David Ferrie and others. He did so with the knowledge and blessing of the CIA and was financed by a number of incredibly rich oil magnates who stayed in the background and were well screened. President Kennedy, Garrison maintained, was killed for only one reason: he wanted to alter the course of America's foreign policy and to normalise relations with the Soviet Union and Cuba. The conspirators, including the CIA, intended to resort to the most extreme measures in order to thwart such a possibility. In Garrison's opinion, Lyndon Johnson was aware of the background to the assassination, of the true identity of the killers, but played no active role in the conspiracy.

Such is Jim Garrison's story. Why then, if he had the necessary proof, did the District Attorney lose his case against Clay Shaw, who was found not guilty? The answer to this reasonable question is not as complex as one might think.

In the first place, with the assassination of Robert Kennedy, the support which he lent to the investigation, ended. That such support was extended, there is no doubt. It is known for instance, that a few weeks before his death Robert Kennedy sent Garrison a letter in which he expressed his conviction that there had been a plot and that Garrison was on the right track. In the same letter Robert Kennedy promised that if he were elected President, the conspiracy would be exposed and the real plotters would be punished.

It was much harder for Garrison to proceed without the support of the Kennedy clan. Shortly after the death of his second brother, Edward Kennedy publicly dissociated himself from the Garrison inquiry. Who could blame him? What was the point of making a target of yourself prematurely?

Secondly, and this is the main point, at the beginning of the Clay Shaw trial in 1969, a considerable part of Garrison's file on the case, including concrete evidence, was stolen. Jim Garrison described the situation in the following somewhat guarded terms to Henry Borovik, Soviet APN correspondent in the United States:

"I understand now, looking back, how naive I was two years ago. I had no idea how powerful the CIA was in this country.

"We were short-handed. That is why, when people came in and offered their services, we carried out only the most superficial inquiries and if they appeared honest, we availed ourselves of their help. Imagine for yourself — a man comes in and says he's a journalist and even shows us his published, signed articles in various magazines and says: you don't have to tell me anything, you don't have to show me anything, I simply want to help. Well, why not?

"We didn't notice right away that these people had connections with each other. To be honest, I was the last one to realise it, because I'm used to trusting people. Afterwards we discovered that the information they provided led off on a tangent. They confused the investigation. They provided false clues and false witnesses.

"Besides me, there are only three investigators working in my office. We couldn't tear ourselves into bits. We were given a written statement from a man who was supposed to be living at a certain address, who had a telephone, his name was in the directory, he even had a paid telephone bill in his name. Then it turned out the address and the bill and everything was phony. I somehow never thought then that it was nothing for the CIA to provide their agent with a false telephone bill.

"All kinds of people got into the office. One of them must have been a pretty high-ranking agent. Probably he was in charge of the whole operation directed against our investigation. We exposed him a few hours after he began to destroy our files and almost succeeded. The rest of them melted away with him, so they must have been connected. Of course, it's flattering that one of the most powerful agencies in the world — the CIA — was so scared of me, but it's small comfort. Over two years they managed to make off with almost all our files." (Retranslated from the Russian — Tr.)

Now it is clear why Garrison was not simply removed, like scores of others who knew too much about the murder in Dallas. It was much more effective to deprive him of the evidence and destroy his case. That is why the District Attorney hardly bothered to appear in court and the reporters were quite right in concluding that he had lost interest in the Clay Shaw trial.

Now all that remains is to discuss one more outcome of the Garrison investigation, one that is preferably forgotten in America. So, to repeat the question posed at the beginning of this chapter: is the New Orleans District Attorney the Don Quixote of the 20th century?

It would seem so. Jim Garrison's Don Quixotism consisted in the fact that he sincerely believed in the existence of a democracy in his country which would permit him, according to the letter of the law, to do what he considered essential. That was his biggest mistake. He had the support of powerful forces, he had the support of the general public. But all this was not enough because his opponents held the reins of political power and by their actions they clearly demonstrated that for them — the masters of America — no laws existed, none of the "democratic traditions and principles" of which American propagandists like to boast so much.

It seems that Garrison himself realised this. In any case, this is what he himself wrote:

"What worries me deeply, and I have seen it exemplified in this case, is that we in America are in great danger of slowly evolving into a proto-fascist state. It will be a different kind of fascist state from the one the Germans evolved: theirs grew out of depression and promised bread and work, while ours, curiously enough, seems to be emerging from prosperity. But in the final analysis, it's based on power and on the inability to put human goals and human conscience above the dictates of the state. Its origins can be traced in the tremendous war machine we've built since 1945, the 'military-industrial complex' that Eisenhower vainly warned us about, which now dominates every aspect of our life. The power of the States and Congress has gradually been abandoned to the executive department, because of war conditions: and we've seen the creation of an arrogant, swollen bureaucratic complex totally unfettered by the checks and balances of the constitution.

"In a very real and terrifying sense, our government is the CIA and the Pentagon, with Congress reduced to a debating society. Of course, you can't spot this trend to fascism by casually looking around. You can't look for such familiar signs as the swastika, because they won't be there. We won't build Dachaus and Auschwitzes: the clever manipulation of the mass media is creating a concentration camp of the mind that promises to be far more effective in keeping the populace in line.

"We're not going to wake up one morning and suddenly find ourselves in gray uniforms goose-stepping off to work. But this isn't the test. The test is: what happens to the individual who dissents? In nazi Germany, he was physically destroyed: here the process is more subtle, but the end results can be the same. I've learned enough about the machinations of the CIA in the past year to know that this is no longer the dreamworld America I once believed in."

So this, it seems, is what life taught Jim Garrison in the course of the road he trod.

Who? How? Why?

On March 31, 1968, Lyndon Johnson made his famous TV appearance announcing that he would not seek reelection and would not accept the Presidential nomination at the forthcoming Democratic Party Convention. The US News & World Report was one of those that risked naming one of the most important reasons for Johnson's decision. It was a case of the President being squeezed out of the White House by his own party, the magazine stated, and quoted a close friend of the President as saying that you can't remain in office when people call you an assassin and when rioting crowds take to the streets.

Yes, in the spring of 1968, thousands of Americans openly referred to their President in similar terms. Things came to such a pass that even among the political elite of Washington, among Senators and congressmen stories like the following circulated:

"What was Lyndon Johnson doing 45 seconds before the shots in Dallas were fired?"

The question was followed by the speaker plugging both his ears with his fingers.

As a matter of fact, this joke was related even to foreigners, Soviet people included. This was not just another nasty joke invented by Johnson's political opponents, as we shall see. There are some facts behind the story.

It goes without saying that it is an exceedingly serious matter when society accuses the leader of its country of being involved in murder, and an incumbent leader at that. The suspicion could not settle merely as a result of intrigues, without at least some foundation. In 1966, two out of 100 questioned in a poll conducted by the Louis Harris Institute of Public Opinion, stated that Lyndon Johnson was behind the assassination in Dallas. Judging by thinly veiled accusations in the press and several other factors, in the spring of 1968 this percentage had increased significantly. I say "judging by" because a similar poll was not conducted in 1968 or if it was, the results were not made public.

Nevertheless, it seems to me that objectivity and justice demand from all who attempt to explore the origin of the assassination, to ask a very precise question: Did the former Vice-President know in advance what was supposed to happen on November 22, 1963? Or did the conspirators, aware that Johnson had plenty of personal reasons to wish Kennedy out of the way, decide not to burden the conscience of the future President with such information? The answers to these questions are extremely important. Is anything known about this side of the story?

Some things are known.

On November 24, 1963, several White House reporters learned the following: as the Presidential motorcade moved through the streets of Dallas, Johnson told his Secret Service guard who was sitting in the front seat, to switch on the car radio. The Vice-President listened attentively to the local radio station, paying no attention to the throngs of welcomers. The incident was remembered, but at the time, along with others, was not thought important.

But two years later, witnesses who were present in the car with Johnson (Senator Yarborough and Secret Service guard),began to talk. Johnson ordered the car radio turned on a few blocks before the murder site. All the way along the route he looked not only glum, but extremely tense. The Vice-President listened, to the radio which he requested be turned up full volume and which drowned out the roar on the street. Nevertheless, Johnson immediately recognized the first shot for what it was. The same second, Secret Service guard Rufus Youngblood yelled:

"Get down!", hurled himself over the seat and covered Johnson with his body. Youngblood, according to his own words, was not absolutely sure that he had heard a gunshot. He had time for the thought that if he were wrong it would be rather embarrassing.

William Manchester emphasises Johnson's absolute conviction as to the nature of the explosion he had heard and the Secret Service guard's uncertainty, a man whose profession should make him quite familiar with the sound of gunfire.

Such are the known facts. What do they signify? Well, as they say in America, "Your guess is as good as mine."

When John Kennedy was already President, a limerick went the rounds which in an amusing and risque fashion suggested that Johnson was in the pay of the "fat cats" of Texas — the oil billionaires of Texas, such as Harold Hunt, one of the richest men in the world.

The name of Harold Hunt was barely mentioned in the American press in the first few months following the assassination. Nevertheless, this man obviously played an important role in the conspiracy. Here are the facts.

July, 1960. The Democratic Party Convention in Los Angeles. Harold Hunt established himself in a hotel not far from Johnson's headquarters. He kept his favourite posted daily with memoranda and advice as to how to ensure the Presidential nomination. Then, when this proved impossible, Hunt complained to friends: "If Lyndon had just strictly followed my advice, Kennedy would never have made it. And it so happens I'm the man who told Johnson to agree to second place on the ticket once it became clear Kennedy had won."

Autumn, 1961. The American journalist, Al Burke, is a guest at the Hunt estate. In his presence the oil king hurls abuse at Kennedy for his policies, which in Hunt's opinion are directed above all, at destroying his, Hunt's, oil empire. Already then the magnate suggests the physical removal of Kennedy from the scene. "There is no other way to get rid of the traitors who have taken over our government," Burke writes down Hunt's words in his notebook. "They should all be shot."

November 14, 1963. In a back room of Jack Ruby's nightclub, a number of people gather — including the owner, the Dallas policeman Jack Tippit (the same one who according to the Warren Commission was shot by Oswald), and another person whose name was not mentioned in the Report. The American press later reported that Earl Warren, Chief Justice of the US Supreme Court and Chairman of the Commission, in questioning Ruby called the unidentified person a "wealthy oil man". Interestingly enough, Warren has not denied the allegation.

November 22, 1963. The Dallas Morning News comes out with the widely-known advertisement, bordered in black like an announcement of mourning and sarcastically headed: "Welcome Mr. Kennedy to Dallas." Ted Dealey, Birchite publisher of the News, was one of H. L. Hunt's closest friends. Later the Warren Commission established that the advertisement had been paid for by three Texas businessmen, one of whom was Nelson Bunker Hunt, son of Harold Hunt.

On the morning of the same day Jack Ruby showed up in Ted Dealey's office and they talked privately. Several days before the assassination Ruby was seen in the office of another son of H. L. Hunt — Lamar. Here too, Ruby spent a long time in private conversation.

In all the above incidents, only once — in reference to the meeting in the back room of Ruby's nightclub — does the name "Hunt" not openly figure. However, the authorities demonstrated quite clearly that they knew exactly who the "wealthy oil man" was. A few hours after the killing, on the evening of November 22, FBI agents arrived at the Hunt estate. They did not come to arrest him — such things simply don't happen to billionaires in America. They had come to warn him: it was not safe for him to remain in Dallas since many people associated his name with the murder. That same night the oil magnate was secretly transported to Baltimore where he quietly remained for several weeks until passions died down. And all this time he was guarded by local police and FBI agents!

Today the most well-founded and documented version of the assassination of John Kennedy is that of Jim Garrison. This is so if only because the investigation of New Orleans' Don Quixote evoked such rabid and scandalously illegal counteraction on the part of Lyndon Johnson's Administration. The facts were there for America and the world to see and can hardly be discounted.

And so, the "fat cat", the ex-politician from Texas and the CIA, all of them, to a greater or lesser degree, have been exposed, both through their own actions and through eyewitness accounts. And all of them, as is not hard to spot, can easily be brought down to one common political denominator — oil.

It is possible that history will add further names to the sinister list of conspirators.

John Kennedy lost his political game, the stake in which turned out to be his own life.

Why did he lose? Why were such extreme measures resorted to?

On January 20, 1961, when the new President took his oath of office in Washington, which is situated on the same latitude as Ankara, the temperature was 20 degrees below zero and that night a vicious blizzard swept over the city. In the National press club, beside a blazing log fire, Republican supporters among the reporters gloomily traded wise cracks: "Even nature is protesting against the White House being taken over by that nice, smooth young man with dangerous ideas."

That day, in his first official Presidential speech, the young man had spoken somewhat unusually, if his speech were to be compared to those made by his postwar predecessors, beginning with Harry Truman.

The most interesting and unusual thought in that speech touched on internal matters: "If the free society cannot help the many who are poor, it can never save the few who are rich." Further, obviously addressing himself to those "who are rich", Kennedy appealed: "And so, my fellow Americans, ask not what your country can do for you, ask what you can do for your country."

These two sentences contain all of John Kennedy's philosophy, his mission in life, the reason for which he fought to become President of the United States. This mission could be defined even more briefly, in three words: to save capitalism.

Walter Lippman, the well-known American columnist, gave an interview in May 1964 to a West German weekly Der Spiegel. He was a thousand times right when he pointed out that many Europeans not only idealised Kennedy, but had formed an erroneous conception of the man. He had been before his death the darling of the left, but he himself was not liberal, he was a conservative.

The West German interviewer hastened to agree with Lippman and added that this was particularly so as regarded internal policy.

Yes, above all in internal policy questions. In foreign policy this tendency was revealed much later — in the third and final year of his Presidency. And it showed itself of necessity in connection with internal problems and the main goal — to save the US system.

In order to explain this, one must understand the changes which have taken place in the structure of American society and which first became evident sometime in the early 1950s. At that time very few defenders of imperialism (Kennedy was one of them) saw the potential threat posed by those changes. I am referring to the population explosion in the United States. In 1940 there were 132,600,000 Americans. By 1960 the figure had risen to 180,700,000. In 1970 the population was over 200,000,000.

However, only two age categories have climbed sharply: those under 18 and those over 50. The number of able-bodied Americans, in other words, producers of material wealth, has of course also grown, but in comparison with non-wage-earners, very little. This is creating serious social problems: the aged and the young have to be fed, schooled and given medical attention. But American capitalism does not wish to expend a greater share of its profits for this purpose. Even the present share is given up grudgingly, only under pressure of class struggles. And also because a new world system of socialism has appeared and thrived in the world, where schooling and medicine and much else is provided free of charge to the people.

Nevertheless, the masters of America did not wish to increase the allotments for social needs. And then, at first here and there and politically not very noticeably, crises began to arise — in education (a shortage of schools and teachers), in medical services and among the aged. The working sections of the population could no longer provide, on their wages, support and security to the ever increasing number of non-working members of society.

In its historical blindness, American imperialism chose another path. It began to improve the situation of only one section of the labouring populace: those engaged in working the new post-war "gold vein" — armaments production, particularly in the nuclear-rocket field. In actual fact, as far as Marxists were concerned, American imperialism had not invented anything new. That path of development was predicted by Lenin back in 1916 when he wrote Imperialism, the Highest Stage of Capitalism:

> The enormous dimensions of finance capital concentrated in a few hands and creating an extraordinary dense and widespread network of relationships and connections which subordinates not only the small and medium, but also the very small capitalists and small masters, on the one hand, and the increasingly intense struggle waged against other national state groups of financiers for the division of the world and domination over other countries, on the other hand, cause the propertied classes to go over entirely to the side of imperialism. 'General' enthusiasm over the prospects of imperialism, furious defence of it and painting it in the brightest colours — such are the signs of the times. Imperialist ideology also penetrates the working class. No Chinese Wall separates it from the other classes.

American capitalists have made an art out of the practice of corrupting significant sections of the working people and making them share the capitalist viewpoint.

One of the most complex aspects of the process of social corruption is intended to direct the enormous native energy of the average American away from his class interests and toward personal aggrandisement. Contemporary American society simply cannot be understood if individualism as a moving force is ignored. "Every man for himself and may the best man win." Anyone who has seen the film It's a Mad Mad Mad Mad World can say he has seen the mainspring of American society in action (naturally putting aside the exaggerations of the comedy element).

In order to allow wider sections of the American working people than in the past to "participate" in the interests of the bourgeoisie, a material base is required. This has been provided in the past decade by the scientific-technological progress of the United States and by the huge profits extracted from the wholesale grabbing and exploitation of the natural resources of other countries. For instance, in the years 1950-64, American companies transferred 5,975 million dollars in profits to the USA from Venezuela alone. The geography of exploitation and impoverishment of whole nations is not limited to Latin America ...

In addition to the two "eternal" sources of profit-making, a third was added after the Second World War — the arms race in conditions of cold war. Over the past 20-odd years, a huge military-industrial complex has been created in America. The world press hardly allows a day to go by without some story on the subject. The more far-seeing sections of the American bourgeoisie (out of self-interest) are now trying to limit the all-embracing influence and power of this complex. How successfully American imperialism has bent the country to its will can be judged by two statistics: every fifth person in America earns his living from funds allotted to the arms race; over 100,000 American companies are working for the Pentagon.

However, instead of liquidating the danger of social upheavals, such "common cause with the interests of imperialism" has only hastened their onset. After all, wide sections of the working people have remained outside the "cold war prosperity". And slowly but surely this has led and will lead to situations promising social unrest which could rock America to its foundations. The first rumblings of such eruptions have already been heard. Back in 1960 they could only be guessed at.

That is why Kennedy appealed to his class brethren — give a little in order not to lose all. On one occasion the new President called his policy "a strategy of survival".

The President began with a decision to shake up the oil producers. It must be said that the personal business interests of the Kennedy clan and of the whole Boston financial grouping not only would not have suffered as a result, but would have gained.

The "Bostonians", as did the rest of America, had to pay a high price for their oil products.

Once in power, John Kennedy wasted no time in worming the oil industry out of the grasp of the Department of the Interior where from generation to generation oil affairs had been handled by trusted and loyal henchmen of the Texas "fat cats". A special Presidential Assistant, Myer Feldman, was put in charge of the oil and gas resources. Under his overall leadership a re-established interdepartmental commission began to work on a new bill which would regulate oil production and taxes levelled on the industry. The prepared draft was published in July 1963. Its essence came down to one thing: if the bill was passed, the profits of the oil companies would be slashed by three-and-a-half billion dollars annually!

This was an open challenge to the oil magnates. Naturally, they counterattacked, and did their best to delay the bill's progress. When in October 1963 the press reported that in the near future the President intended to place before Congress a bill that would repeal the oil depletion allowance and introduce other new rules into the exploitation of oil resources, the magnates undertook their final open demarche: they requested an audience with the President. On November 8, two weeks before the assassination, the presidents of the three biggest American oil conglomerates met with Kennedy for half an hour. The next day Texas newspapers reported that the oil men were "disappointed" with the outcome.

Exactly two weeks after assuming the Presidency, Lyndon Johnson returned oil affairs to the Department of the Interior. Myer Feldman was out of a job. In the Walter Lippmann interview already mentioned, the columnist also declared that Kennedy had divided the country, whereas Johnson was like a well-worn slipper — very comfortable.

John Kennedy's second attempt to restrain the moneybags in their inordinate greed became known as the "steel crisis". At the beginning of April 1962, the steelworkers trade union —one of the biggest in the country — came to an agreement with the steel companies after long and difficult talks in which the then Secretary of Labour, Arthur Goldberg, participated. It was agreed that steel prices would not be raised. Literally within a few days, the president of the major steel monopoly — US Steel — Roger Blough, placed on Kennedy's desk a four-page memorandum which announced US Steel's decision to raise steel prices $6.00 a ton. While Blough was still inside the White House, reporters were handed copies of the memorandum.

Such a move almost automatically entailed price increases on many goods — both industrial and consumer. Major strikes were in the air and consequently the heating up of the social temperature which the President so feared. Kennedy was enraged by the contemptuous lack of respect for himself and the post he occupied shown by the steel magnates who did not wish to look beyond their own narrow interests. Among his own friends the President said: "My father always told me that all businessmen were sons of bitches, but I never believed it till now." This sentiment got into print and for a long time under various guises the papers kept repeating that "Kennedy was against business". Kennedy did not only talk, he acted. He gave orders to the Pentagon to cancel military contracts made with companies that had raised prices. The steel magnates began to back down. Kennedy's entourage exulted, considering that the President had won the "steel crisis". In fact, he had won only a battle, not the war.

By his actions during the steel dispute, Kennedy had seriously alarmed considerable sections of the business world in the United States. No postwar President had even dared to threaten to take away military contracts from such important companies, much less thought of actually doing so. Incomprehension of the "Boston Pup" and mistrust of his policies visibly intensified.

In the fall of that same year of 1962, America had lived through the Caribbean missile crisis. This provided a severe mental shake-up for millions and millions and millions of Americans. For the first time in all my years in the United States, I saw empty shelves in grocery stores — the result of panic-buying.

A group of government leaders, including Kennedy, had peered into the abyss of Hell, as newspapers wrote at the time. After that Kennedy began to understand certain home truths about the nuclear age. He realised, for instance, that in order to save the country from nuclear catastrophe, whether as a result of calculation or of inertia arising from the uncontrolled nuclear-rocket arms race, the two opposing social systems absolutely must enter into talks with the aim of liquidating the danger of frontal confrontations.

The American press was practically unanimous in its view: President Kennedy's attempts to seek ways of easing world tensions and above all of normalising American-Soviet relations, were dictated precisely by the lessons learned in the fall of 1962.

However, a wall arose before Kennedy's intentions. Every single ultra-right organisation in the United States, and what is more important, the military-industrial complex, was vehemently opposed to a detente which inescapably would lead to a deceleration of the arms race and consequently a decrease in profits.

The pressure was unrelenting. It shackled Kennedy's actions, in most cases rendering them impossible or fruitless. Recall the storm of opposition raised in the United States against the limited nuclear test ban treaty.

In this situation John Kennedy took an impermissible step, according to all former American concepts. (Before him, only Franklin Roosevelt had done the same thing.) The President addressed himself directly to the American people, wishing to ensure their support in putting pressure on the military-industrial complex. That was the essence of John Kennedy's speech at the American University in Washington, D.C. in the summer of 1963. Kennedy called on Americans to re-examine attitudes to the cold war and to the Soviet Union.

He said:

> Today, should total war break out again — no matter how — our two countries will be the primary targets. It is an ironic but accurate fact that the two strongest Powers are the two in the most danger of devastation. All we have built, all we have worked for, would be destroyed ... We are both caught up in a vicious and dangerous cycle, with suspicion on one side breeding suspicion on the other, and new weapons begetting counter-weapons.
>
> In short, both the United States and its allies, and the Soviet Union and its allies, have a mutually deep interest in a just and genuine peace and in halting the arms race.

It is my deep conviction that that speech was the last drop that filled the cup to overflowing and decided his fate.

(please turn to page 43)

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FORUM

On The Legal Side:

A LIEN ON COMPUTER TAPES?

Milton R. Wessel, Attorney
New York, N.Y.

A recurring question in times of financial distress, is whether, and to what extent, a computer company has a lien on its customers' property for unpaid bills. The answer in most American jurisdictions is "Maybe a lien exists, depending on the particular circumstances." But in the context of real life, often that is little better than a flat, resounding "No."

Frequently the difficulty is because the lien question arises regarding a relatively small bill which has accumulated over a long period with respect to the processing of routine commercial data such as accounts receivable. The customer says that he is cash tight, with all creditors clamoring, and that no one is entitled to a preference on past due charges. When further services are finally cut off, he demands his tapes or access to them so that the data can be processed elsewhere. He says that if he can't invoice his receivables he will go out of business, and that his trustee in bankruptcy will be delighted to have a several million dollar lawsuit (including punitive damages!) for the wilful and malicious withholding of his property and consequent destruction of his business.

In contrast to the trustee (who employs assets of the bankrupt estate to prosecute the claim), the EDP manager knows that even a successful defense can cost him many multiples of the unpaid bill, unless there is certainty of dismissal of the litigation at its outset.

Of course, the mere threat of a lien can often work wonders, avoiding the legal question of whether it really applies — especially where confidential data is involved. Indeed, the threat of making or withholding a duplicate confidential tape, foreclosing on it and marketing the information to competitors can sometimes be decisive. But all too frequently the threat doesn't work and the EDP manager must make his decision to "chirp or get off the perch."

Conceptual legal analysis is not very helpful. An artisan has a lien at common law, still applicable in most states, for reasonable (not necessarily contract) charges for unpaid labor and costs expended on improving personal property. However, there is no clear answer as to whether the addition of electrical impulses to a tape constitutes such "improvement." In one state case (involving the construction of a statute similar in this respect to the common law), an accountant was ruled to have a lien on the books of his client where he had entered the client's information into the books. This is a helpful precedent. But even assuming that with it the EDP manager can successfully contend that the impulses constitute "improvement," there is the further difficult question whether the resulting lien will be limited to charges for the particular computer run which added the impulses to the tape — a fraction of the unpaid bill — rather than the total of the back charges, which includes the preliminary key punch effort and the other earlier services necessary to the creation of the updated data bank and final product.

Perhaps with some of these problems in mind, many states have enacted statutory liens modifying the common law and eliminating the requirement of improvement, not always successfully. Thus, one statute provides for a lien to anyone who "alters" an article of personal property; this seems simply to substitute the issue of whether EDP impulses "alter" a tape for the common law issue of "improvement."

Another statute provides a lien to anyone who "performs work or services of any nature and description upon ... an article of personal property." Although there is no record of the relevant legislative history, it is a fair guess that the legislative intent was to eliminate the common law requirement of "improvement," perhaps even at the urging of those with EDP problems in mind. A third statute gives a lien (in the amount of the contract price, not just the reasonable value as at common law), to anyone "who has expended labor, skill or materials upon any chattel." Even these latter statutes, however, by no means resolve all the problems. For example, they do not deal with the extent of the lien insofar as back service charges are concerned. A wrong guess here might be as serious as one about the lien itself.

Another problem — electronic impulses are probably not "personal property" or "chattels" under these statutes; so that the lien they create must be with respect to the tape or other storage device. Suppose the customer simply demands his underlying invoices back. Can there then be any lien on such invoices, where the only work done was to copy by key punching without changing them in any respect? Pity the EDP organization that has destroyed its customer's raw data under these circumstances, without clear advance permission. Or, even more perplexing, suppose the customer asks only for a chance to copy his electrical impulses onto his own tape, at his own expense.

If all of this isn't enough to insure that certainty is impossible, confusing the matter further is the suggestion in some recent cases that the imposition of a lien on someone else's property without prior judicial approval, may be subject to constitutional impediment.

My personal view is that there is a lien in most jurisdictions on a customer's tape for accrued and current reasonable charges on continuing processing, where the final product reflects all that has gone before. But the businessman who decides to assert such a lien surely assumes a risk both as to its existence and extent. Few computer companies will voluntarily permit themselves to become "test cases" under these circumstances, and will simply yield to a customer's demand and swallow the loss.

This is an example of an area in which some kind of joint computer industry action is appropriate, such as by establishing a clearing house of information with regard to legislative and judicial activity in the hope of securing proper guidance to those considering these problems, or by drafting a model statute. It is also another instance of the special managerial difficulties faced by entrepreneurs in this new industry. □

DATA BANKS ENDANGERING PERSONAL LIBERTY: Report of Debate in Parliament, London, England, April 21, 1972

The Times, April 22, 1972
Printing House Sq.
London EC 4, England

> *Mr. Gummer, M.P.: "This may well be as important to human rights as any of the great steps the Government have taken. Magna Carta may be putting it too high, but not by much."*

Mr. Huckfield (Nuneaton, Lab), moving the second reading of the Control of Personal Information Bill, said its purpose was to set up a data bank tribunal and to establish a comprehensive legal framework to govern and regulate the supply of personal and confidential information.

We are now approaching the stage (he said) and may already have approached it, where there are so many people in Government departments, private companies and agencies gathering so much personal information on us all that our personal liberty, privacy and freedoms are already endangered.

Once they introduced the computer into the storing and compiling of information its particularly unique contribution was that it enabled them for the first time to store vast quantities of information of a magnitude which they had not been able to encompass and comprehend before. Access could be had to that information almost immediately.

An even more threatening contribution the computer could make was that it enabled one to integrate various categories of information. That was where he saw the main danger building up. They were speaking of a machine which in 10 years would be as commonplace as the telephone and television.

Everyone had the right to be left alone — the right to personal anonymity.

The Bill aimed to establish a data bank tribunal to licence stores of information and to set up a data bank inspectorate — data guards — to make sure the conditions of the licences were being adhered to.

The Bill provided that no store of information on more than 100,000 people should be operated without a licence. There would be a right for the individual to see his own files at least every two years, or every time he asked for them.

The tribunal would have power to order the erasure of information. Provision had been made completely to regulate the flow of information. Not only must the individual have the right of access to his own files, but the tribunal must have power to update the files and make sure they were accurate.

Council house tenants who signed the means test form to get a rent rebate would literally sign away their birthright. If anything was ever an encouragement to the building up of personal files and dossiers on people it was the Housing Finance Bill.

People were still a little too trusting when they completed a government form or hire purchase contract. If the Bill did no more than make them ask questions about confidentiality and its protection it would have served some useful purpose.

This country was building for the not too distant future what he could only call the goldfish bowl society. They could end up like goldfish, swimming around with every individual activity being observed and recorded. Their most precious commodity was time. They had got to act now.

Mr. Gummer (Lewisham, West, C) said it was a necessary Bill. It was too late because it would be more difficult to control information, more difficult to say whether information was right, now that information had already been collected in computers.

This may well be (he said) as important to human rights and personal freedom as any of the other great steps the Government have taken. Magna Carta may be putting it too high, but not by much.

Mr. Davidson (Accrington, Lab) said the Bill was to protect the interests of people who did not choose to give information about themselves — for innocent reasons or otherwise (Cheers).

He feared that not enough people expressed their fears over information being stored about them. If it was brought to people's attention just how much information about them was being stored and the possible uses to which it was put, there would be far more cries of protest.

Mr. Carlisle, Minister of State, Home Office (Runcorn, C) said the problem with which the Bill was concerned existed in isolation from the computer. All that the computer had done was to accelerate what was in any event happening already in a twentieth century industrialized society. The computer had made simpler the collection and holding of vast amounts of personal information and their method of transfer from one body to another more speedily available than would otherwise be the case.

The problem was the safeguarding of information and security of files and the integrity of those who had the keys to the places where the information was stored. It was because the previous Government recognized the concern about this that the issue of privacy was referred to a committee under the chairmanship of Mr. Kenneth Younger.

The Prime Minister, shortly after taking office, set up an inter-departmental group under leadership of the Home Office to make a comprehensive survey of the categories of personal information held or likely to be held in the computer system of Government departments and the rules governing its storage and use.

Within the next few weeks or months he expected the Younger Committee to be in a position to give their report to the Home Secretary. The review of the use of computers by the Government was also complete and would soon be in the hands of the Home Secretary.

If the Government felt that further safeguards were required for the protection of personal information in data banks they would not hesitate to take whatever measures were necessary.

The debate was adjourned. □

PERSUASION--ITALIAN STYLE

Peter Tumiati, Rome Correspondent
The Financial Times, April 21, 1972
10 Cannon St.
London, EC-4, England

The world's two biggest computer manufacturers, IBM and Sperry Rand's Univac division (which with its acquisition of RCA's computer division has moved up to become the world's number 2), have chosen Italy for a European computer "soft sell."

Last year IBM bought one of Lombardy's loveliest country homes, at Novedrate, between Milan and Como for the purpose. It is being converted into a guest house for the chairmen and managing directors of Europe's big companies, for Generals and Admirals and the most senior Civil Servants.

Univac started its "International Executive Centre" on the outskirts of Rome 3 years ago in a villa called "Les Aigles," belonging to a Greek millionaire, M. Jean Papadopoulos (no relation to the Colonel). Already over 1,000 "guests" have spent a couple of days there.

The only other similar establishment Univac has is in Japan. The explanation Mr. Gerald Probst, president of Univac, gives for the lack of a similar "guest house" in America is that top American businessmen are too busy, they do not have time for it.

Two-day symposiums and seminars are held at "Les Aigles." They are guided by one absolute rule: Univac must never be mentioned. Mr. Probst says: "they are devoted to the philosophical approach to computers. They give our guests an opportunity to get to know us."

The Roman Catholic Church is Univac's newest target. "Les Aigles" has just staged a "Roman Catholic Church seminar." Mr. Probst says that until recently he had not thought of the RCC as a possible customer for computers. An American cardinal "who is absolutely enthusiastic about computers" sold him the idea.

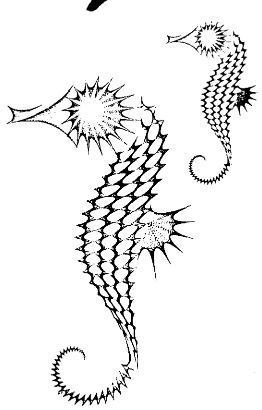
From the programme for the seminar, it looks as though the Monsignors (about 20 of them, including the Vatican's best golfer, the American Monsignor Marcinkus, who is head of the Vatican's financial department) have had a busy three days.

Mr. Papadopoulos does pretty well out of his former residence. According to the centre's managing director, its upkeep costs Univac about $500,000 a year "nearly all of which goes for rent and to the catering company Mr. Papadopoulos has set up to service the centre."

The guest house IBM is completing at Novedrate will be used for the same purposes as Univac's Rome centre. Up to last year Novedrate was one of the last aristocratic country homes near Milan. It consists of a 19th century country house surrounded by some 30 acres of gardens and parkland (the park is a national monument). The old stable and carriage house wing is being converted into bedrooms and bathrooms for IBM guests. □

You are invited to enter our

Tenth Annual
COMPUTER ART CONTEST



"Seahorses"
– Derby Scanlon

the special feature of the August, 1972 issue of

computers and automation
815 Washington St., Newtonville, Mass. 02160

The winning entry will appear on the cover of our August issue – more than 25 entries will be published inside, and other entries will be published later in other issues. The 1971 first prize winner, "Seahorses", is shown here at the left.

GUIDELINES FOR ENTRY

1. Any interesting and artistic drawing, design or sketch made by computer (analog or digital) may be entered.
2. Entries should be submitted on white paper in black ink for best reproduction. Color entries are acceptable, but they may be published in black and white.
3. The preferred size of entry is 8½ x 11 inches (or smaller); the maximum acceptable size is 12½ x 17 inches.
4. Each entry should be accompanied by an explanation in three to five sentences of how the drawing was programmed for a computer, the type of computer used, and how the art was produced by the computer.

There are no formal entry blanks; any letter submitting and describing the entry is acceptable. We cannot undertake to return artwork, and we ask that you NOT send originals.

DEADLINE FOR RECEIPT OF ENTRIES IN OUR OFFICE IS JULY 2, 1972.

CALENDAR OF COMING EVENTS

June 22-23, 1972: ADAPSO's 35th Management Conference and 3rd Software Conference, Sheraton Boston Hotel, Boston, Mass. / contact : ADAPSO, 551 Fifth Ave., New York, N.Y. 10017

June 26-27, 1972: First Annual Government Data Systems Conference, New York City, N.Y. / contact: William A. Kulok, New York Univ., Div. of Business and Management, Suite 2G, 1 Fifth Ave., New York, N.Y. 10003

June 27-30, 1972: DPMA 1972 International Data Processing Conference & Business Exposition, New York Hilton at Rockefeller Center, New York, N.Y. / contact: Richard H. Torp, (conference director), or Thomas W. Waters (exposition manager), Data Processing Management Association, 505 Busse Hwy., Park Ridge, Ill. 60068

July 3-6, 1972: First Conference on Management Science and Computer Applications in Developing Countries, Cairo Hilton, Cairo, U.A.R. / contact: Dr. Mostafa El Agizy or Dr. William H. Evers, IBM Corporation, Armonk, N.Y. 10504

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

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

Aug. 15-17, 1972: Seminar on ADP in Law Enforcement, Washington, D.C. / contact: ADP Management Training Center, U.S. Civil Service Commission, Washington, D.C. 20415

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

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

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

Oct. 8-11, 1972: International Conference on Systems, Man and Cybernetics, Shoreham Hotel, Washington, D.C. / contact: K. S. Nurendra, Yale Univ., 10 Hill House, New Haven, Conn. 06520

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

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

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

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

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

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

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

April 10-12, 1973: Datafair 73, Nottingham University, Nottingham, England / contact: John Fowler & Partners Ltd., 6-8 Emerald St., London, WC1N 3QA, England

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

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C.a

ADVANCED NUMBLES

Neil Macdonald
Assistant Editor
Computers and Automation

Solution to Advanced Numble No. 72401

E = 5	S = 4	ONE X TEN = SEVEN
N = 0	T = 1	305 X 150 = 45750
O = 3	V = 7	

We invite our readers to send us solutions, together with human programs or a computer program which will produce the solution.

Hamming — *Continued from page 29*

What are we to say to this? We can deny that the game requires intelligence, but we will be doing violence to the idea of the common man who plays the game since he feels that he is thinking hard when he tries to beat his opponent.

The attraction of playing games on a computer is that there are such nice, clean-cut rules of play and such a clear recognition of a win that it does provide a good testing ground for ideas. ...

Schools of Artificial Intelligence

There are a number of approaches to the general field of artifical intelligence. One school tries to duplicate human behavior and might be called the robot school. Another, for which the author feels more empathy, is more interested in using machines to supplement human behavior. The machine has such obvious advantages over humans in so many directions that it seems a shame not to combine our abilities with the machine's to produce a team that is more powerful than either one alone. To list a few of the advantages that are on the machine's side, first there is its blinding speed. Whereas humans signal through their nervous system at a few hundred meters per second at best, the signalling speed of machines is close to the velocity of light in a vacuum, namely, 186,000 miles per second. Second, there is their tremendous reliability. There is no question that a machine can do arithmetic and follow out simple instructions, one after another, far more accurately than humans can, no matter how hard humans try. In one second a machine can do more arithmetic than the average person will do in a lifetime, and so far as is known, no human ever did a full year of arithmetic without making a single mistake, yet machines usually get through a second safely. Third, there is the freedom from boredom that machines seem to exhibit while man is all too susceptible to it.

There are still other schools of artificial intelligence. One school tries to simulate small parts of the human nervous system, such as artificial neurons. Another tries to simulate gross behavior, such as having the machine produce an output much like that of a human when he is presented with a problem similar to the classic cannibals and the missionaries.

There is an amusing program which gives the illusion of acting like a psychoanalyst, another which answers a wide range of questions concerning baseball put to it (in slightly restricted English), and so it goes: many special programs appear on the surface to act intelligently.

Creativity

We have tended more or less to equate intelligence and thinking and have occasionally slipped in the word originality. We shall now change a bit and use the word creativity. These ideas are all closely associated, so that since we apparently cannot actually define any one of them in a precise enough manner for testing on a machine, we will not bother to distinguish shades of meaning between them.

Creativity is a fancy word for a very common thing, originality. In women's clothes originality means fashion. It is something that almost everyone in our society wishes to have — he likes to feel that in some way he is unique. But, we agree that some people have it more than others. The margin between originality and crackpottery is as thin as that between genius and insanity is traditionally considered to be. The difference between fashion and bizarre clothes is likewise very little.

But creativity is something that our current culture puts great value on, regardless of whether that is wise or not. Until now theories of creativity (originality, or whatever you wish to call it) have necessarily been complex and beyond the hope of checking in detail. Now with the machine we have a chance to explore the question. If we have a detailed theory of what creativity is, then it can probably be simulated by a machine, or at least parts of it can, and the model can be tested out.

Such has been the approach in music composition, in theorem proving, and some other programs that fall in the field of artificial intelligence. The results to date seem, to this author at least, to show more where creativity is not than where it is. But that is the way most fields begin. There are many false starts, a few small gains, and a great deal of confusion. Sometimes this is followed by clarity, and sometimes not. But only where there is activity is there much hope for progress. Again, it is better to assume that machines can do it than it is to assume that they cannot: one leads to action, often foolish to be sure, but the other is apt to lead to nothing but a dead end.

Let us repeat the point. The machines for the first time in human history give us the power to explore the fascinating field of creativity. Given a detailed enough model it seems likely that we can simulate it, or part of it, on a machine to test out whether the model has any merit or not, and thus correct our errors and recognize our good guesses so that progress can be made. □

Sagatelyan — *Continued from page 38*

John Kennedy wanted to save American capitalism. He intended to manoeuvre a bit, to strengthen the rear, to plaster over the cracks that had appeared in the social fabric, in the hope that after such minor repairs, imperialism, having gathered its forces, would once more be able to renew its onslaught, open and direct, on the world of socialism. However, the 35th President was not allowed to do this. That is Kennedy's personal tragedy.

He was a misunderstood President ...

He was a victim of the historical blindness of the most war-like sections of American imperialism. The murder in Dallas reeked so strongly that the stink was smelled by America and the rest of the world. The sentence on John Kennedy, pronounced by the darkest forces in the country, was executed by the oil magnates through their henchmen.

Even such an outcome satisfied wide circles of American business. They, too, had been frightened by Kennedy's activities — all those owners and co-owners of over 100,000 firms fed by the American taxpayers through the intermediary of the Pentagon.

That is the paradox: John Kennedy was removed from the political arena by the very system which he sought not only to strengthen, but to preserve forever.

The 35th President of the United States of America was, perhaps, imperialism's last hope. But his planned operation of rejuvenation on this greatest evil of our time did not take place. It did not take place because the surgeon was cut down in the heart of the festering ulcer — Dallas. □

ACROSS THE EDITOR'S DESK
Computing and Data Processing Newsletter

COMPUTER HELPS A TREE-CARE COMPANY SCHEDULE AND PLAN

Davey Tree Surgery Company
P.O. Box 351
Livermore, Calif. 94550

The West Coast division of a well-known tree-care company, Davey Tree Surgery Company in Livermore, Calif., is using a computer to control rising costs. The computer keeps track of crews, equipment, and jobs from the Rocky Mountains to Hawaii.

In addition to offering tree care and landscaping services, the crews clear branches from thousands of miles of utility line right-of-way. Power-line clearing, in fact, has become the largest single aspect of the company's work in the West.

"With crews spread out all over the place, we need to know how many men and how much equipment are going into various jobs, then compare this with what we're being paid for the work," said E. W. Haupt, vice president and general manager of the West Coast operation. "The computer system lets me know."

"We've grown 400 per cent in the last two years, and it would have been impossible without our computer."

The computer permits determining, for instance, if part of a San Diego-based crew should be transferred to Los Angeles, where the workload is heavier, or if a certain piece of heavy equipment currently in Phoenix would find more use in Portland, Ore.

The computer reports exactly how much each of 350 vehicles is costing every month — gasoline, oil, maintenance, depreciation, everything. From these figures it's easy to tell which equipment isn't being used enough to justify cost and upkeep.

The company was started in 1901 by English-born John Davey, whose lifelong interest was the diseases and ailments of shade trees; he planted hundreds of trees thoughout northeastern Ohio.

Though the company was started essentially to care for trees at private homes, it has widened its work to include the landscaping of commercial buildings and institutions. Today it does much of its landscaping on freeway right-of-way.

"We are investigating the use of the computer in keeping track of repetitive jobs," Mr. Haupt said. "The time may come when such information will be stored in the computer and printed out each day, directing us to the specific trees or shrubs that need spraying, root feeding, or pruning." The computer is an IBM System/3 Model 6.

TOXICOLOGY RESEARCH DATA AVAILABLE VIA ON-LINE NATIONWIDE NETWORK

Informatics, Inc.
6000 Executive Blvd.
Rockville, Md. 20852

What is described as a major advance in making research information on human and animal toxicity studies and other data on drug reactions, poisons, chemicals and pollutants, available to the public as rapidly as possible, was demonstrated recently at the Annual Meeting of the American Pharmaceutical Association in Houston, Texas. Representatives of the Toxicology Information Program of the National Library of Medicine, National Institute of Health, U.S. Department of Health, Education and Welfare, and Informatics Inc., a computer software and systems firm, performed on-line demonstrations of TOXICON, a service sponsored by the Toxicology Information program and operated by Informatics.

Utilizing a Cathode Ray Tube (CRT) terminal, commands were issued via a keyboard to a computer in Washington D.C. to search files of citations and abstracts of published toxicology and pharmacology studies of drugs, pesticides, and environmental pollutants and to provide information in the specific areas. The response from the computer took a matter of seconds.

Dr. Walter F. Bauer, president of Informatics, said, "TOXICON puts the health researcher, be he employed by a commercial firm, a governmental agency, a foundation, a college, a hospital, or working on his own, in direct touch with the information he may be seeking from virtually any point in the country and from many places in the world. No special computer know-how is necessary. The researcher can be trained in a short time to operate any of a number of existing typewriter-like terminals which interface with the network. Besides the considerable savings in time spent searching for information compared to manual or batch processing methods, the on-line system may considerably reduce research costs because the software needed to operate the system is already built-in."

The cost of the service is nominal, Dr. Bauer said, and may consist of an installation and monthly rental of a terminal (subscribers may elect to use terminals already installed for other purposes) plus possible communications costs and computer time charges. The network already has numerous entry points from which a subscriber can contact the network without incurring separate communications charges. Other subscribers incur standard telephone tariffs to the nearest entry points. Foreign exchange and wide area telephone service (WATS) apply to the use of TOXICON just as they do to ordinary voice calls.

An added security feature of TOXICON, Dr. Bauer said, is that the computer does not keep any record of the nature of the information sought; it computes times charges only. Further information on TOXICON may be obtained from Informatics Inc., Systems and Services Co., Rockville, Md.

HEALTH AND EDUCATION OF MIGRANT WORKERS IS BEING WATCHED BY A COMPUTER

Ayer Public Relations
1345 Avenue of the Americas
New York, N.Y. 10019

The critical needs of a child's health and educational development are usually attended to by the family doctor and the community school. However, in this country there are more than 800,000 children who have never received this kind of attention. On an average these children move from school to schooland state to state anywhere from 3 to 15 times per year; and in most cases, both their health and education suffer significantly.

These children are the offspring of migrant workers who follow the harvests to eke out a living to support their families. Today, with the aid of advanced technology, their health and educational development is being watched by a computer. This enables teachers to give them the kind of care and individual attention they deserve.

Recognizing the needs of these children, the Directors of the Departments of Education of the 48 contiguous states met in 1968 to discuss what kind of system should be developed to accommodate them. At this meeting the Migrant Student Record Transfer Committee was formed. "The major objective of the committee," says Vidal A. Rivera, Jr., Chief-Migrant Programs Branch, United States Office of Education, "is a multiple assessment of a migrant child's needs on an individual basis. Moving from school to school need not be a disadvantage if his records are kept properly."

The committee's first task was to create a transfer record that would be acceptable throughout the 48 states. Essentially it would offer a profile of the child as he moved from school to school. The next problem, due to the migrant child's mobility, was to get the transfer record to the school he was attending before he left for another district. Originally transfer records were mailed, but, in most cases, by the time the transfer record reached a school, the child had moved on to another; his record was lost; his whereabouts were unknown. The obvious solution to the problem was transferring the student's records from a computer over regular telephone lines to the new schools they were registered in.

Among the states involved in the program, Arkansas, California and New Mexico were the only ones to compete for a contract to develop a computer base. Based on a formal proposal, the United States Office of Education under the Health, Education, Welfare Department allotted the contract to Arkansas. The development of the computer base and the depository of migrant student information in Little Rock has probably become one of the most coordinated efforts of communications aiding an educational system in the United States.

Today, a central computer base in Little Rock, Arkansas is connected by Wide Area Telephone Lines (WATS) to 137 teletypewriters (serving over 7000 schools) positioned throughout the United States. At the computer base, health and educational information on 245,000 migrant children is updated and transmitted over these lines every time a child changes schools. Transmitting migrant student information anywhere in the country takes four hours.

Every time a migrant child arrives at a school, his identifying and enrollment data are collected and relayed to the nearest teletype operator. The operator prepares a paper tape of this information and transmits it to the depository in Little Rock. The computer scans its files to determine if the child is currently registered at the data base. If this is the case, the enrollment information is updated. The computer then extracts critical data (information which is significant to the initial placement and care of the migrant student) from the student's record and transmits it back to the operator, who in turn relays the data to the school. The entire process takes four hours. (Additional in-depth data is air mailed to the school within 24 hours.) Furthermore, elaborate safeguard measures programmed in the computer make it virtually impossible for any of this information to be sent to the wrong school or to get in the wrong hands.

Currently there are about 245,000 of the estimated 800,000 migrant children in the country registered at the depository. The chief aim of the coordinators of the program is to register them all.

COMPUTERS TO HANDLE PROBLEMS ON NATIONAL ECONOMY, POWER NETWORKS AND ECOLOGY

Department of Information Services
University of Notre Dame
Notre Dame, Ind. 46556

Two electrical engineers at the University of Notre Dame have received a $57,000 grant from the National Science Foundation to study improved techniques for using computers to handle complex, large-scale problems like the national economy, power networks and ecology.

Drs. Ruey-wen Liu and Richard Saeks, professor and associate professor of the electrical engineering, respectively, explained that while computer simulation techniques have been applied to some problems in the social sciences or ecology, most issues in these fields are too complex for the traditional techniques of mathematical modeling. Liu and Saeks are working on a two-year project to develop theoretical foundations for new techniques capable of handling complex, large-scale systems. In particular, they hope to develop a method for considering one unknown quantity at a time, while also taking into account the ways in which each unknown is related to the whole system.

Liu and Saeks believe their new methods will be applicable to a wide range of complex systems, but are beginning their examination with the problem of "fault isolation." Identifying what part of a large machine is faulty without taking the whole system apart is similar, they explained, to diagnosis in medicine — another area where their new techniques might find application.

DATRAN RECEIVES INITIAL CONSTRUCTION PERMITS

University Computing Co.
P.O. Box 6228
Dallas, Texas 75222

The Federal Communications Commission recently announced the grant of initial construction permits to Data Transmission Company (Datran) for the company's proposed national data communications network. (Datran is a subsidiary of University Computing Company.)

In addition to the 63 permits granted today, Datran will have completed filing all additional applications with the Commission for the remaining sites on the all-digital data network by summer and expects to have them granted by fall of this year. Construction is expected to begin during the last half of 1972 and service offerings on initial routes are expected to be made in late 1973 or early 1974.

Last June in a landmark decision, Datran received approval from the FCC to compete as a specialized carrier in the data transmission field, which has heretofore been dominated by AT&T and Western Union. Datran's nationwide, switched network is designed to provide high-quality, economical data communications service in and between major metropolitan areas for its subscribers.

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Control Data Corp., Minneapolis, Minn.	Defense Dept. and General Services Administration	One medium and six large-scale systems for implementing new and advanced management techniques which are expected to produce savings of over $100 million during 7-year life of contract	$83 million (approximate)
Burroughs Corp., Detroit, Mich.	Defense Dept.'s General Services Administration	Lease of two B6500 systems and related support services; systems will be installed at Defense Logistics Services Center, Battle Creek, Mich. for Defense Integrated Data Systems (DIDS)	$24.3 million
Burroughs Corp., Paoli, Pa.	Electronic Systems Division (ESD), Air Force Systems Command	B6700 system (replaces B5500) to support educational and scientific users at the Air Force Academy in Colorado	$5.2+ million
Honeywell, Inc., Waltham, Mass.	Gosbank, Leningrad, U.S.S.R.	Two Honeywell Model 615 systems which will form a communications network designed to automate administrative functions and control a variety of banking applications	$5 million (approximate)
Univac Division, Sperry Rand Corp., Blue Bell, Pa.	Berlin Power and Light Co. (BEWAG), Berlin, West Germany	UNIVAC 1108 system to process customers' bills for computation of load distribution and to execute technical and scientific calculations involved in power engineering	$4 million (approximate)
National Cash Register Co., Dayton, Ohio	Strasbourg Savings Bank Strasbourg, France	Two NCR Century 300 computers which will process savings, checking, and loan accounts at 34 French savings banks	$3.3 million
GTE Sylvania Inc., Western Div., Mountain View, Calif.	San Antonio Air Materiel Area, Kelly Air Force Base, Tex.	Modernization of Air Force electronic receiving system	$2.2 million
Univac Division, Sperry Rand Corp., Blue Bell, Pa.	Erste Osterreichische Spar-Casse (EOSC), Vienna, Austria	A UNIVAC 1106 and associated equipment to establish a real-time banking system	$2.1 million
Epsco, Inc., Westwood, Mass.	U.S. Navy	Modifying signal data converters currently used in the P-3C ASW (Anti-Submarine Warfare) aircraft	$1.8+ million
Varian ADCO, Palo Alto, Calif.	Planning Research Corp., Los Angeles, Calif.	Development of automated, remote-access microfilm storage and retrieval system; initial maximum capacity, 28 million pages; ADCO A626 System will be core of a fully-automated Military Personnel Records System at Randolph AFB, San Antonio, Texas	$1.8 million
GTE International, Inc., New York, N.Y.	Compania Paulista de Forca e Luz, Sao Paulo, Brazil	Supply and install computerized supervisory control and data acquisition system to monitor and control generation, distribution and transmission of all electric power	$1.7 million (approximate)
Computer Optical Systems, Inc., Burlington, Mass.	World Market Centers, Inc., Oklahoma City, Okla.	Design development of do-it-all electronic cash register using magnetically encoded cards	$1.2 million
Trans-A-File Systems Co., Sunnyvale, Calif.	Virginia Commonwealth University	An all-digital automated filing and retrieval system to be installed at Medical College of Virginia's Health Science Div.	$1,090,000
Univac Division, Sperry Rand Ltd., London, England	Miles Druce and Co., High Wycombe, England	Two UNIVAC 9400 computers, extending firm's real-time order entry and inventory control systems; replaces two UNIVAC 1050 systems	$1+ million
Massachusetts Institute of Technology, Cambridge, Mass.	Department of the Navy, Arlington, Va.	Establishment of an Artificial Intelligence Laboratory; initial goal is to conduct research on techniques that will endow robot-like devices with human-like learning, viewing, and manipulative capabilities	$1 million
Honeywell, Inc., Minneapolis, Minn.	Rocketdyne Div. of North American Rockwell Corp. (NR), Canoga Park, Calif.	Electronic control system to serve as "brain" of Space Shuttle main engine	$800,000
EMR Computer, Minneapolis, Minn.	State of Wisconsin, Crime Information Bureau, Madison, Wisc.	A twin EMR 6135 computer system to serve as control center of statewide law enforcement communications network	$600,000 (approximate)
RCA Aerospace Systems Div., Burlington, Mass.	NASA, Washington, D.C.	Laser land-surveying system called "Smokey", consisting of two ruggedized, back-packable, 40 lb. units; upon acceptance, US Forest Service will conduct a one year, all weather, environmental evaluation program in national forests through U.S.	$175,000
Custom Computer Systems, Inc., Plainview, N.Y.	Eastern Hudson Parkway Authority, N.Y.	Automated toll data collection system maintaining "round-the-clock" surveillance of traffic flow and operator activity	$129,000
Information International, Los Angeles, Calif.	Univac Division, Sperry Rand Corp., Roseville, Minn.	FR 80 COM (Computer Output Microfilm) recorder to produce logic diagram drawings and software listings in development of large-scale 1110 computer; FR 80 replaces a pen-and-ink drum plotter used in development of previous UNIVAC systems	—
Interdata, Inc., Oceanport, N.J.	Kearney & Trecker Corp., Milwaukee, Wisc.	New Series Model 70 processors with Real-Time Operating Systems (RTOS) and peripherals for use in K&T's SYSTEM GEMINI	—
Alan M. Voorhees & Associates, Inc., McLean, Va.	West Virginia Department of Highways	Developing a coordinated data system for highway planning	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B 2500 system	Western Data Associates, Casper, Wyo.	Serving data processing needs of Casper area businesses; will provide capabilities to expand services to small businesses throughout the state (system valued at $356,000)
	Wiremold Company, West Hartford, Conn.	Market demand forecasting, order entry payroll preparation and purchasing
Burroughs B 4700 system	Virginia Commonwealth Services, Inc. (VCS), Richmond, Va.	General banking applications including Mastercharge, certificates of deposit, and trusts (system valued at approximately $2.5 million)
Control Data Cyber 70 Model 72 system	Methods et Traitment de l'Information (METTI), Western France	Expanding time-sharing data center activities; services customers in banking, agriculture, general business, construction, etc. (system valued at $1.4 million)
	Mexico Department of Communications and Transport, Mexico City, Mex.	A variety of internal business data processing procedures; also will process data resulting from communication and transportation studies (system valued at $1.2 million)
Control Data 3150 system	LIPS, Netherlands	Scientific research and business data processing; replaces two current computers (system valued at $251,000)
Control Data 6600 system	Reactor Centrum Netherlands (RCN)	Processing nuclear reactor problems (system valued at $2.2 million)
Control Data 7600 system	Aerospace Corp., El Segundo, Calif.	Performing scientific and engineering computation
	University of London, London, England	Expanding existing data processing services; serves as regional DP center for 9 universities in SE England
Honeywell Model 2060 system	Metropolitan Savings, Brooklyn, N. Y. (2 systems)	Internal accounting and on-the-spot updating of customers' savings accounts (system valued at $1.18 million)
IBM System/360 Model 50	Fulton County Juvenile Court, Atlanta, Ga.	Maintaining name index and family history of juveniles handled by the court; a daily census of juveniles in detention; automatic preparation of court calendar
IBM System/370 Model 135	City of Garland, Garland, Texas	Tasks ranging from projecting the city's financial growth to controlling traffic
IBM System/370 Model 145	Macy's of Northern California, Cupertino, Calif.	Customer-account identification and account status verification
NCR Century 50 system	Beistle Company, Shippensburg, Pa.	Order processing and invoicing, accounts receivable, accounts payable and inventory control
	Bray Lines, Cushing, Okla.	Payroll, billings, and general ledger accounting
	Chicago, West Pullman & Southern Railroad Co., Chicago, Ill.	Replacing a manual system of inventorying inbound and outbound freight cars
	Concord Union School District, Concord, N. H.	Student scheduling, grade reporting and general accounting
	Wickes Furniture, Northbrook, Ill. (6 systems)	Inventory control, sales analyses and computation of sales commissions at 6 new warehouse/showrooms
NCR Century 100 system	Commercial Cold Storage, Atlanta, Ga.	Inventory control and invoicing
	Internationale Verbandstoff-Fabrik IVF, Zurich, Switzerland	General office applications, production planning, statistics, and shareholders register
NCR Century 200 system	Capri Beachwear, Inc., Farmingdale, N. Y.	On-line inventory system, also order processing, payroll, etc.
	Co-operative Pure Milk, Cincinnati, Ohio	Route control, inventory and payroll functions
	South African Permanent Building Society, Johannesburg, South Africa (2 systems)	Nucleus of nationwide on-line computer network; will connect all 71 branches with Johannesburg data center (system valued at $3.4 million)
UNIVAC Series 70/7 system	Florida Power and Light Co., Miami, Fla.	Production applications and assembly, compilation, and testing of programs for firm's computer complex
UNIVAC 1106 system	Burndy Corp., Norwalk, Conn.	An on-line entry system as well as general office applications (system valued at $1.7 million)
UNIVAC 9200 system	Keystone Life Insurance Co., New Orleans, La.	Insurance applications and general office applications
	M. L. Engineering Company, Ltd., Slough, Trading Estate, England	Payroll, purchase ledger and contract costing work
	H. Rollett & Co., United Kingdom	Providing up-to-date sales, invoicing, stock and payroll information
UNIVAC 9300 system	Abraham & Co., New York, N. Y.	Implementing a special back-office brokerage system known as TRADES; replaces a UNIVAC 1004
	Wyoming Valley Distributing Co., Wilkes-Barre, Pa.	Expediting the firm's business and general accounting operations
UNIVAC 9311 system	Records Automation, Frederick, Okla.	Accounting services for customers which include radio stations and small municipalities
	Research Computers, Oklahoma City, Okla.	Teaching data processing and for general insurance applications
UNIVAC 9400 system	Coronadata Company, Gothenburg, Sweden	A variety of business applications including investment analysis; a 9700 system will be added in 1974
Xerox Sigma 8 system	Federal Aviation Administration, Atlantic City, N. J.	Simulating air traffic conditions as part of study to meet future demands of U.S. air transportation; system joins a Xerox Sigma 5 computer (system valued at approximately $680,000)

MONTHLY COMPUTER CENSUS

Neil Macdonald
Survey Editor
COMPUTERS AND AUTOMATION

The following is a summary made by COMPUTERS AND AUTOMATION of reports and estimates of the number of general purpose electronic digital computers manufactured and installed, or to be manufactured and on order. These figures are mailed to individual computer manufacturers from time to time for their information and review, and for any updating or comments they may care to provide. Please note the variation in dates and reliability of the information. Several important manufacturers refuse to give out, confirm, or comment on any figures.

Our census seeks to include all digital computers manufactured anywhere. We invite all manufacturers located anywhere to submit information for this census. We invite all our readers to submit information that would help make these figures as accurate and complete as possible.

Part I of the Monthly Computer Census contains reports for United States manufacturers. Part II contains reports for manufacturers outside of the United States. The two parts are published in alternate months.

The following abbreviations apply:

- (A) -- authoritative figures, derived essentially from information sent by the manufacturer directly to COMPUTERS AND AUTOMATION
- C -- figure is combined in a total
- (D) -- acknowledgment is given to DP Focus, Marlboro, Mass., for their help in estimating many of these figures
- E -- figure estimated by COMPUTERS AND AUTOMATION
- (N) -- manufacturer refuses to give any figures on number of installations or of orders, and refuses to comment in any way on those numbers stated here
- (R) -- figures derived all or in part from information released indirectly by the manufacturer, or from reports by other sources likely to be informed
- (S) -- sale only, and sale (not rental) price is stated
- X -- no longer in production
- \- -- information not obtained at press time

SUMMARY AS OF MAY 15, 1972

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Part II. Manufacturers Outside United States							
A/S Norsk Data Elektronikk	NORD-1	8/68	2.0	0	82	82	16
Oslo, Norway	NORD-2B	8/69	4.0 (S)	0	20	20	X
(A) (May 1972)	NORD-5	-	-	0	1	1	0
	NORD-20	1/72	3.5 (S)	0	7	7	4
A/S Regnecentralen	GIER	12/60	2.3-7.5	0	40	40	0
Copenhagen, Denmark	RC 4000	6/67	3.0-20.0	0	19	19	3
(A) (Jan. 1972)							
Elbit Computers Ltd.	Elbit-100	10/67	4.9 (S)	-	-	300	20
Haifa, Israel							
(A) (Jan. 1972)							
GEC Computers Ltd.	902	5/68	-	0	15	15	2
Hertfordshire, England	903,920B	12/65	-	1	258	259	85
(R) (Mar. 1972)	Marconi-Elliott 905	5/69	-	0	45	45	14
	Marconi-Elliott 920M	7/67	-	0	98	98	-
	Marconi-Elliott 920C	7/68	-	0	13	13	6
	Myriad I	1/66	-	0	47	47	-
	Myriad II	11/67	-	0	32	32	-
	Marconi-Elliott M2140	10/69	-	9	21	21	-
International Computers, Ltd. (ICL)	Atlas 1 & 2	1/62	65.0	0	6	6	X
London, England	Deuce	4/55	-	0	7	7	X
(A)	KDF 6-10	9/61	10-36	0	58	58	X
(Jan. 1972)	KDN 2	4/63	-	0	1	1	X
	Leo 1, 2, 3	-/53	10-24	0	59	59	X
	Mercury	-/57	-	0	13	13	X
	Orion 1 & 2	1/63	20.0	0	17	17	X
	Pegasus	4/55	-	0	30	30	X
	Sirius	-/61	-	0	22	22	X
	503	-/64	-	0	16	16	X
	803 A, B, C	12/60	-	0	83	83	X
	1100/1	-/60	5.0	0	22	22	X
	1200/1/2	-/55	3.9	0	68	68	X
	1300/1/2	-/62	4.0	0	196	196	X
	1500	7/62	6.0	0	110	110	X
	2400	12/61	23.0	0	4	4	X
	1900-1909	12/64	3-54	2	2200	2202	C
	Elliott 4120/4130	10/65	2.4-11.4	0	160	160	C
	System 4-30 to 4-75	10/67	5.2-54	0	160	160	C
							Total: 400
Japanese Mfrs.	(Mfrs. of various models include: Nippon Electric Co., Fujitsu,						
(N) (Sept. 1970)	Hitachi, Ltd., Toshiba, Oki Electric Industry Co., and Mitsubishi					Total:	Total:
	Electric Corp.)					4150 E	800 E
Marconi Co., Ltd.							
see GEC Computers Ltd. above							
N.V. Philips Electrologica	P1000	8/68	7.2-35.8	-	-	89	34
The Netherlands	P9200	3/68	-	-	-	300	50
(A)	P9200 t.s.	3/70	-	-	-	4	0
(Jan. 1972)	P-800	9/70	-	-	-	50	200
	ELX1	5/58	12.0	-	-	20	-
	ELX2/8	3/65	6-21	-	-	27	-
	DS714	-/67	-	-	-	31	12
	PR8000	1/66	-	-	-	23	-
Redifon Limited	R2000	7/70	-	1	13	14	6
Crawley, Sussex, England							
(A) (May, 1972)							
Saab-Scania Aktiebolag	D21	12/62	7.0	0	38	38	-
Linkoping, Sweden	D22	11/68	15.0	0	31	33	3
(A) (May, 1972)	D220	4/69	10.0	0	16	16	2
Selenia S.p.A.	G-16	7/69	10.9 (S)	0	95	95	38
Roma, Italy	GP-160	-	5.6 (S)	-	-	-	250
(A) (Mar. 1972)							
Siemens	301	11/68	0.9	-	-	99	14
Munich, Germany	302	1/68	2.1	-	-	30	6
(A)	303	4/65	2.7	-	-	71	1
(April, 1972)	304	5/68	4.5	-	-	79	15

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Siemans (cont'd)	305	2/68	6.1	-	-	113	16
	306	6/70	7.9	-	-	23	5
	2002	6/59	16.4	-	-	39	-
	3003	12/63	15.8	-	-	32	-
	4004/15/16	10/65	6.1	-	-	102	2
	4004/25/26	1/66	10.0	-	-	68	16
	4004/35	2/67	14.2	-	-	211	39
	4004/135	10/72	20.5	-	-	15	49
	4004/45	7/66	27.3	-	-	340	31
	4004/46	4/69	41.0	-	-	15	1
	4004/55/60	7/66	35.0	-	-	27	-
	4004/150	10/72	49.0	-	-	4	47
	4004/151	10/72	61.0	-	-	3	-
	404/3	4/71	2.1	-	-	19	12
	404/6	10/71	4.5	-	-	32	43
						Total: 1251	Total: 297
USSR (N) (May 1969)	BESM 4	-	-	-	-	C	C
	BESM 6	-	-	-	-	C	C
	MINSK 2	-	-	-	-	C	C
	MINSK 22	-	-	-	-	C	C
	MIE	-	-	-	-	C	C
	NAIR 1	-	-	-	-	C	C
	ONEGA 1	-	-	-	-	C	C
	URAL 11/14/16 and others	-	-	-	-	C	C
						Total: 6000 E	Total: 6000 E

C.a PROBLEM CORNER

Walter Penney, CDP
Problem Editor
Computers and Automation

PROGRAM 726: A POPULARITY PROGRAM

When Joe walked into the Computer Center, he saw Al and Bob huddled over a pile of coding sheets. "Whenever I see you guys working so hard on a program, I can be sure it's not company business," he said. "What is it this time?"

"There's a contest to pick the order of popularity of a group of songs," Al said. "We're trying to write a program for it."

"Something like the old Hit Parade contest?"

"Yes, but here it's the number of places you get right, not necessarily the top three."

"How many songs are there?"

"Ten. We figure with a little computer assistance we'll be able to determine the smallest number of tickets that will stand the best chance of winning a prize."

"Oh, there's a cost, then? Joe began to get a little suspicious.

"Yes, it's a little like a football pool," said Al. "But this may turn out to be more like a race – a race against factorial n. The numbers seem to go up very fast."

"What numbers are these?"

"The number of tickets that have to be bought to be sure of getting a certain number of positions right out of n." Bob pointed to some calculations he had made. "You have to put in a lot more, for example, to be sure of getting five right out of ten than five right out of nine."

"Yes, but how about other numbers? Is it true that the number to guarantee r right out of n is always greater than the number to guarantee r right out of n-1?"

Solution to Problem 725: Stuck-Up Stick-Ons

The boxes A = A-1 and A = D+1 have been interchanged. If these are reversed the flow chart will represent a program to compute E $\frac{1}{1+}\frac{2}{2+}\frac{3}{3+}\cdots$ ... which is equal to $\frac{1}{e-1}$.

Readers are invited to submit problems (and their solutions) for publication in this column to: Problem Editor, Computers and Automation, 815 Washington St., Newtonville, Mass. 02160.

CORRECTIONS

In the May 1971 issue of Computers and Automation, the following corrections should be made:

Page 19, "Deciphering an Unknown Computer Program, as Compared With Deciphering of Ancient Writing", at bottom of right column: Replace the contract number "N0014-C-70-0225" by "N00014-C-70-0225".

Page 26, "Deciphering an Unknown Computer Program, as Compared With Deciphering of Ancient Writing", under "References": Replace "Chadiwick" by "Chadwick".

ADVERTISING INDEX

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

Announcement

The Most Important of All Branches of Knowledge

(Based on the editorial in the April 1971 issue of *Computers and Automation*)

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

If so, I would maintain that it is a subject which used to have the name "wisdom" but nowadays does not have a recognized scientific name, or in any college a recognized department or faculty to teach it. This subject currently is a compound of common sense, wisdom, good judgment, maturity, the scientific method, the trained capacity to solve problems, systems analysis, operations research, and some more besides. Its earmark is that it is a general subject, not a special one like chemistry or psychology or astronautics. Useful names for this subject at this time are "generalogy" or "science in general" or "common sense, elementary and advanced".

Many editorials published in "Computers and Automation" have in one way or another discussed or alluded to this subject:

- Examples, Understanding, and Computers / December 1964
- The Barrels and the Elephant: Crackpot vs. Pioneer / May 1965
- Some Questions of Semantics / August 1965
- Perspective / April 1966
- Computers and Scientific Models / May 1967
- New Ideas that Organize Information / December 1967
- How to Spoil One's Mind – As Well as One's Computer / August 1968
- The Catching of Errors by Inspection / September 1968
- Tunnel Vision / January 1969
- The Cult of the Expert / May 1969
- Computers, Language, and Reality / March 1970
- Computers and Truth / August 1970
- The Number of Answers to a Question/March 1971

In the editorial "The Cult of the Expert" we offered a leaflet that belongs in this subject, "Right Answers – A Short Guide for Obtaining Them". More than 600 readers asked for a copy; so clearly this subject is interesting to the readers of C&A.

This subject is related to computers and the computer field in at least two ways:

First, many of the general principles which this subject contains can be investigated in experimental or real situations by means of a computer. In fact, far more can be investigated by computer than can possibly be investigated by ordinary analytical mathematics.

Second, since computer professionals are in charge of computing machines, many people consider these professionals responsible for the worthwhileness of the results of computers. Because of "garbage in, garbage out", computer professionals have a responsibility to apply common sense and wisdom in at least three ways:

- *Input* – in the selection and acceptance of the data with which they begin;
- *Processing* – in the processing through a system;
- *Output* – in the interpretation and use of the answers.

Then the computerized systems will produce strong structures that human beings can use and rely on, and not weak structures which will crash with false information or ridiculous results.

"Computers and Automation" for April 1971 contains an article, "Common Sense, Wisdom, General Science, and Computers", which deals with this subject. For more than a dozen years I have been studying this subject – ever since I searched in a very large and good public library for a textbook on common sense or wisdom and found none at all. There is, however, a great deal of information to be gathered on this subject because a large number of great men, ancient, medieval, and modern, have made remarks and comments (usually while talking or writing about something else) that belong in this subject.

The subject of wisdom is particularly important in these modern days. The subject has been neglected, while special sciences have been cultivated. Investigators have pursued the special sciences with the enthusiasm of a child with a new toy. Specialized science and specialized technology have rendered our earthly world almost unrecognizable:

- All major cities on the planet are only a few hours apart by jet plane.
- Millions upon millions of people who otherwise would be dead are alive because of miracle drugs, – thus creating a population explosion;
- Nuclear weapons if used can destroy mankind and civilization in a few hours; etc.

To deal with so many diverse, vast problems we need wisdom. To use wisdom we should study it.

The staff of "Computers and Automation" have decided that it is desirable to make the drawers full of information we have been collecting on this subject more accessible and more widely distributed. We have decided to publish twice a month a publication of newsletter type called "The C&A Notebook on Common Sense, Elementary and Advanced". For more details, see the announcement on the opposite page. (The first few issues of the Notebook are free.)

We invite you, our readers, to join us in the pursuit of this subject, as readers of the Notebook, and as participators with us in the research and study.

Wisdom is a joint enterprise – and truth is not shaped so that it can fit into the palm of any one person's hand.

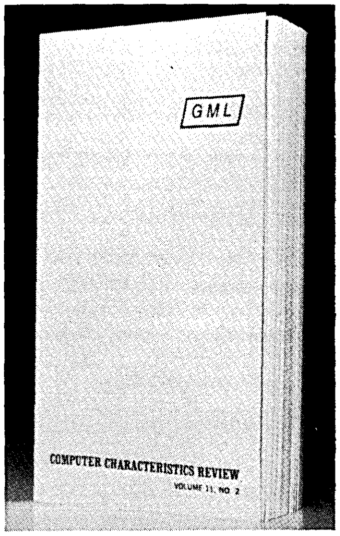
Edmund C. Berkeley

EDITOR

INVENTORY OF THE ISSUES OF — TITLES AND SUMMARIES
THE C&A NOTEBOOK ON COMMON SENSE, VOLUME 1

1. Right Answers — A Short Guide to Obtaining Them
   A collection of 82 principles and maxims. Example: "The moment you have worked out an answer, start checking it — it probably isn't right."
2. The Empty Column
   A parable about a symbol for zero, and the failure to recognize the value of a good idea.
3. The Golden Trumpets of Yap Yap
4. Strategy in Chess
5. The Barrels and the Elephant
   A discussion of truth vs. believability
6. The Argument of the Beard
   The accumulation of many small differences may make a huge difference.
7. The Elephant and the Grassy Hillside
   The concepts of the ordinary everyday world vs. the pointer readings of exact science.
8. Ground Rules for Arguments
9. False Premises, Valid Reasoning, and True Conclusions
   The fallacy of asserting that the premises must first be correct in order that correct conclusions be derived.
10. The Investigation of Common Sense
11. Principles of General Science and Proverbs
    8 principles and 42 proverbs
12. Common Sense — Questions for Consideration
13. Falling 1800 Feet Down a Mountain
    The story of a skimobiler who fell 1/3 of a mile down Mt. Washington, N.H., and was rescued the next day; and how he used his common sense and survived.
14. The Cult of the Expert
    Rules for testing expert advice.
15. Preventing Mistakes from Failure to Understand
    Even though you do not understand the cause of some trouble, you may still be able to deal with it. The famous example of a cure for malaria.
16. The Stage of Maturity and Judgement
17. Doomsday in St. Pierre, Martinique — Common Sense vs. Catastrophe
    How 30,000 people refusing to apply their common sense died from a volcanic eruption.
18. The History of the Doasyoulikes
    A parable in which the stern old fairy Necessity plays a part.
19. Individuality in Human Beings
    Their chemical natures are as widely varied as their external features.
20. How to be Silly
    71 recipes for being silly. Example: "Use twenty words to say something when two will do."
21. The Three Earthworms
    A parable about curiosity; and the importance of making observations for oneself.
22. The Cochrans vs. Catastrophe
    The history of Samuel Cochran, Jr., who ate some vichyssoise soup.
23. Preventing Mistakes from Forgetting
    The commonest cause for mistakes probably is forgetting. Some remedies.
24. What is Common Sense? — An Operational Definition
    A proposed definition of common sense not using synonyms but using behavior that is observable.
25. The Subject of What is Generally True and Important — Common Sense, Elementary and Advanced
26. Natural History, Patterns, and Common Sense
    Some important techniques for observing.
27. Rationalizing and Common Sense
    Coming to believe what you want to believe; and some antidotes for this common mistake.
28. Opposition to New Ideas
    Some of the common but foolish reasons for opposing new ideas.
29. A Classification and Review of the Issues of Vol. 1
30. Index to Volume 1

A Quick, Easy, Fingertip Reference



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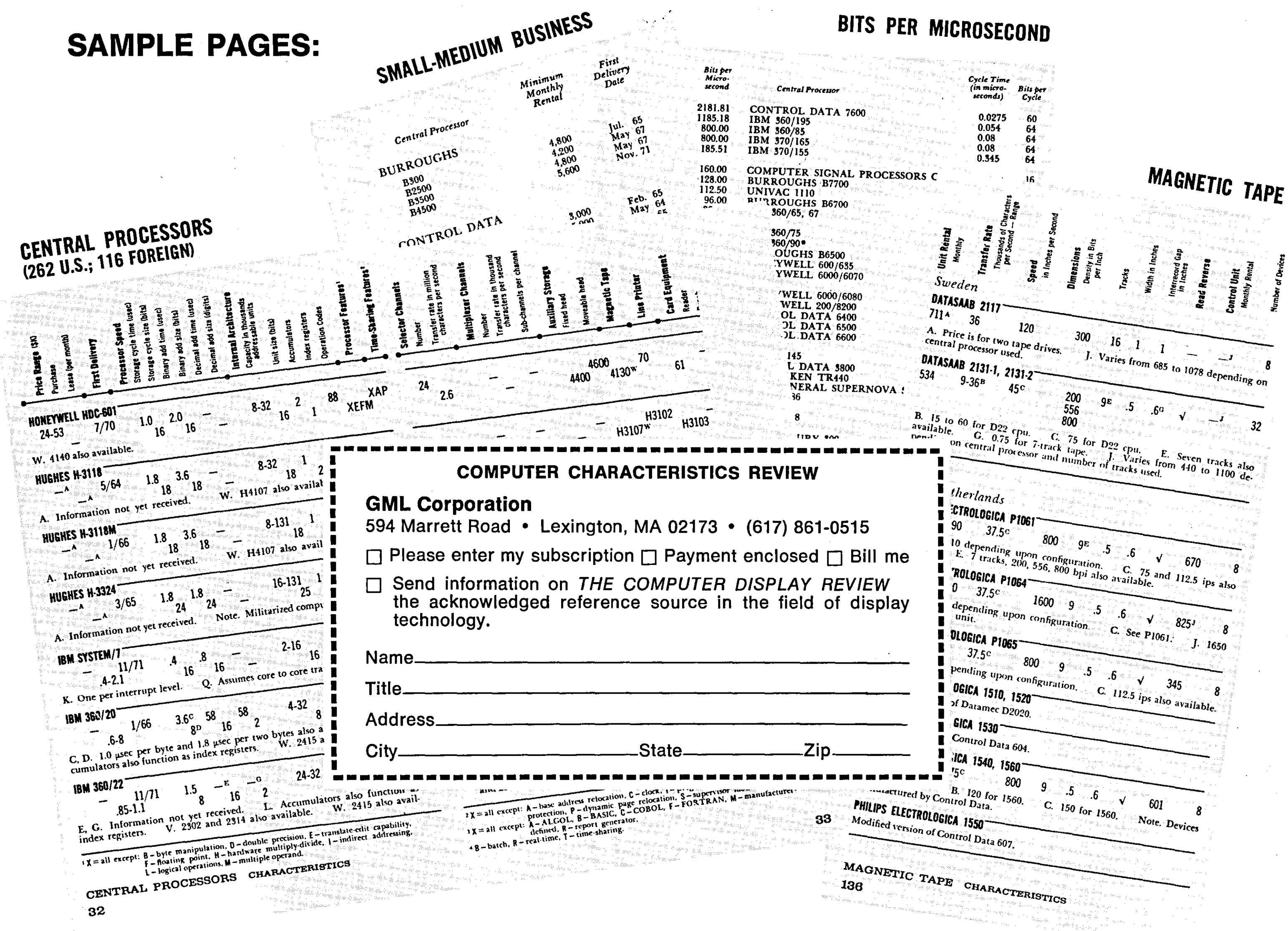

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