January, 1976
Vol. 25, No. 1

computers and people

formerly *Computers and Automation*

LOVE LOVE BUTTERFLIES
by Mutsuko Sasaki

GAMES AND PUZZLES for Nimble Minds – and Computers

Neil Macdonald
Assistant Editor

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

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

NAYMANDIJ

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

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

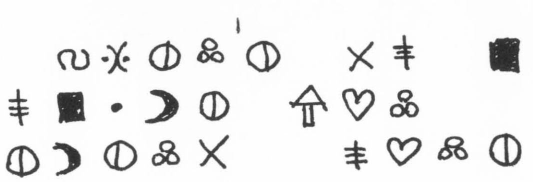
NAYMANDIJ 761

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

MAXIMDIJ

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

MAXIMDIJ 761



NUMBLES

A "numble" is an arithmetical problem in which: digits have been replaced by capital letters; and there are two messages, one which can be read right away and a second one in the digit cipher. The problem is to solve for the digits. Each capital letter in the arithmetical problem stands for just one digit 0 to 9. A digit may be represented by more than one letter. The second message, which is expressed in numerical digits, is to be translated (using the same key) into letters so that it may be read; but the spelling uses puns, or deliberate (but evident) misspellings, or is otherwise irregular, to discourage cryptanalytic methods of deciphering.

NUMBLE 761

```
                      M U C H
                  x H O N E Y
                    ---------
                    C N T O A
                  S M C M E
U = T           T H M H N
              E M E O N
            Y N C T H
            -----------------
        =   H E E A O N C Y A

            99085   93761
```

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

SOLUTIONS

MAXIMDIJ 7512: Even one enemy is one too many.

NAYMANDIJ 7512: Column 8, below 3.

NUMBLE 7512: He who knows most knows least.

Our thanks to the following individuals for sending us solutions: L. R. Chauvenet, Silver Spring, Md. : Naymandij 7511; Maximdij 7511; Numble 7511 – T. P. Finn, Indianapolis, Ind. : Maximdij 7511 – Ronald C. Graves, Ashland, Mass. : Naymandij 7511; Maximdij 7511; Numble 7511 – Abraham Schwartz, Jamaica, N. Y. : Numble 7511

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FROM: Berkeley Enterprises Inc., publisher

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   (2) when your subscription was paid for;

   (3) how much you paid; and

   (4) in what way you paid.

3. If you have failed to receive any issues to which you believe you are entitled, please write us at once and ask for those issues.

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Period	Without Directory Issue	With Directory Issue
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   815 Washington St.
   Newtonville, Mass. 02160, U.S.A.

6. All subscription correspondence should be directed to us.

Vol. 25, No. 1
January, 1976

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"Computers and People," formerly "Computers and Automation," is published monthly, 12 issues per year, at 815 Washington St., Newtonville, MA 02160, by Berkeley Enterprises, Inc. Printed in U.S.A. Second Class Postage paid at Boston, MA, and additional mailing points.

Subscription rates: United States, $11.50 for one year, $22.00 for two years. Canada: add $1 a year; elsewhere, add $6 a year.

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

Front Cover Picture

The front cover shows "Love Love Butterflies" by Mutsuko Sasaki, Tokyo, Japan. He says: "A program is constructed which eliminates invisible areas and paints surfaces in assigned ways. Basic data are sets of numbers representing a butterfly divided into parts. This figure is drawn by using the program, and by scattering many butterflies made from the data with various sizes and positions. The calculation was made on a FACOM 270-30 computer."

1975 Annual Index – Notice

The Annual Index for the 12 regular issued in 1975 (Volume 24) of "Computers and People" (formerly "Computers and Automation") not including the 1975 "Computer Directory and Buyers' Guide" (which was not printed early enough for inclusion) is printed on pages 17 to 21 of this issue. We regret that the index did not fit into four pages pages – but the center four pages of this issue can be removed, and only one page (page 21) has to be photocopied in order to put together a complete separate index for binding the 1975 volume (not including the 1975 "Computer Directory and Buyers' Guide").

Key

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

NOTICE

*D ON YOUR ADDRESS IMPRINT MEANS THAT YOUR SUBSCRIPTION INCLUDES THE COMPUTER DIRECTORY. *N MEANS THAT YOUR PRESENT SUBSCRIPTION DOES NOT INCLUDE THE COMPUTER DIRECTORY.

EDITORIAL

What We Do Depends Upon What We Think

Near Tallahasse, Florida, one day in early December or late November, Frank D. Booth, an official of Brevard County, was in his car on his way to his father's funeral. He had parked on the shoulder of a highway, apparently seeking to control his grief, to pull himself together. A state trooper Robert E. Rennie, Jr., noticed the car and radioed the license number to the Florida State crime computer. The reply he received was that the license number was the number of a stolen car, and that it had been stolen in 1971. Booth's car was a 1975 Chrysler with an orange-on-white license plate issued in 1974 and validated with a 1975 decal. But the trooper nevertheless approached the car with his .38 caliber pistol loaded and cocked. During the verbal encounter that followed, Booth was shot and killed.

In the State of Florida, the same license numbers are issued repeatedly to different cars and drivers, and the differences in color of license plate serve as additional indicators of difference.

At present writing, the trooper is suspended from his duties, and a coroner's jury is to inquire into what happened and reach a verdict. But of course no verdict will restore Booth to life, nor relieve Rennie of the horrible knowledge that he shot and killed a totally innocent man.

I think this case focuses a searchlight on the system design of "crime computers". There is no doubt in my mind that a crime computer, properly designed, is a useful and nowadays a necessary adjunct to law enforcement in the United States. But the socalled computer professionals who designed and installed the system in use in the Florida State crime computer allowed this kind of mistake to occur. They did not design into the system extra checking, extra built-in reliability. They are to my mind more culpable than Rennie.

For example, it ought to be possible to include in the system of the crime computer a requirement that any license numbers reissued by the State of Florida which agree with the number of a stolen car should also be reported to an inquiring policeman. Rennie in this way could have been told by the computer that there were, say, four cars with the same Florida license number. Inevitably then the information, arriving on the trooper's radio at the critical moment when he has to make a decision to approach and be prepared to arrest the occupant of a strange car, would then be the equivalent of "Wait a bit — this is one of four cars — which one might it be?"

Or, for example, it ought to be possible for the crime computer to require that the identifying color (signifying the year) of a license plate, in addition to the number, should be supplied to the system BEFORE it will reply to the question, "Is this the number of a stolen car?" In this way it would again help the state trooper at the critical moment to make a correct decision instead of a faulty one.

At this late date, it is to be hoped that the computer professionals in charge of the Florida State crime computer system are saying to each other, "Let's modify this computer system so that this kind of mistake will never, never happen again." Feedback should always be applied to improve the design of any system.

What we do depends upon what we think. A computer — programmed — is a modern tool to assist thinking. Let us make these tools as splendidly reliable as an Apollo spaceflight computer.

Edmund C. Berkeley

Edmund C. Berkeley
Editor

MULTI-ACCESS FORUM

VALENTIN TURCHIN, AND SOME OTHER TOPICS

1. From: Gerard Salton, Chairman
Dept. of Computer Science
Cornell Univ.
Ithaca, N.Y. 14850

Last summer the Christian Science Monitor ran a poll among its readership with the aim of identifying "America's Ten Most Livable Cities". Two lists were published representing respectively reader opinions, and selections made by the Monitor staff. Six cities appeared on both lists. They were San Francisco, Boston, Seattle, Denver, San Diego, and Minneapolis. As you know, the last two of these cities provided the locations for the ACM National Conferences of 1974 and 1975, respectively. Obviously we have been fortunate twice in a row. I found Minneapolis attractive, with clean, good looking streets, interesting shopping areas, and friendly people.

The ACM Council met for ten hours in Minneapolis. On the whole, it was not a very productive meeting: a number of political issues emerged whose disposition took a good deal of time; the list of accomplishments is thus rather meager. The problem never seems to be lack of good will, or of hard work; in fact, the level of debate is often surprisingly high. But difficulties are bound to emerge when an attempt is made by 25 people with highly divergent views to reach a consensus on any issue. This time around we had more than our normal share.

The financial news continues to be good. The net income of the Association for the fiscal year which ended on June 30, 1975, was approximately $450,000, instead of $100,000 as originally budgeted; and for the months of July and August 1975 for which data are available we are already about $50,000 ahead of the projected budget. Some people have suggested that we should promptly institute a reduction in dues. The officers feel, with some justification I think, that such a step would be premature at this time. Much of the income produced by membership dues and subscriptions is treated as "unearned" when received, in the sense that this income is used to pay for member services for the year which lies ahead. Thus when the Association shows cash reserves of about a million dollars, as it does at the present time, most of the money is clearly not available to be returned to the members. There is also a desire to increase the size of the reserves which should be carried and to allocate some amounts to new ventures, such as the new journal for all members (JAM). Finally, the feeling is widespread that a dues decrease, if instituted, should be maintained for some years. In short, no support exists for a dues decrease at the present time. Fortunately, no one (except the Treasurer who is bound to make all sorts of contingency plans) speaks of any increase in dues for the foreseeable future. ....

Council spent time on a few additional issues: ....; and then there was the matter of Valentin Turchin.

Turchin is a Russian computer expert who for some years has had increasingly serious problems with the Soviet authorities because of political activities with which the government there disagrees. His activities include open support for Andei Sakharov and other Soviet dissidents, and the signing of petitions and appeals of which the Soviets do not approve. Unhappily for Turchin, he is not as prominent as Sakharov or Solzhenitsyn, and thus instead of being booted out, as Solzhenitsyn was, he is being denied the right to exercise his profession, and otherwise subjected to harassments of various kinds.

You may ask what all this has to do with the ACM. First Turchin is apparently an active computer scientist; second he is an ACM member because an American friend for reasons not entirely clear has recently paid Turchin's ACM dues; finally, Turchin has been offered a post as a visiting scholar at Columbia University, and the Soviet government has up to now refused to let him come.

I cannot go into all the details and ramifications — the back-up material furnished to Council in this case covered over 150 pages. Suffice it to say that the Council was faced with a resolution "expressing the hope that Dr. Turchin will be permitted to accept the invitation by Columbia University, and voicing its concern that he may be prevented from doing so."

The resolution itself, I consider unexceptionable; scientists in many countries — not only in the Soviet Union — have been used as pawns by their respective governments for a long time, and the situation of dissident intellectuals is generally intolerable. On the other hand, one may ask oneself what the ACM Council can or should do about such matters. I myself agreed with the ACM Constitution and Bylaws Committee which suggested that no action be taken:

(please turn to page 11)

The Universal Product Code:
and the High Cost and Long Task of Conversion to it, for Many Manufacturers

Thomas C. Sobczak, Ph. D.
Director, Information Processing
Waldes Kohinoor Inc.
47-16 Austel Place
Long Island City, N.Y. 11101

"In summary, the onetime cost to convert to the Distribution Code for at least one large inventory, low volume per part manufacturer could reach $1.4 millions if all possible costs were considered."

The distribution code for distributors is an offshoot of the Universal Product Code presently being implemented within the Grocery Industry. The concept is being marketed by Distribution Codes, Inc., Washington, D.C. DCI is owned jointly by the Uniform Grocery Product Code Council and the National Association of Wholesalers/Distributors. NAW/D is an association of associations. Each association member is coordinating its activities concerning coding through Distribution Codes, Inc.

At the present time, the Universal Product Code exists under several names:

Name	Abbrev.	Sponsoring Distributor Association
National Drug Code	NDC	National Wholesale Druggists
Health Related Items	HRI	National Wholesale Druggists
Publication Code	UPC	Council of Publication Distributors
Alcoholic Beverages	UPC	Wine and Spirits Wholesalers
Stationery & Business Supplies Code	DC	Business Records Manuf. Association
		Nat. School Supply & Equipment Association
		Paper, Stationery & Tablet Manuf. Assn.
		Wholesale Stationers Association
Electrical Supplies	DC	Nat. Assn. of Electrical Dist.
Air Conditioning	DC	A/C-Refrigeration Wholesalers
Plumbing	DC	Nat. Assn. Plumbing Wholesalers
Distribution Industries	DC	NIDA/SIDA (Nat. & Southern Industrial Distributors)

UPC is growing continually, under its many different names; therefore most people tend to underestimate the power of its spreading.

The Domino Effect

Figure 1 shows the domino effect on industry as UPC moves from place to place. UPC was developed for the Grocery Industry but since Drugs and Health Related Items are sold in supermarkets, the Food and Drug Administration was convinced (lobbied?) to change the National Drug Code and the Health Related Items Code to the UPC format. Books and Magazines are sold in Supermarkets; so the Publications Distributors were next to embrace UPC. Recently the Alcoholic Beverage Commission was convinced to specify the UPC. Outside of New York State, alcoholic beverages are sold in Supermarkets. The trend continues with Stationery and Business Supplies. The logic is the same. In time, everything sold in Supermarkets must be scanned mechanically.

The mass merchandising (Discount) stores are accepting UPC because it exists on products they buy. The Federal Department of Transportation is proposing to modify 49 CFR577, the law controlling manufacturer marking of auto parts. This opens the door to UPC. The code exists in wholesale electrical, air conditioning, refrigeration, and plumbing. UPC goes on and on and on without anyone realizing how quickly it grows or how much it affects their daily lives.

No Benefit to the Manufacturer

The large inventory, low volume per part manufacturer has a massive problem in conversion to the "Distribution Code" variant of the Universal Product Code. His cost is excessive while his return on investment is customer (distributor) goodwill plus some non-quantifiable savings if he installs in-house scanners in the stockroom.

The first problem is to rationalize the transition from a perfectly good code which your customers are familiar with to an eleven digit, all numeric code where the first six digits identify the manufacturer and the next five digits randomly and non-significantly define the product. This problem is compounded, if the manufacturer sells to the Federal Supply Service, the Defense Supply Agency or the Department of Defense, because they utilize the Federal Stock Number or the National Stock Number. They are required to utilize a uniform system of item identification and nomenclature to describe, classify and number each item included in the Federal Catalog System so that an item of supply is identified by a single stock number.

This is required by Title 10, United States Code, Chapter 145. Assuming most manufacturers will have to operate a dual code to convert to UPC, this means that a minimum of three codes will be effective simultaneously if you sell to the government.

Assigning Distribution Codes

Before any operation within the manufacturer's plant is affected, he must decide how he wants to code. Let us assume a manufacturer, such as Waldes Kohinoor, has 17,685 separate and distinct parts in his inventory and follows the pamphlet "Guidelines for Establishing Distribution Code (DC) Unique Product Numbers" as recommended by Distribution Codes, Inc.

It is recommended that Waldes should have a code which leaves the first 10,000 numbers blank. The remaining 80,000 numbers divided by 17,685 allows a spacing of four numbers between the numbers we assign (i.e. 1, 6, 11, 16, etc.).

Assuming Waldes wants to group the twenty-nine standard styles of its retaining rings and twenty special styles, testing shows that they cannot assign clean blocks of numbers (i.e. thousands digits) to the part number. We immediately lose anything promised by the DCI pamphlet. The pamphlet was written for small inventory, large volume per part manufacturers. Regardless of this fact, let us assume all items are coded.

At this point all 17,685 items have been assigned a distribution code. We must prepare a cross reference list so that the new numbers can be aligned with the old numbers.

Our costs to this point are:

1. Major meeting of concerned Department Heads to explain code and establish coding committee.	$ 600
2. Cost of coding (including tests for grouping similar styles)	$ 6,000
3. Cost of typing and proofreading	$ 1,800

Quite a bit of detailed proofreading is required to be sure that there are no transpositions in the new non-significant numbers. If we had continued the old system, transpositions would have surfaced immediately. Under the new system, if a transposition is typed into the initial cross reference list, a major problem occurs. You could have a duplicate number. As a check digit would be a twelfth digit, it cannot be considered on human readable labels.

The Distribution Code Label

The next conversion cost encountered is the label for normal packaging. The Distribution Code Label, as specified now, matches the UPC bar code. The film master manufacturers presently charge $25 per film master. As Waldes Kohinoor has 17,685 separate and distinct parts, the film masters of the Distribution Code in Bar Code format will cost $442,125. (I have assumed that pieces per package are not considered for DC coding as they are for UPC, for Waldes has 6 package sizes. If the requirement is for total uniqueness within size, Waldes has 106,110 unique numbers whose initial film masters would cost $2,652,750. An additional consideration is that Waldes, to retain its 4 number spacing would need five different manufacturer numbers.)

Waldes presently uses a dozen label types which we prepare as needed in batches ranging from 2 labels for slow movers to 500 for fast movers. To keep our perspective, some 3,500 items are the 20% which controls 80% of the movement. A check with printers capable of printing to the DCI specified parameters indicates that a minimum DC bar coded label printing run is 5,000 at a cost of $12.00 per lot (low estimate based on volume). This adds $212,220 to our conversion cost.

Based on a review of several drug and grocery manufacturers, we can assume that we will need clerical assistance to maintain masters and labels as well as coordinated issuance of new codes and deletion of displaced items. Using our prior extrapolation, three clerks handling 1,200 fast movers and 4,800 slow movers will be required. This adds $28,080 to our cost, assuming $120 per week salary and 50% fringes.

In summary the segment of conversion costs:

1. film masters	$ 442,125
2. labels	212,220
3. clerical control	28,080
Sub-total	$ 682,425

100,000 Boxes to Relabel

Next we move to the stockroom where Waldes Kohinoor maintains several hundred million parts in packages ranging from 250 pieces to 50,000 pieces. There are packages in boxes, boxes in cartons (shipping containers), and cartons on pallets. All told over 100,000 boxes have to be relabelled. A decision is required. Do we stop shipping for the two weeks it will take to relabel? or do we relable piecemeal on weekends running the risk of confusion, misshipments, and loss of business? If we shut down for two weeks, we lose approximately $600,000 in billing and several customers who cannot wait for delivery. If we shut down, do we still pay a payroll of $80,000 per week and $42,000 in outlays and $120,000 if competitors ship only 20% of what we cannot.

This segment of conversion costs:

1. relabelling	$ 364,000

The Effect on Data Processing: The Cost of Lowered Efficiency

Now that we are prepared to ship orders using the Distribution Code, let us examine the effect on data processing. Once the new code is decided upon, many decisions have to be made. The key management decision required is "Do we abandon the existing code or do we maintain two codes?". Logic dictates that initially we must keep two codes in order to maintain normal operations. A company can ill afford to confuse its blue collar workers. The learning curve is shallow and of long duration. In time everyone will learn the code. The cost of lowered efficiency cannot be really measured but it exists and is potentially great.

Initially the cross reference table previously prepared has to be programmed so a table look-up routine can identify any new code being input on order forms. As an additional feature the new code must be added to all records and reports to facilitate the transition. At Waldes Kohinoor, 398 programs will have to be modified so that transaction and data records retain two codes and printer formats are expanded for the new code.

Another problem exists, in that, if someone wants to learn what was sold in a particular style, or in a particular metal or finish, the new non-significant Distribution Code cannot accommodate this task. This means that at a minimum, in data processing, dual coding is a requirement which cannot be omitted.

In order to provide a continuity of sales history in the new code format all prior records maintained on magnetic files must be modified to identify the new DC code as well as the existing code. This means that every record in your sales history file, at Waldes some 51,600,000, will have to be modified.

New Costs Equal Savings

The foregoing are simply programming (software) changes. It is probable that at the same time these modifications are made, equipment (hardware) will be upgraded to "on-line" status to make use of the new code via scanners in the stockroom.

The approach is simple; each item ordered by a customer should be scanned so that the automated data capture reduces inventory, keys a new production requisition if required, generates the daily billing file, updates receivables, etc. While logical, the task is so massive as to be a tangent from this analysis. Suffice it to say that over a three year period new costs equal savings.

The data processing conversion to "DC" costs:

1. Table lookup routine and modified Order Entry System	$ 3,000
2. Program Modification to expand data records and Printer Formats	$ 40,000
3. Tests and Debugging	$ 15,000
4. New Forms	$ 3,500
5. Scrap and Waste paper	$ 2,000
	$ 63,500

No effort has been made to extrapolate increased processing times, system documentation, user documentation, etc. It exists and will cost money but the costs incurred depend on the depths of coverage in the documentation produced. As an example, Waldes "TRUARC" division order takers have a preprinted "how-to-do-it" manual which covers every conceivable incoming order/change condition. This looseleaf manual is updated monthly. The "DC" change would require basically a total regeneration of this documentation.

"Tower of Babel"

Now we review the cost to the Marketing and Sales areas. Sales must, first, announce to its customers, OEM as well as Distributor, that the addition of a new part number has been made. They must be told that in time the old code will be phased out so that the customers have time to change their internal records. Sales Dept. must be prepared to deal with OEM manufacturers who might not be interested or willing to convert their records. Or, the OEM customer could say, "If you can use a distributor-imposed part code, why not use my part code as well? I am X percent of your business." Mishandling this segment of the conversion will cause chaos, reminiscent of the "Tower of Babel".

While the new "DC" codes are being prepared, internal sales personnel (order takers) must be trained to convert manually from the new part code (DC) to the old part code and vice versa. This requirement is imposed so that there is an orderly transition during the period when EDP is reprogramming and testing its changes. Each time an order comes in this translation step must be effected.

The cost to sales for its segment of DC is:

1. Announcement Mailing	$ 1,000
2. Training	$ 4,000
	$ 5,000

At this point no attempt is made to estimate the cost of sales calls to explain the code and convince OEM and non-association distributors to use it.

Reformat Entire Catalog

Marketing Dept. has to modify its plans and implement changes to the catalog and price lists to allow for both codes, DC and old code. This initially sounds like a simple change. It is not. It is very expensive because you must reformat your entire catalog to allow space for the new coding. It is possible that a soft cover bound 8 ½ x 11 book will be inadequate. You would be required to go to a non-standard size to allow for the "DC" coding or you have to reduce your print size by image reduction to maintain a standard size. If this is the case you have the added problem of misinterpretation and misreadings if your printing isn't perfect.

The Waldes "Truarc Retaining Ring Technical Manual: Design and Engineering Specifications" is in use by many schools as a text book for mechanical design; approximately 175,000 books have been issued. They would have to be replaced. The cost to redo the catalog is $70,000 (approx.) while printing costs $1.00 per copy (large volume including binding and cover).

This means that the catalog portion of DC conversion is:

1. Redo catalog	$ 70,000
2. Replace current Manuals	$ 200,000
	$ 270,000

Transpositions Go Unnoticed

The price book must have the new distribution code (DC). Waldes price book is computer typeset. The addition of DC and refabrication of negatives would cost $15,000 and a reissue about $4,000. However, an additional consideration must be given to the potential for transposition previously mentioned. If a transposition should occur in your catalog or your price book, who would be liable for the effects? Using the significant code system transpositions become an outstanding characteristic of poor preparation. Using the non-significant DC, they go unnoticed until the problem appears.

The price book contributes:

1. Redo	$ 15,000
2. Reissue	$ 4,000
	$ 19,000

Loss in Efficiency and Productivity

In summary the one-time cost to convert to the Distribution Code for large inventory, low volume per part manufacturers could reach $1.4 millions if all possible costs were considered. Assuming that catalogs and price books are needed in any case, the cost could be lowered to about $1.1 millions. Assuming another type label was allowed, the basic cost would be $1.45 million.

This sum does not include the loss in efficiency and the loss of productivity during the conversion and learning cycle. A twist drill manufacturer indicates its two code format has been in existence for many years and that the company anticipates that it will not eliminate the code in the next twenty years.

Let us now consider the intangibles which will add costs that are not readily quantifiable until they have been experienced.

Further Modifications

The Merchandising/Public image people within marketing must analyze the package design, label formats, invoice forms, pick/packing slip forms and any piece of paper which leaves the company. All of these exist with areas designated as the location of the old code format. They must be modified to accept the Distribution Code as well, for a period of time and then be further modified to the new DC solely in the future.

Plans must be formulated to scrap or use up and then reorder paper stock as required. Paper stocks must be segregated to prevent using the wrong style form with a given computer processing. In all a conversion control center must be established to coordinate and to guarantee minimum disruption to normal activities during the conversion and subsequent learning period.

The order picking instructions to stock clerks must be modified to conform to the new DC code. The computer must access the cross reference table to be sure the old code is listed. This requirement is imposed because the rearrangement of the stockroom to the DC coding will occur slowly over a prolonged period. Imagine the amount of confusion and delay when people start trying to pick five-digit randomly ordered "DC" code numbers while using their old code Translation dictionary.

Murphy's Law

To keep our perspective, while all the changes are going on, so are normal operations, both administrative and production. This means that the conversion and implementation are a long, stretched-out process. To speed the process, you have the option to increase your staff. Or you may have an outside consultant group. In any case, however you look at it, hidden costs will reveal themselves in the predictable manner of Murphy's Law.

In an industry which thrives on response to customer special requirements, Waldes finds that customers quite frequently will order a product which is not in stock, with, for example, a particular plated finish. We presently take a similar product from stock in one finish and rework it to the finish being requested by the customer. We have been using a significant code for thirty years and the new code is forcing a change to a widely separated, not definable number which could force production to decide to keep its old code and let the computer do conversions. Woe to the day of the broken-down computer. The factory stops.

The Potential for Problems

Information is collected during the production cycle at various operations where blue collar workers fill in times, feeds and speeds. The existing union agreement specifies what information the operator will or will not collect. It requires a negotiated contract modification to change the input presently being prepared. What will the manufacturer lose in this change? In reality the manufacturer cannot substitute "DC" for "Old Code" for no one understands the "DC". Until the "DC" is learned, the union worker must add data. The probability is that the union will call this extra effort and request salary adjustments for affected workers.

Cementing the reality of a dual code is the envisioned confusion of each production worker and/or foreman with a manual which says this new DC code is really this old code. The cost of scrap and rework because of misinterpretations and lack of comprehension has not been considered by the people developing the distribution code. A manufacturing professional rather than a warehouse administrator is needed to analyze the effects of DC.

The Distribution Code may be fine when one considers the operations of a DC in a warehouse, provided the warehouse is physically arranged to follow the code. However the potential for problems exists if coding is not thoroughly thought out. As an example, if the size order is maintained, then "1 X 2 inch" plastic packages will be in place next to 3 inch high boxes. These in turn will be next to 6 inch boxes, etc. Wasted space could become the rule. Also spacing has to be left for new items; otherwise the stockroom cannot be maintained without a fourth code, the DC stockroom locator (Row A, Aisle 6, Shelf 14). Probably the locator is the safest control you can have in a DC stockroom.

Someone Has to Pay the Piper

In conclusion let us realize that this is the cost and some problems, with various options available, to the manufacturer I know best. People in large inventory, low volume per part, plants have not been faced with the spectre of a DC so they have not thought enough about the consequences of the transition to make a valid decision concerning whether that transition should happen. Talk is cheap until someone has to pay the piper.

Can U.S. manufacturers each afford to pay between ½ million and 1-½ million dollars to test a theory, and perhaps tempt providence in a soft economy? I think not. □

Forum — *Continued from page 7*

I perceived a substantial political component in the manner in which Turchin recently became an ACM member, and in the reasons for which he was offered a visiting appointment at Columbia University. I am also unconvinced that an official position makes any difference whatever in the Soviet Union or elsewhere — when Jean Sammet some months ago transmitted a Council resolution to the U.S. State Department, she received no response, not even an official acknowledgement. Finally, as we venture forth into such areas, it will become increasingly difficult to draw the line anywhere. Injustices and untenable situations occur all over the world; we might as well

(please turn to page 16)

AMTRAK — The National Railroad Passenger Corporation: Facts and Goals

Paul H. Reistrup, President
National Railroad Passenger Corp.
955 L'Enfant Plaza North, S.W.
Washington, D.C. 20024

"Even today, more than 87% of the travel between American cities is still done in the automobile. That market is our target. To make inroads into that huge market, we are going to have to get our trains up to what used to be called 'Express Train' speeds, 80 miles an hour plus or minus."

We are what our history has made us. This country is great because it has had a great banking system and because it has had a great railroad system. These are not its only outstanding attributes, but they certainly rank among the top. And there is, and always has been, a strong relationship between banking and railroading. We have seen great years together. We have gone through some of the country's greatest emergencies together. Today banking and railroading are going through trying times. Perhaps at no time in our history have we had greater need to understand each other well and to stand together. Certainly we are at a most crucial period.

Unwanted Passenger Business

I want you to know something about Amtrak, the National Railroad Passenger Corporation. I want you to understand us. When Amtrak was created in 1971, one of the underlying purposes was to relieve the railroads of the unwanted passenger business on which they had been losing about $500 million per year. But this did not mean that the railroads went out of the business; it simply meant that Amtrak came in to assist them and the country. The actual operation of this 26,000 mile network is still carried out on the tracks of these same railroads, with enginemen up front who are still the employees of the railroads and with conductors in the trains who are still employees of the railroads. Inevitably, the relationship between Amtrak and the railroads is very close and it must continue to be very close.

Reversal of Down-Trend

The significant point about Amtrak is that by its very existence, and I should add...by dint of hard work, this company has brought about a reversal of a generation long downward trend in rail passenger transportation. This was an absolute necessity. Highways are congested; airways, airports and their facilities are overcrowded and our petroleum-based transportation system faces an uncertain future. It was absolutely essential in 1971 to create an alternative to the automobile and in 1975 we can look back on the wisdom of that action.

But nothing happens by itself. Who would invest in a rail passenger system, especially in one which had to be stretched thin from coast to coast and from border to border with no hope — at least at present — for profitability? Where would those investors come from who would have to put up billions of dollars to recreate and to regenerate a system which for more than twenty years had done nothing but lose money and discourage passengers? This situation had to be faced and the solution had to be compatible with our free enterprise system. After all, the railroads of this nation are all private corporations. They own their own equipment. They own their right of way and they could hardly be expected to diminish their assets further to support an uncertain new enterprise.

Based on a talk before the Graduate School of Banking, University of Wisconsin, Madison, Wisconsin, August 14, 1975.

New Solutions

It is perhaps a mark of the maturity of our free enterprise system that, as the economy of this nation matures, it is able to identify new problems and come up with new solutions. Here was a great national asset just falling apart. If we did not have this rail passenger potential in being today and we decided that we had to build it now, from the ground up, we would certainly have to face the prospect of an initial investment in the nature of $100 billion dollars. Private enterprise alone could not afford the burden, yet the people of this country demanded that rail passenger service be saved. The result was the Rail Passenger Service Act of 1970 and the series of laws which derive from that basic act.

Running Trains and Using Track

Amtrak is a "for profit" corporation in concept, which has access to public funds. Amtrak is an operations-oriented organization. Amtrak is, by law, not a policy-making agency of the Federal Government. We are designed to be implementors. I know how to run trains and how to coordinate with other organizations that are running trains, and I know about track. We get things done within the parameters established by Congress and the will of the American people, and we do them in a thoroughly businesslike manner.

We are a public-sponsored organization operating on private property while the other major modes of transportation are private corporations operating on public property. This brings about some basic comparisons which are not generally considered.

Subsidy vs. Investment

In most of the public discussions of Amtrak which appear in the media, references are made to the "heavy subsidy" which has been poured into Amtrak from the Federal treasury. While the word "subsidy" is generally used to describe the some $200 million per year average which has been supplied to Amtrak since its inception, it is quite common to use the more palatable word "investment" for the billions of dollars each year which are poured into the other means of transportation. This needs to be put into perspective.

Let's put this another way:

> "It takes two lanes to move 40,000 people per hour across a bridge if they travel on trains; four lanes to move them on buses; twelve to move their cars and one to allow them to cross it on bikes. Of all vehicles, only the cycle can take the rider from door to door."
>
> — Ivan Illich, New York TIMES, Sept. 1973

And if energy requirements were equal for all modes, which of course they are not, just consider the energy savings which are apparent in the above statistics from the point of view of volume alone. The "investment" in rail transportation pays off on all counts.

$400 Billions for Highways: Subsidy or Investment?

This country has a major highway system which has already cost more than $400 billion and present estimates are that it will cost an additional $32 billion just to complete that part of the system which has already been started. This is all called an "investment" and not a "subsidy". I have seen a recent report which states that funds "would be earmarked... in support of a total highway program (at) the level of $8.5 billion for each fiscal year 1977 to 1978." Today there are 915,000 miles of Federal-aid highways and 25,000 miles of government built and maintained navigable waterways, plus the entire nationwide network of federally-supported airways, airports and air facilities. Now contrast this with the fact that there are 325,000 miles of railroad all privately owned and tax generating. It has been estimated, as recently as 1974, that just to overcome the backlog of deficiencies in highway maintenance (not construction), the backlog alone would exceed $400 billion between 1973 and 1990. The annual Federal, State and local highway expenditure on highway maintenance alone is in excess of $23 billion and this is adequate to do only 50% of the requirement. And this is always termed "investment", not "subsidy".

3/4 of $1 Billion for Four Years for Railroads: Subsidy or Investment?

There is no need to add more of these statistics to the record. When the American public is paying such staggering sums for a highway system, and on top of that, more billions for a waterway and airway system, then calls that an "investment", it seems only reasonable to concede that the "subsidy" of Amtrak which has totalled $731.2 million from 1971 through FY 1975 is relatively a modest amount and that the money which will be required for future development is certainly not unreasonable. We just need to put things in perspective.

Start-Up Day

What is the American public getting for its "investment" in the nationwide rail passenger system? On the day Amtrak started service, the number of trains operating throughout the country dropped from more than 400 to about 186. These trains operated between 21 pairs of Congressionally designated end-point cities, over a 24,000 mile system so fragile that if one more route had been cut or if one or two end-point cities had been eliminated, there would have been no national system at all.

On that start-up day, Amtrak had no employees; Amtrak owned no railroad tracks, no stations, no terminals, no yards, no commissaries and no other essential facilities. Not even any passenger cars, no locomotives and no manufacturer in the United States had an open production line which was capable of manufacturing the type of cars needed for long-haul passenger service. That was a tough beginning! But we have turned things around in less than five years and we have shown not only that the American rail passenger system is worth saving but that it is potentially viable.

Performance

Last year we carried more than 18,000,000 passengers and in 1974 we grossed $257 million. That is more income than all the railroads together grossed in 1970 on passenger service with more than twice the service.

In our first years of operation we have improved our on-time performance substantially. During 1974, the first year of our new incentive contracts, on-time performance over all of Amtrak routes averaged 75.3% and is still on its way up.

Computerized Reservations

One of the most significant improvements made by Amtrak, is its interface with the American public. On June 28, 1974, our nationwide computerized reservation and information system went into effect. Where once we had been sorely abused for not answering the telephone, we are now able to handle more than 78,000 calls per day and to provide correct, realtime information including the preparation and mailing of tickets on credit card data alone.

We have organized and staffed a major headquarters. This was no small task. Never before had a nationwide rail passenger system of any kind existed nor had a staff ever been developed to handle problems involving passengers from coast to coast. More than 3,000 jobs previously performed by employees of the affiliated railroads have been transferred to Amtrak. All service functions, and most station service functions, are now discharged by Amtrak personnel. Ten labor contracts have been concluded on behalf of nearly 8,000 Amtrak employees.

Available Cars

Yet, we still have some very real problems. Problems which only time, hard work and money are going to be able to resolve. When Amtrak started, our railroad men went out and looked over thousands of cars that had been in service for years. We bought some 2,000 of them and were forced to put them into service at once and as they were. They were (all we had and) thought to be the best for a national fleet that we could get at that time. They average now about 24 years in age and during their last years with the railroads, they got very little care. Those companies knew they were going out of the passenger carrying business.

Now, four years later, we have put about 1,200 of them through an expensive refurbishing program. It has helped, but a 24 year old car has — in most cases — a 24 year old air conditioner, a 24 year old steam heating unit and 24 year old parts and wiring! These are things which you would not normally want to do business with, especially if you were setting up a new business and trying to regenerate an old industry which had nearly expired. We have had to make do. We could not buy new cars right away. No one was making them and we did not have enough guaranteed credit at that time to induce any manufacturer to open a new production line.

Available Locomotives

Fortunately, we were able to buy locomotives. At first the fleet we used, leased, borrowed was pretty poor. But there were factories making locomotives which we could use and we bought a number of them. We now own 150 new locomotives and most of our power problems are on the way to being solved.

With cars, it was a different story. We needed more "seats" out there on the rails. Our engineers went all over the world searching for "off-the-shelf" equipment. We found a very modern, utilitarian French Turboliner — a five car set powered by two turbine engines, with seats for almost 300 people. To expedite its acceptance and delivery, we leased two sets and put them right to work on the Chicago-St. Louis run. They have been very popular and very reliable. We then ordered 4 more from France and the Rohr Company here in the United States will deliver 7 more sets. In addition to the St. Louis operation, we now operate an all-turbine train service between Chicago and Detroit. This is by far the fastest growing route in Amtrak today. It takes new equipment and good service to do this.

New Cars

With each passing year, we needed new cars desperately. Eventually, we had accumulated sufficient guaranteed credit to interest the Budd Company in reopening their old Metroliner production line. We compromised with them and placed an order for Metroliner-type cars but without the Metroliner's on-board motors for self-propulsion. They will be locomotive hauled and can be run where there is no electrification. We have 492 of these fine new cars on order and the first of them go in service this month. This is another significant breakthrough.

Financial Arrangements

As bankers, you may be intersted in how we have worked out "Leverage Leasing" for acquisition of much of our new rolling stock.

The first step was to place a conditional sale agreement with the manufacturer. We put down approximately 27% of the total cost, with the balance in 27 semi-annual payments. Title to the equipment rested with Amtrak at that point.

The next step was the assignment of the conditional sale agreement by the manufacturer to an interim lender, who paid the balance of the purchase price, the 73% remaining, to the manufacturer. The interim lender received the assignment of the manufacturer's rights.

Then there was a "sale and leaseback" agreement made by Amtrak with a trustee. The trustee returned the original 27% down payment amount to Amtrak. The trustee assumed Amtrak's obligation under the conditional sale agreement and title to the equipment was transferred to the trustee prior to the first use.

Then an equipment lease arrangement was worked out between Amtrak and the trustee which covered a period of 15 years at a very attractive rate, which in all cases has been under 5%.

At this point, Amtrak's unique characteristic, as a quasi-federal corporation, played a part in this arrangement. The U.S. Government guarantee was placed over the entire package covering the exposure of the lender and the trustee. This was certified on behalf of Amtrak by the Federal Railroad Administration.

Elaborate as this is, it provides a special insight into a particularly significant aspect of this corporation. As a private corporation, we have and make use of all of the advantages of that type of corporation; yet, as a quasi-federal corporation, we are able to take advantage of the necessary federal guarantees of these loans.

Bi-Level Cars

This year we have entered into a contract with the Pullman-Standard Co. and have ordered 235 bi-level cars from them. These cars are going to be the finest long-haul service cars ever built. They are our own design and they will feature a double-deck arrangement which will drastically change the appearance and the style of American train travel. These cars will improve comfort, train reliability and the economics of operation. Car reliability and ease of maintenance, beyond anything ever designed into cars before, will be found on these new cars. Most of the passengers will enjoy "dome car" visibility from their seats as well as from the dining car. The climate within the train will be electrically controlled and a sound system will be available for communication with the passengers and for entertainment where desired.

The seats will be built for comfort. They will be spaced at least as far apart as first class airline seats and they will have adjustable backs, foot rests and folding tray tables.

Some of these cars have been designed for food service. On the upper level they will be configured as a coach and on the lower level there will be bar-lounge space and facilities for the service of such food options as beverage choices, snacks and full hot meals which can be consumed at the passenger's seat.

In addition, other cars will be configured as diners with full food preparation facilities and storage on the lower level and a car-length combination of lounge and dining area on the upper level. These will be the finest dining cars on the rails.

These cars will have a unique lower level central entry way and a stairway will connect upper and lower levels. Each car entry will have fold-out ramps, wide aisles and handrails to allow unassisted mobility and access to all facilities by handicapped travelers including those confined to wheelchairs.

Better and Better Service

I have gone into this new car description in some detail because we at Amtrak have been burdened for almost five years now by our inability to make a rapid response to what we all know is the paramount public demand...better and better service. We are now in a position where we can see the first of these major steps coming over the horizon. From now on, it will be our job to get these new cars into operation as quickly as possible and then to provide the excellence of service which was at one time the tradition of the railroads.

Reducing the Cost of Money

The purchase of capital equipment on this scale has resulted in a high dollar program. Amtrak is authorized a $900 million debt guarantee ceiling. As we approached the top of that ceiling, we began to see very quickly that our cost of borrowing money was skyrocketing. During FY 75, our debt service amounted to 19.7 million. We could see the possibility of more than $50 million per year in interest costs if we committed the entire $900 million. As a result, we have begun a program of money cost reduction. First of all, we have converted all of our bank loans from commercial sources to the Federal Financing Bank. Furthermore, we are now authorized by the General Accounting Office to draw down our quarterly federal grant monies and to use those unspent funds to temporarily reduce some of our loans.

Repurchase Agreements

Throughout the country we have primary depository accounts at about 450 banking offices. We concentrate these accounts daily into four central offices of Bank of America, Citizens and Southern, Chase Manhattan and in the First National Bank of Chicago. Then each day we place those funds in REPO's. (Explanation: Repurchase Agreement: We buy a "repurchase agreement". We loan a bank money, usually for one day. The bank puts up collateral and agrees to repurchase that collateral after one day. This gives us interest income on our unused money each day.) By this action, we generate more income, which we use to further reduce the cost of money. As a result of these efforts, we expect that our interest costs will not exceed $22 million for FY 76.

Recently, it has been proposed to Congress by the Secretary of Transportation that even this burden on the federal treasury be reduced by providing capital grants for equipment purchases. We expect to receive these grants and to be able to eliminate additional borrowing from the Federal Financing Bank. This will leave us with $900 million of guaranteed loans at the Federal Financing Bank and an unencumbered $100 million Line of Credit at Chase Manhattan.

Line of Credit

You may be interested in that Line of Credit. It is one of the most unique Lines of Credit ever written. It was placed with Chase Manhattan after competitive bidding, in the amount of $100 million. It is established at a rate of ½ of 1% over the weekly average of the cost of Federal Funds and it requires no commitment fee or compensating balances.

The procedure described above is advantageous at the present time. We may, someday, go outside of the Federal Financing Bank for money, but the market will have to change quite a bit before we do or other factors which we are not now aware of may bring about a change in our tactics.

Uniqueness of Amtrak as a Way to Do Things

I have given you this unusual bacground to show you how very unique, flexible and responsive this corporation called Amtrak is. I said earlier that this corporation may well represent the peak of maturity of the American free enterprise system. It certainly permits management to take advantage of the best of both systems — public and private — to create a most unusual corporation which is equipped to perform the important task set before it.

Corridors and Long-Haul

When I mentioned our bi-level cars, I told you that they were a most significant step in the development of this company. I meant that in more than one way. There has been, since the creation of Amtrak, a rather massive dilemma lying astride our tracks. There were those who said that Amtrak should cut back all money-losing routes right away and concentrate on high-volume, high density corridors. Then there were those who would not premit the reduction of one single mile of the lean basic system for fear that there would never again be a national system if that system were not kept intact. Thus, the dilemma was: corridors only vs. long-haul with corridors.

Amtrak was impaled on the horns of this dilemma from 1971 until early this year when we were finally authorized to order long-haul cars. With that order, the choice had been made: Amtrak will serve the corridors and Amtrak will continue to serve the entire nation over its long-haul system. Already there are 15 more routes being served today than there were back in 1971 when we started, and we are working on more new ones right now.

Northeast Corridor

There was another significant item tucked away in the legislation about the Northeast Railroad Reorganization which states that Amtrak will acquire, from ConRail, by lease or purchase, the trackage between Boston and Washington — the Northeast or Colonial Corridor. This small item, frequently unnoticed in the law which was so heavily involved with the restructuring of the entire northeast railroad system, was scarcely noted, but it is the first word from Congress that stipulates Amtrak is to acquire track.

Improvements of Track

Up to now we have had so many everyday problems that we have had to live with, the track problem is one of many. But as we see our way through these other matters, we keep running into the same old track problem. We own none of the track and we have no way — other than to work through the railroads which do own that track — to get improvements made on that one item wherein lies the key and essence of all railroading. If Amtrak is to operate a safe, comfortable, on-time and viable rail passenger system, it will be able to do so only in so far as the track under our trains has been designed, constructed — and then maintained — up to the particular standards of passenger operations. No where is this more important than in the corridors where most of our trains run and where most of Amtrak's future growth is going to take place.

Showcase Corridor

This is why the Colonial Corridor project is so vital to our future. It will be the guinea pig; it will be the test center and it will be the goldfish bowl for Amtrak. The future of Amtrak will rest on what the public decides about our work there. The great railroad companies of the world are judged by the excellence of their showcase corridor operations. The British have their London to Glasgow APT trains; the French have their Paris to Bordeaux trains and the Japanese have the famous Bullet trains which now run from Tokyo all the way to Kyushu, about one third longer than from Boston to Washington. We are planning to upgrade the Colonial Corridor by stages, first to 2 hours and 30 minutes from Washington to New York

City and 3 hours on to Boston and perhaps eventually to 2 hours from Washington to New York City and then 2 hours and 30 minutes to Boston. The latter will give us an average speed of close to 100 mph. That's a challenge.

Emerging Corridors

With the success of the Colonial Corridor operations, and I can assure you it will be a success, this proto-type model will be applied to such other emerging corridors as Chicago-Detroit, Chicago-Cincinnati, Chicago-St. Louis, Chicago-Milwaukee and such other places as San Diego to Los Angeles. The priority in which such work will be done and the elapsed time involved in developing such a massive program are things which future legislation will have to take into consideration. But this is definitely in the Amtrak future as one of our major goals.

Intermodal Services

Corridor travel concepts bring with them the idea of intermodal services. More and more Amtrak stations and terminals are being planned along with other modes of transportation so that a common terminal will be able to serve mass transit, commuters, buses and even air terminals. This is definitely the way of the future. We already serve some intermodal facilities and the number is growing each year.

Elapsed Time Test

We are working hard on contractural programs designed to bring about better service over all of the railroad tracks where we operate. If you take all of the Amtrak timetables and work out our average systemwide speed right now, you will find that it is too slow to appeal to a public accustomed to automobile travel speeds — even at 55 mph. We must reduce elapsed time on almost all of our routes, but we can only do this with the cooperation of all of our affiliated railroads. We are working on this and we are making slow but steady headway.

Express Train Speeds

Our first and most urgent objective is to accomplish what I believe was one of the most important reasons for the creation of Amtrak...that was to get a significant proportion of those Americans who do their intercity travel in automobiles into the train. Even at today's fuel prices, with today's congestion and with today's uncertainty over the future availability of gasoline, more than 87% of the travel between American cities is still done in the automobile. That market is our target. To make inroads into that huge market, we are going to have to get our trains up to what used to be called "Express Train" speeds, 80 miles an hour, plus or minus. We are going to have to run our trains safely and comfortably and they are going to have to be on-time. Having said that, I have described for you a generation of work. This will not be easy. It will not be quick and the bill is going to be in the billions of dollars.

Research and Development

Meanwhile, we are not resting on present equipment and on present "state-of-the-art" ideas. We are actively supporting joint Research and Development programs with the Department of Transportation. DOT does the basic research and we are the implementors. Sometimes the product is a better shock absorber, a better air conditioner or a better power plant. But bit by bit, the whole system grows. We establish the requirements and the targets and DOT goes out and finds how to do it.

Top Speeds for Steel Wheels on Steel Rails

A railroad system is fairly well delineated by now. It ought to be. It has been around a long time. None of us expects to see big surprises in the near future. After all, we are talking about turning steel wheels on steel rails. This is still the most energy efficient system of transportation of all and it can be a safe and comfortable system. Steel wheels can probably be rolled at top speeds up to about 150-155 mph without exceeding sensible state of the art limitations. And trackage can be designed for such speeds. Somewhere within that envelope is where we are going today and tomorrow. As for me, I would be content during the next ten to fifteen years to see good Amtrak trains operating in corridors at average speeds approaching 115 mph and out on the long-haul system at 80. Then I would want to see standards of service equal to or better than "old time" railroading. That is Amtrak and that is what I am trying to do for the American traveling public. □

Forum — *Continued from page 11*

devote our energies full time to ferreting them out and to drafting appropriate resolutions.

In the end, all of these considerations were swept aside because a substantial majority of Council convinced itself that the ACM could save Turchin from disaster, and that the resolution was in fact compatible with the defined purposes of the Association. In such circumstances any opposition is treated as callous, and reactionary: for if Turchin is eventually permitted to leave the Soviet Union, the Council will argue that its actions did the trick; if on the other hand, the harassment continues, it will be said that our action was too late, or not forceful enough. Once it was agreed to put the matter to a vote, the resolution itself was adopted by a vote of 18 in favor, none opposed, with 5 abstentions.

I wish most sincerely that we will have done some good in this instance. But we represent neither the Executive Board of the National Academy of Sciences, nor a collection of Nobel prize winners; and the government of the Soviet Union can hardly be expected to wait for the pronouncements of a few unknown American computer people before deciding on policies which they treat as entirely internal in any case.

(Excerpts from Prof. Salton's letter to the ACM Members in the Northeast Region)

IN MEMORY OF AUGUST DVORAK

2. From: Philip Davis, Publisher
"Quick Strokes"
267 Ellis Ave.
Irvington, N.J. 07111

August Dvorak, Ph. D., author of the forthcoming Synergistic Typing for ASK and of a hundred published scholarly works before it, died on October 9, 1975.

His Typewriting Behavior (American Book, 1936), written with W. B. Dealey, Nell Merrick, and Gertrude Ford, is a seminal work on alphanumeric keyboard learning and teaching, which has been freely used by younger authors.

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computers and people

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SOLUTIONS TO PUZZLES IN 1975 ISSUES

Maximdij

751 Life is not simple.
752 Where there is a will, there is a way.
753 One gets the fish one fishes for.
754 There is no rest for the weary.
755 The present for the present, the future for the future.
756 If it is OK do it. If it is not OK do not do it.
757 He who gives is king.
758 Only you can shame you.
759 We are too soon old and too late smart.
7510 The rose is the mother of the thorns.
7511 If it is different, it is wrong.
7512 Even one enemy is one too many.

Naymandij

751 Make V of 2's.
752 Make octagon of 5's.
753 Make 2 follow 1.
754 Row 8, maximum 3.
755 Reverse sequence column 14.
756 Make W of 4's.
757 Make diagonal of 4's.
758 Make 7 touch 0.
759 Column 9, over 7.
7510 Make diagonal of 5's.
7511 Make row 3 even.
7512 Column 8: below 3.

Numbles

751 The poor feed the rich.
752 There is no sigh without tears.
753 Naked truth hurts.
755 The wood has eyes, the wall has ears.
756 The thread breaks where it is thinnest.
757 Wisdom sails with wind and tide.
758 Ignorance of the law is no excuse; and lack of knowledge of science does not shield us from harm.
759 Know thee thyself; thus learn about others.
7510 Stars shine always in a clear sky.
7511 People learn by losing and losing.
7512 He who knows most knows least.

Numble 754 was reprinted as 755 with only a solution to 755.

Information, Power, and Complexity

Abbe Mowshowitz
Dept. of Computer Science
Cornell University
Ithaca, N.Y. 14560

"The appeal to social complexity as an evolutionary principle which necessitates the growth of central power is a modern equivalent of the theory of the divine right of kings."

The role of technology in our society has become the subject of intense controversy during the past few years. Erstwhile champions of the era of industrial and technological expansion have metamorphosed into villains of a mounting ecological crisis. The blind faith of our Victorian forebears in the virtues of unending progress has been laid to rest with the dead of two global and countless local wars. Where there was once faith and optimism, we now find cynicism and despair. Yet the change in attitude toward technology does not signal a fundamental departure from its constitutive role in our society. With sociologically insignficant exceptions, the change in attitude has been from one of expectation of reward to acceptance of the inevitable. Virtually all participants in the current debate over technology share the assumption that continued development is inevitable, barring some catastrophe.

In its simplest form this assumption of inevitability is a response to the seeming futility of challenging established authority. The characteristic feature of the position which springs from this assumption is that society is evolving into ever more complex forms which necessitate the continued elaboration of technology. Our contention is that this reasoning entails an implicit ideological commitment to the maintenance of centralized power. The desirability of promoting the self-interest of a few is confused with the inevitability of social evolution. As a result, advocates urge accelerated implementation of the latest technical innovation, while opponents are content to impose formal restrictions on machine based power.

It is certainly no accident that information technology appeared on the scene in earnest at mid-century. The computer and the large-scale information-processing systems spawned by it emerged at a time when pyramidal social organization seemed to require ever increasing direction from the apex. What could be more natural than the birth of a technique for processing massive amounts of information, just when our highly complex and differentiated society required such a capability for its continued functioning. It appears to be a case of necessity mothering invention. No doubt there is some truth in this observation, especially within the framework of a localized view of history. However, to see in this particular response to particular social conditions a sign of the inevitable and the necessary is to indulge in a form of egocentric projection, no different in principle from the anthropomorphic animism observed among primitive peoples.

The appeal to social complexity as an evolutionary principle which necessitates the growth of central power is a modern equivalent of the theory of the divine right of kings. History makes it abundantly clear that power cannot be exercised for long without a cogent claim to legitimacy. Whether authority be sanctioned by divine providence or as an expression of a collective will, it seeks justification in moral agency. Through the replacement of the active hand of God by natural law, scientific rationalism has contributed to a shift in the basis of legitimacy from divine to natural or social necessity. Contemporary views owe much to social Darwinism, wherein society is likened to a hierarchically structured organism with its differentiated components integrated according to subordinate-superordinate relationships. The analogy with biological organsims is buttressed by examples taken from the physical world and is expressed more generally by means of the notion of complexity as applied to arbitrary systems. In all of these analogies, the legitimacy of social authority is embedded in natural law or evolutionary principles. The unfolding of providential designs is thus transmuted into a species of social necessity.

In what follows, we will explore the intellectual and moral significance of social complexity in legitimizing the centralization of power in our society. The first issue to be considered is the notion of complexity itself. Close examination reveals a multiplicity of different concepts, some of which are closely related to certain ideas of information. This connection leads us to examine the function of information both in systems which operate under uncertainty and in organizational structure. Proceeding from this analysis, we will attempt to characterize social complexity, and identify its principal manifestations. The main purpose of this inquiry is, of course, to illuminate the dependence of contemporary beliefs in the necessity of continued elaboration of information technology on the acceptance of increasing complexity as an inevitable consequence of social evolution. To this end, we will investigate the role of computers as instruments of social authority designed to cope with complexity by promoting the centralization of power.

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1. An Anatomy of Complexity

The notion of complexity seems far removed from moral and political issues, but in fact it is ever present both as background and in the form of a common species of argumentation. Complexity is generally taken to be a meaningful feature of the real world, exhibited by intricate patterns, complicated interactions, differentiated structures, abundance of choice, things with many parts, etc. These instances serve to elucidate the concept in ordinary usage, and exemplify its intellectual content as background to analysis and decision-making. Somewhat closer to our present concern is the influence of the notion of complexity on attitudes toward problem-solving. Problems perceived as complex are usually thought to be beyond the scope of the ordinary person. Complication typically signifies something of a technical nature and calls for the special competence of an expert in a given subject area. In some cases, such as solving a system of differential equations, the division of labor is sensible and unambiguous — mathematicians are trained to solve mathematical problems. Moreover, to set up a production process for a certain chemical, one calls on the services of a chemist or chemical engineer; designing a bridge requires the specialized knowledge of a civil engineer. But some kinds of problems are not so clearcut. To whom does one turn to decide whether or not a bridge should be built? Various experts can contribute to particular aspects of this question, such as determining the number of vehicles that might use the bridge, or estimating construction costs, etc. Still there are issues which do not fall within the competence of any particular specialist. What if limited resources force a choice among a new school, a bridge, and a hospital? Assuming a need for all three, how is the choice to be made?

There is no specialized branch of knowledge for resolving questions of priority. Thus belief that all complex problems must be handled by experts leads to moral and political difficulties. Clearly, the "argument from complexity" entails a fallacious transference. Since the intellectual division of labor is so pervasive, one is inclined to assume that every issue has its appointed discipline. This misguided assumption contributes to the erosion of individual responsibility for decisions affecting the community. The transformation of political questions into technical problems obscures the values and priorities upon which policy objectives are based. In the context of social development, the argument from complexity is used to support the contention that consolidation of power in centralized bureaucracies is both natural and essential to the preservation of society. This justification for the concentration of authority feeds on the widespread acceptance of the expert as the arbiter of complex problems. In order to demonstrate the misguided character of this argument, it is necessary to take a closer look at the concept of complexity itself.

Perhaps the most important observation about complexity is that it does not appear to be an intrinsic property of things or processes. Its dependence on our knowledge and methodology is evidenced by the multiplicity of different meanings attached to the term and the absence of a unifying framework for its analysis. A broad distinction is often drawn between disorganized and organized complexity (Weaver, 1948). The disorganized variety refers to situations with no apparent structure, an example of which is a collection of particles randomly distributed in some medium, whose motions do not exhibit patterned behavior. The main criterion for this distinction is methodological. Disorganized complexity is characteristic of problems whose analysis requires statistical methods. Such a problem is one with a large number of variables which behave erratically or in an unknown manner, but whose aggregate behavior exhibits statistical regularities.

According to Weaver (1948), organized complexity is characteristic of "problems which involve dealing simultaneously with a sizeable number of factors which are interrelated into an organic whole." As the name suggests, organization is the critical feature of such problems. A system with a large number of interacting components whose behavior is structured or patterned reveals organized complexity. Biological functions, chemical interactions, genetic mechanisms, economic systems, etc., provide examples of this type of complexity. Despite the diversity of problems included in this category, the idea of "organic whole" leaves little doubt as to the principal frame of reference. The underlying model is based on an analogy with biological organisms, and the criteria for structure or pattern is embedded in some form of purposive or goal-seeking behavior.

As indicated above, the taxonomy of problems according to different types of complexity is motivated by methodological considerations. Statistical methods are inappropriate for problems of organized complexity since one is not interested in average behavior; moreover, the techniques developed in the nineteenth Century to deal with a small number of variables are inadequate.

> These new problems, and the future of the world depends on many of them, require science to make a third great advance, an advance that must be even greater than the nineteenth-century conquest of problems of simplicity or the twentieth-century victory over problems of disorganized complexity. Science must, over the next 50 years, learn to deal with these problems of organized complexity. (Weaver, 1948, p. 540). /1/

Natually, the entire discussion would be somewhat incomplete if it did not suggest future directions. The computer coupled with the methods of operations research and their progeny are seen to be likely candidates for handling organized complexity. These developments, then, come to be linked with the world's salvation in the future.

The organismic model of complexity is carried further by Simon (1962), although he is careful to eschew any hint of metaphysical presuppositions which may cling to the relationship between the whole and its parts. Hierarchical organization is the distinguishing feature of this formulation. "[O]ne path to the construction of a non-trivial theory of complex systems is by way of a theory of hierarchy. Empirically, a large proportion of the complex systems we observe in nature exhibit hierarchic structures." (Simon, 1962)./2/ The concept of hierarchy allows for defining organization in terms of a decomposition of the parts of a system into interacting subassemblies. This constitutes a generalization of the structure of an organism in the sense that it encompasses relations between components which in principle need not reflect dominance patterns. However, Simon's hierarchical model of complex organization is based on a certain type of goal-seeking behavior. The evolution of systems organized for efficient production replaces the simpler notion of command hierarchies as the expected form of "natural" growth processes, thus providing a more abstract foundation for theories of social Darwinism.

Since the concept of complexity is relevant to virtually all phenomena, there is a strong tendency to view it as a property of existence. Part of the reason for this is purely linguistic. When someone uses the word "complexity" to describe an event or an object, it does convey some meaning, but the content is too diffuse to be of much use analytically. On the other hand, when the meaning is made precise, it ceases to have the generality of a universal property. The tantalizing character of this elusive notion is illustrated by an observation of Von Neumann concerning the ability of a system to reproduce itself.

> There is thus this completely decisive property of complexity, that there exists a critical size below which the process of synthesis is degenerative, but above which the phenomenon of synthesis, if properly arranged, can become explosive, in other words, where synthesis of automata can proceed in such a manner that each automaton will produce other automata which are more complex and of higher potentialities than itself. (Von Neumann, 1966, p. 80)

Of course, as Von Neumann points out, "none of this can get out of the realm of vague statement until one has defined the concept of complication correctly." But the correct definition depends on the nature of the problem, and also on what we know about it as well as the methods used for analyzing it.

That complexity is not a unitary concept, but a host of essentially different attributes of systems and objects is clearly evident from mathematical studies. Measures of complexity have been investigated for computations, algorithms, graphs, and various algebraic systems. Consider the question for an algorithm. The reason algorithmic complexity is important is that it is associated with the cost of executing computer programs. Typically, complexity in this context measures the number of basic operations which must be performed, and thus gives some indication of the execution time and relative cost. But this is by no means the only feature of an algorithm which determines its "complexity." Storage requirements and structural features are also of interest, and these lead to very different formulations. Complexity based on execution time gives no information about internal organization, so that algorithms of widely divergent character which perform a computation in a comparable number of steps would not be distinguished. This is not to say that computation time is an inappropriate index of complexity, but that others are needed for different purposes.

Studies of the complexity of mathematical structures such as graphs confirm this conclusion. The characterization of an object's complexity is relative to a particular structural feature, and different measures need not correlate with one another at all. For example, a graph which is highly complex on the basis of one measure many turn out to be exceedingly simple when analyzed from a different point of view. /3/ The dependence of complexity on our knowledge and objectives is captured by Stafford Beer's remarks on the nature of systems.

> A pattern is a pattern because some one declares a concatenation of items to be meaningful or cohesive. The onus for detecting systems, and for deciding how to describe them, is very much on ourselves. I do not think we can adequately regard a system as a fact of nature, truths about which can be gradually revealed by patient analytical research. A viable system is something we detect and understand when mapped into our brains, and I suppose the inevitable result is that our brains themselves actually impose a structure on reality. (Beer, 1960, p. 12) /4/

2. Information, Choice and Structure

Complexity and information are closely related. In the disorganized case, it is intuitively clear that as complexity increases, so does the amount of information required to specify any particular outcome or configuration. Consider the problem of guessing the winner in a lottery. Assuming that the winning ticket is drawn at random from all the entries, the "complexity" of the task is proportional to the number of entries. One way to make this precise is to define the information associated with any outcome of the draw, as of the number of yes-no type questions required to determine that outcome uniquely. /5/ Thus if there are eight entries, exactly three questions suffice: the first can be chosen to eliminate half of the possibilities; the second, to eliminate half of the remaining entries; and the third, to specify a unique outcome. Information as used here is equivalent to uncertainty about the state of affairs. The amount of information (or uncertainty) depends on the statistical properties of the selection to be made.

Organized complexity can also be analyzed in terms of information, but, in this case, information signifies something else. Instead of determining outcomes subject to statistical considerations, one is interested in specifying structures. Suppose we would like to characterize the complexity of an organic molecule. An important structural feature has to do with the different ways in which a molecule can enter into combinations with other molecules. This property is partly a function of topological structure and may be expressed in terms of a molecule's symmetry: the more symmetric, the fewer the modes of combination. The "amount of information" needed to specify symmetry properties can thus be taken as a measure of structural complexity. /6/

The preceding examples illustrate the main technical uses of the concept of information, and indicate their respective relationships to the study of complexity. Our main objective is to probe the different forms of social complexity, but the present preliminaries are needed to clarify some important distinctions which apply in the context of social phenomena. Although the theme of this book is information-processing, we have not attempted to present a formal definition of information. For most practical purposes, our intuitive notions are sufficient, and context can usually be counted upon to provide the appropriate interpretations. The management of large data files, for example, is normally conducted independently of the semantic of meaning of information items contained therein. On the other hand, the semantic component is clearly relevant to the design of systems which require facilities for extracting "information" from a database in order to answer questions posed by users, such as might be needed in computer-assisted instruction applications. The need for a formal treatment arises when one starts to theorize about the role of information generally. Then it becomes apparent that the different senses of the word must be respected.

As suggested above, information comes in two models. The first, illustrated by our lottery example, is known as selective information, and forms the basis of the theory of information elaborated by Shannon (1959) and others. /7/ This theory was formulated in the context of communication systems and is concerned with the problem of transmitting messages over channels whose behavior is characterized probabilistically. In other words, interference (noise) in the transmission medium may introduce errors in the messages transmitted, so that it is necessary to operate within certain restrictions imposed by the channel, and design codes to insure reliability. For present purposes, the point to be made is that the definition of information is based on statistical considerations. A message may be characterized as the outcome of an experiment, or as an element of an ensemble which occurs with a given relative frequency. /8/ The possible outcomes of a lottery provide a concrete example of such an ensemble.

The second type of information actually includes a variety of subspecies which are commonly referred to by the terms structural and semantic information. We have already discussed an instance of the structural type. In cases where one is concerned with structure or meaning, the selective notion of information does not apply, at least not in any obvious way. The meaning of a word or a message has nothing to do with our expectation of its occurrence in a communication medium; uncertainty is not at issue, choice is not the fundamental consideration. The problem here involves capturing the relationship between a sign or symbol and its referents. Similarly, structure is a relational property which depends upon the interaction of the different parts of a system. There is no general theory of structural or semantic information comparable to that developed for the statistical variety, although various special cases have been considered. Part of the difficulty stems from the ambiguities described earlier in connection with studies of organized complexity. The requisite unifying concepts are not forthcoming.

The connection between information and organized complexity is especially transparent in the problem of providing a description of a system. In fact, the "information" contained in a description could be taken as an index of complexity. For purposes of measuring complexity, one might wish to identify descriptions with the objects they describe, but this would require looking at all possible descriptions, which is not a feasible procedure. To avoid this difficulty, the object and its description must be distinguished, and a "grammar" of allowable descriptions established. Such a strategy would facilitate a measure of complexity (relative to a grammar) which could be used to determine the "goodness" of any particular description. This approach is in accord with our earlier observation, to the effect that complexity is a function of knowledge and methodology. The information in a description is a direct reflection of what we know about a system, rather than any intrinsic system property.

The importance of choosing an appropriate description may be seen from a simple example given by Simon (1960). Consider a two-dimensional array of letters. If certain subarrays are repeated, one can take advantage of this redundancy to simplify the description. In such cases, the number of symbols required to specify the array can be reduced. Generally, by a judicious choice of basic elements or building blocks, it is possible to obtain greater economy of description. Since many systems are composed of a relatively small number of subsystems and some interactions among components may safely be neglected, such choices are feasible.

Having considered some of the characteristics of the different types of information, we turn finally to their special roles in organization. To say that information is the life blood of organization is probably not too great an exaggeration. Our primary interest lies in social organization, but suitable examples of organized activity are also provided by biological organisms, artificial control systems, computers, etc. Consider the ways in which information is processed by the human organism. Signals from the environment impinge on sensory receptors such as the eye and the ear; they are encoded into neural impulses and in this form are transmitted to the brain. The process of transmission may be modeled by means of a noisy communication channel, thus introducing the selective theory of information. However, when messages are interpreted and translated into action, the semantic component of information comes into play. Information is essential to the integration and coordination of the various functions and activities of an organism. Both internal homeostatic controls and mechanisms mediating responses to external stimuli are driven by information. Most of these uses have parallels in social systems.

3. Social Complexity

That society is becoming ever more complex, no one seems to doubt. One source of this belief lies in the observation that social organization is more differentiated now than in the past. Division of labor and specialization of function are all-pervasive features of a society which appears to us as an exceedingly intricate web of interdependent elements. Industrialization and its concomitant urbanization are the principal formative influences in the emergence of this intricate web. According to Faunce (1968)

> One of the best-documented effects of the emergence of manufacturing industries in the early stages of the Industrial Revolution was an increase in the degree of division of labor. This pattern of effects could clearly be seen in England during the period we have been describing and was repeated in Continental European countries and the United States as they became industrialized during the next century. Agricultural societies are relatively undifferentiated ... India, with its highly elaborated caste structure, however, is a clear exception to this generalization. Although industrialization is obviously not the only process capable of producing an extensive division of labor, it may still be said that all industrial societies are characterized by a high level of occupational specialization, while agricultural societies, with few exceptions, are not. /9/

In addition to structural differentiation, complexity is manifest in social choice. Mobility characterizes all spheres of social existence. The individual is free to choose an occupation, a place to live, a mate, a life style, etc.; and none of these choices are exclusive forever. It is largely this diversity of options which generates the enormous volume of transactions typically cited to justify computer applications. The itinerant character of modern life necessitates extensive record-keeping in order to provide social services. Physical transfer of cash is too clumsy to meet the needs of a fluid business community and a public in perpetual motion, so that mountains of checks must be handled and credit card transactions processed. Educational institutions offer training programs in much the same way as department stores market the seasons' fashions. The ubiquitous media feature entertainment to satisfy our craving for novelty. Even our maladies, such as the once fashionable "information-input overload," reflect a super abundance of possibilities. In short, prodigal choice is the hallmark of contemporary life, from the garage to the bedroom.

The apparently anomalous example of India as a non-industrialized but highly differentiated society provides some insight into the divergent sources of social complexity. Freedom of choice is not a necessary consequence of structural differentiation. In the elaborate caste structure of India, behavior is rigidly prescribed; yet social scientists regard Indian society as complex. The specialization of function which is common to the predominantly agrarian society of India and the industrialized West warrants the ascription of complexity to both. But the relative absence of individual choice in the former, testifies to a significant difference. Both societies exhibit organized complexity, whereas only the latter reveals a high degree of disorganized complexity. This distinction helps to clarify the import of the argument from complexity as it applies to the question of the centralization of authority.

A highly structured social system in which patterns of behavior are mediated endogenously requires a minimum of coercion to insure satisfactory performance. In such a case, admittedly an ideal situation, deviance is truly aberrant behavior. By contrast, where internal weakness supports exaggerated choice, exogenous controls become necessary. The disorganized complexity characteristic of our own society raises the specter of chaos. And it is this aspect of complexity to which the modern Hobbesian responds with visions of a computer-based future. Social experimentation does not require the technological apparatus so dear to the advocates of real-time information systems. In any event, it is superfluous when the community is ill-disposed and ill-equipped to discover its own interests and identity. One may object to free information flow on grounds analogous to Marx's objections to the unconscionable practices of free trade in the early nineteenth century. Development of the instruments for controlling potential chaos is not likely to underwrite the emergence of Dewey's ideal public.

Contemporary society may be compared to a rambling edifice which has grown by accretion. Unlike the great cathedrals which inspire our admiration for the virtues of a simpler age, it is singularly deficient in architectural integrity. For lack of a compelling aesthetic, we describe its form in terms of complexity. But even so, we fail to distinguish between structure and mere diversity. The edifice has become problematic because its internal flaws and contradictions are beginning to surface. Now and then, part of the structure collapses, and we are forced into taking remedial action. Many programs have been proposed for coping more systematically with these problems. Two divergent approaches deserve comment. According to conventional wisdom, the defects of the building can be checked by installing sensors in the various components and monitoring them at a central location. In this way, it is believed that deterioration can be reversed and new development undertaken by an enlightened team of planners making effective use of the information available from the sensors. The rationale here is based on transmuting selective information into structural gold.

Perhaps the modern alchemists will be more successful than their ignorant ancestors. But there is another alternative: reduce the disorganized complexity. It is possible in principle to alter the structure by creating a constellation of smaller buildings, each with its own autonomous organization./10/ In such an arrangement, genuine experimentation might prevail, without the risks attendant upon large-scale enterprise. Local integrity is a more manageable goal. The sacrifice of choice for its own sake seems like a small price to pay for stability and coherence. These ends are certainly not alien to the conventional program, but under it they are likely to obtain as side effects of oppressive control; and, in the long-run, stability cannot be maintained by police and armed guards.

The politics of complexity lead to many distortions. A historical trend demanding a particular course of social action is more powerful than the will of any individual and creates the conditions of its own rationality. Since decision-makers are in the business of eliminating alternatives, complexity for a corporate manager or government official is likely to signify a situation with many choices. This primary understanding, based as it is on concrete experience produces a distorted picture of reality when coupled with what everyone knows about the division of labor and specialization of function. Identification of the two types of complexity sustains one's faith in the rectitude of the technological approach to the control of chaos. From such a position, it is difficult to see that the technology itself may contribute to increasing disorganized complexity.

The possibility of complexity with limited individual choice points up the critical importance of values in preserving social stability. Social complexity need not generate the problems of control that we face. It is the absence of a coherent system of values rather than any intrinsic structural complexity which accounts for the disorder threatening our society. Vulnerability is a more appropriate concept. The massive concentration of capital resources in industries which depend on one another for production and distribution of commodities demand protection against social disorder caused by the lack of coherence in contemporary life. Our society is extremely vulnerable not simply because of the functional and structural interdependence of people and institutions, but as a consequence of stretched or broken threads in the social fabric. This is a feature of modernity better described by poets than social scientists.

> Turning and turning in the widening gyre
> The falcon cannot hear the falconer;
> Things fall apart; the centre cannot hold;
> Mere anarachy is loosed upon the world,
> The blood-dimmed tide is loosed, and everywhere
> The ceremony of innocence is drowned;
> The best lack all conviction, while the worst
> Are full of passionate intensity.
>
> W. B. Yeats, 1924/11/

(To be continued in next issue)

Computerized Data Base Systems

Ronald G. Ross
Dade County Public Schools, Systems and Programming
10477 S.W. 108 Ave., No. 213B
Miami, Florida 33176

"The next level in data base design is the definition of a logical data base, in which cross references are generated between physical files, so that individual data need not be duplicated."

Themes for Design

Data Base design philosophy in the data processing environment has a number of recurring themes. Some of them are the following:

(1) Independence of data between application programs and file storage;

(2) Reduction of data redundancy;

(3) Improvement of physical access to data;

(4) Simplification of application programming;

(5) Consolidation of update procedures;

(6) Reduction of the need for program maintenance; and

(7) Standardization of data definition and documentation.

The present generation of data base management systems with the software packages that implement computerized data base systems, are achieving basic success in each of the above categories. This success has translated directly into improved productivity for many installations.

This is not true, however, across the board. Some data base projects have proven ill-conceived at best and are nightmarish at worst.

Frightful Structures

The term data base has several connotations. Administrators and managers look upon the aggregate of data from which budgets and decisions are made, and call it, nebulous as it may be, the data base. Data processing people, especially those with little experience in the new technology, have tried to "capture" that "data base" all at once, without realizing the magnitude of the task.

Out of this situation have arisen some frightful structures, which have surpassed the capabilities of the best data base management systems. These structures have often been labeled corporate style data bases, or management information systems. In theory they are good; in practice they have not proved viable, except where the best (and most expensive) expertise is available. Somewhat less ambitious systems are a prudent choice for most organizations.

Data Base Definitions

To the technicians of data base systems, a data base is a collection of physical records, similarly defined, which pertain to a single general application purpose. Examples of physical data bases are a customer file, a list of all customers with which an organization does business; a product file, a file containing information about all products the organization has in its line.

The next level in data base design is the definition of the logical data base in which cross references are generated between physical files, so that individual data need not be duplicated. An example of such a logical data base is an order data base in which customer orders are cross-referenced against the two physical files mentioned above — customer and product data bases.

Data base management systems have no trouble in handling this type of organization, given appropriate design and support. When, however, additional levels of logical cross-referencing are defined, a pyramid-type structuring results that greatly strains data base system performance. At some point, the degradation in performance becomes intolerable.

Guidelines

Careful design of the data bases is the key. There are several guidelines which are useful in good data base design:

(1) The definition of individual data base files should be kept as simple as possible. In Figure 1, this results in the creation of several new files, but more importantly in a less complex definition for the product master file. Under the new design, application processing is more appropriately channeled, so that improved performance results.

(2) The size of data base records should be kept as small as possible. In Figure 2, the segregation of a large, but seldom used history segment results in much improved performance for most applications against the data base.

(3) The definition of data bases should reflect as nearly as possible the most frequently used paths of data access. An example is given in Figure 3.

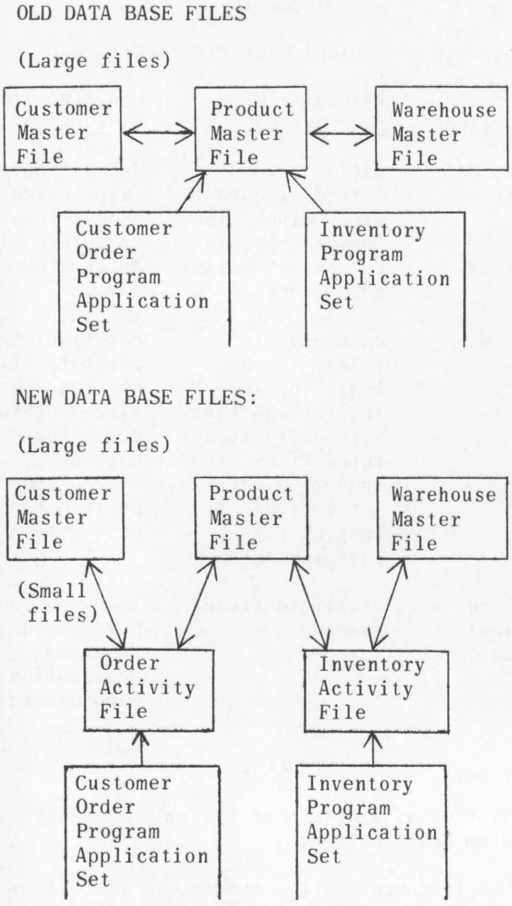

Figure 1. Redesign of data bases improves operational efficiency

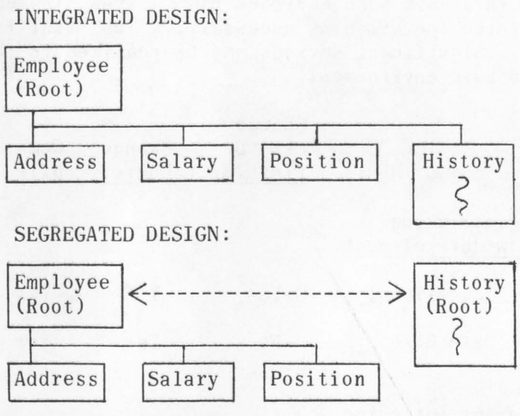

Figure 2. Multi-file Data Base Design:
Segregation of large but seldom used segments results in improved access.

The Environment of a Data Base

As these guidelines suggest, data base management systems of this generation are not so generalized that application environments can be completely ignored. Nonetheless, many of their deficiencies are minor in comparison to the advances that they represent over systems available a few years ago.

A few of the areas in which truly significant advances in system technology have been achieved are the following:

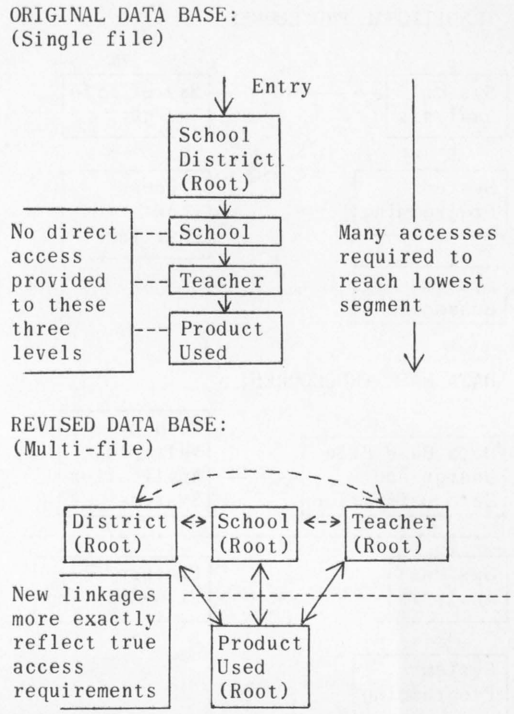

Figure 3. Improved access through system redesign

(1) The size of application environment that can be supported and the number of files that can be co-joined;

(2) The ease with which the system may be interfaced with other useful systems, such as teleprocessing, report writers, and query languages;

(3) The ability of the system to preserve its own integrity through such features as checkpointing, restart, prevention of concurrent update, and so forth.

(4) The security features provided for the monitoring of data access and prevention of unauthorized transactions.

(5) The general accessibility of data, especially through primary and secondary data inversion, and through an independently maintained data directory/dictionary system.

Design of Applications Systems

Data base management systems vary greatly from one to another in their approach to each of the above areas.

There is much less difference, however, in the tasks involved in the design of application systems under the various systems. It is not unreasonable then to take system design in the data base environment as a whole, and compare it to system design in a traditional installation.

In Figure 4 a comparative diagram of system design procedures under traditional and data base environments is shown. The procedures envision the creation of a set of interrelated programs that process data for one moderately-sized application purpose. Examples of such a system might be payroll, student grade reporting, inventory, etc.

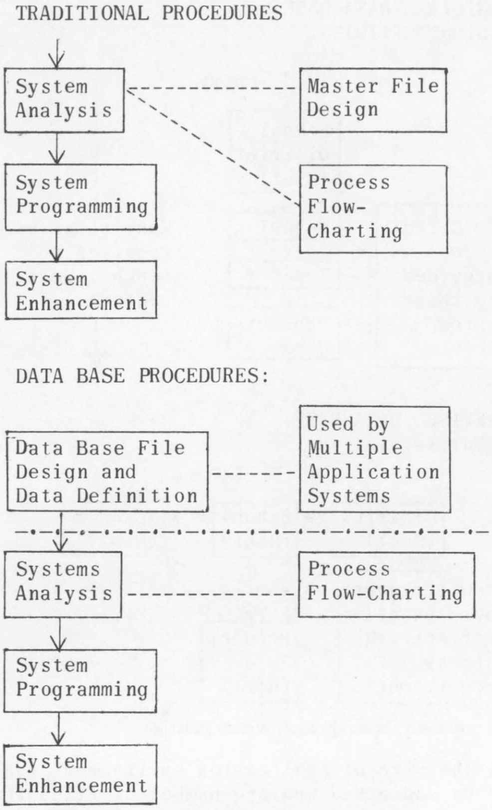

Figure 4. Traditional vs. Data base system design procedures

System Programming

In the traditional third generation data processing environment, system analysis consists of two major tasks: file design and process flow-charting. A data base environment greatly simplifies system analysis by eliminating the master file design task. Pre-existing data, defined and retrieved under the data base management system, is available for ready use in the process fow-charting task. This reduces the time and investment necessary for typical application system design.

A data base management system also has important advantages during the system programming stage, which may result in a significant reduction of the time required for coding and testing. These advantages are summarized in Table 1.

Probably the most dramatic advantage associated with the data base environment occurs during system enhancement. Data independence, occasioned by the intercession of the data base management system, allows a facility for system modification not available in the traditional environment. An illustration is given in Table 2.

The overhead associated with system design in the data base environment is the task of data base file design and data definition. This task, whose difficulty should not be underestimated, precedes system analysis and may be performed by a separate team of individuals. Data base files are designed for use by multiple application systems, so that the burden of investment in their creation is divided among many beneficiaries. Thus, the proportioned cost of data base file creation is probably little more than the cost of master file design in a single traditional application system.

TABLE 1

A Comparison of Typical User Programmer Functions:

Function	Without a Data Base System	Under a Data Base System
File Definition	define access method, record size, block size, device type, input/output buffer, core index	define input/output area and/or invoke an externally defined data area
Coding	open and close files, set up logic for searching through hierarchically structured files, read and write records, set up logic for special file positioning	construct CALL parameter list or code specialized statement types; data base search and positioning is automatic
Record Formatting	attribute field names	invoke standard field names in application programming

TABLE 2

Illustration of a Data Base System's Facility for System Modification:

In a given application system, in production for several months or more, it is decided that a new field must be added to one of the system's files. The following chart compares the necessary operations for this change in a traditional environment and in a data base environment. A "yes" indicates that the operation is necessary; a "no" that it is not. Significant savings may be realized in the data base environment.

	Change File Definition	Change Logic	Compile	Test
Programs using new data element				
Traditional	Yes	Yes	Yes	Yes
Data Base	No	Yes	Yes	Yes
Programs not using new data element				
Traditional	Yes	No	Yes	Yes
Data Base	No	No	No	No

In contrast to the typical master file, however, data base files render data much more available for ad hoc searching and access. Also, standardization of data definition and centralization of update procedures in data base systems offer a quality of system design that is harder to achieve in the traditional environment. □

Computing and Data Processing Newsletter

"PRECISION JOURNALISM" PRODUCES RAPID PAYMENT OF OVER $1 MILLION IN DELINQUENT TAXES

Donald H. Reck
IBM
Data Processing Division
590 Madison Ave.
New York, N.Y. 10022

Precision journalism — a technique by which a reporter works with a computer to research complex stories — was used recently by "The Knickerbocker News" of Albany, N.Y., to help produce a series of reports on delinquent tax accounts in Albany County. Within one month of publication, more than one million dollars in delinquent taxes had been paid.

Steve Kent, executive city editor, says, "It made possible an investigative report that otherwise would've been too time-consuming, expensive and, probably, impractical. Total time for the project, from inception, through copying tax files, keypunching and processing on an IBM computer to publication was about six months. To do the same job manually would have required about 15 months and dozens of people, assuming we could have devoted that much of our resources full time to the project.

"The intent was to name names; so all the facts had to be thoroughly checked before publication. We wanted to make sure that any information punched on the cards, for example, exactly matched the data on the original tax records. In some cases, there were surprises. One man called to thank us for letting him know he even owned property. He was more than happy to pay the back taxes."

The five part series had been prompted by an announcement from the Albany County Treasurer's Office last February that the county was owed some $20.6 million in unpaid taxes — the largest unpaid taxes bill in the state, outside New York City.

To create a data base from which to research the series, reporters Gene Weingarten and Arlene Bigos, who collaborated on the story, obtained the county treasurer's office files in an effort to learn who owed how much, for how long and why. Originally filed only by street address, the 8,700 record cards had to be cross-indexed into 11 new categories for processing. "They weren't digging into private files," says Kent. "The county's delinquent-tax records are public records, available for inspection by any citizen."

The resulting 95,700 separate pieces of information were transferred to punched cards and a program was developed to enable an IBM System/370 Model 125 computer to produce the information in the most accessible form. The printout, about 30 feet long, also helped identify "patterns" of delinquency, which proved of particular benefit to the tax office.

According to Robert G. Fichenberg, executive editor, increasing use of the computer will help reporters study and evaluate vast amounts of material in a short time in other fields, too.

"Precision journalism provides an unparalleled ability for us to undertake penetrating, complex investigative reporting projects that would have been impractical, if not impossible for us previously," he points out. "We think the public will benefit from the reporter's ability to more easily identify discrepancies and shortcomings in government, as well as take more meaningful surveys of public opinion and attitudes, that the computer now makes possible."

The new categories the computer produced that gave better insight into the tax delinquency problem were:

— An alphabetical list of tax-delinquent properties, by owners.

— A list of delinquent properties, by street.

— A list of property owners who owe more than $5,000 in delinquent taxes.

— A list of non-foreclosable property.

— The total number of tax-delinquent properties and their appraised value.

— Subtotals showing how many taxpayers owe more than $100, more than $500, more than $1,000, etc.

— A breakdown of delinquent properties by city wards.

— A breakdown of delinquent properties by towns.

THE WORLD'S BIGGEST MODEL RAILROAD: A SIMULATION OF SEVEN RAILROADS AND 3,000 MILES OF TRACK

Jim Furlong
Computer Sciences Corporation
650 North Sepulveda Blvd.
El Segundo, Calif. 90245

A model railroad bigger than any child's wildest Christmas wish is stored in the Chicago suburb of Oak Brook. The railroad is a model of the 30,000 miles of track (hills, curves, and speed limits included) and the train yards, stations and freight traffic of the Consolidated Rail Corp. (ConRail), the nation's newest railroad company.

But this model doesn't run on tracks. It runs on the Oak Brook computers of Infonet, a computer time-sharing network operated by Computer Sciences Corporation of Los Angeles. It's a mathematical simulation of ConRail's operations, and includes the company's projected costs and revenues. The model was developed to assist the U.S. Railway Association in planning the largest corporate reorganization in U.S. history — the formation of ConRail from the operations of seven bankrupt railroads: Penn Central, Erie Lackawana, Reading, Central of N.J., Lehigh Valley, Lehigh & Hudson River, Ann Arbor.

Day & Zimmermann, Inc., consultants to the U.S. Railway Association, developed the model and "run" the railroad through remote computer terminals in Philadelphia. The terminals are linked to the Oak Brook computers by satellite circuits.

ConRail will start operating most trains in the northeastern United States next February, according to present plans. Based on computer simulations of ConRail's operations, the U.S. Railway Association has predicted that ConRail will become profitable in 1979 and generate earnings of almost $600 million in 1985.

LOOKING AT WINDS OF THE PACIFIC OCEAN TO DETERMINE WISCONSIN WEATHER FIVE DAYS LATER

Robert Ebisch
University Industry Research Program
University of Wisconsin
610 Walnut St., Rm. 1215
Madison, Wisc. 53706

A machine named McIdas is fomenting a scientific revolution at the University of Wisconsin-Madison. McIdas, short for the title, "Man-Computer Interactive Data Access System," unites a man's qualitative judgement with a computer's speed and analytical abilities.

The machine was developed slowly over seven years by Wisconsin scientists in order to accurately measure winds from satellite observations. It includes a computer, a teletype through which the operator can talk to the computer, and a color television screen through which the computer can talk back. McIdas also controls a number of specialized electronics packages which color the TV-picture, choose appropriate views of the Earth, filter image data, and help a human operator get along with McIdas.

A serious problem in many research fields is that satellite data pouring in at rates as high as one TV picture every three seconds, 24 hours a day, produces an information glut totally beyond the grasp of those who need the information.

McIdas assimilates the avalanche of data with ease. The scientist sitting before McIdas' screen can scan thousands of electronic pictures quickly and efficiently. From moment to moment he can order up visual displays from the computer's vast information store, manipulate the picture, and view changes as he commands the machine to make complicated mathematical analyses. The results can be amazing.

In a month-long test during August and September, for example, McIdas used pictures from a satellite 20,000 miles up in space to measure wind speeds on the earth's surface to an accuracy with two miles per hour. "This is more accurate than the resolution of the camera that took the pictures," says Tom Haig, dirctor of Wisconsin's space science and enginerring center. "McIdas made 1,100 measurements of the wind's speed, direction and altitude every six hours and automatically distributed them to forecast centers. And each wind measurement costs us only 28 cents. This is remarkable when you consider that the conventional method of measuring winds with a balloon costs $15 or $20 per reading. And the balloon system is limited because the world is mostly water with no weather stations on it.

"The conventional monitoring systems are doing well if they keep track of 15 to 20 per cent of the earth," Haig continues. "We have to make the coverage 100 per cent if we're ever going to forecast effectively.

"You have to look to the Pacific Ocean to see what kind of weather Wisconsin will have in four or five days."

HOCKEY SHOULD BE COMPUTERIZED, MANAGEMENT CONSULTANT ASSERTS

Andrew S. Edson
Cresap, McCormick and Paget, Inc.
245 Park Ave.
New York, N.Y. 10017

Baseball, the nation's pastime, is an exceedingly slow and convincingly boring — to some — game when compared with ice hockey, full of rapid fire action. Statistics are what's keeping baseball alive, asserts Raymond J. Epich, a sports addict and vice president in the Chicago office of Cresap, McCormick and Paget Inc.

"Baseball statistics form the basis for numerous 'hot stove' discussions throughout the winter," says Mr. Epich, who heads his firm's services in information systems, data processing and operations research. "It is these statistics that save the game from being exposed as the bore it actually is."

By contrast, he claims, ice hockey is one of the fastest moving sports we have, next to auto racing, skiing and jai alai, but it has relatively few statistics beyond goals, assists, penalty minutes, saves, and goalie shutouts for the fan to study.

To add a new dimension to the game, Mr. Epich has proposed and applied for a U.S. government patent to computerize ice hockey. Mr. Epich's idea is to underlay an entire hockey rink with a grid of conducting wire, and to place transmitting devices in the puck and on player sticks and skates. A computer would track the movements of each hockey player in real time throughout the game, as well as the movement of the puck as it criss-crosses the rink. He says:

"Think of the limitless possibilities which can result: The computer would make it possible to calculate the velocity of each and every shot leaving the stick of a player and moving toward the goalie. We would be able to calculate the fastest skaters and shooters, players who spend the most time on ice, retain control of the puck longest, etc. By using a computer, these statistics could be displayed during the course of the game, providing instant readouts of the velocity of a shot microseconds after it had been completed.

"It could be programmed to announce such feats as 'Bobby Hull just drove his slap shot beyond the blue line at 148 m.p.h.' or 'Bobby Orr controlled the puck for 32.2 minutes during the evening.' Similarly, the computer could announce the number of feet or miles skated during a period. This three-way combination of imbedded wires, transmitters and a computer would thus open up a fantastic new dimension to ice hockey. The result would be a sport with the action of hockey and the statistics of baseball."

TALKING IN MUSIC LANGUAGE WITH A COMPUTER

William T. Struble
News Office
Mass. Inst. of Technology
Cambridge, Mass. 02139

How can a musician "talk music" with a computer?

Very easily, if he happens to be in the Massachusetts Institute of Technology Experimental Music Studio. There he encounters a computer-based music system (complete with organ keyboard, music display, and sound synthesizer) than enables him to converse in musical language and which promises to be a powerful tool in musicological research and in composition. The organ keyboard is the input console to the computer. The computer, a PDP 11/50, was a gift of the Digital Equipment Corp., Maynard, Mass.

The question of "talking music" with a machine arises in the context of some of the most progressive research and creative activity in music today, according to Barry L. Vercoe, M.I.T. associate professor of music and director of the project.

When a music historian wishes to find the "unknown composer" of a 15th century chanson (such as Je ne vis oncques la pareille, one of the hits of its time), he may use the computer to compare its stylistic characteristics with those of hundreds of other known songs of its day. Or, when a contemporary composer wishes to obtain a "perfectly accurate synthesis" of a new electronic composition whose rhythms are too complex to be adequately performed on a standard Moog synthesizer, he may also use the computer — either to control a collection of sound-synthesizing equipment or perhaps to "perform" the entire piece using digital synthesis techniques.

How does a composer enter the information of a musical score into a computer? Up to this time musicians have had to make do with strings of letters and numbers. "However, while the card punch and the teletype are just fine for some things," Professor Vercoe says, "they make very poor musical instruments. 'Talking with a machine' has traditionally meant conversation in a foreign tongue. And it has always been the musician who had to learn the other language."

At the Experimental Music Studio, he says, "the shoe is on the other foot now." The computers there are being taught to converse in the musician's language — standard music notation. Using a high-resolution scope, the system can display about 20 lines of music at a time. The composer can "stroll around" to any part of his large score-in-progress, make some changes, and ask to hear the result. The computer will then synthesize a complete performance of the score. The system also will provide the composer with a hard copy music printout if he wants it.

"Although the sound synthesis part is not unlike text-to-speech translation," Professor Vercoe says, "the manner in which it must be specified is quite different. Moreover, the manner of writing a score becomes important. Composers use music paper not just to display music, but to permit quick changes. A phrase played into a computer via an organ keyboard sometimes appears wrong when seen in context. We therefore had to develop a graphical Music Editor that would enable the computer to be at least as practical as pencil, paper and eraser."

The Experimental Music facility is used by students taking the subject, Electronic Music Composition (21.628). It is also beginning to attract the attention of professional composers from the Boston area and other parts of the country. Meanwhile, the combined power of the PDP-11/50 computer and the IMLAC PDS-4 display system provides an environment for other computer-music research, including more flexible man-machine dialogues, more suitable high-level languages, and improvements in digital-audio interfacing, Professor Vercoe says.

COMPUTER HELPS DOCTORS IN REMOTE AREAS PLAN RADIATION TREATMENT FOR CANCER

Al Hicks
Office of Public Information
Univ. of California at Los Angeles
405 Hilgard Ave.,
Los Angeles, Calif. 90024

Doctors in rural or medically underserved central city areas soon may be able to call up a computer here to help calculate precise radiation treatments for cancer patients.

The computer, at the UCLA Health Sciences Computing Facility, will calculate the direction and depth radiation beams should take to direct the maximum dosage to cancerous cells with minimal damage to surrounding healthy tissue.

To communicate with the computer, doctors at remote health centers need only a standard telephone and a television-like computer graphics terminal.

By calling special numbers at the UCLA Medical Center, a physician can connect his terminal to our IBM System/360 Model 91 computer. Then, with an electronic light pen, the doctor draws a diagram of the patient's body area to be treated and pinpoints the tumor. The light pen is a photosensitive pointer that allows information to be entered into the computer or displayed on the terminal.

Once the doctor indicates where he would like to position his radiation beams, the computer plots the depth and direction of the dose to be administered to the tumor, and informs the doctor by displaying the information of the screen of the terminal.

Although many health centers have facilities for radiation therapy, few remote from large computers

Dr. Carol Newton, UCLA professor of biomathematics, studies the increasing relationship of normal human cells, represented by the broken lines on the computer terminal screen, to malignant cells, represented by solid lines, after advanced radiation treatment. UCLA uses its computer to help doctors throughout the country plan radiation treatment for their patients. The doctors need only a computer graphics terminal, similar to the terminal Dr. Newton is using here, and a standard telephone. They can get precise radiation treatments for their patients calculated by the UCLA computer.

have the sophisticated capability to plot radiation treatment with precision. The delicate procedure involves aiming radiation beams at precise angles to bring a lethal dose to the tumor while minimizing the damage to adjacent cells.

The program, developed at the Health Sciences Computing Facility, has been tested for almost three years at Cooper Hospital in Camden, N.J., in a pilot study for cancer treatment planning. It has proved effective in helping radiation therapists treat cancer patients.

A physician can learn to communicate with the computer with a minimum amount of instruction, much of it self-taught. The computer will respond on the graphics terminal in his clinic after he has provided his information through pictures and diagrams, using the light pen.

An important aspect of the program is the relatively inexpensive cost of the terminal. This enables group medical practices in rural settlements or medically underserved inner city areas to gain access to large medical computer facilities for diagnostic procedures and treatment planning.

UCLA's large computer also has been made available to remote medical centers involved in diagnosing heart disease. Doctors can use terminals in their offices to compare information on their patients with the descriptions of various categories of heart disease stored in the system.

ARTIFICIAL INTELLIGENCE AND AUTOMATIC THEOREM PROVING

Jim Hicks
News and Information Service
University of Texas at Austin
Austin, Texas 78712

A University of Texas professor of mathematics and computer expert, Dr. Woodrow W. Bledsoe, has become a co-chairman of the Oberwolfach Conference on Automatic Theorem Proving, to be held in Oberwolfach, West Germany, Jan. 5-10, 1976.

Automatic theorem proving is Dr. Bledsoe's primary research interest in the field of artificial intelligence. He has been supported since 1972 by a National Science Foundation grant of approximately $45,000 per year.

"Artificial intelligence is the study of the computer and computer-related techniques to get the computer to do intelligent things that men do," says Dr. Bledsoe. "For example, computers can play chess, recognize pictures and prove theorems — things which men, rather than machines, normally do."

In September Dr. Bledsoe was one of seven experts invited to lecture to the Fourth International Joint Conference on Artificial Intelligence in Tbilisi, USSR. He was elected general chairman of the next conference which will be held in August, 1977 at Massachusetts Institute of Technology.

Dr. Bledsoe serves on the editorial board and as review editor of the International Journal on Artificial Intelligence. He also is the editor of the SIGART Newsletter, which is published by the Special Interest Group on Artificial Intelligence of the American Association for Computing Machinery.

Faculty members at UT interested in artificial intelligence have formed an artificial intelligence group. In addition to Dr. Bledsoe, they include Dr. Robert Simmons, professor of computer sciences; Dr. John C. Loehlin, professor of psychology; Dr. Laurent Siklossy, associate professor of computer sciences; Dr. Daniel Chester, assistant professor of mathematics, and Dr. Donald Good, assistant professor of computer sciences.

"Probably the leading institutions in the country in the field of artificial intelligence are MIT, Stanford, and Carnegie-Mellon," Dr. Bledsoe says, "and UT probably comes in a close fourth because of the quality of people we have involved here."

Dr. Bledsoe has been a member of the UT mathematics faculty since 1966. His research interests, in addition to automatic theorem proving, include measure theory, systems analysis and pattern recognition. He has written more than 30 articles for scientific journals.

He is a member of the American Mathematics Society, Institute of Electrical and Electronics Engineers, and Association for Computing Machinery. □

Forum – *Continued from page 16*

The Dvorak name is on the title page of Merrick and Bown, My Typewriter and I (American Book, 1937), a seventh-grade grammar school text for classes conducted with a typewriter on each desk. This text, with a Simplified-arrangement supplement, was used in a large-scale application in the Tacoma, Washington, public schools at one time. Students in the typewriter-equipped classes learned more grammar than the control group and acquired a useful typing skill as well, without any extra expenditure of time.

Dvorak's, Scientific Typing (American Book, 1939) a learner's manual for personal and vocational typing was also published for the traditional arrangement,

(please turn to page 35)

Forum — *Continued from page 34*

with a Simplified Keyboard Supplement, and it is this supplement which has been supplied by Levine Books, of Irvington, New Jersey, to purchasers of Synergistic to tide them over.

The death of the author, who was attending to copyright negotiations and the printing, may cause further delay in the delivery of the promised complete manual for the American Simplified Keyboard.

Remembering very well the exhaustive investigation that the authors of Behavior, together with Frank and Lillian Gilbreth, had made before the publication of that report, August Dvorak nonetheless was at all times willing to concede the possibility that some other researcher had devised a better arrangement. He examined each one that came to his attention; all suffered sadly in comparison with the classic Dvorak diagram until Joseph Rosenblum, consultant on product planning to the Smith-Corona Laboratory, presented his solution to the promotability problem with a diagram that preserves the traditional arrangement of the digits and all the traditional pairing. Rosenblum accepted one Dvorak recommendation, relocating four characters, and Dvorak and his wife, Hermione, went to work on the manual for ASK operator training.

IBM, THOUGH LATE, MAY GET ON THE SUPPLY SCHEDULE OF THE U.S. GOVERNMENT AFTER ALL, VIA A SECRET CONTRACT WITH THE DEPARTMENT OF DEFENSE

From: Becky Barna
Computer Industry Association
1911 North Fort Myer Drive
Rosslyn, Va. 22209

Representatives of the Computer Industry Association met on December 9 with Congressional staff to voice concern over what appears to be a violation of the Brooks Bill. That legislation is intended to centralize federal computer procurement within the General Services Administration, as opposed to having fragmented procurement efforts throughout the government. The controversy arose over a proposed supply schedule contract arranged exclusively between IBM and the Department of Defense. Until recently, the proposed contract had been a secret.

IBM missed out on being included in the fiscal 1976 Federal Supply Schedule contract because the company submitted its schedule to GSA after the cut-off date for proposals. Now, DoD and IBM have drawn up their own supply schedule contract and are submitting it to GSA for approval. Such a procedure gives GSA after-the-fact authority rather than prior approval before procurement.

The representatives of the Computer Industry Association told staff members of the House Government Operations Committee that the implications of the proposal are grave. If GSA approves the contract, it will in effect grant DoD an authority that is not permitted to the government as a whole. Furthermore, if the contract between IBM and DoD gets through, GSA will have little power to preclude such practice by other agencies. Enforcement of the existing 1976 Federal Supply Schedule will be impaired, as will be the intent of the Brooks Bill, if IBM is allowed to circumvent the rules followed by its competitors. If the schedule pact between IBM and DoD is allowed, the government's largest procurer of computer equipment could conceivably allow millions of dollars worth of equipment to be provided by a sole source, and thus effectively squelch the competitive aspects of the procuring process.

According to one Congressional aide, the pact between IBM and DoD appears to be a "mirror" of the schedule IBM would have filed with GSA had it been done on time. The aide expressed outrage over the apparent subversion of existing procurement mandates, but he indicated that unless there is substantial industry clamor over the issue, GSA will probably give its blessing on the pact. As the aide put it, "We'll be stuck with practices such as these as long as GSA keeps bowing to DoD."

The Association has filed for a copy of the contract proposal between IBM and DoD under the Freedom of Information Act. In the meantime, the Association urges other industry groups to make their views known to GSA.

THE REVOLUTION IN THE COMPUTER BUSINESS EQUIPMENT INDUSTRY, NOW AND COMING

From: E. Lawrence Tabat
Chairman of the Board
Computer and Business Equipment Manufacturers Association (CBEMA)
1828 L St., N.W.
Washington, D.C. 20036

Although the Computer and Business Equipment Manufacturers Association (CBEMA) is entering its 60th year, this $26 billion a year industry seems really to be in its infancy. It is among the nation's most innovative, most exciting, and fastest changing fields.

During the next five years, there will be more technological breakthroughs than we've seen in the past twenty. These should change office life the way jet aircraft has revolutionized travel.

New equipment introduced last year supports this view. For example, several manufacturers unveiled: (1) lower priced mini-computer systems; (2) high-speed copying equipment capable of printing 8,000 to 9,000 copies an hour; (3) automatic text-editing typewriters that were smaller, faster and quieter; (4) computerized central dictation system for word processing; etc.

A spur to the industry's rapid rate of change has been computer technology. Although a new instrument, the computer has dramatically changed the way in which manufacturers design and engineer equipment. Today, microcomputers using silicon chips slightly larger than one letter in this type face — perform more quickly and accurately than an 18,000 vacuum-tube computer of 18 years ago. The cost of 100,000 calculations using a computer is now a penny.

According to reports in several recent surveys, in the next decade: (1) sales of data communications equipment are expected to increase five-fold; (2) sales of automatic typewriters will grow at an annual rate of 21 per cent; (3) by 1980 there will be 400,000 automatic typewriters sold annually; (4) the copier market is expected to double by 1980. More than 18 million calculators were sold last year. □

Announcing plans for a new quarterly magazine:

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

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COMPUTER GRAPHICS AND ART

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

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

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

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

Cordially,

Grace C. Hertlein

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

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