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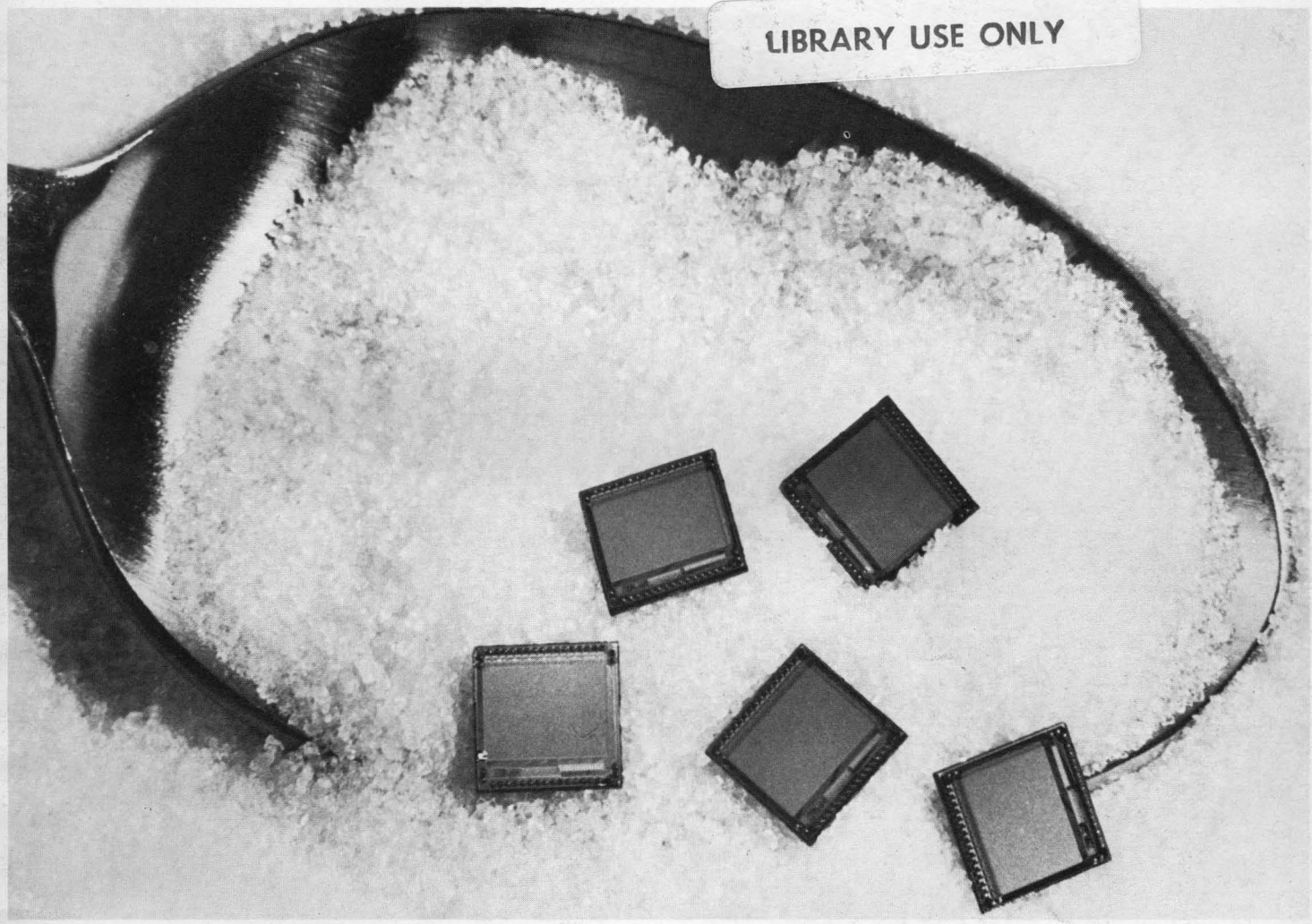
formerly *Computers and Automation*



CIRCUIT CHIPS FOR COMPUTER, WITH SUGAR IN TEASPOON

"RIDE THE EAST WIND: Parables of Yesterday and Today"

by Edmund C. Berkeley, Author and Anthologist

Published by Quadrangle/The New York Times Book Co., 1974, 224 pp, $6.95

The Fly, the Spider, and the Hornet

Once a Fly, a Spider, and a Hornet were trapped inside a window screen in an attic. For several hours they walked up and down, left and right, here and there, all over the screen. They could look through the screen at the summer woods, feel the summer breezes, and smell the summer smells; but they could not find any hole to pass through the screen to the woods and fields so tantalizingly close, yet so far away.

Finally they decided to hold a conference on the problem of getting through the screen. The Fly spoke first, and said, "My Colleagues, ...

The Fox of Mt. Etna and the Grapes

Once there was a Fox who lived on the lower slopes of Mt. Etna, the great volcano in Sicily. These slopes are extremely fertile; the grapes that grow there may well be the most delicious in the world; and of all the farmers there, Farmer Mario was probably the best. And this Fox longed and longed for some of Farmer Mario's grapes. But they grew very high on arbors, and all the arbors were inside a vineyard with high walls, and the Fox had a problem. Of course, the Fox of Mt. Etna had utterly no use for his famous ancestor, who leaping for grapes that he could not reach, called them sour, and went away.

The Fox decided that what he needed was Engineering Technology. So he went to a retired Engineer who lived on the slopes of Mt. Etna, because he liked the balmy climate and the view of the Mediterranean Sea and the excitement of watching his instruments that measured the degree of sleeping or waking of Mt. Etna. The Fox put his problem before the Engineer . . . .

The Fire Squirrels

Scene: Two squirrels, a young one named Quo, and an older one named Cra-Cra, are sitting by a small campfire in a field at the edge of a wood. Behind them hung on a low branch of a tree are two squirrel-size hammocks. Over each of the hammocks is a small canopy that can be lowered to keep out biting insects. It is a pleasant summer evening; the sun has just recently set, and the stars are coming out: ——

Quo: Cra-Cra, you know I don't believe the old myths any more. Tell me again how it really happened.

Cra-Cra: Just this: we received our chance because they dropped theirs. It is as simple as that.

Quo: In other words, they were the first animals to use tools, and we are the second?

Cra-Cra: Yes. There is a mode of surviving in the world . . . .

Missile Alarm from Grunelandt

Once upon a time there were two very large and strong countries called Bazunia and Vossnia. There were many great, important, and powerful leaders of Bazunia who carefully cultivated an enormous fear of Vossnia. Over and over again these important and powerful leaders of Bazunia would say to their fellow countrymen, "You can't trust the Vossnians." And in Vossnia there was a group of great, important, and powerful leaders who pointed out what dangerous military activities the Bazunians were carrying on, and how Vossnia had to be militarily strong to counteract them. The Bazunian leaders persuaded their countrymen to vote to give them enormous sums of money to construct something called the Ballistic Missile Early Warning System, and one of its stations was installed in a land called Grunelandt far to the north of Bazunia.

Now of course ballistic missiles with nuclear explosives can fly any kind of a path all around a spherical world, and they do not have to fly over northern regions. But this kind of reasoning had no influence on the leaders of Bazunia who wanted the money for building BMEWS. Nor did it have influence on their countrymen, who were always busy, trying to make money — in fact often too busy to think clearly . . . .

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52 parables (including fables, anecdotes, allegories)
23 never published before
27 authors
18 full-page illustrations
330 quotations and maxims

7 Parts: The Condition of Man / On Flattery and Persuasion / On Perseverance and Resourcefulness / Behavior — Moral and Otherwise / The Problem of Truth / On Common Sense / Problem Solving

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MULTI-ACCESS FORUM

SURVEILLANCE AND INFLATION – SOME COMMENTS

1. From: R. A. Sobieraj
702 Columbus Circle
Perth Amboy, N.J. 08861

The "Daily Surveillance Sheet, 1987" reprinted (from 1969) in the August 1975 issue did offer some food for thought.

It showed that inflation had not only been stopped but annihilated: 10¢ for a phone call, 10¢ for the Wall Street Journal. But I don't understand the $8.10 for the purchase of a newspaper (last line). Could this be a program bug? An I/O error?

Spending $3.00 to fill the tank of a VW indicates that the oil shortage has long been solved.

I'm optimistic in thinking that a National Data Bank would be no more politically possible then than it would be today.

2. From the Editor

I believe your optimism is unjustified -- and I hope I am wrong.

A national data bank already exists in many countries, certainly in the Soviet Union, very likely in Spain, certainly in Brazil, Uruguay, and other countries where the government is a dictatorship either by an individual or a party and which are well enough off to understand and to pay for the computerized equipment needed. The strong efforts in the United States to put together a national data bank while at the same time denying that such exists is a modern pattern of incipient authoritarian establishments. It is not reasonable to expect that any dictatorship or incipient dictatorship will normally admit the existence of a national data bank of the kind able to produce a "daily surveillance sheet" on suspected persons.

INSTRUCTIONAL APPLICATIONS OF COMPUTERS

From: Dr. Howard A. Peelle
Instructional Applications of Computers
School of Education
University of Massachusetts
Amherst, Mass. 01002

The program here in Instructional Applications of Computers is a specialized program of graduate study with emphasis on uses of computers in learning and teaching. Master's and Doctoral degrees are offered.

Study is interdisciplinary, and broadly includes the fields of computer science, psychology, mathematics and education. Foci of interest are: Computer-Assisted Instruction / Simulation and Gaming / Programming Language / Computer Art / Artificial Intelligence / Mathematics Education.

Current topics of research are: (1) conceptualizing and testing new approaches to computer-related curriculum development, e.g., the Computer Glass Box Approach; (2) use of artificial intelligence techniques in computer-assisted instruction (AI in CAI); (3) mathematics teacher training via A Programming Languages (APL); (4) sexism in the use of computers and the teaching of mathematics; (5) semi-quantitative problem-solving processes in children; (6) an existential philosophy of educational computing; (7) critique of computer-managed instruction; (8) use of APL for teaching college mathematics; (9) teaching mathematical modeling of ecosystems; and (10) a comparison of programming languages (particularly, APL, BASIC, LOGO) as frameworks for teaching children thinking.

The program maintains a modest computer-assisted instruction laboratory, with access via remote terminals to a CYBER 74 time-sharing computer provided by the University Computing Center.

Faculty and students in the program interact freely with prospective teachers and students in the field, as well as with other Clusters within the School of Education, other departments in the University and colleges in the Pioneer Valley area of Massachusetts. Local relationships include Mark's Meadow Elementary School, Amherst Regional High School, Deerfield Academy, Hampshire College, and UMass Department of Computer and Information Sciences. Additional contacts are with MIT (Artificial Intelligence Laboratory), IBM (Philadelphia Scientific Center), and SECOS (Shared Educational Computer Systems, Inc.). For more information, please write me.

COMPUTER NETWORKS: THE INTERNATIONAL JOURNAL OF DISTRIBUTED INFORMATIQUE

From: North Holland Publishing Co.
P.O. Box 103
Amsterdam, The Netherlands

Our present-day society is undergoing important changes due to the rapid introduction and expansion of new communications concepts. Among these, none is affecting more fundamental changes than computer networks. These new systems and their application raise technical, economic, social, legal, and regulatory questions at a rate that taxes the ability of human institutions to consider them. Yet no regularly-scheduled journal is gathering information on these issues in a form which is both timely and interesting

(please turn to page 20)

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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 five circuit chips contrasted with granulated sugar in the hollow of a teaspoon. Each chip is about ¼ inch square; each holds 48,000 binary digits (bits) of information. The chips use Metal Oxide Semiconductor Field Effect Transistor (MOFSET) Read–Only Storage (ROS) circuitry. Such chips are part of the IBM 5100 Portable Computer announced September 9. The circuit chips are made by the IBM Systems Communications Division, Manassas, Va.

Message from Neil Macdonald:

WOULD YOU LIKE A COLLECTION OF THE PUZZLES PUBLISHED IN *COMPUTERS AND PEOPLE?*

IF SO, WRITE US AND TELL US WHAT YOU WOULD LIKE.

MAYBE WE CAN WORK SOMETHING OUT.

Key

[A]	–	**Article**
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[F]	–	**Forum**
[N]	–	**Newsletter**
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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

"Quick and Dirty" Methods in Operations Research

A stream of books flows through the office of "Computers and People" for review or mention or notice in the pages of this magazine. Every now and then, an unusually interesting and important book appears in the stream: widely applicable instead of narrowly; wise instead of academic or technical; and sometimes even thoroughly entertaining as well.

Such a book is "Operations Research for Immediate Application: A Quick and Dirty Manual" by Robert E. D. Woolsey and Huntington S. Swanson. This book is published by Harper and Row, 10 East 53 St., New York, N.Y., 10022, copyright 1975, paper bound, 204 pages.

A quotation at random (from page 67) will show the flavor and practical significance of this book:

[Beginning of Quotation]

.... The person proposing to inject methods into a large organization should beware of doing it from the top down. Too often, in this author's experience, upper management tends to view this new tool as the answer to all ills. In the initial burst of enthusiasm the upper manager will sell it to his peers and embody this new method in the policy manual before the analyst is really aware of what may happen.

The inexperienced analyst will view the embodiment of his technique with great joy, not yet realizing that for his method to work, the data must be supplied and implemented in the model by lower management.

At some point in this process the phrase "Let's now disseminate this to lower management" will be used by the big dog who has been sold on the method. Let us list the steps of dissemination in order:

1. The new method is shoved down the throat of lower management.

2. Lower management appears to comply.

3. The usual process grinds to a halt.

4. The upper manager points out that "lower management in this company is against progress."

5. The method dies (at least as far as this company is concerned).

We should note however that if we start from the bottom and go up, the shark we have chosen sees implementation of this method as a way to get ahead. Therefore we are assured of implementation at least at this level of management.

[End of Quotation]

Chapter 7 is entitled "Networks we have Node and Loved"; Chapter 11, "Esotericae - Academic Quick and Dirtys". The subjects of the remaining nine chapters include production scheduling, inventory control, capital budgeting, Markov chains, geometric programming, economic analysis, etc. And whenever a friendly explanation for some high-brow term is needed, the authors give a "tutorial".

Fourteen computer programs in conversational FORTRAN are stated in two dozen pages of the book. The authors say with their usual fresh, "early morning" mode of expression:

> It is certainly not expected by the authors that any of the programs will be used with no modification in an industrial situation. They should be treated as signposts rather than a road and certainly not a freeway.

I have never found the important and interesting subject of operations research treated with more apparent irreverence and more real respect. "Learning can be fun" and irreverent, down-to-earth learning can be the most fun. I think the authors should receive an award for common sense, elementary and advanced.

We are grateful to receive the permission of Harper and Row to reprint in this issue of "Computers and People" a large part of fourteen pages in the early part of the book. We hope that many of our readers will find the whole book instructive, amusing, and worthwhile.

Edmund C. Berkeley

Edmund C. Berkeley
Editor

Operations Reseach for Immediate Application:

A Quick and Dirty Manual -- Excerpts

Robert E. D. Woolsey
Huntington S. Swanson
Rocky Mountain Fire Brigade, Inc.
Golden, Colorado 80401

"Let me define operations research . . . as I see it: Operations research is the application of logic and mathematics to a real-world problem in such a way that the method doesn't get in the way of common sense."

Preface

Before you plunge into this Quick & Dirty manual, I would like to say a few words as to what it is and how it came about.

For some time now, I and a few other practitioners in the areas of operations research, management science, and industrial engineering, have had the feeling that our profession is turning more and more inward and is talking less and less to the managers who have real problems.

This trend is exemplified by the appearance of papers in the journals of the profession that seem to be cures searching for a disease. On the rare occasions when a real problem is presented, it is usually disguised by a level of mathematical jargon that is beyond the potential user.

Over a period of years as a consultant, this author discovered that some of the simple methods for selected real-world problems, which have been known by the academics in this field for some time, were totally unknown to the people who really needed them. Study of this problem showed that the main reason was that the academics, naturally, wrote about the methods in such a manner as to ensure acceptance in academic journals. Unfortunately, the degree of mathematical rigor and fashionable notation required by these journals assured that the methods were incomprehensible to the final consumer.

This Quick & Dirty manual is an attempt to bridge this gap in communication. With rare exceptions, this author has simply taken the creative work he has learned from others and presented it in what he hopes to be plain English.

This manual is, frankly, a cookbook. This means that using the recipes herein may cause acute corporate (or governmental) indigestion if some careful thought is not given to the actual circumstances of the problem. Thoughtful consideration of the references supplied is a requirement for meaningful use of this manual.

The basic format for each chapter is a general discussion and brief summary of each Quick & Dirty, followed by the Quick & Dirtys themselves, each with an example and a reference. In a number of cases conversational FORTRAN programs are supplied to show how the methods may be implemented in practice.

Some chapters, however, are rather more concerned with HOW a given quantitative approach may be introduced into an organization. For example, Chapter Three, on capital budgeting, has "The Prince" of Niccolo Machiavelli as its principal inspiration. It is the contention of this author that DEFINING the model is often the easiest part of the optimization problem. The most difficult part is convincing someone with the problem to USE your solution. For this reason, various apparently cynical comments and suggestions for practical use of the methods and programs in this book are scattered throughout the text. Some chapters are really essays on case studies in which the author, at worst, has hit the wall at high speed or, at best, has done a little better than break even. I realize the implication that this author has not always done splendidly in his professional work breaks with the usual scholarly tradition that authors of operations research texts never admit error. However, after a few years of professional experience, this author must confess that you win a few and you lose a few. It is painfully clear that the best way to be unbeaten, untied, and unscored is simply not to play.

To the academic reviewers of this book, I can only say that this book is not for you, but rather for your students -- who are often turned loose on the world knowing all about the problem but who are unable to find the answer. Let me define operations research/management science as I see it:

> Operations research is the application of logic and mathematics to a real-world problem in such a way that the method doesn't get in the way of common sense.
>
> Robert E. D. Woolsey

Note: This book was NOT supported by the National Science Foundation.

Instructions for Industry

This book should not be considered a cure for all ills. The probability that any one of the Quick & Dirtys or one of the programs will exactly fit a real-world situation is extremely small. The Quick & Dirtys are, at best, a guide for developing a rule of thumb to fit the situation at hand. The programs are only examples of how a given method might be presented in order to help its

acceptance in the real-world situation at hand. As is sometimes suggested in the text, forms may be easily constructed to accomplish the desired objective without a computer. Whenever possible, this should be the goal and some examples of this are provided. People will use a nomogram or a chart long before they will consider using a computer. Say, for example, that a nomogram is constructed that will tell an inventory controller when to reorder so that total costs are minimized. Acceptance of this chart is helped by (1) making it look just like the form he has been using for years, (2) making it easy to read, and (3) if it is to be placed on a wall, having a full-color pin-up above the chart to ensure that it will not be misplaced.

Instructions for Students

This book should be used as a supplement to the usual college course in operations research or management science. Some problems are provided in this text, but they are not keyed to any given chapter. Experience has shown this author that problems at the end of Chapter X are usually attacked with the methods to be found in Chapter X. The student will notice considerable commentary on the fact that the data fed into most models is usually not accurate. This was brought home to this author most strongly when he realized that an operations research group in an oil company was worried about the third decimal place in a linear programming output, when the data on viscosity of the input stream had been obtained by a refinery worker rubbing it between his fingers! Indeed, one of the bigger problems faced by the young management scientist is to construct a model for which data may be obtained quickly and at reasonable cost. Woolsey's bean-counter theorem states that: "Either the data is not present, or if it is present, it is not in the right form." The student is strongly encouraged to include in his school program sufficient accounting so that he can use data with some understanding of the assumptions under which it was collected. For example, many economic order quantity models require that an inventory holding cost for some item be obtained before the model may be implemented. The budding analyst who asks the accounting organization to give him the holding cost will discover that they will give it to him every time. The good accountant will ask the analyst if he wants a first-in first-out, last-in first-out, lower-of-cost-or-market, or a how-we-do-it figure. If the analyst states that his model needs only one number, the usual reaction of the bean counter is to "give 'em what they want" just to get rid of the interruption. The student is therefore encouraged to give his instructors a bad time by asking questions on how the data is to be collected for models, assuming that such data CAN be collected if it exists. Finally, the student is encouraged to inquire as to how to "sell" the model once it is defined. If the instructor feels that this is of no importance, because the method is so elegant that it will "sell itself," ASK FOR EVIDENCE. If the instructor states that he is interested only in the theory, you must decide if that is also your interest and make plans accordingly. There is no question that theory is important as a conceptual tool; however, to allow a student to think that he is a competent management scientist because he has earned a degree in it on the basis of good absorption of theory is tragic. The student should therefore examine what is presented to him as "useful" theory with care.

Instructions for Teachers

This manual can best be used for teaching in the following way. The presentation of Quick & Dirtys in this text should be contrasted with the presentation that appears in journals or other books. The methods presented here are deficient in that mathematical rigor and elegance of presentation is ignored. The original articles contain carefully listed assumptions concerning the conditions under which optimality may be proven. The purpose of the original presentation was to provide a conceptual base for further development. The presentation here is solely on the basis of maximizing utility, an inelegant deity at best. After exposing students to, say, the two- and three-machine job-shop methods, homeworks are suggested in which the students have to construct their own Quick & Dirty for a case where different machine orderings are allowed. The Quick & Dirty must be written so that a person WITH THAT PROBLEM can understand and use it. Then take it to a man with that problem. Assign a grade of F to anything he finds difficult to understand. Assign a grade of C to anything he can READ. Assign a grade of A to the few he would like to put on a wall and USE. The instructor will find that only a few homeworks like this will do wonders for the student's ability to communicate effectively.

General Discussion

For some years there has been a communication gap of some magnitude between the theory of production scheduling and its day-to-day implementation. Elegant formulations of production scheduling appear in journals but for some reason never seem to be implemented. The academic who ventures into a real-world situation is often made to feel as Sir Isaac Newton must have felt the first time he informed a major of the Royal Artillery that "The cannon ball will fall right THERE, neglecting air resistance." The major's reply has not, alas, been recorded for posterity. However, there is little doubt as to its content. As a result, Sir Isaac went back to Cambridge and the major went back to doing it the way he had always done it -- both with a solid contempt for the other.

Unfortunately, much the same situation still exists today in production scheduling. The academics cheerfully go on designing total systems that seem to work only with at least a 5-megabuck computer, three management scientists to explain the printout, and ten programmers to keep it working. The author recently had the unnerving experience of being asked to demonstrate some of the simple-minded programs in this book, on his Brand X minicomputer, for the production-scheduling organization of a large plant manufacturing Brand Y computers. Upon close questioning, the head production-scheduling supervisor admitted that the overall system really didn't work too well in practice. The reason given was that because the system considered EVERYTHING, no one group was ever able to figure out why they should follow it.

What was wanted was something that THEY could use and understand. At this point the author proceeded to pass out copies of the "Quick & Dirty" methods to be found later in this book. It can be seen that implementation of these techniques on a teletype on the shop floor is quite straightforward. For this purpose some programs with examples are provided. By looking at the sample program one can see that the basic idea is that of CONVERSATION. That is, there is no barrier between the user and the computer. The computer can be made to get the data needed from the scheduler in English, and to return the answer in the same language.

A Note on the Shop Scheduling Program

The shop scheduling program examples that follow the Quick & Dirtys allow the user to do conversationally the eight different shop scheduling methods covered in this chapter. The program will first ask the user how many processes (machines) the jobs have to go through. Note that a whole shop may be considered as one process if desired. If the user answers that there is only one process, the program then goes into the subroutine for one-process scheduling and proceeds to request how many jobs are to be processed over the one machine or process. After the user gives an answer, the program will then allow the user to choose which of five different criteria to use to optimize the schedule. After the appropriate criterion is chosen, the program will then request such data as is needed for optimization of the schedule. When the schedule is optimized, the answer is printed out in the form of the sequence that is optimum for the criterion chosen. The program then will ask if it is desired to "optimize this problem another way?" If the answer is yes, the program will return to the place where the user is asked which of the criteria he wishes to choose.

If the user inputs two different processes, the program branches to the Johnson two-machine method discussed in the first Q & D. However, if the answer to the next question, "All jobs processed in the same order thru the shop?," is "no," the program then branches to the Q & D that considers the two-machine case with technological ordering. In this case not only the processing time data is required but also the order that each job is to be processed through the two machines.

If the user inputs that there are three or more processes, the program branches to the Q & D based on the method of Gupta, and proceeds accordingly. (The program itself -- Program 1.1 -- will be found in the appendix on page 172 of the book from which these excerpts are taken.)

The following 'Quick & Dirty' methods are, of course, severely restricted in their applications. Most assume that in-process inventory is available, and that no passing of jobs is allowed. Others assume that all jobs have equal priority. Candor compels the author to admit that the only place he ever found where all jobs had the same priority was the County Clerk's office of Jefferson County, Colorado.

The methods presented here are not to be considered as panaceas, but only as methods that work (under the conditions stated) and that are simple to teach and to understand. All that this author has accomplished here is to act as a translator. The following Quick & Dirtys are the creative work of the referenced authors only.

Q & D To Minimize Total Processing Time for N Jobs on Two Machines

This method, due to S. M. Johnson, is probably one of the most referenced papers in production scheduling. It makes the usual amusing assumptions about inventory being present when needed, no passing of jobs, set-up and tear-down time included, no breakdowns, and no strikes. However, the importance of this method is that it requires only that the user can read, can tell when one number is larger than another, and knows left from right.

Q & D To Minimize Total Processing Time for N Jobs on Three Machines (Special Case)

This method, also due to Johnson, is the natural extension of the above problem to the three-machine case. In this extension, Johnson shows that if the minimum processing time over all jobs on the first process is greater than or equal to the maximum processing time on the second process, then an equivalent two-machine job shop problem can be constructed. Further, another equivalent two-machine problem can be constructed if the minimum processing time on the third process is greater than or equal to the maximum element in the second process. In short, if the second process is dominated by either the first or the last, we can solve the problem as an equivalent two-machine problem.

Q & D To Minimize Total Processing Time for N Jobs on M Machines

With three or more machines, we leave the world of optimal solutions and enter the area of heuristic techniques. The procedure presented here was extensively explored by Dudek and Ghare, and shows that the logical extension of Johnson's three-machine special case to more machines is a reasonable and easy-to-use heuristic. This method is presented here, but careful note should be made of another approach to this problem, presented later in this manual, based on the method of J. N. D. Gupta. Gupta's method is perhaps easier for hand computation; however, the programming of both methods is quite straightforward.

Q & D To Minimize the Number of Late Jobs for N Jobs on One Machine

This method is due to Moore and is one of two methods presented in his paper. The method assumes that all jobs are of equal priority, and makes the usual above-stated assumptions in inventory, and so forth. The method is extremely simple, and a form can be easily designed for scheduling use. The most obvious application is to treat the whole shop as one process and operate from there. A sample of the program for conversational mode treatment is provided.

This method has its greatest potential in its use as a defensive weapon for production schedulers in their continuing war with the marketing or sales departments. Let us now explore how this method can be used to sandbag the opposition into letting the production run optimally. Let us assume that our production scheduler had used this method to come up with an optimum schedule that will make only one job late out of six jobs to be done. The law of scheduling states that: "The late job is the one that becomes the hot job." Now we usually assume that all accounts are equal, but we know that they never are. As soon as the optimal schedule is posted, the salesman whose job is to be late will scream. He will usually bring pressure to bear higher up, which will force the production scheduler to place his job in the sequence in such a way that it is on time. This, naturally, means that somebody else is going to be late. He will scream in turn, forcing another change in the schedule, and so on. However, the alert production scheduler can use this situation to his own advantage in the following way. The scheduler resequences the jobs in such a way that the late job is now on time. This will cause, say, two other jobs to be late. The scheduler then sends a memo to the person whose job WAS late, stating that his job will now be on time at the expense of making two other salesman's jobs late. A copy of this memo is also sent to the two salesmen whose orders will NOW be late. These two people will usually form a coalition against the first salesman. They will take the memo to the

(please turn to page 15)

Federal Legislation on Antitrust and Monopoly: Improvements Needed

A. G. W. Biddle, President
Computer Industry Association
1911 No. Fort Meyer Drive, Suite 801
Rosslyn, Va. 22209

"The chief executives of our member companies are fully cognizant of the realities of competing on the merits in an extremely competitive market place."

As this committee knows from prior appearances before it of the Computer Industry Association, the Association represents some 35 member companies with combined revenues in excess of $1.5 billion dollars annually, and employing more than 40,000 persons in facilities throughout the country. Our member firms range in size from under a million dollars in annual sales to something in excess of $300 million. Their products cover the full spectrum of goods and services associated with computers and data processing — mainframes, memories, tape drives, disk drives, printers, data entry devices, terminals, software and services such as leasing and systems consulting.

Free and Open Competition

The Association was formed three years ago this month. Its objective then and now is to endeavor to bring about free and open competition within the computer and data processing industry — an industry that has, since its inception, been dominated and controlled by one company.

At the outset I would like to state that the Computer Industry Association wholeheartedly supports Title I (the declaration of policy contained in S-1284). In this regard, the Association may be somewhat unique among business leagues and some explanation is in order.

"Tiers" in the Computer Industry

The membership of our association includes a substantial portion of the viable business organizations that comprise what I might refer to as the third tier in the computer industry. The first tier consists essentially of the International Business Machines Corporation.

The second tier consists of some five to seven companies who are primarily involved in the computer systems marketplace. These include firms such as the UNIVAC division of Sperry Rand, National Cash Register, Burroughs, Honeywell, Control Data Corporation, Xerox Data Systems, and Digital Equipment Corporation. I list these firms as being in a market tier separate from that of IBM because they have individually been unable to capture more than a 10% share of this marketplace in a little more than 2 decades. All together, they hold approximately 30% of the general purpose computer systems market, well behind IBM's approximately 70%.

The third tier, which our Association represents, includes those companies who have chosen to compete as specialty producers within the total market environment. As such they are sensitive to the problems of competing in a market place that evidences a monopoly or oligopoly structure.

Competing on Merits

The chief executives of our member companies are fully cognizant of the realities of competing on the merits in an extremely competitive market place. In many respects they represent the personification of the American free enterprise system at work, since many were founders of their companies or represent second generation management in rapidly developing high technology fields. Here past success is quickly forgotten and customer service and performance today establishes success or failure. As with all business executives, their day-to-day decisions are affected by a variety of pressures. They must compete effectively and they must compete within the strictures of established law and legislative mandate. At the same time they must maximize both their corporate growth and profitability, if in turn they are going to have reasonable access to the capital that is essential to sustain further growth. This is especially true in the computer industry since the dominant company within our industry has established rental of equipment as the prevalent means of doing business — as a result, ours is an extremely capital intensive field.

The chief executives of our member companies are also motivated to achieve sound growth because in so doing they are able to provide opportunity and job security to their employees, appropriate rewards to their shareholders which facilitates the raising of needed additional capital, and generate the profits needed to develop superior products and technological innovations so necessary to insure the company's future growth. Obviously most chief executives are also aware that the attainment of these objectives will result in both personal recognition and reward.

Based on the statement of the "Computer Industry Association", by A. G. W. Biddle, President, before the Subcommittee on Antitrust and Monopoly of the Committee of the Judiciary of the United States Senate, on bill S-1284, "The Antitrust Improvements Act of 1975", in Washington, D.C., on June 5, 1975.

Effective Working of the Free Market System

As our members see it, the free market system in America today is not working as effectively as it should. They view the Antitrust Improvements Act of 1975 as but one of a number of constructive steps that are needed in our nation's efforts to seek ways to correct the basic conflicts that now exist between what is perceived to be for the common good by many within our society and the objectives of the capitalist system as perceived by business management. We seek to stimulate a return to a balanced economic structure where industry can provide the consumer with goods and services at the lowest prices consistent with a fair and equitable return to management, labor, and capital. We believe that American industry is capable of providing a continuing stream of new products, goods and services, through innovation and the exploitation of American technological skill.

We share with the sponsors of S-1284 the belief that unhealthy concentrations of economic power serve to undermine the workings of free markets for goods, capital, labor, and ideas. Unhealthy concentration of any one of these ingredients essential to the workings of the free enterprise system can, we be believe, lead to undue concentration of political power and in turn to an erosion of our free democratic society.

For these reasons, although some of the provisions of S-1284 that we endorse today may come back to haunt one or more individual member companies in the years ahead, we must as citizens endorse and support many of the specific provisions of this important legislation.

I would now like to submit for the subcommittee's consideration our specific thoughts with respect to the various sections of the bill.

TITLE II

The Tool of "Discovery"

Section 201 would in major substance extend the Antitrust Division's authority to issue Civil Investigative Demands to include authority to issue "CIDs" to individuals as well as to companies, and to include the taking of depositions and written interrogatories. In many respect, this section would give the antitrust division the tools of "discovery" prior to bringing an action, instead of waiting for the case to be filed.

As keenly interested observers of the antitrust enforcement process over the past few years, it has become obvious to the Computer Industry Association, that the Department of Justice is at a distinct disadvantage in carrying out its mandate to enforce the antitrust laws if it must depend on voluntary cooperation by industry in its investigative activities. Generally — and particularly — now that the Antitrust Division and the FTC are focusing their efforts on the larger monopolization cases, customers and competitors are reluctant to testify or to provide information to the Department. In part this stems from fear that the information so provided might in turn be misused by the Antitrust Division in an attack on the company that provided the information. In addition, it is only reasonable that a company would fear a possible adverse impact upon its relations with the financial community if the "truth were known" about the severe impact that an antitrust violator has had, or may in the future have, upon that company's viability and future prospects.

Reluctance to Testify Because of Fear of Retaliation

And lastly, as we have observed in the current US vs. IBM litigation, many persons and entities who could shed light on the specific practices of the alleged violator of our antitrust laws and the impact that these practices have had on the marketplace are reluctant to come forward for fear of retaliation by the company under investigation. This retaliation can take many forms, including the loss of business, and in the case of an individual, the loss of employment or the prospects of meaningful employment in the future.

The broadening of the Antitrust Division's ability to obtain information under this new CID authority would thus serve to protect these individuals and entities in a number of important ways and thus facilitate the Antitrust Division's enforcement efforts.

The ability to develop many of the facts pertaining to the alleged violation before filing the complaint would be beneficial to the antitrust enforcement process. Cases might also be shortened somewhat, since some of the delay now involved in post-complaint pretrial "discovery" might be cut down by "discovery" before the complaint is filed.

Blind Alleys for the Department of Justice

In the current IBM case, this procedure would undoubtedly have served to more precisely match the allegations and proposed relief contained in the original complaint with the realities that exist in the marketplace — thus minimizing the defendant's ability to send the Department of Justice down blind alleys. It would also have served to insure that relief is consistent with trends in the marketplace, technology, and consumer needs.

The Company That is Striving to Obey the Law

Furthermore, our members believe that the company that is striving to conduct its operations well within the letter and the intent of our antitrust laws should have little to fear from the basic provisions of Title II. In fact, it would serve to eliminate possible damage to a firm's reputation or market position that might result from the bringing of a federal action that was without merit. The entity in violation of our nation's antitrust laws would have much more to fear since the Antitrust Division would be better equipped to carry its case forward aggressively once the decision had been made to bring suit. This, too, would benefit most industries, for any shortening of the trial process would serve to remove the clouds of uncertainty surrounding an industry during the course of any major antitrust legislation.

In summary, our Association supports Title II. As we note in the paragraphs to follow, some provisions should be tightened up to limit its scope where appropriate. For example, we would suggest that access to, and use of, data obtained under a CID should be limited to those members of the Antitrust Division directly involved in the investigation for which the information was obtained. It should not be made available to the Federal Trade Commission, other government agencies, or to other members of the Department of Justice unless it bears directly upon the alleged antitrust violation specified as set forth in 201(d). It would seem to us that exceptions to this restriction should require prior notification to the party or entity representing

the CID and that they should be provided the opportunity to seek the protection of the Courts through due process. This is not meant to imply that we oppose the transfer of documents from the Antitrust Division to other antitrust enforcement agencies when this is appropriate.

Defense Strategy: Bury the Plaintiff in Paper

We have observed several recent cases where part of the defense strategy has been to bury the plaintiff under masses of paper and extensive deposition programs. The plaintiff's task has largely become one of sorting and selecting from this mass of material.

IBM Paid $100 Million to Destroy the CDC Index

The value of this sorting and selection process was clearly demonstrated by IBM's willingness to pay Control Data Corporation something in excess of $100 million to destroy the computerized index to materials that had been prepared by CDC in the course of its pretrial preparation. Certainly, if the Antitrust Division has expended substantial amounts of taxpayer dollars in obtaining and organizing information as to an antitrust violation, this information should be available to other enforcement agencies. However, consistent with legislation now pending in the personal privacy area, notification should be required and the opportunity to oppose the transfer before a court of law should be made available to the affected parties.

Protection of Certain Material

Similarly, although our Association has been a strong supporter of the Freedom of Information Act, we believe that care must be taken to protect the CID material from public access. Current law probably provides this protection, since the materials are of an investigatory nature; however, we would suggest that S-1284 provide specific legislative protection. Failure to do so would undoubtedly reduce the benefits otherwise provided by Title II.

We concur with many of the suggestions relative to Title II proposed by the Assistant Attorney General in his appearance before this committee on May 7th. Specifically, inconsistencies between section 201 and the Federal Rules of Civil Procedure should be eliminated. Likewise, we would recommend elimination of the phrase, "or may have reasonable means of access to" information from sections 201 (i), and 201 (j).

TITLE III

Title III, Federal Trade Commission Acts Amendments — provides for increased penalties for failure to comply with FTC special orders and subpoenas. It places the burden of proof for a stay of the accumulation of such penalties on the party seeking relief. It also prohibits the courts from issuing an order enjoining the enforcement of legislatively authorized subpoenas and orders unless the plaintiff has first demonstrated that the required subpoena or order is unduly burdensome or that the information is not reasonably relevant to the inquiry being conducted by the Commission.

"Hard" Economic Information in the Actual "Real World"

Our Association believes that the Federal Trade Commission Line of Business program can be of substantial benefit to our total economy. To illustrate, in April of 1974 the Computer Industry Association was a co-sponsor of a major national conference on Industrial Concentration. Under the sponsorship of the Columbia University School of Law, leading economists, industrial organization specialists, and members of the bar met at Arlie House to discuss the issue of industrial concentration within our economy. Few significant conclusions were reached. In large measure this was because the economists and industrial organization specialists lacked sufficient "hard" information as to the overall structure and actual "real world" operation of the industrial sector of our economy. At a time in our nation's history when we need all of the help we can get with respect to solving the dual problems of inflation and recession, the leading experts in our nation were stymied in their efforts to reach sound conclusions simply because SIC two and three digit information was inadequate to make objective judgements as to the ramifications of concentrated economic power.

Meaningful line of business information would be of benefit in our nation's antitrust enforcement efforts and also stimulate the working of the free enterprise system. This was suggested to the committee during the course of hearings on the computer industry in July of 1974 by Marylin Walter-Carlson. She noted during the course of her testimony that the lack of meaningful data about IBM — which in turn means a lack of meaningful data about the computer industry — limits the amount of venture capital available to the industry, since no prudent investor wishes to make a commitment without knowledge as to the structure and potential profitability of the industry in which he is investing. From the smaller businessman's point of view, aggregate line of business information would serve to identify new market opportunities and areas of unusually high profit potential. This in turn would stimulate the competitive process and benefit all consumers.

Title III would substantially increase the fines imposed upon a company that was non-responsive to an FTC request for an annual or special report or that failed to obey an FTC subpoena.

Delaying Tactics

We agree that a means must be found to accelerate the compliance process and stop the delaying tactics that are often used to frustrate the intent of Congress. However, we believe that the fines levied for non-compliance with FTC orders should be commensurate with the parties' ability to pay, and the value of that delay to them. For example, the provisions of Title III could have very serious financial impact upon a smaller company, whereas the amounts that are involved would be insignificant to a multi-billion dollar company such as IBM or AT&T. We would hope that this committee would give some consideration to amending this portion of the bill to provide for a fine which is proportionate to the gross annual revenues of the entity that fails to comply with appropriate orders. For example, a fine based upon 1000th of 1 percent of gross annual revenues for each and every day of the continuance of such failure would in all probability achieve the desired objectives. Under this proposal, a company with revenues of $10 million a year would be fined $100 per day. Whereas a company with revenues of $1 billion a year would face a maximum fine of $10,000 per day. In both cases the parties would be motivated to accelerate compliance.

Section 301 (b) addresses itself to a significant problem — that of insuring speedy compliance. This we believe to be a commendable objective.

One Year's Delay and No Fine

For example, in the pretrial proceedings in the current US vs. IBM case, Judge Edelstein levied sanctions of $150,000 per day upon IBM for its failure to deliver up documents relevant to the plaintiff's case. IBM was able to obtain a stay of execution of this sanction and appeal the Court's order all the way to the Supreme Court. Although the Supreme Court denied the relief IBM sought,their objectives had been achieved. They had prevented the Department of Justice from obtaining the necessary documents for nearly a year and had diverted significant portions of the Antitrust Division staff to the appeal rather than to preparation of their pending case. When it was all said and done, IBM delivered the documents and paid no fine. It would seem to us that this is a miscarriage of justice.

On the other hand, we would not wish to see business firms subjected to materially enhanced risks and liabilities in those areas where legitimate differences of opinion may exist between the corporate entity and the government agency. A legislative mandate that calls for a substantial increase in fines while putting the courts on notice that stays of execution should be used with extreme care may well make it prohibitive for a company to move to protect its interests. We do not know the proper solution for this problem.

Speedy Judicial Review of Contested New Legislation

In the case of the FTC line of business program, it may well be appropriate to consider legislation that would provide for expedited judicial review of contested new legislation. Under present procedures, the 1973 line of business information that has been collected may well be out of date and useless by the time the judicial review process is complete. This is particularly important in a legislatively mandated program such as LOB where the life of the program is limited.

TITLE IV

Class Actions

Title IV, the Parens Patriae section of S-1284 would permit state attorneys general to file actions on behalf of their citizens as a class, and political subdivisions to gain single damages for antitrust violations. The state could sue for treble damages as to federally funded programs. The Attorney General of the United States could sue in the state's place if the state declined to act.

The members of our Association believe that there is a need for a procedure by which damages can be recovered where antitrust law violations have caused small individual damages to large numbers of natural persons. Without such a procedure, those antitrust violations which have the broadest scope, and often the most direct financial impact on the man in the street, would be most likely to escape the penalty of loss of illegally obtained profits. Those whose injuries were too small to bear the burden of complex litigation would have no effective access to the courts. We strongly support legislation that would attain this objective and we believe that section IV c (1) would achieve it.

However, we believe that Parens Patriae actions under our antitrust laws should be limited to individual consumers, resident in the state in question, since they would be most likely not to have the resources and potential claims to initiate their own actions. It would also seem appropriate that such actions be limited to those violations where a substantial portion of the state's citizen-consumers are affected.

If, for example, the telephone company were guilty of over-charging for services, IV c(1) would permit the Attorney General to sue on behalf of individual residential subscribers. Business subscribers, and the city and state government could sue to collect damages under rule 23 as class actions.

Damages to the Economy

We cannot support section IV C(2) because we believe that the difficulty involved in any rational attempt to measure and apportion antitrust damages to the general economy of the state or its political subdivisions would be an almost insurmountable undertaking.

In summary, as we see it, one of the basic purposes of section IV is to stimulate the state attorneys general to seek out localized violations of the antitrust laws that affect large numbers of their citizen-consumers. This is a commendable objective. The delegation of this power to the state attorneys general would in turn free the U.S. Department of Justice of focus on violations which are more pervasive in nature. This separation of responsibility and emphasis seems worthwhile. If both the states' attorneys general and the Department of Justice assume responsibility for prosecuting those violations of the laws in their respective areas, we would anticipate substantial consumer benefit. We would question, however, whether section IV D which authorizes the U.S. Attorney General to sue in behalf of the states would then be necessary or even desirable.

TITLE V

Concentration of Economic Power

Title V of S 1284 deals with pre-merger notification. A few comments relative to the specific sections of this portion of the Antitrust Improvements Act of 1975 may be appropriate. The members of our Association, like the sponsors of Title V, are deeply concerned about the growing concentration of economic power in the hands of the very few large and dominant corporations. During the 1950's and 1960's, a substantial portion of this concentration came about as a direct result of the merger and acquisition activities of a relatively small handful of companies. The Congress acted through the Williams Act and the Federal Trade Commission to insure that the merger wave was closely monitored and controlled. It would appear that this has largely been effective.

Pre-Merger Notification

Our members are of two views as to a substantial increase in the overall scope of the pre-merger notification program. We recognize that this could serve to reduce actual or incipient monopoly situations in many parts of our economy. On the other hand, the extension of the pre-merger notification requirement to include companies with a hundred million dollars in sales or assets would cover literally thousands of transactions which have no legally significant anti-competitive impact. Further, this would impose unjustified and pointless burdens on many small and medium sized companies when the real intent of the legislation is to prevent undue concentration among what might be appropriately

described as the Fortune Top 100. In fact, in the recent annual directory issue of Forbes magazine (May 15, 1975 issue) it is to be noted that the 500th largest firm in 1974 sales had $520 million in revenues and the 500th largest firm in assets had $824 million in assets. The proposed $100 million threshold would largely affect the small to medium sized business enterprises in America.

In our view, so long as we continue to allow excessive concentration at the very top of our corporate pyramid, mergers among small to medium sized business enterprises is almost essential to their survival.

We would suggest that the present authority of the FTC to obtain pre-merger reports from the 200 largest corporations is in the public interest and adequate. The scope of the pre-merger notification requirement might be expanded to include pre-merger notification where the surviving company involved would hold 30% or more of one or more of the market or markets involved in the transaction, be that on a national or regional basis.

We cannot support the other provisions of Title V as they appear to us to be an inappropriate intrusion of government regulation on, and in effect of, licensing normal commercial transactions. The administrative provisions involved in the proposed approval process allow the Department of Justice and the FTC to string out the approval process excessively. It in effect allows postponement of ALL acquisitions by indirect administrative delay.

TITLE VI

Title VI of S-1284 - Nolo Contendere -- involves but one element of the total antitrust enforcement process. Although we can see some benefit to injured third parties in being able to introduce a Nolo Contendere plea as prima facie evidence of a violation of the antitrust laws, we defer to the views of the Department of Justice on this matter. The passage of Parens Patriae (Title IV) provides an effective avenue of relief to the individual consumer. Rule 23 class actions provide relief to groupings of injured parties who share a common cause of action. The larger corporate entity that has been impacted by the illegal actions of a defendant can normally call upon a growing private plaintiffs antitrust bar for an adequate presentation of its case. Thus it would appear that potential harm to the Antitrust Division's ability to effectively conclude a case in the public's interest is of greater overall importance than that of providing prima facie evidence to third party plaintiffs.

TITLE VII

Our Association endorses and supports section 701 which would amend the Clayton act so as to deal effectively with acts and practices "affecting commerce," as well as practices "in commerce." This would appear to be a constructive extension of existing law.

We also support and endorse section 702 which provides for expedited treatment of complex antitrust cases. We would suggest that the scope of section 21 be expanded to provide that counsel for the defendant may also file, subject to approval of the court, a request that the case be designated as a complex antitrust case and be in every way expedited.

We believe that the provision in section 21 that authorizes the appointment of special masters, economic experts and other designated assistants to the trial judge represents a positive step forward. The adversary nature of an antitrust case mitigates against an objective presentation of the material required to reach a judgment that is BOTH legally sound and of long term social benefit. Particularly in complex cases dealing with high technology industries, the availability of neutral and objective experts would assist the trial judge in his efforts to reach a decision that is both fair and in the public interest.

We cannot support section 703. It would seem to us that the dangers inherent in denying a full and complete hearing under due process principles outweigh the possible benefits to be provided by such sweeping authority.

TITLE VIII

Let me now turn to the amendment to S-1284 proposed by Senator Bayh. Section 801 would expand the scope of our present antitrust laws by eliminating the "specific line of commerce" or "relevant market tests," as well as the "dangerous probability of success" criteria now used by the courts in monopoly cases where criminal or fraudulent means are used to exclude competition. In our view the key words here are "criminal or fraudulent", since, in reality, it is virtually every businessman's objective to out-compete, out-sell, and out-service his competitors. If he does his job well, competitors who are less efficient or less willing to meet the needs of the market place will undoubtedly fail. This is one of the strengths of our competitive system. However, when criminal or fraudulent means are employed to reduce true competition, the courts should be encouraged to find for the injured party. We support this amendment to the Antitrust Improvements Act of 1975.

Damages Payable to Competitors

I have some problems with Sec. 3B which calls for a civil penalty of twenty percent (20%) of the revenue received by the defendant in the relevant lines of commerce during the period of the violation of our antitrust laws. Generally there are two classes of injured parties when an antitrust violation occurs; competitors,whose business has been injured as a direct result of the defendant's acts or practices,and consumers, who have directly or indirectly paid higher prices for the goods and services than they otherwise might have under truly competitive conditions. In a sense the latter group would receive, at least indirectly, some recompense as a result of the imposition of this penalty. Competitors however, would be second in line, and might well find that the defendant was no longer able to pay damages that might be awarded.

It would seem to me that there might be several alternative approaches that might better achieve the true intent of Section 3B of Title VIII. I should hasten to point out, before I submit these suggestions for the Committee's consideration that I am not an attorney. I have, however, been closely following the numerous antitrust cases that now affect our industry, and I believe that they provide some insights as to areas worthy of further exploration.

The Name of the Game is Delay

The U.S. v IBM case finally came to trial late last month -- more than six years after it was filed in January of 1969. In this, as in most

antitrust actions, the name of the game has been delay and more delay. It may be another five to eight years before it is finally resolved.

The Amount of Fines

In the meantime, if the Antitrust Division's allegations are correct (and I happen to believe that they are), IBM will have accrued pre-tax profits in excess of 25% (some $36 billion dollars) on cumulative revenues of more than $145 billion dollars, during the time that elapses between the bringing of the action and final adjudication. In the meantime, the combined cumulative net pre-tax profits of the entire rest of the computer industry will have amounted to less than 10% of IBM's. Proposed Section 4B would allow the courts to levy a civil penalty in this case of almost $30 billion dollars, more if the fine included revenues during the entire time of the violation. Certainly the Treasury would be pleased, but the damage to IBM would be almost catastrophic -- and perhaps for our industry as well. I don't believe that this is the true intent of our antitrust laws.

It would seem to me that any system or formulae for levying fines should include several factors. Since one of our objectives is to speed antitrust cases along, and make it disadvantageous for the defendant to delay, some consideration should be given to relating possible fines to the length of time that elapses between filing and final adjudication and the revenues or profits derived from the act or acts of monopolization. If the Government wins its case against IBM, a number of treble damage suits will follow wherein injured competitors and injured consumers will seek restitution. These follow-on suits will crowd our already overcrowded courts.

It might be more appropriate for the trial court to quantify the differential between the profits of the monopolist and the combined profits of all others within the industry, market, or submarkets involved. A civil penalty amounting to the sum of the profits derived during the period of the violation, plus an amount equal to some percentage of the profits derived during the period from the bringing of the action thru final adjudication could then be levied. The monopolist would therefore have been forced to give up the gains from the illegal conduct AND been encouraged to expedite the proceedings.

If the court were then permitted to call forth all injured parties to prove their individual and separate damages, the ill gotten gains could be distributed on an equitable basis. Any funds remaining after the court's distribution would be paid into the Treasury of the United States.

I am aware that some would view these proposals as a radical departure from our traditional approaches. However, if we are to achieve the objectives of both enforcement and equity to the victims of the monopolist's illegal actions, some significant changes in present procedures appear needed.

I sincerely appreciate this opportunity to once again appear before this Committee. We hope that the Congress will act promptly on passage of the Antitrust Improvements Act of 1975. It is legislation that is sorely needed if we are going to protect the free enterprise system from further erosion. □

Woolsey – *Continued from page 9*

sales manager, who must then determine the relative priorities. He is, of course, confronted with the following facts: (1) Two salesmen are getting shafted to benefit one, and (2) the two salesmen would get off his back if he allowed the OPTIMAL schedule to stand. The scheduler has adroitly called for the basin by presenting an original optimal schedule and then, reluctantly, changing it. This is known as "doing a Pontius Pilate." This same procedure can be adapted to most of the methods in this study, if the scheduler is sure what the criterion of operation actually IS. If, for example, the criterion is to minimize the maximum tardiness that can take place over all possible sequences that may be considered, then the reader should consider the Q & D to do that, which appears later in this book. Under these conditions we can consider that the latter Q & D would really be minimizing the maximum scream that would take place whenever a particular job would be late. The proper choice of the method, however, will always depend upon the circumstances of the particular situation, especially the politics at that time.

Q & D To Minimize Total Processing Time for N Technologically Ordered Jobs on Two Machines

We consider the problem of scheduling a batch of technologically ordered jobs through two machines in such a way as to minimize total processing time. By technological ordering we mean that (1) some jobs are done on machine A or B only, (2) some jobs are done on both machines in order A, B, and (3) some jobs are done on both machines in order B, A. The usual assumption is made that all the necessary inventory to do the jobs is present when you need it, and that all the jobs are of equal importance. The method used is due to Jackson and, because it is an optimum method, should properly be called a Quick & Clean. Again it should be noted that the "goodness" of the answer is directly related to the accuracy of the estimated processing times supplied to the method. In this author's experience, forecasts can be amazingly accurate when the method is used by the man who will have to do the work. Conversely, forecasts tend to have large error when the data is collected from one man, processed elsewhere, and returned to the first man. For a discussion of this and related phenomena, the reader is directed to the author's paper, "On Lying to Industrial Engineers and Other Traditional Shop Practices" (forthcoming). □

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SOLUTIONS TO TEN MAXIMDIJES FROM WILLIAM RAY JINES

On page 7 of the September issue, ten Maximdijes contributed by William Ray Jines were presented. The solutions follow: (1) Hope is where the heart is. (2) Either fifty-four forty or fight. (3) Commonness is not so common in men as it is in women. (4) There are many terrors at sea. (5) Unsafe at any speed. (6) If your auto rusts out, it's your fault. (7) Love is a silly game, my love. (8) Gone with the wind. (9) The evil live on the good. (10) One more for the road.

Science and the University — The Developing Dilemmas

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"Many serious thinkers are expressing sincere doubts that possible benefits of science in the future may not be enough to offset the possible ill effects of science if we continue to let science grow as we have."

There is little doubt that one of our great national strengths has been the excellence of programs in science and technology in our colleges and universities. Research accomplishments have touched and influenced our lives in countless ways. The education of students in science and technology has provided the nation with a unique and impressive human resource that has enabled us to become one of the most advanced technological societies in the world. The accomplishments of the colleges and universities in the areas of science and technology could be regarded with pride. Moreover, it was clear that the scientific endeavors of the colleges and universities enjoyed full public support — that is, until recently.

Decline of Support for Science

Today there are few colleges and universities with large programs in science and technology that are not looking at the future with concern. Enrollments of students are often declining, research support has been seriously reduced, and students who have completed years of work in graduate education are worried about the prospects for employment. This is but the visible evidence and end result, however, of the pursuit of certain policies within the universities and developing attitudes in society toward science and technology.

Here I would like to focus my attention on three questions that relate to these policies and attitudes. There are many questions that could be asked, but I believe that the three that I shall single out are questions that the universities and the scientific and technological establishments in general need to wrestle with if we are to maintain the strength and the vitality of our scientific endeavors.

(Based on an address at the Iowa Academy of Sciences, Iowa City, Iowa, April 28, 1972.)

Impact of Science on Society

As a preface to the first question I would point to what appears to be an increasing concern with the impact of science on society. At one extreme we have a group of opinion makers characterized by a sentiment that is strongly antiscientific and anti-technological. Critics from this group often single out and identify only the problems that have resulted from our scientific endeavors while ignoring benefits. More objective critics would at least make the claim that science, as a rational system, tends to develop as if it had a sense of direction independent of value considerations. They support this position by pointing out that in this time of rapid communication and dissemination of knowledge, new research builds on past research without a great deal of thought as to where it might be headed.

Is the Ivory Tower Scientist Now a Criminal?

From one perspective, man is considered to be the slave of the "big science" system rather than its master. The well-known psychoanalyst, Erich Fromm, expresses the opinion of many modern writers who hold this view when he states:[1]

> "In the search for scientific truth, man came across knowledge that he could use for the domination of nature. He had tremendous success. But in the one-sided emphasis on technique and material consumption, man lost touch with himself, with life.... The machine he built became so powerful that it developed its own program, which now determines man's own thinking."

The point that needs to be recognized is that many serious thinkers are expressing sincere doubts that possible benefits of science in the future may not be enough to offset the possible ill effects of science if we continue to let science grow as we have. These issues are also being brought to the general public. For example, a recent article in the magazine, Saturday Review,[2] discusses the tremendous moral and social issues inherent in bio-

logical research that may lead to "genetic engineering."

In the article, the author, Caryl Rivers, quotes Isaac Asimov as saying, "Scientists have always had a supreme obligation to be concerned about the uses of their work. In the past an ivory tower scientist was just stupid. Today he is stupid and criminal."

We now come to the first question that I believe needs examination by both the university and the scientific community. The question is this: to what extent should we be concerned about the current criticism of science and technology and if we do feel that either certain fears may be justified or that the public needs to be better informed, what do we do about it? To some degree we are found with the following dilemma: We may go on largely as we have and hope that either public sentiment will not force controls on the development of science and technology and that the social impact will not be too traumatic, or we may engage in examination and self-regulation of scientific endeavors which would probably change the classic pattern of scientific investigations and the application of new knowledge.

The "Hands-Off" Policy

One ardent spokesman for a "hands-off" policy is the science advisor to the President, Dr. Edward E. David. In February of last year he remarked to a seminar of the Council for the Advancement of Science:

> "Make no mistake, a limitation on experimentation in whatever cause is the beginning of wider suppression. When we fail to experiment, we fail. In failing we bring the best part of American society as we know it today to a halt. Already we see timidity in new undertakings. We require over-analysis before we are willing to find out what are the real possibilities. If these trends progress, our society will become dull, stodgy, and altogether stagnant."

With all respect to Dr. David's position, it seems more than likely that bills will soon be enacted in Congress that will have as their goal the assessment and control of science and technology. The bills would create boards or regulatory agencies to give early warning of the consequences of our research and development programs and, in addition, to explore possible economic, environmental and cultural consequences of unintended or "second order" effects of these programs.

Sensitivity to Human Values

For many who express grave concern about this trend toward ever increasing control by central authority, the problem remains as to how to convince the public that science and technology can and should be sensitive to human values. That conviction might be fostered if specific plans that illustrated this sensitivity were currently being presented to the public. The fact is that they are conspicuous by their absence. Here then is a challenge to the scientific and technological community both within and outside of the university. The dilemma is how to proceed to meet this challenge and to be certain that the net effect will not be more detrimental to our welfare than helpful.

The second area I would like to explore relates to the current manpower problem that has emerged in science and technology. This problem is most visible in the production of scientists and engineers having doctoral degrees.

Oversupply of Ph.D. Holders

Dr. Allan Cartter was one of the first to predict an oversupply of Ph.D. holders in the 1980's. Since that time many forecasts have been published. Interest in such forecasts has been heightened by the unemployment problems that emerged for many scientists and engineers following the reduction in aerospace spending.

The National Science Foundation, for example, has come up with a set of predictions that has been widely referenced. The forecasts for 1980 show an oversupply of engineering Ph.D.'s (40% excess), an oversupply of life sciences Ph.D.'s (9% excess), an oversupply of mathematics Ph.D.'s (10% excess), an oversupply of social science Ph.D.'s (20% excess), and a balanced situation for Ph.D.'s in the physical sciences. One may quarrel with the exact percentages or claim that they are not representative of the situation in a particular discipline, but there is enough evidence for oversupply to cause those in academic planning to seriously reflect on the future of graduate education in science and engineering.

Changing the Nature of the Ph.D. Degree

The questions that must soon be faced in planning graduate educational programs include the following: In view of the high cost of graduate education, should voluntary restrictions be placed on the size of graduate programs in areas where an oversupply is currently indicated? Is it enough to say that a student for an advanced degree who insists on pursuing a program with a limited market potential carries the main responsibility for ultimate utilization of his talent? The point at issue is, in part, the relative weight given to individual self-fulfillment and personal choice as an educational goal versus filling a societal need for a specific manpower requirement. The issue, of course, may not have to be settled on quite such simple grounds. It would be possible to reconsider the nature of the Ph.D. degree, for example, and make it less specialized and better designed to permit its recipient to have greater vocational options upon graduation or at a later period in life.

More Modern Education

Along with the potential problems of oversupply, there is a new phenomenon appearing in many areas of scientific and technological employment. From a strictly cost-effectiveness point of view it is often advantageous to terminate the employment of scientists and engineers in mid-career in favor of hiring younger graduates at lower salaries and with an education that is far more modern and up-to-date than that of a man who has been out of school a number of years.

This possibility raises a host of challenges concerning continuing education programs at advanced levels or educational programs designed to give a person a chance to choose a wholly new career. There has been much said about these challenges, but very little action.

Responsibility of Educators

Basically, the question then that I would offer for consideration is this. What is the responsibility of educators (and for that matter, of the employers of scientific and technological manpower) to insure that our national needs for scientific manpower are in balance with the output from our colleges and universities? Furthermore, if it is felt that there is a responsibility, then the dilem-

ma that must be faced is who should take corrective action and how. The larger and more elite graduate schools will argue that they should probably take little action because of the quality of their students, while smaller and less elite graduate schools will argue that they wish to achieve quality by maintaining their programs and strengthening them even more.

The issues are partly political in that no one wishes to be the first to take action and that each school will first make a case for federal help on the basis of some general need that relates to public interest. Once more, facts are fairly widely known, but the response to the facts is not in evidence. Shall it be that once again, the decisions are left to a central authority, or the federal government? If not, what might be done before decisions of this type become inevitable?

Responsibility to People Who Need the Truth

I would finally like to turn to a third area of concern and begin my discussion by repeating a quote from Prof. Alexander Meikeljohn that was referenced in an article in the American Scientist by William Bevan.[3] The statement attributed to Prof. Meikeljohn is this:

> "Our final responsibility as scholars and teachers is not to the truth. It is to the people who need the truth."

I would follow this quote with a statement from a report of the National Science Board that made recommendation for a national science policy.[4] The statement that appears in the introduction to the report is as follows:

> "We confront a variety of complex problems throughout the American society. We must broaden and intensify our efforts to deal with them. This is opportunity as well as need. We believe there is now a bright promise that American scientists and engineers can, indeed, help to meet our material and social requirements and help to solve major societal problems."

The Social Responsibility of Science

The thrust of both of these quotes has a common thread. As scientists and engineers we need to be very much aware of society's needs and bend our efforts to meet these needs. In some respects this is the positive side of the issue relating to the social responsibility of science whereas the first topic raised in this paper might be considered to be the negative side. This emphasis on the application of science to meet social needs is gaining wide acceptance on many university campuses. One hears more and more of interdisciplinary efforts that combine the talents of researchers and scholars from a variety of disciplines to lend their expertise to the solution of a particular problem in the social realm. As any university administrator well knows, hardly a month goes by when a new "institute" is not proposed that has an interdisciplinary base to deal with a particular mission. Interestingly enough, the model that is often cited as an example of the worth of such a concept is the classic agricultural experiment station with its pattern of bringing "real world problems" to the working scientist for examination and study.

Search for Truth with a Practical Goal

I believe that there are few members of the scientific community that would not concede that there are a number of important challenges to be found in the "real world." The question that needs to be examined, however, is this: To what extent should the pure search for truth be de-emphasized relative to a search for truth that has a particular applied or practical goal in mind? This issue is far from academic although it may be of great concern to scientific investigators in the academic community. In the past few years there has been a growing trend to shift support from basic research that is not mission-oriented to research that is. One suspects that the question that will be asked more and more frequently by funding agencies in the future will be, "Does this proposed program have as its objective the fulfillment of a practical need?"

The Atmosphere of Free Inquiry

It is not my intent to argue the pros and cons of the best way to allocate the limited resources we have at our disposal. I would, nevertheless, point out one final dilemma. Some of our most significant advances in the world of science and technology have come from research that was originally quite far removed from the final application of that research. This is the classic argument for making a case for pure research that is not mission-oriented to those who believe that research should have a practical goal.

Thus, we as a nation are faced with the problem of how we should respond to pressing societal problems that cry for scientific and technological input and yet maintain the atmosphere of free and unhampered inquiry that has characterized our past scientific endeavors in many areas. I believe that the answer will be in favor of the direct attack on problems of general concern rather than on basic research as an attempt to search for truth for its own sake. Do those in the scientific community wish to encourage or debate against this approach? It is a question that we should not pass over lightly.

A Stable and Secure World

In summary, I would like to make the point that the main topic that I have been examining in this paper is the relation between science and technology in the years ahead. Society has received much from the efforts of our scientists and technologists and has, in turn, rewarded them in many ways. As the Bible states, "To whom much is given, much will be expected." We have the obligation, therefore, to re-examine our roles, restate our reason for support and trust, and, most important of all, to make certain that we help to make a world which is stable and secure enough to allow us to practice our professions.

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□

"Almost True" Theorems, Computations, and Computers

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" Remarkableness diminishes as we add more special knowledge to the process of just blindly trying."

You may be interested in some comments, as well as the two enclosed reprints, relating to the note "An 'Almost-True' Theorem Involving Tetrahedral Numbers," in Computers and People, August 1975, p. 33.

I did not know that I was going to be the published "author", since this note was prepared without my knowledge, and I first found out about it just today. (Editorial Note: the editor "lost" Herbert Salzer for about 25 years, and joyfully found him again as a result of the August article.)

Had I known about it I could have brought both yourself and Jeffrey Mogul up to date (see the enclosed reprints). Thus Mogul, if he follows his intent announced at the end of the next to last paragraph, might be wasting his time, since, with Norman Levine, all numbers through one million were examined by a machine program nearly twenty years ago. Also your initial editorial note would have upped the 2500 to 100,000 since no other number ending in 6 less than or equal to 1,000,000 and beyond 6186 requires more than four tetrahedrals. You will also note that since 1314 is the only number ending in 4 and less than or equal to 100,000 that a statement concerning the sum of four tetrahedrals is "equally almost true".

Extension of Range

The entire picture and import has been changed by extending the range from 20,000 to 1,000,000 as seen from the table below, since for tetrahedrals it is extremely likely that beyond the highest exceptional number, namely 343867, every integer requires only four tetrahedrals. This type of pattern when there are cubic addends, namely a density of several percent of exceptions among the first thousand or so and then a thinning out to zero beyond a few hundred thousand, was described to me by John Selfridge.

"Painting a Target Around a Bullet Hole to Show the Accuracy of Shooting"

Following is the most essential point concerning the "remarkableness" of that statement which is the subject of the note. Upon reflection it seems to me far less remarkable and noteworthy.

Take for an illustration the example, $x^2 - x + 41$ produces a prime for the 41 values of x from 0 to 40; or better yet, $x^2 - 79x + 160$ gives 80 consecutive primes for x from 0 to 79. Suppose we just blindly took all quadratic expressions of the form $x^2 + ax + b$ for a, b each less than or equal to 1000; 1,000,000 such combinations. Almost by chance alone we might expect one combination to give a run of primes. In a sense, once we state something we can always play around with a few integers in a sort of ex post facto manner. This is rather like painting a target around the bullet hole to show the accuracy of the shooting! Thus we can easily manufacture situations where there can be a long run before an exception occurs. Thus from the table shown below taken from the earlier reprint we can write down this "almost-true theorem" which holds for the first 195429 cases; namely, "Integers of the form 148437 + n are the sum of four tetrahedrals."

A More Satisfying Type of Almost True Theorem

A far more satisfying type of "almost-true theorem" which does not depend on particular choice of number base, and which has an intrinsic character is furnished by what I consider the "greatest mathematical surprise ever encountered" (at least involving numbers). It was not discovered by any of today's computers, even though many surprises and counterexamples due to computers fill the journals. This greatest surprise of all goes back to the middle of the 17th century and is due to the great mathematician Fermat, who showed that the problem of finding a Pythagorean triangle with sides a, b, c (all integers) whose hypotenuse c was a square and whose two arms a and b added up to a square had solutions, but the smallest such solution was a = 1061652293520, b = 4565486027761, and c = 4687298610289, i.e. the smallest side being greater than a trillion. Just imagine somebody in complete ignorance programming a computer to find a solution by pure trial! He would think probably not true when the smallest side a passes 1000; be convinced when a passes 1,000,000; be almost certain when a passes 1,000,000,000; and dead certain (absolutely convinced) when a passes 1,000,000,000,000; and yet the first exception to the untruth of the existence of a solution would occur when a is greater than 1,000,000,000,000. Now the remarkableness diminishes as we add more special knowledge to the process of just blindly trying (e.g., we should be foolish to try all trillions of c's when we would test just those c's that are squares, and so on, each bit of special knowledge changing the problem to one where less searching is required (in the limit, complete knowledge equals a solution or proof of no solution).

Some Reminiscences

I believe our last personal encounter was around September 1947 at Columbia when the Association for Computing Machinery was founded, J. H. Curtiss elected president and you secretary. And you once wrote to me out of curiosity concerning my "device for mass computation" which consisted of two sheets of graph paper with holes. I also wish to commend your "Computers and People," a truly apt and much needed enterprise!

Numbers not Expressible as the Sum of Four Tetrahedrals

For the past 21 years one of the authors has been concerned with empirical theorems expressing certain classes of positive integers as the sum of four tetrahedral numbers, or "tetrahedrals" tee n = n(n + 1) (n + 2)/6, n more than or equal to 0, the results being contained in short notes and abstracts, as well as unpublished tables .... We use sigma p to denote a sum of p tee n's.

The exceptional numbers, which by definition are those not expressible as sigma 4, were tabulated previously only up to 2000. But even that far, interesting features turned up, such as 1314 being the only exceptional number ending in 4, and the very few ending in 1 or 9 .... Then for numbers ending in 6 and less than or equal to 20000, 6186 turned out to be the only exceptional one .... Also there was no striking difference between the density of exceptional numbers in the first thousand and in the second thousand brackets, decreasing from around 4½% to 3%, so that it was interesting to speculate upon the approximate density in the neighborhood of say 1,000,000.

Surprising Distribution

This table of exceptional numbers less than or equal to 1,043,999 presents a great surprise in its picture of their distribution which is entirely different from that envisioned from those less than or equal to 2000 .... Most strikingly unexpected is the decrease in the density of exceptional numbers from several percent in the neighborhood of 2000 to what appears to be practically zero near 1,000,000. The scarcity of exceptional numbers in the higher ranges is in accordance with Hua's result that "almost all" positive integers are expressible as a sigma 4 .... But even more, this table shows that the likelihood of a given number m being exceptional falls off so rapidly with increasing m that it appears to be a plausible conjecture that there might be some m sub zero sufficiently large such that every m more than m sub zero is a sigma 4 (a conjecture unlikely to suggest itself from the exceptional numbers among only the first few thousand).

Computation by Computer, Vintage 1958

The method of computation was to obtain tee i, tee j, tee k, and tee l for every i, j, k, l more than or equal to 0 until one found for every m less than or equal to 1,043,999 either a representation as a sigma 4 or that that m was exceptional. The calculation was begun upon the Univac Scientific Computer (ERA 1103) at the Convair Digital Computing Laboratory, the initial part re-run, and then those results were checked and continued upon the IBM 704 Digital Computer. At the start upon the ERA 1103, 500 words of high speed storage with 36 binary bits in each word permitted the investigation of 18000 numbers at a time. Then the IBM 704 had at its disposal 3000 words of high speed memory, each of the 36 binary bits in a word representing a number, so that 108,000 numbers could be investigated at one time. The 108,000 binary bits were filled with 1's at the start, and a 0 introduced into the binary position of the word which represented a non-exceptional m. After all possible combinations of i, j, k, l had been exhausted, each of the 3000 words was searched for binary bits that remained 1 and the exceptional numbers m corresponding to those bits were printed out. In choosing combinations of i, j, k, l, repetitions due to symmetry were avoided, as well as combinations yielding an m that was either too large or too small for the group of 108,000 numbers under consideration.

Actual Mathematical Proofs

Those interested in actual mathematical proofs (which appear to be rather involved) may consult Dickson .... for earlier work, and Watson .... for the sharpest results to date. It is rather amazing that the proved p in m equals sigma p for every m is p equals 8, and no better than p equals 8 for arbitrarily large m, while the actual p (according to the evidence in this table) may be only 5 for every m, and 4 for sufficiently large m, less by 3 and 4 respectively. Considering the difficulty of the existing proof for p equals 8 ...., one may well wonder, should p equal 5 or p equal 4 be the truly minimum values, for every m, and m sufficiently large, respectively, how long the world must wait and how difficult and sharp the mathematical tools must be, until the desired proofs would be found. □

Reprinted from "Table of Integers Not Exceeding 1,000,000 That Are Not Expressible as the Sum of Four Tetrahedral Numbers" by Herbert E. Salzer and Norman Levine, "Mathematical Tables and Other Aids to Computation," Vol. XII, No. 62, April, 1958

Forum — *Continued from page 3*

to specialists and useful to others involved with the subject.

"Computer Networks" is a journal devoted to the publication of material on the broad range of subjects that relate to all forms of distributed computation and information systems. Emphasis will be given to articles reporting on studies and experience addressing practical aspects of networking. The journal will provide a forum for the presentation and discussion of the many social, legal, economic, management, and technical issues involved. All types of articles will be considered for publication in the journal. Articles may cover design, implementation, and operation of networks as well as the associated non-technological issues. Notes on application techniques, descriptive articles, surveys, and tutorial papers are acceptable if they are deemed to be of reference value. Short notes on current projects as well as selected bibliographies will also be considered for publication.

The first issue is scheduled for publication towards the end of 1975. The editor in chief is Philip H. Enclow, Jr. The editorial board consists of 41 members from 12 countries. For more information, please write us, or Mr. Don Malt, American Elsevier Publishing Co., 52 Vanderbilt Ave., New York, NY 10017. □

Table of Exceptional Numbers Less Than or Equal to 1,000,000

i.e., the Numbers Not Expressible as the Sum of Four Tetrahedrals

17	1227	3183	9772	29157
27	1233	3218	9973	29487
33	1243	3263	10397	29938
52	1314	3463	10467	30298
73	1382	3512	10532	31973
82	1402	3887	10633	33183
83	1468	4003	10852	36262
103	1478	4307	11237	36913
107	1513	4317	11302	37798
137	1523	4563	11737	38453
153	1578	4832	11962	38707
162	1612	4923	12247	38807
217	1622	5013	12547	39693
219	1658	5142	12722	39913
227	1678	5238	12777	41278
237	1693	5283	12843	41322
247	1731	5483	12858	41433
258	1738	5508	13127	44833
268	1742	5538	13393	47627
271	1758	5563	13822	48043
282	1767	5618	14492	56467
283	1803	5647	15122	56842
302	1858	5707	15483	58613
303	1907	6022	15867	59077
313	1923	6057	16097	62158
358	1933	6067	16538	64752
383	2037	6186	16637	65253
432	2053	6213	16742	65567
437	2172	6263	17253	71157
443	2198	6343	17683	74687
447	2217	6462	17813	78003
502	2218	6863	17893	78787
548	2251	7067	18573	83603
557	2253	7278	18782	84023
558	2327	7377	19168	85993
647	2372	7387	19277	91128
662	2382	7423	20918	1 06277
667	2417	7497	21523	1 13062
709	2437	7542	22618	1 34038
713	2457	7662	22657	1 48437
718	2537	7793	23677	3 43867
722	2538	7873	24237	
842	2578	8223	24317	
863	2687	8307	24338	
898	2818	8322	25447	
953	2858	8973	25723	
1007	2898	9063	26007	
1117	2973	9488	27858	
1118	3138	9687	28617	
1153	3142	9753	28847	

Computer Programming Languages In Use In Business -- A Survey

Neil Macdonald
Survey Editor
Computers and People

What are the computer programming languages in use in business?

To what extent is each used?

How much money is spent to train a person to use one of these languages?

To obtain a provisional answer to these questions, we sent out a survey form to some 200 large organizations (business and industrial). The first survey form is shown in Appendix 1. To increase the number of returns, we mailed the survey form a second time with a covering letter (see Appendix 2) to organizations which did not reply to the first inquiry.

Almost 30% of the organizations replied (57). It seems reasonable to believe that the responses are fairly typical.

The questions we asked were these:

1. What is your estimate of the number of programs you use?

2. What are the eight or so programming languages which you use most?

3. What is your estimate of the approximate time and cost of training a new person to program competently in the programming language that you use most?

The answers were very interesting.

Number of Programs Used

- Range: from 100 programs to 3800 programs.
- About 1/3 use from 100 to 500 programs.
- Another 1/3 use from 500 to 1000 programs.
- The last 1/3 use from 1100 to 3800 programs.

Comment: It is hard to imagine how any organization can use 2000 or more programs. It would seem that they are missing opportunities to generalize their programs by inserting parameters.

Programming Languages Used Most

- About 1/3 of the organizations use COBOL, 85 to 100%.
- Another 1/3 use COBOL, 40 to 80%
- About 1/4 do not use COBOL at all.
- About half use FORTRAN; but the largest percent of use is 20%
- More than half of the organizations do not use FORTRAN.
- About 1/3 use RPG or RPG II a little; but 2 organizations out of the 57 use it 100%.
- About 1/4 use PL/I a little; but 2 organizations use it more than 90%.
- About 1/5 use BASIC a little; the largest percent of use by any organization is 35%.
- About 1/6 use ASSEMBLER; the largest percent of use by any organization is 60%.

Comment: FORTRAN can be successfully used for many business problems, and is much more efficient than COBOL. The lack of more extensive use of FORTRAN is an indication of general failure to use software well.

Training Cost

Programming Language: COBOL

28 organizations train in COBOL, and gave both the number of weeks and the total cost.

Range of time: 2 weeks to 52 weeks

Range of cost: $200 to $15000

About 1/4 spend $200 to $1200

About 1/4 spend $1500 to $4000

About 1/4 spend $5000

About 1/4 spend $7000 to $1500

Comment: Training in COBOL surely should be rationalized, and the higher costs of some of these training courses surely could be substantially reduced.

In "The Computer Directory and Buyers' Guide" issue of "Computers and People", dated August 30, 1974, we published a survey of computer programming languages in use in business. In order to make this information more available to all our subscribers and readers, this survey is here reprinted.

Following are a set of tables reporting on the data received in the survey. The organizations reporting were serially numbered from 1 to 57, and all or nearly all of the data they provided is given in the following tables.

TABLE 1

Estimate of the Number of Programs in Use — Responses By 57 Organizations

(1) Organization Serial No.	(2) Number of Programs	(1)	(2)	(1)	(2)
1	400	21	400	41	525
2	550	22	400	42	1200
3	650	23	400	43	1000
4	200	24	400	44	1500
5	1000	25	-	45	600
6	450	26	3800	46	1400
7	800	27	500	47	350
8	3000	28	450	48	250
9	-	29	3000	49	100
10	1000	30	200	50	525
11	-	31	1000	51	1600
12	-	32	1500	52	1000
13	300	33	-	53	1550
14	2000	34	1300	54	1100
15	250	35	450	55	600
16	700	36	700	56	3000
17	1300	37	100	57	-
18	-	38	750		
19	-	39	300		
20	800	40	2500		

TABLE 2

Estimate of the Number of Programs in Use — Summary

(1) Number of Programs	(2) Organizations Reporting	(1)	(2)	(1)	(2)
100	1	550	1	1300	2
200	2	600	2	1400	1
250	2	650	1	1500	2
300	2	700	2	1550	1
350	1	750	1	1600	1
400	5	800	2	2000	1
450	3	1000	6	2500	1
500	1	1100	1	3000	3
525	2	1200	1	3800	1
	19		17		13

TABLE 3

Computer Programming Languages that are Used Most, and Percent of Use — Responses By 57 Organizations

(1) Org. No.	(2) COBOL	(3) FOR-TRAN	(4) BASIC	(5) RPG or RPG II	(6) Other
1	-	-	-	100	-
2	-	-	-	99	Assembler
3	97	-	-	-	ALC, PL1
4	10	-	-	-	BAL(90%)
5	80	0.5	-	-	BAL, Mark IV, PL1
6	60	-	-	-	Easycoder(40%)
7	-	10	-	-	BAL(90%0
8	90	1	1	8	-
9	90	-	-	-	Autocoder(10%)
10	70	-	-	30	-
11	90	-	-	-	BTAM, DVL260
12	90	9	-	1	-
13	95	-	-	5	-
14	50	-	-	20	Assembler(30%)
15	-	-	-	-	NEAT/3(100%)
16	1	1	-	-	NEAT/3, LEVEL2(98%)
17	88	-	-	10	Assembler
18	75	10	-	5	PL1, Mark IV
19	38	-	-	2	ALP(60%)
20	98	-	2	-	-
21	99	-	-	-	Assembler
22	-	2	-	5	PL1(93%)
23	90	-	10	-	-
24	-	-	-	-	BAL(100%)
25	70	-	15	-	1410 Autocoder(15%)
26	37	10	-	-	Series(46%), Assembler
27	40	-	-	-	Assembler(60%)
28	3	1	-	-	BAL(90%), PL1, 1410 Autocoder
29	90	1	-	-	BAL
30	-	-	-	100	-
31	78	-	-	1	Assembler(21%)
32	3	0.8	1	-	ADPAC(95%)
33	-	15	-	5	PL1(75%)
34	-	-	-	-	PL1(50%), BAL(50%)
35	75	20	-	-	BAL
36	85	1	-	-	Autocoder(13%), Assembler
37	99	-	1	-	-
38	99	-	-	-	Easycoder, DESCAP
39	-	-	10	90	-
40	70	5	-	1	ALC(15%), SPS, Autocoder, other
41	75	20	-	-	PL1
42	80	-	20	-	-
43	90	-	-	2	BAL
44	20	20	-	-	Assembler(40%), other
45	95	2	-	-	GECOM
46	85	7	4	-	PL1, BAL, APL
47	100	-	-	-	-
48	75	5	-	-	BAL(18%), Autocoder
49	80	20	-	-	-
50	80	18	-	-	370 A/L
51	-	1	-	-	PL1(99%)
52	30	2	5	-	PL1-OPT(63%)
53	25	-	-	-	ALC(75%)
54	60	-	35	-	Autocoder
55	-	5	-	-	BAL(95%)
56	80	1	-	1	TOPSTRAN(13%), ALC, CULPRIT
57	95	2	-	1	ALC

TABLE 4

Summary of the Use of COBOL

(1) Percent of Use	(2) No. of Organizations	(1)	(2)	(1)	(2)
0	12	38	1	85	2
1	1	40	1	88	1
3	2	50	1	90	7
10	1	60	2	95	3
20	1	70	3	97	1
25	1	75	4	98	1
30	1	78	2	99	3
37	1	80	4	100	1
	20		18		19

TABLE 5

Summary of the Use of FORTRAN

(1) Percent of Use	(2) No. of Organizations	(1)	(2)
0	30	7	1
0.5	1	9	1
0.8	1	10	3
1	7	15	1
2	4	18	1
5	3	20	4

TABLE 6

"Approximate Time and Cost of Training a New Person to Program Competently in the Programming Language that You Use Most" – Responses from 57 Organizations

(1) Organization Ser. No.	(2) Programming Language	(3) Number of Weeks	(4) Cost
1	RPG II	10	2500
2	RPG, RPG II	4	800
3	COBOL	8	-
4	BAL	20	5000
5	COBOL	3	200
6	COBOL	26	5200
7	BAL	24	6000
8	COBOL	2	400
9	COBOL	4	800
10	COBOL	-	-
11	COBOL	26	5000
12	COBOL	52	10000
13	-	-	-
14	COBOL	20	5000
15	NEAT/3	8	1800
16	NEAT/3	26	5000
17	COBOL	39	7500
18	-	18	8000
19	COBOL	0	0
20	COBOL	3	600
21	COBOL	20	3000
22	PL/1	10	2000
23	COBOL	52	7000
24	BAL	10	4000
25	COBOL	6	1500
26	-	-	-
27	-	-	-
28	BAL	52	10000
29	COBOL	26	4000
30	RPG II	26	4000
31	COBOL	4	600
32	ADPAC	2	500
33	PL/1	6	1500
34	BAL	8	2000
35	COBOL	25	5000
36	COBOL	26	2000
37	COBOL	6	2000
38	-	-	-
39	RPG	6	1200
40	-	-	-
41	COBOL	13	2500
42	COBOL	30	15000
43	COBOL	4	1000
44	ASSEMBLER	13	2600
45	COBOL	26	7500
46	COBOL	26	-
47	COBOL	6	1200
48	COBOL	26	7500
49	COBOL	26	10000
50	COBOL	26	5000
51	PL/1	24	4800
52	PL/1-OPT	8	1850
53	ALC	25	10000
54	COBOL	12	3000
55	BAL	4	1200
56	COBOL	5	3500
57	COBOL	12	5000

TABLE 7

Summary of Approximate Cost of Training a New Person to Program Competently in COBOL

(1) Cost	(2) No. of Organizations	(1)	(2)
$200	1	$3000	2
400	1	3500	1
600	2	4000	1
800	1	5000	5
1000	1	5200	1
1200	1	7000	1
1500	1	7500	3
2000	2	10000	2
2500	1	15000	1
	11		17

TABLE 8

Line of Business, and State in Which Located – for the 57 Organizations

(1) Organization Serial No.	(2) Line of Business	(3) Location
1	industry	NY
2	credit	Conn
3	machines	Ohio
4	dry goods	NY
5	banking	Calif
6	drugs	NJ

7	electric utility	Mass
8	business	Ill
9	automotive parts	Ohio
10	oil	Wisc
11	business	Ohio
12	business	Ohio
13	laboratories	NJ
14	business	Ohio
15	business	Texas
16	electric utility	Ohio
17	business	Ohio
18	chemicals	Delaware
19	banking	NY
20	banking	Pa
21	banking	Nevada
22	minerals	Pa
23	parts	Georgia
24	savings and loan	Calif
25	groceries	NJ
26	canned food	Minn
27	toy manufacturing	NY
28	clothing	Oregon
29	insurance	Tenn
30	parts	Pa
31	business	Ohio
32	fibres	Wash
33	business	Wisc
34	home appliances	Iowa
35	oil	Colo
36	life insurance	Mass
37	music	Ill
38	business	Ohio
39	lumber	Calif
40	oil	Texas
41	steel	Pa
42	bank	Pa
43	business	Pa
44	business	Pa
45	rubber	Ohio
46	beer	Wisc
47	foods	Iowa
48	foods	NY
49	business	Calif
50	containers	Ill
51	oil	Texas
52	business	Ohio
53	insurance	Texas
54	banking	Texas
55	manufacturing	Wisc
56	railroad	Nebraska
57	steel	W Va

Appendix 1

SURVEY FORM

SURVEY OF COMPUTER PROGRAMMING LANGUAGES IN USE

Dear Friend,

We are seeking to put together a report on computer programming languages in use at a sample of major computer installations. We plan to publish this report in the "1974 Computer Directory and Buyers' Guide", 20th annual edition. Would you please help us by anwering the following survey questions? (If you would like a copy of the report when put together, please say so.)

With much appreciation for your help,

Edmund C. Berkeley, Editor,
Computer Directory

- - - -(may be copied on any piece of paper)- - - -

1. What is your estimate of the number of programs you use?

2. What are the eight or so computer programming languages which you use most?

( ) COBOL, about _____ percent
( ) FORTRAN, about _____ percent
( ) BASIC, about _____ percent
( ) _____, about _____ percent
( ) _____, about _____ percent
( ) _____, about _____ percent
( ) _____, about _____ percent
( ) _____, about _____ percent
( ) _____, about _____ percent

3. What is your estimate of the approximate time and cost of training a new person to program competently in the programming language you use most:

a. Programming Language:_____
b. Time:_____ weeks
c. Cost: $_____

Filled in by: Name_____
Title_____
Organization_____
Address_____

When completed, please send before_____ to: Berkeley Enterprises, Inc., 815 Washington St., Newtonville, Mass. 02160

Appendix 2

COVERING LETTER – SECOND MAILING

RE: SURVEY OF COMPUTING PROGRAMMING LANGUAGES IN USE

Dear———

About three weeks ago, we carefully selected you as one of about 200 firms to survey as a sample. We sent you the enclosed survey form, asked you for some information, and offered you a copy of the report we are putting together when it is ready.

We have not heard from you.

The responses we have so far received indicate some fascinating information. For example:

> The estimated cost of training a new programmer ranges from $400 to $7500.

Won't you please send us your response? Another copy of the form is enclosed, and a business reply envelope. Your reply will be most appreciated.

Yours sincerely,

Edmund C. Berkeley
Editor

Computing and Data Processing Newsletter

LOCAL AIR POLLUTION LEVELS

Tom Anderson
Science Writing Program,
University-Industry Research
University of Wisconsin — Madison
610 Walnut St., Rm. 1215
Madison, Wisc. 53706

Local air pollution levels to be expected after highway expansion can now be readily predicted. A computer program, developed by Kenneth Ragland, a University of Wisconsin-Madison engineer, simulates local landscapes and weather conditions and can be used to indicate the pollution levels that will be caused by vehicles traveling along a proposed highway.

Pollution near a highway is closely related to the level of traffic, but air quality in neighboring areas is also affected -- depending on winds, land contour, number of buildings, distance from the highway, and atmospheric turbulence. There will be greater concentration of pollutants in an urban area, for example, than on an open, windy plain. Predicting the way in which future highways will affect local air quality is now necessary because of increasingly stringent federal air pollution standards. Planners must show that pollution anticipated from new highways will not exceed the standards.

The probability of surpassing the permissible levels can be estimated by considering maximum taffic under conditions in which maximum concentration of the exhaust pollutants will occur. The computer prints out the predicted pollution levels on tables giving concentrations to be expected at distances up to one-half mile from the highway. The levels of five different kinds of pollutants are considered in the computer program -- carbon monoxide, hydrocarbons, nitrogen dioxides, particulate matter, and sulfur oxides. When factors influencing dispersion of the pollutants change, it is necessary to run the computer program again; but each run takes only a few minutes, and the cost of making several runs is generally less than a dollar.

The computer program for predicting the pollution levels can be obtained from the Academic Computing Center on the University of Wisconsin-Madison campus.

SOLAR ENERGY COLLECTION BY SATELLITE, AND CONVERSION TO USE ON EARTH

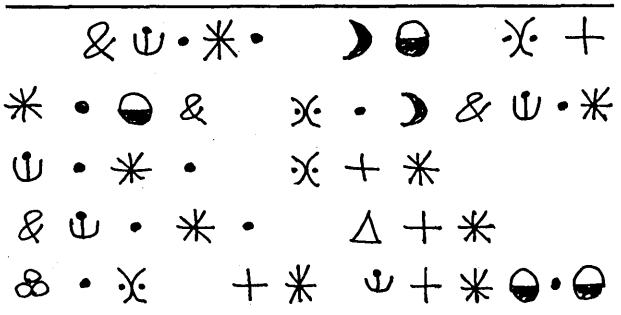
Diane Wilson
Dept. of Information Services
Notre Dame, Ind. 46556

Dr. Joseph J. Nahas, assistant professor of electrical engineering, at the University of Notre Dame, is involved in a NASA project to develop a system for solar energy collection and conversion to electrical power. He is using computer simulation to optimize operations on the earth end of the proposed satellite system.

The plan of NASA is to collect solar energy on a satellite orbiting the earth synchronously, in order to be totally in sunlight except for a few minutes each spring and fall. An antenna about two-thirds of a mile in diameter will beam the energy back to earth in the form of microwaves (very high frequency radio waves). Although the system will have a very large transmitting antenna and a very narrow transmission beam, the great distance involved -- about 26,000 miles -- will result in a widely dispersed beam on the receiving end.

Consequently, a circular receiving area about six miles in diameter will be required to collect the microwave energy and convert them to DC electrical power. The collection area will contain approximately ten billion small, identical converters on a series of panels. Because of the quantity of elements required, they have to be cheap. They also have to be efficient -- that is, the elements can't lose energy as heat. That's the objective of this project.

Nahas has developed a mathematical model of the 2-1/2-inch-long T-shaped solid-state conversion element, which consists of a dipole antenna, filters, and a diode. "Like 99 per cent of the world, this is a highly nonlinear system. Ninety-nine per cent of analysis, however, is designed for linear systems," Nahas commented wryly. He runs many computer simulations of the model's complex operation, varying about a dozen parameters to find out how they influence the operation of the element and to determine the optimum mix. So far, his model has predicted a maximum conversion efficiency of 80 per cent. He has identified the points of energy loss and hopes to increase the efficiency to 85 to 90 per cent.



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 7510

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

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 7510

```
                    S T A R S
                  x S H I N E
                  -----------
KTE = WYN         L H Y I E R
              L H T I N R
            H I A N H I
          R T I S C Y
        I W H L C A
      -------------
    = I R A Y H C T E C R
```

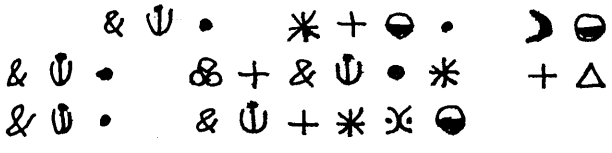
94091 75698 46927 01

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

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 7510



SOLUTIONS

MAXIMDIJ 759: We are too soon old and too late smart.
NAYMANDIJ 759: Column 9: over 7
NUMBLE 759: Know thee thyself; thus learn about others.

Our thanks to the following individual for sending us solutions: Ronald C. Graves, Ashland, Mass. – **NUMBLE 758.**

CORRECTION: In the September issue, on page 35, in "Solutions", replace 757 by 758 in eight occurrences.

Announcing plans for a new quarterly magazine:

COMPUTER GRAPHICS AND ART

To all persons interested in:

Applied Arts and Graphics
Architectural Graphics
Cartography Systems
Computer Aided Design
Computer Assisted Instruction in Computer Graphics
Computer Graphics in Physics, Chemistry, Mathematics, and Other Sciences
Computer Graphics in Literature, Semantics, Fine Arts, Applied Arts, and Other Fields
Computer Graphics in Business, Industry, and Other Branches of Knowledge
Interactive Graphics Languages
Courses in Computer Graphics
. . . .

Dear Colleague,

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.

Accordingly, this is your invitation to submit material and to begin subscribing (or indicate your intention of subscribing) to

COMPUTER GRAPHICS AND ART

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

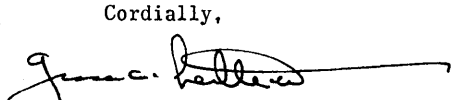
At the present time an advisory board of distinguished people and a group of contributing editors well known in graphic fields are being assembled. Your suggestions and nominations will be welcome.

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

Here is your chance for feedback to us:

- - - -(may be copied on any piece of paper)- - - -

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8. Any Remarks or Comments? _____

_____

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Name _____ Title _____

Organization _____

Address _____

*A - attach paper if needed