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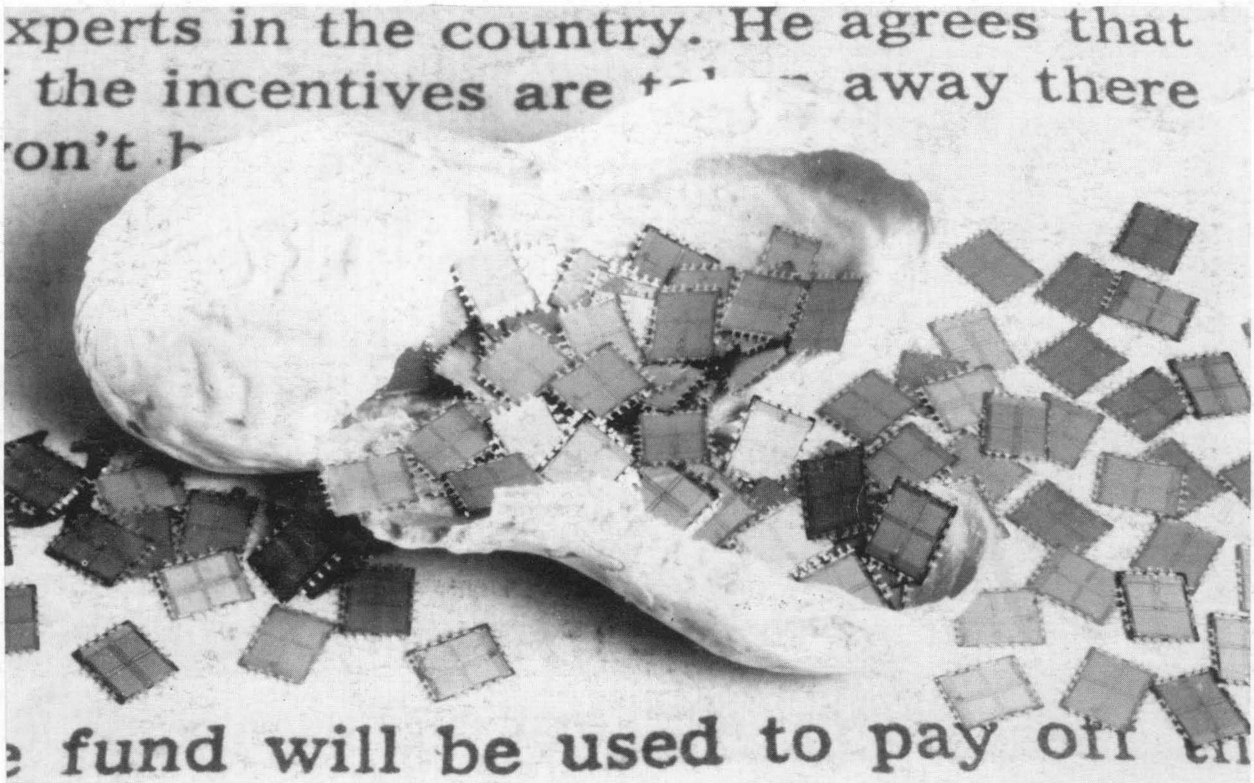
computers and automation and people



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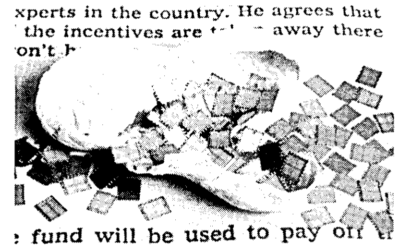
computers and automation and people

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.

The Profession of Information Engineer and the Pursuit of Truth

Computers and Puzzles



Front Cover Picture

This peanut shell contains 180 silicon integrated circuit memory chips (hundreds of transistors and other electronic components on tiny chips of silicon). These chips are of a type being used in Bell System's new electronic switching systems. The 180 chips can store a total of 5,000 words, the average number on the front page of a daily newspaper. For more about the 25-year old transistor and its inventors, see page 44.

Departments

NOTICE

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Key

[A] – Article
[C] – Monthly Column
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EDITORIAL

What Use Is A Computer?

Joe: What use is a computer? Tell me in simple words.

Ed: Well, a computer is a machine that handles information and solves problems – and that's useful.

Joe: What do you mean by information, and handling it? You can't handle information the way you can handle potatoes. Tell me in simple words.

Ed: Well, I'll try to use simple words: information is facts and guesses, words and numbers, letters and digits, marks and pictures, questions and answers. Handling means copying, storing, looking up, calculating, reporting, etc.

Joe: OK, I think I have an idea. You mean to tell me that machines can take in facts and guesses and give out answers to questions?

Ed: Yes.

Joe: Then I can talk to a computer the way I can talk to a person? and the computer will answer questions for me? – tell me facts that I can believe in and tell me guesses that I might or might not believe? Is that so?

Ed: No, you can't talk to a computer the way you would talk to a person.

Joe: Then what the devil use is a computer to me – all sorts of things that I might want to know – and I can't talk to it!

Ed: But you can talk to a computer with another machine, for example, an electric typewriter connected to the computer, or some other gismos like that.

Joe: That's interesting. How come I have to talk to a computer with a typewriter and not with spoken words?

Ed: To tell you the truth, Joe, the boys who have been all excited about computers for the last 25 years still have not made a computer that people can talk to – but they can make computers that do lots of neat tricks if people give them written words with a typewriter.

Joe: But I use the hunt and peck system, and so it will take me a long time to say anything I want to say to a computer that way.

Ed: But they have computers that will ask you questions, and you read the questions that the computer types out on paper, and then you can for example type Y for "Yes" or N for "No" or DK for "I don't know," etc. – and so you can have a kind of one-sided conversation with a computer that way.

Joe: But how am I to explain to a computer what I am really worried about, the real questions I want answers to – like, what made the Americans give a landslide vote to Nixon when he has dropped more bombs on people than any other man in history?

Ed: A computer can't answer that kind of question.

Joe: Well, if a computer won't answer that question, how about this one – how can I "get rich quick" in the stock market?

Ed: A computer can't answer that question either.

Joe: Oh? How about this problem: what should I do this year, next year, and the year after that, so that I can earn much more money than I am now earning, what with prices going up and up and up and up? Ed, it is going to be damn hard for my present income to continue to pay even my present expenses.

Ed: I am sorry, Joe, a computer can't answer that kind of question either – but a computer could throw a lot of light on it.

Joe: Huh! How about this one – what will the weather be on Friday, March 16 this year, when I want to start driving from South Dakota to Oregon?

Ed: I'm sorry, Joe, a computer can't answer that question either.

Joe: Wow! A know-nothing on that question, too! Well, what are the kinds of questions a computer can answer?

Ed: They can tell American Airlines whether that airplane seat you want for arriving in Sioux Falls on the morning of March 16 can be surely reserved for you, and they can tell the Collector of Internal Revenue how your 1972 reported income compares with what other people said they paid you, and they can tell the National Aeronautics and Space Administration when and for how long to fire a rocket on a spaceship, so that an astronaut can land on a particular spot on the moon, and they can tell ...

Joe: One crumb of useful information for me, and a stack of useful information for the government!

Ed: Not exactly, Joe. I have a list right here, of 2300 fields where computers can be applied, where lots of detailed answers to lots of detailed questions can be obtained by a computer.

Joe (shaking his head): The computer reminds me of the story of the idiot genius who could add all the numbers on the freight cars as they went past a railroad crossing in Indiana, at 70 miles an hour – but he did not know how to tie his own shoelaces.

Ed: I am sorry to say that although the computers are marvelous, and very useful, and have done much useful work, and have a wonderful public relations image – on net balance they may be doing as much harm as good – because of their side-effects.

They are being used by people and organizations who have money and resources, and who want and need good images and more profits – in order to keep on doing the often thoughtless, and occasionally wicked, things that they are doing.

And so far as I know there is nobody, no organized group, in the computer field or out of it, in government or outside of it, really making sure that the power of computers is being used to help solve the really important problems of society.

Joe: Gee! If you ask me, I think computers are for the birds!

Ed: If the birds had computers, they might well be worse off.

Thoughtless technology is a curse, because the side-effects are on such a large scale.

Edmund C. Berkeley

Edmund C. Berkeley
Editor

(Reprinted from *Computers and Automation*, February, 1970.)

c.a **EDITORIAL**

"The House is on Fire"

In the computer field, there are basically two kinds of attitudes about the applications of computers and data processing—information handling—to the solving of problems.

On the one hand there is the attitude:

> Computers are tools like matches—and we are just mechanics. We take the data as given (the kindling). Our responsibility is the processing—swift, economical, correct (making a fire with matches). The answers belong to our employer (he uses the fire as he sees fit).

The group who holds this attitude—let's call it Group I—takes the data and the problem as given—given by the corporation or the government, the employer or the client, who has the problem.

This group works on payrolls, etc.—and on the targeting of nuclear missiles and on calculations of the dissemination of nerve gases. And they work on the latter with the same "I'm just doing my job" attitude that they work on the former. In Nazi Germany Group I would have worked "under orders" on the design of ovens for efficient mass incineration of thousands of corpses from the gas chambers. (The Nazis put to death in concentration camps over 11 million Jews, Russians, Poles, Czechs, French, etc., in pursuit of the "final solution".) If you read "Treblinka" by Jean-Francois Steiner (Simon & Schuster, New York, 1967) you find out how one Nazi scientist graded corpses from fat to thin so the fires would burn better.

On the other hand there is the attitude:

> Computers are tools like bridges—and we are professional engineers. We take the data as given (the materials and the site) but we check the data independently. Our responsibility is not only processing—swift, economical, correct (building a bridge with girders)—but also worthwhile answers (bridges that work). The bridges we build must carry people, and we don't want them to crash.

The group who holds this attitude—let's call it Group II—works on payrolls, etc.—but they will refuse to work on calculations for the dissemination of nerve gases, or on calculations for targeting of nuclear weapons, or on calculations for the design of crematoria for thousands of human corpses. They see a responsibility greater than that to their government or employer—they see a primary responsibility to their fellowman.

A recent vote of members of the Association for Computing Machinery indicated that the proportion of Group I to Group II is about two to one. In other words, two-thirds of the computer people who replied to the survey on the "questions of importance", voted that the ACM should not "take a stand on deeply political questions."

The attitude of Group I is a characteristically conservative attitude: "The world is going along pretty well"—"Let us not rock the boat"—"The existing system should be tolerated"—"Things will eventually work out all right"—"Professional people have their major allegiance to the persons who pay them"—"A computer professional has no social responsibility different from that of the nonprofessional man". . . .

The attitude of Group II is a characteristically liberal attitude: "The world can be a much better place than it is now"—"It is important to try to improve the world"—"Such a vast number of sad and evil things happen in the world that everybody must do something significant to help prevent them"—"The fact that thousands of human beings have been killed by both sides in the Viet Nam conflict requires people everywhere to seek withdrawal of foreign armed forces from that unhappy civil war."

Scientifically it is easy to show that the attitude of Group I will lead to the destruction and extinction of the human race, just as the dinosaurs became extinct. Scientifically it is not possible to show that the attitude of Group II will lead to the survival of human beings on the earth: it is only possible to show that the attitude of Group II offers human beings some hope of survival in the increasingly more difficult environment on earth, the "house" for all of us.

For "the house is on fire": the earth as an environment for human beings has changed enormously in the last 25 years and is deteriorating fairly rapidly. Before 1945, the factor of sufficient distance from a danger could almost always save human beings alive. Now, distance is not enough. Now, because of interlocking planet-wide systems of consequences, the environment of the earth is no longer safe for human beings. For example:

> Large-scale nuclear war (and its radioactivity) between two countries in the Northern hemisphere can kill all the inhabitants of that hemisphere. International anarchy allows this to break out at the choice of one government.
>
> The explosive increase in the number of human beings alive—the so-called population explosion—seriously threatens the power of the earth to support them. Worldwide anarchy allows any man and woman to bear children unrestrictedly.
>
> Pollution of the air, the water, and the land by man's activities is becoming world-wide. Again, international anarchy allows this to happen everywhere.
>
> Etc.

"The house is on fire". So it is necessary for all persons living in the "house" to take some time away from their play rooms, their work rooms, and their bedrooms, their computer rooms, their laboratories, and their ivory towers—and to try to help put out the fire. The fire is licking at the edges of the roof and the walls and the floors—and time is pressing and will not wait.

Accordingly, **Computers and Automation** with this issue is starting a department in the magazine which for the present will bear the subtitle "The House is on Fire" and the title "The Profession of Information Engineer." Here we plan to publish information from time to time which will help focus the attention of computer professionals in the direction of becoming information engineers, "bridge" engineers,—not mechanics, not artisans. For we are, first of all, human beings with professional training, and secondly, we are computer professionals. We need to shed light on major urgent problems of the earth today. These are the great problems which cause our children to be "a generation in search of a future," to use the phrase of Professor George Wald, Nobel prizewinner in biochemistry. These are the great problems which raise the great question:

Will there be any future at all for our children?

Edmund C. Berkeley
Editor

The Domination of the Computer Industry by IBM

D. James Guzy, Vice President
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"The capital imbalance in our industry beggars the imagination: 'IBM pays out more in yearly dividends to its shareholders than the total capital which all its competitors are able to raise in a year'."

This time last year, I stated that the restoration of a vital competitive structure in the computer business had finally become a topic demanding wide national public concern; and I asserted that unless the industry could bring about more active competition through some form of self regulation or adjustment, a broadly based and powerful public pressure would develop for more direct and immediate government regulation. The somewhat clarion point of my remarks then was that stultification of competition through a monopoly in our business serves neither the best interests of the data processing industry nor the American public interest.

In this context, the company enjoying a monopoly position is IBM. And while one can question whether IBM exercises a legal monopoly over the data processing industry, it surely exercises a clear and effective domination of a market that is probably the greatest by any single company in any major industry.

Government Controls or Active Competition?

Given the growing resentments and cynicism toward many aspects of our present industrial order, and the zeal of reformists to undo the supposed mischief which our political and economic system has created, the data processing industry must now come to grips with the question of whether Government imposed controls or active competition will set the pace of our future.

A year ago, I said that the American data processing industry was facing a period of intensive challenge in both the domestic and the international marketplace. I should have added the dimension of a political challenge as well. At home, most of us are familiar with the Justice Department suit against IBM, now pending in the Federal District Court in New York. This action is four years old and has received extensive press attention. More recently, a piece of legislation was introduced in Congress with the intention to eliminate alleged economic concentration and to provide for more effective competition. I refer to Senator Philip Hart's Industrial Reorganization Act which he views as "the greatest effort which has been put to finding a solution for economic concentration." In his opinion, the measure offers "an alternative to Government regulation and control," the alternative being the restoration of competition and "freedom of enterprise" in the economy. Hearings on this legislation are being scheduled now, and it is most relevant to note that the computer industry has been selected for the first investigation by the Senate Antitrust and Monopoly Subcommittee. The implication is that Senator Hart and his colleagues share my concern that the absence of free and active competition in the computer industry is a real danger to the technological competitiveness of this country and of the highest priority to our nation.

Crucial Role of the Industry

There is no single answer, of course, but the crucial role that the data processing industry plays in American society and the nature of the industry itself bear on the issue. The computer has been described as America's greatest long-range asset. Computer technology has been one of America's prides. I think it is not too bold a statement that the computer will be a major factor in determining whether the U.S. succeeds in establishing a favorable equilibrium in its international trade and monetary position. Our preeminence in computer electronics is already being challenged by European and Japanese firms, often with the active cooperation of their Governments. The question of what directions the American computer industry will take in the coming years is a critical one indeed.

One of the serious, traditional, problems which growing economic concentration causes is that it defeats new ideas and new products. When innovation is suppressed, one generally thinks that the consumer always loses. In the case of the computer industry, the national economy loses too.

From within the industry, we sometimes lose perspective as to the absolute size and rapid growth of this business. Historically, the American economy has promoted industries that are capital-intensive,

(Based on a talk before the Association for Computing Machinery, December 14, 1972.)

dynamic, technological, education-dependent, universal in application, and large scale.

Data processing is the most recent example of such an industry, a relative newcomer to economic prominence. Insignificant in the U.S. economic picture scarcely 20 years ago, its explosive growth was triggered by relatively few companies in the early 1950's. Presently, information processing is a multibillion dollar worldwide enterprise whose sustained growth has resulted from investment of billions of dollars in research and development, aided by a flow of the better qualified younger people entering business. The field has been characterized by growth and change, requiring large infusions of talented people and capital to keep pace with the demands of technological advancement and applications use.

During the Greyhound-IBM trial last year, evidence was submitted which documented a U.S. market for electronic data processing products and services that has grown from $45 million in revenues in 1952 to $9.4 billion in 1970. Industry analysts estimate that the dollar value of the business will exceed $20-billion by 1975, and double by 1980. If this is even reasonably accurate, in less than a decade the data processing industry will rival the American automotive industry in sheer size and economic contribution. With specific regard to international trade, it will likely exceed the contributions of the automotive industry to American export earnings.

Broadened Applications Vital to Growth

In the low point of the recent economic recession, the first to affect our industry, some analysts questioned the future growth potential. This judgement has, of course, proved wrong. Fundamental to the future expansion of the industry is the growth in the volume of information processed by computer systems. One can readily understand that investment in data processing equipment, supplies, and services is directly related to the volume of information processed. Today's existing volume of processed information is expected to grow at a rate at least equal to that of the general economy, while new applications in the use of data processing will provide added growth several times that of the existing information base.

Some of the major incentives for broadened applications lie in the decreasing cost of data processing services, the increasing knowledge of how to use the equipment capability through proper software, and the rising cost of reasonable alternatives. Given America's pioneering accomplishments in the information processing field and the increasingly technological and service-oriented character of our economy and our workforce, one might expect a marked acceleration of new ideas and products, both material and intellectual, to issue from the data processing industry in response to new requirements at home and abroad.

Need for Capital

Instead, you have seen major firms getting out of the business and a relative slowdown in new research and development efforts. If you share my view that there are many opportunities for new products in our business, and that the technology to create these products is available, there must be another explanation to the slowed growth and innovation in the industry. There is, and that explanation is a need for capital. At present, the need is for capital, and the magnitude of this need is immense. The problem of financing, not technology, retards the development of the data processing industry.

Just as all roads lead to Rome, it is quite difficult to discuss major issues related to the computer industry without bumping into IBM. It's hard to ignore this business behemoth, particularly as regards the financial structure of the industry. In our industry or another, there are understandably large vested interests at stake which frown on the temerity of commentators. But that's all in the nature of things, and I view the fundamental task as fortifying one's nerve and grasping whatever long-run realities are visible to you.

Relating back to the industry's need for capital, it is important to note that IBM has the only true capital surplus in the business. The balance of the industry operates with a capital deficit. On this exceptionally critical point, the often cited figures of total market size and comparative market shares mean very little. While IBM can make a yearly half billion dollar distribution of funds to its shareholders, its competition is dependent on a continued flow of outside capital contributions for the growth of their operations. It is worth asking the question of how this came about.

Capital Imbalance: The Causes

Virtually unique among American businesses, the data processing industry finances not only development and manufacture, but also customer acquisition of a broad range of new products. Early in this industry's history, IBM had the foresight to meet its prospective users' doubts about the viability of electro-mechanical punch card equipment and numerical calculators by forming the capital base from which it could finance a customer's acquisition of its equipment. Certainly this was a necessary economic tactic throughout the depression years of the 1930's. Thus the die was cast.

Today, as a result of this practice, much of IBM's leaseflow income derives from fully depreciated computer equipment. The lack of capital and a healthy return on investment on the part of potential competition are serious deterrents to the free working of the competitive market process within the EDP industry. IBM is on the far side of the leasing business having financed its core of equipment leases and built the initial foundation of its lease base in another era. All of IBM's competitors are on the near side of this leasing business, plowing by far the largest amounts of their available capital into creation of a body of equipment for lease. Accordingly, every competitor to IBM requires new capital investment, and because there are slight net retained earnings among these competitors, there has been practically no return on the existing investment. Furthermore, the near-term absence of such a return exacerbates the existing imbalance in available capital by reducing the attractiveness of additional external investment.

The capital imbalance in our industry beggars the imagination:

- IBM pays out more in yearly dividends to its shareholders than the total capital which all its competitors are able to raise in a year.

Moreover, IBM retains an even greater amount in cash and liquid items because it cannot invest these excess funds to earn the same high rate of return that they have in the past. IBM's product line, broad as it is, is insufficient to provide the growth in customers and applications which would absorb fully that cash flow. With the vast capital requirements already existing in the data processing industry, and the promise of even greater capital needs in the future, IBM's nearly $2 billion in cash items stands out as a rather untoward monument to success. And with the national mood being what it is, I expect that greater public awareness of the capital imbalance issue will work toward deconcentration of IBM's position as one part of any broad effort to abate market power in the national economy. In any case, it will be interesting to observe the Senate subcommittee discussions on capital availability in the industry.

The last attempt by the Justice Department to increase effective competition in the industry by getting IBM to sign a consent decree had a generally disappointing result. Fifteen years ago, IBM agreed not to lease on a long-term basis, thus giving competitors a chance to sell an IBM customer who might otherwise be tied up in a five-year lease. In fact, IBM showed itself to be the only company wealthy enough to finance short-term leases. Thus, the decree served only to place competitors at a more serious market disadvantage based chiefly on their higher cost of money relative to IBM.

Savings to All Computer Users

I think it is a fundamental point that the result of adequate capital for our industry would be predictable savings to all computer users.

Unquestionably, the many innovations outside IBM could, if properly financed, supply significant additional growth to the industry and great utility to the user. Let me be understood in saying that broad public participation is necessary in the coming months if the Senate hearings are to have a salutory result for the industry and the national welfare too. And along this line, I think it's important that the multitude of IBM users be helped to understand that they can benefit in still new ways from their investment made month by month in payments which far exceed, under the typical terms of lease, the outright sales price of equipment. Let me recommend that the so-called "excess" lease payments — those beyond recovery of costs and after a contribution to profit — be reinvested in the industry to produce tangible benefits to the user community. For a number of reasons, it will likely require strong outside pressure to move IBM to activate these vast funds in a manner which is not prejudicial to competition. By any measure, this would be a highly sensitive and complicated task.

If the computer user should gain some form of access to IBM's huge cash surplus, would most of our problems be solved? and the renewed growth of the industry thereby be assured? Of course not.

Nonetheless, in the history of anti-trust remedies, the use of capital by the industry leader to restrain competition has frequently been an issue. Its unconstrained use as a competitive weapon is now prevented in automobiles, appliances, steel, and shoe machinery.

The capital question is only one aspect of a competitive computer industry, albeit a major aspect. But the availability of IBM credit to all users of computers would open up a new source of capital to finance acquisition of data processing equipment. Perhaps an analogy could be drawn to the operation of General Motors Acceptance Corporation, or to General Electric Credit Corporation. This new — let us call it an IBM credit window — would supplement, not supplant the nation's commercial banking system as a source of capital. It would be a major step in placing the burden of financing user acquisition of equipment where it more rightly belongs — that is with the user and not with the manufacturer.

It is time that we cast aside the myth that a company's expansion is limited only by its ability to perform and get its product accepted in the marketplace. Access to capital on reasonable terms is antecedent to these acts.

We should recognize that our industry has come into a phase of its development when the concentration of capital and initiative within a small number of companies is working not only to impede the even growth of the industry at large but also contributes to an unhealthy public feeling that the economic life of the nation is really after all dominated by a few.

Several months ago, in explaining why he was proposing new legislation in the form of his Industrial Reorganization Act, Senator Hart said that while he still believed that the antitrust laws could go a long way toward eliminating much of the concentrated economic power, he had given up hope that — without a new congressional mandate — any attorney general will bring the necessary cases to undo the concentration which has already taken place.

Toward a Proper Social Balance

A year ago, when I called for broad public consideration of the state of competition in our industry, there was slight favorable response. Today, there is significant movement on a broad front directed at a redefinition of the desired balance in the sectors of our national economy and proper relationship between government, business, and the society which they both serve. The controversies surrounding the ITT affair stung the Administration and aroused the public to question the actual substance of actions instead of accepting as real the semblance of business intent and sometimes even government intent.

The assignment of Chief Judge David Edelstein as the presiding judge in the Justice Department antitrust action against IBM should be viewed as a most significant event in that case. Judge Edelstein has a close knowledge of Justice Department suits against IBM. It was he who signed the 1956 consent decree settlement and has since overseen its enforcement. With an opinion that the significance of the present action goes far beyond the data processing industry to touch on basic issues of the social order and the conduct of the country's foreign affairs, Judge Edelstein has taken a firm hand in imparting a definite sense of forward movement.

In a departure from generally accepted practice, Judge Edelstein has further declared his intention to participate in the deposition of key persons, or in instances where counsel anticipates some obstruction or other problems. In these instances, Judge Edelstein will preside at the deposition in open court in New York City. This active involvement in the IBM case is certainly a stimulating influence in what had become a stagnant case. For much of the general public, and a not inconsiderable segment of the computer industry, too, it had come to seem incredible that a major Justice Department action filed in January, 1969 should have languished for so long with so little result. Certainly it cannot be that the case was not important enough to warrant the government's best efforts and attention.

(please turn to page 24)

Menace, Messiah -- or Machine?

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"The computer will make possible the accumulation and instant accessibility of vast amounts of minutiae and details reaching into our most intimate moments. The implications are both tremendous and terrifying."

Introduction — The Computer Dilemma

It was 1953 — the height of the McCarthy era. The American atmosphere was charged with suspicion, distrust and hatred. Accusations of being a "fellow traveller" or a "Communist front," based on the flimsiest of evidence or even contrived evidence or none at all, were enough to destroy a career and a lifetime of effort.

I was an Assistant United States Attorney for the Southern District of New York, air bound for Washington. Mine was a particularly sensitive prosecutor's office, for we were handling many of the important Smith Act and other subversion cases. The 1951 Rosenberg convictions in our District, the first to end with civilians put to death for espionage by order of a civil court, were still making front page headlines. Roy Cohn, notorious for frequently out-McCarthying the Wisconsin Senator, had only recently left our office to join the McCarthy Committee as Chief Counsel, and had many friends among us. The Committee had held widely publicized hearings in Courtroom 110 at the United States Court House in New York City's Foley Square where we were located, attended by television cameras, publicity seekers and much excitement. I recall going downstairs one day to watch, being much embarrassed but drawn by the circus character of the supposedly quasi-judicial proceeding and hiding in the background lest I be photographed, or someone see and greet me or call me onstage. I left quietly and very quickly, despite my great interest in the spectacle.

Secret Reading

Already there had been leaks of classified information to the Committee. All of us were intensely security conscious. Little wonder that when the stewardess handed me a copy of a current Life magazine, the cover of which announced a critical examination of Senator McCarthy and his activities, I flipped quickly to the article and began to read.

My memory of the trip almost two decades ago is otherwise clouded, but I vividly remember sitting on the right-hand side of the plane, half way back in an aisle seat in the coach section. A few seconds after turning to the article I became conscious of a man sitting next to me in the window seat, whose face is a blur which I may never have seen. I reflected for no more than a moment about who my fellow passenger might be, what he might think about my reading the article and the reaction on my face, whether I should smile, look glum or whatever, how quickly I should read, what he might say and to whom he might report — and then almost immediately flipping on through the magazine to some other section.

Later I purchased another copy of the magazine at a newsstand, and read it secretly in my hotel room — a little ashamed of myself.

* * *

Not Permitted to See One's Own File

It was 1958. I had resigned as an Assistant United States Attorney, returned to private practice and was now back in government as a Special Assistant to the United States Attorney General. I was the chief organized crime prosecutor in the United States, probing the November, 1957 Apalachin "crime convention" and trying to find out what was wrong with organized crime enforcement and recommend improvements. Security was again a touchstone of our operation, and information concerning me and my assistants was evaluated carefully and promptly. I studied the data on each of the key regional chiefs, and they in turn examined the reports with respect to their subordinates. No one was permitted to see his own file, and Dick Ogilvie, then Chief of the Mid-Western Region of our Special Group on Organized Crime and now Governor of Illinois, reviewed the information about me.

Again time has blurred the details, but I do clearly recall sitting in Assistant Deputy Attorney General John Sheneman's office while Dick and I inspected some files. Dick was looking at one of the early reports on me. At one point he said, "I see your father signed the Stockholm Peace Pledge in 1945."

The Stockholm Peace Pledge

Even as late as 1958, subscription to the Stockholm Peace Pledge was accepted by many as evidencing subversive or at least "fellow traveller" tendencies, for among its sponsors were organizations identified as "Communist Fronts" on the Attorney General's list of subversive organizations. The pledge itself was a document circulated world-wide during World War II while America was actively allied with Russia, expressing innocuous sounding platitudes adding up to a plea that the nations of the world unite to stop the brutality and destruction of war.

My father's three sons had all been overseas during the War, in the European Theatre of Operations; one had crossed the Channel to France the day after D-Day, and for a period was missing in the Battle of the Bulge; a second, an Infantry private, had come to Europe through North Africa, Sicily and on through the Italian boot, a good part of the time carrying a piece of a mortar in his back. I had been in England with the 8th and 9th Air Forces. My father loved his sons deeply, and his concern for their safety was great. But none of the latter information was in the investigative report.

I looked at Dick Ogilvie after he revealed this bit of "derogatory" information in my file and he looked at me, as if to say, "Can this be happening here?" But I remember still being careful later to find an opportunity without being too obvious, to tell him that my father was a lawyer and a conservative, and had been a registered Republican all his life.

And by this time I had had enough further experience with security matters and the use of facts, not to be ashamed of my feeling of a need to protect the record, even though I knew my father and me to be innocent of any of the adverse implications of the fact revealed.

* * *

Adverse Use of Isolated Facts

Neither of these two isolated episodes has anything to do with the computer; each took place years before it became a significant factor in our society. Instead they reflect the deep concern of one individual — trained as a trial lawyer and prosecutor in the marshaling, selection and use of facts — about the possible adverse use against him of an isolated fact which might be brought to light years later in an unrelated context; about how and why one might measure and adjust one's conduct accordingly; and about what this means to freedom.

Only a person in a most sensitive position and trained in the use of facts, would have reacted as I did to these events. Even today details such as how a man travelling alone on an airplane looks while reading a Life magazine article, or whether a father was one of several million signatories to a world plea for peace thirteen years before, can be processed only for a miniscule fraction of society. Tomorrow, however, the computer will make possible the accumulation and instant accessibility of far more such minutiae, reaching into our most intimate moments. The implications are both tremendous and terrifying.

Discretion vs. Valor

Falstaff may have been correct that discretion is the better part of valor, but I was not pleased with my reaction or conduct in either of these episodes. What happened surprised (and disappointed) me at the time; it would not surprise me now. I fear that another thirteen years from now it may not surprise anyone.

This is the dilemma of the computer, which is apparent whenever one probes its impact. Every exciting new benefit the computer promises, such as the marshaling of myriad isolated facts to aid in criminal prosecution, is accompanied by a concomitant risk often obscured by the glitter of the benefit, such as the loss of freedom.

Other Consequences

I fear even more the other not yet apparent adverse consequences of the computer dilemma. Unless we recognize and understand those consequences, and do something about them before it is too late, the computer's tremendous capacity to retain a staggering volume of information, to process and control it almost instantaneously and to make it available in virtually unlimited ways, may create a very different way of life than anything we have had before — and one in which freedom as we know it simply cannot exist. For example —

> Our future checkless cashless banking structure can process and help make possible enormous wealth, yet further isolate and make pariahs of the impoverished, the unwanted and the deviants.
>
> Instant mass voting and opinion polls can mean unparalleled responsiveness to the wishes of the public, yet destroy traditional limitations on majority control.
>
> Incredible oral, visual and written communications capabilities can inform and educate the masses instantly, yet vest such huge power in the hands of one or a few persons, as to give rise to new Hitlers and Stalins holding powers far greater than their predecessors.
>
> Marketing and manufacturing point of sale and process controls can effect labor savings reducing the work week to almost any desired minimum, but also mean vertical integration and oligopoly or monopoly in a few resources of supply, destroying freedom of economic opportunity.

The Intelligent Functioning of Lay Leaders

Human technological specialization, to this point an apparently unavoidable feature of the computer era, can create a set of persons controlling the productive segment of society which is not equipped to deal with traditional values. It can make it increasingly difficult for democratically selected lay leaders to function intelligently. It can result in human technological obsolescence at an early age, developing a new class of the unwanted which poses far more difficult problems than the science of geriatrics has yet seen; to some extent it already has; I know some members.

The computer's threat to privacy is already documented and recognized in government and private circles, and at least some corrective action seems under way; the degree of attention focused on that area may indeed have contributed to obfuscation of other more serious risks. It may well be that these other computer associated developments will ultimately turn out to have far more significant adverse impact on our lives than the vast storehouses of information built up in credit files and government dossiers, about which so much has been said.

Far Too Little Discussion

Non-computer people are most reluctant to disclose their ignorance of the computer's special esoteric language and operations. As a result, there is precious little discussion and debate about what is happening and its consequences within other disciplines in the universities and professional associations, and among the public generally. Before it is too late, our society requires intensive, non-technical, free swinging inter-disciplinary discussion of these issues. This will furnish the information enabling each of us to decide for himself what measures are required for the public good. In this way the risk/benefit equation posed by the computer dilemma can be solved by man, not the computer, so that we will all be masters of the new technology rather than its servants. The computer will then be neither a menace nor a messiah, but simply an extraordinarily valuable machine to be used to help us to move forward to a better life. □

The Church and the Computer

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"There are those who object to automation in Church administration, feeling it is too slick and businesslike and smacks somewhat of the market place. . . . some of the younger element of society . . . feel that automation in the Church is much like 'the abomination of desolation in the holy place' spoken of by the prophet Daniel."

Introduction

Quite frequently, when one looks at a local church, one tends to see only the building itself with its rectory and possibly its school and convent. What one does not see is the larger administrative structure behind that complex which is involved not only with the spiritual and educational needs of the local parishoners, but with the needs of the sick, the aged, the orphaned, the blind, the deaf and those people who are in some material need. In the Roman Catholic Church, these larger administrative units are called Archdioceses or Dioceses and these cover a specified geographic area which, in some cases, may include an entire state. The Archdiocese of New York encompasses the counties of Manhattan, Bronx and Richmond in New York City, as well as the six proximate counties to the north of New York City, an area of some 4,000 square miles. In this geographic area, there are some 405 parishes, 285 elementary schools, 70 high schools, 17 colleges and universities, 17 hospitals, 13 child caring agencies and numerous other support agencies concerned with the administration and functioning of these many organizations. Some 5,000 priests and religious workers together with some 22,000 lay people staff these institutions. Thus, it should come as no surprise that even the Church with some 2,000 years of history and tradition does use computers in its administration. Today, with spiraling costs, social changes and the various other pressures that bear down on established institutions, it has become critical for even the Church to make use of automatic data processing.

In 1968, the Archdiocese of New York installed its first computer, an IBM 1401 and in 1971 this unit was replaced with a UNIVAC 9400. Presently, because of the administrative structure of the Archdiocese, the present data center serves the Central Administrative Offices, the Education Department, the Cemetery Office and Catholic Charities.

Central Administrative Offices

Under the aegis of the Central Administrative Offices, the accounts payable system monitors the expenditures and the budgets of 22 agencies. This system is quite similar to that of any large corporation where once approval of payment is confirmed at the local level, batch control reports, agency reports, checks, monthly operating statements and vendor reports are generated by the Data Center. Obviously, a uniform chart of accounts permits the consolidation of reports by function on an Archdiocesan level. Within the Central Office, one agency monitors the performance of the parishes much as a corporation would monitor the activity of a branch office. The budgets and actual operating reports are stored in the computer system to provide the data base for the analysis of trends as well as the comparison of similar items of activity. From these analyses, advice can be given by the Central Office to help increase income or to cut back on expenditures real or anticipated. Systems have been developed which allow for the internal assessment of funds based on simulations that permit monies to be transferred to "needy parishes" from the parishes in better fiscal condition through the activity of the Commission on Interparish Finance. Computer simulations test various assessment formulae against budgeted needs to determine the formula that will best answer the expected demands.

Quite obviously with such a large number of personnel, systems have been developed to process data for both the priests' retirement plan as well as the lay pension plan. Programs have been developed to keep track of employees in the plan as well as all employees awaiting entrance.

Terminations, deaths and transfers must be processed as well as annual billings and in some cases, quarterly billings. Retirement checks must also be drawn at appropriate times. With these personnel files, studies are compiled for the funding of the pension plan, and other actuarial reports are generated to cover requests for information from the Pension Board. A Tax Sheltered Annuity Plan for lay employees is also processed so that employees' money is properly reported and monitored. As with the Pension Plan, this requires the obvious up-dating of the files, together with the necessary billing procedures.

All of the above systems are presently in operation and of course growing, as the requests for new and more varied reports are developed. Plans are in the process of implementation to expand the above operation to include employee information on hospitalization, major medical coverage and insurance. As time passes, this file will become an extensive personnel file that will provide information about employees in a manner presently not available within the Archdiocese, since much of the activity tends to be at a local level due to decentralization.

Education Department

Because of the extensive involvement of the Archdiocese in education, one of the very large areas of service is within the Department of Education. Here the services of the computer are used in the area of administration both on the central level as well as the local level. In this latter area, some 40 high schools and 3 colleges make use of the computer for reporting student grades and keeping student records. Several schools also use the computer to analyze teacher grading techniques and measure student performance in comparison to results attained on standardized tests.

Each year, most of the above schools make use of the computer to schedule students into classes. The system used for this procedure permits great variation in the type of schedule with traditional as well as modular type schedules handled by a master schedule allowing for up to eight day cycles with thirty periods per day and twenty-four requests per student.

The Archdiocese operates 14 high schools directly while the others are operated by the local parishes or various religious orders operating within the Archdiocese. For these 14 high schools and 19 educational support agencies, the accounts payable system of the Central Administrative Offices is used to monitor fiscal activity. Over and above this application, the tuition billing procedure for some 15,000 students in these schools is also automated. Here an Optical Document Reader is used to process these documents monthly, and to render the necessary reports and reminders.

Essentially then, the operating condition of all Central Administrative Offices and the Department of Education are linked together through a unified system which permits monthly examination of fiscal performance. Within the period of the next year, plans will be implemented for the centralization of purchasing for those units within the structure of the accounts payable system.

Naturally, for an organization as complex as the Archdiocese, the need for up-to-date information is critical. For that purpose, the actual and budget financial reports of each parish are stored in the computer for the church as well as the school. Basic reports for items of income and expense are compared for similar units within the Archdiocese and performance is measured with an eye to making suggestions for improvements and allocating available resources to "needy areas". Various summary and profile listings highlight problem areas. In recent negotiations with teachers' unions, simulation of suggested settelments, together with historical financial data of the parishes, permitted a detailed examination of the effect of these settlements on the long term fiscal health of each parish individually and the Archdiocese as a whole.

Extensive data files for each of the 6,000 or so teachers within the school system permits the analysis of salary distributions, age distributions, degree distributions, etc. Also, a similar file together with responses to a preference questionnaire filled out by the priests of the Archdiocese assists in generating reports that result in the assignment of priest personnel based on preference and qualification. Presently, a complete parish survey is being conducted by the Planning and Research Department of the Archdiocese that will allow for a detailed examination of parish plant, activity and personnel. A record of 4,000 characters of information will be stored on each parish within the Archdiocese, and will contain information on mass attendance, sacramental and liturgical activity, social clubs, work load of personnel, together with historical data for cross reference.

Catholic Charities

Since this arm of the Archdioces is responsible for numerous works of child care, the sick, the aged and others in material need, a good deal of its activity is directed towards fund raising. Systems have been developed for pledge payment programs as well as for processing information about outright cash gifts. Through the use of the computer, reminder notices are mailed to donors in the various plans. From this data base statistics giving trends in geographic areas are derived and analyzed. This type of information, coupled with responses to questionnaries provided by team workers and donors, helps to spot strengths and weaknesses of the various programs, and provide accurate information for future planning,

Aside from the above, other aspects of financial reporting for several of the agencies associated with Catholic Charities round out the spectrum of activities in this area.

Method of Operation

In essence then, the DATA SYSTEMS CENTER of the Archdiocese of New York, is a service bureau processing information for parishes, schools, cemeteries, administrative offices, pension plan, child care agencies, and all of the numerous other organizations affiliated with a Church structure having 1.8 million members in a geographic area of 4,000 square miles. To process this information, the Archdiocese uses a UNIVAC 9400 with 98K of memory, three 8414 disk drives, four 12C UNISERVOS, two printers, a card reader, a card punch and a 2703 optical document reader. The staff of the Data Center consists of both lay personnel and religious (members of religious orders). One of the more unusual aspects of the staffing is the location of keypunch/verification equipment in cloistered convents. Here the Sisters, who have chosen to follow the contemplative life, use their manual labor time to keypunch data files for processing at the Data Center.

Thus, all of the activity of the Center is focused around the administrative needs of a large metropolitan Archdiocese that shares many of the same problems as municipal governments in large urban areas. The demands that are made upon this structure for service are innumerable and of course, these seemingly limitless demands must be met with limited resources. Hence, the Church must strive for an efficient allocation of resources both in the area of personnel and funds. This is no easy job today in view of the decrease in Church attendance as well as the spirit of freedom resulting from the teachings of the Second Vatican Council. It is an increasingly difficult problem to balance the decreasing resources with the ever growing needs and demands of the urban environment. Thus, it is that the Church has turned to data processing to assist in the work of monitoring resources and providing the necessary control that will allow for the most efficient use of personnel and funds.

Conclusion

In an age of advanced technology, even the most traditional of organizations must rely on data processing if it is to meet the demands placed upon it by society. Most assuredly, Christ did not wish the preaching of the gospel to be done in a careless and

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The Impact of Computers on Undergraduate Mathematical Education in 1984

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"To my mind, the use of computers is analogous to the use of logarithm tables, tables of integrals, . . . Far from muddying the limpid waters of clear mathematical thinking, they make them more transparent by filtering out most of the messy drudgery which would otherwise accompany the working out of specific illustrations."

1. High School Preparation

Although the mention of 1984 suggests a mood of Orwellian gloom, I think there are grounds for cautious optimism if mathematicians are willing to show restraint, to plan honestly and carefully, and to follow up their plans with effective and proportionate action. Now that our post-Sputnik euphoria has faded, and the post-war baby bulge and prosperity have had their impact on college enrollment, it seems clear that the mathematical community is faced with a return to a more normal balance between supply and demand. As a result, mathematicians as individuals seem likely to be less affluent in 1984; as a partial compensation, they should be able to receive and provide better education!

If our present rate of production of Ph.D.'s continues, which seems to me likely, we shall have about 15,000 new Ph.D.'s in mathematics by 1984. This great reservoir of highly skilled talent can greatly improve the quality of mathematical education, provided that Ph.D. training is broadened* and geared more realistically to our national needs. In particular, it can greatly improve the quality of undergraduate mathematical education, especially if incoming students and their teachers have clearer ideas about the power and limitations of mathematics. Since the number of Americans of college age will be smaller than now, students should be able to get considerably more faculty attention.

It should also be possible to raise substantially the level of high-school mathematical education, by taking advantage of the "buyer's market" which is already here. At present, relatively few high-school teachers know as much as a B.A. in mathematics who has had training meeting CUPM standards. The possibility of improving the quality and level of high-school education is, to be sure, only a very pale silver lining to the dark cloud currently threatening widespread unemployment among mathematical Ph.D.'s, but I think we should make the most of it. Actually, many high-school teaching jobs pay tolerably well. Therefore, if our school systems can be persuaded to select and promote teachers on the basis of how well they understand and can communicate the subject which they teach, our high-school mathematics teachers of 1984 should be able to prepare students much better. Specifically, a large fraction of entering college students (they are already 4-8 years old!) could have an understanding of the meaning of differentiation and integration, at least as applied to polynomial functions.

In any case, present trends indicate that most college students in 1984 will be acquainted with computers and the rudiments of at least one programming language. This will make it much easier to utilize computers in standard mathematics courses, a possibility which I shall discuss next.

2. Calculus with Computers

First, consider the calculus. I think that the interest and "relevance" of calculus courses can be greatly enhanced by a little judicious use of computers. Preferably, this should be done on interactive terminals, and graphic output capabilities should be available for at least classroom demonstrations.

I gave a freshman honors calculus course using computers last year; the cost per student for the use of terminals might have averaged $20-$25 per student per term. (In all, 35 terminals were available within our Faculty of Arts and Sciences; these and 35 others at the Business School used a PDP-10 as a time-shared central processor; experience indicated that this processor could really only handle 50 terminals at one time.)

In my course, students used the computer to tabulate functions, to solve equations, to tabulate

* Esoteric research might well be de-emphasized; see I. Herstein, This Monthly, 76 (1969) 818-824.

Based on a talk given at the Mathematical Association of America meeting at University Park, Pa. in September, 1971, and reprinted from, and

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inverses of monotonic functions, to compute definite and indefinite integrals, and to compute partial sums of power series. Students were given the names of "debugged" programs which had been written by my teaching assistants, Bruce Levin and Ben Setzer, and whose construction had been carefully explained in advance. The main purpose of having the students use the programs was to make existence and uniqueness theorems and sequential convergence (the limit concept) more vivid and convincing.

We also tried to teach the students about differences in the rates of convergence of different algorithms — e.g., of the bisection and Newton-Raphson methods for solving equations of the form $f(x) = 0$; and of the three methods of Riemann sums, trapezoidal quadrature, and Simpson's rule for evaluating integrals. Finally, we tried to bring out the great power of the computer for solving problems to any desired degree of approximation — such as the initial value problem $y' = y, y(0) = 1$, whose solution defines the real exponential function.

The significance of the computer output would have been much more easily absorbed and more suggestive if the numerical printout had been represented graphically. (This and several other pertinent observations made here were suggested to me by my colleague Donald Anderson, whom I wish to thank here.) One can hope that, by 1984, this will be possible and fairly economical on an easily automated basis. It would make it much easier for students to visualize more advanced concepts of the calculus, such as conformal transformation of the complex plane, curvature and torsion, and lines of (principal) curvature on a surface.

3. Numerical Algebra

As everyone knows, computers also make it easy to solve (again approximately) algebraic equations whose unknowns are real or complex numbers. In particular, they greatly facilitate the solution of simultaneous linear equations and other problems of real and complex so-called linear algebra and polynomial algebra.

Without computers, students cannot in practice handle more than 2 x 2 and 3 x 3 matrices without an excessive amount of drudgery. Whereas with readily available computer programs, the solution of (say) five or ten simultaneous linear equations in as many unknowns becomes a routine matter. So does the calculation of the eigenvalues and eigenvectors of the coefficient matrix, although I doubt whether sophomores can appreciate the reasons underlying the computer algorithms used. (In this connection, see Forsythe [4].)

In fact, perhaps the biggest objection to using such programs, from an educational standpoint, is that they are too routine: nothing is learned from copying 30 or 110 n-digit numbers and waiting for the computer to print out the values of 5 or 10 unknowns x_i or z_i, except the difficulty of copying hundreds of digits without a single mistake!

Perhaps a step-by-step printout of what is obtained by different variants of Gauss elimination can be made interesting, especially if carefully selected "ill-conditioned" coefficient matrices are used, so as to bring out the value of pivoting, scaling, and symmetric Gauss elimination. However, I have had no experience in this area.

Neither have I had any experience with linear programming techniques. These should also be taught in courses on equation-solving, which seems to me a better name than either "linear algebra" or the high-sounding "theory of equations" of yore.

Such courses could also involve diophantine equations, for which solutions in integers are sought. These can also be solved by computers, using so-called integer arithmetic whose study also has, in my opinion, great educational value for mathematically minded students. In more advanced algebra courses, the related tool of polynomial arithmetic can be used to factor polynomials with integer coefficients exactly. In such courses (cf. Chapter 7), students could also be introduced to the fascinating subject of formula manipulation by computer.

4. Probability and Statistics

If the present trend towards the increasing use of mathematics in the biological, social, and management sciences continues, courses in probability and mathematical statistics may rival calculus courses in popularity by 1984. Though I have had no personal experience in teaching such courses, with or without computers, it seems to me obvious that their interest, scope, and professional vraisemblance can also be greatly enhanced by moderate use of interactive computer terminals.

For example, consider the Central Limit Theorem, which is the high point of our basic course on probability at Harvard. Why should not students make experimental comparisons between the numerical coefficients $\binom{n}{k}p^{n-k}q^k$ of the weighted binomial expansion of $(px + qy)^n$ for different positive integers n and real numbers p and $q = 1 - p$, and the asymptotic Laplace-Gauss approximations to these coefficients? Or compare Gaussian distributions with iterated convolutions of the uniform and other probability distributions.

Since statistics is so largely concerned with data analysis and data-processing, it seems even more obvious that computers can be helpful in statistics courses by making accessible to the student problems involving relatively large amounts of data — such as are typical in practical professional work. Actually, it may be easier to process masses of data than to find interesting and "relevant" (to the student) data to process!

5. Some General Opinions

To some, the idea of using computers in basic mathematical courses may seem to transform them into courses in applied mathematics. I emphatically disagree.

To my mind (see also Chapter 7), the use of computers is analogous to the use of logarithm tables, tables of integrals, carefully drawn graphs of the trigonometric functions, or carefully drawn figures of the conic sections. Far from muddying the limpid waters of clear mathematical thinking, they make them more transparent by filtering out most of the messy drudgery which would otherwise accompany the working out of specific illustrations. Moreover they give a much more adequate idea of the range to which the ideas expressed are applicable, than could be given by a purely deductive general discussion unaccompanied by carefully worked-out examples.

Therefore, I believe that the courses I have briefly outlined should be considered as basic courses in pure mathematics, to be taken by all students wishing to understand the power (and limitations) of mathematical methods. The extent to which logic is emphasized is a question which is almost independent of whether or not 20% of the work is done at a computer terminal. Actually, the fact that even one slip can ruin a computer program should tend to make students more rather than less receptive to the idea of achieving equally faultless precision in writing a mathematical proof — i.e., to mathematical rigor.

By making the material taught more obviously applicable to more typical and substantial problems, the use of computers in the basic courses outlined above should also make them more palatable as "service courses" for non-mathematicians. Thus, it should help to reverse the deplorable tendency of recent decades, of having special courses in "mathematics for engineers," thus encouraging engineering concentrators and mathematics concentrators to think of mathematics in very different ways. If we wish colleges to hire us and students to attend our courses, we must think of ourselves as serving humanity and not as high priests of an esoteric cult (or cults).

Finally, although the cost of providing enough computer terminals and time on a central processor is of course not negligible, there is every reason (including the potentialities of mass-production) to hope that it will decline in the next 10-15 years. Hence, if it is $3000 per terminal per year now (or $3 per hour), and $5 per hour for an auxiliary graphical capability, one can reasonably expect both to be available in 1984 for 10 hours per student in a one-semester course, at a total cost not exceeding $25.

6. Comparisons with Other Programs

Next, I should like to present some comparisons, in support of my thesis that it would be reasonable to implement the changes suggested above by 1984. If one compares them with two recently published CUPM recommendations and with the earlier "Goals for School Mathematics" as of 1999, one sees them as a quite reasonable compromise.

First, let me refer to the CUPM recommendations for an "Undergraduate Program in Computation Mathematics" dated May, 1971. Here it is proposed to offer a new major based on 5 one-semester courses in "mathematics," 4 one-semester courses in "computational mathematics," plus 3 one-semester courses in "computer science." The proposed courses in "mathematics" are on the calculus and linear algebra, to be taught following what I would call "the gospel according to CUPM." The proposed courses in "computational mathematics" are related to those which I shall discuss in Chapters 7-8 and those in "computer science" essentially follow the ACM recommendations.

To avoid misunderstanding, let me say that I consider the CUPM gospel sound for the average student of 1971. Moreover, the more modest "Course in Basic Mathematics for Colleges" also appeals to me for the general, not too ambitious student of today. I note that, like my proposals outlined in Chapters 2-4 above, the CUPM proposal recommends that about 20% of the time be devoted to the use of the computer. It is, however, much more modest than I would be, in that the advanced calculus and what used to be called "modern algebra" are conspicuous by their absence from the list of 9 basic one-semester courses proposed in the core program proposed.

I claim that, by 1984, even a minimal undergraduate concentration in mathematics should include versions of both the advanced calculus (including some fragments of complex function theory) and modern algebra, as well as an appreciation of computer programs such as those I have mentioned. Lest I be accused of being Utopian, let me quote from the "Goals for School Mathematics" formulated only 8 short years ago. At that time, the importance of training a scientific elite was overemphasized about as much as, in my opinion, the importance of catering to the bottom 10% of our school population is overemphasized today.

In his preface, the then Commissioner of Education comments that: "If one were to look for the most significant development in education over the past decade, it would be reasonable to single out the wave of curriculum reform which has swept the school system...." "Can the goals set forth in this report be trusted? Can we be confident the curricula set forth here will indeed be the optimum curricula for 1999? As the years pass, these goals may well change, but at least" (if we take steps in the direction indicated) "we will be in motion in the general direction of the new goals, and in a fair way to get there sooner or later."

These brave new goals for elementary and high school education included the following:

- Grades 3-6 (p. 36): Finite fields and 2 x 2 matrices.
- Grade 7 (p. 43): Euclidean algorithm, polynomial rings, modular arithmetic, complex numbers as residue classes of polynomials mod $x^2 + 1$, derivative of a polynomial.
- Grade 9 (p. 45): Fundamental theorem of the calculus.
- Grade 10 (pp.44, 46): Linear algebra.
- Grade 12 (p. 46): Differential geometry of curves in space, integral equations, Green's functions, variational and iterative methods.

My proposal would be to include these topics, and the others recommended for school mathematics in the pamphlet from which I quote, at least for concentrators in college mathematics by 1984, along with their implementation by computers, using certified codes on time-shared interactive terminals. I think that, given the additional four years, this should be possible.

7. Discrete Mathematics

The proposals outlined in Chapters 2-4 were intended essentially to up-date existing basic courses in college mathematics by providing students in them with modern tools. I would regard the up-dated courses as sound introductory courses in pure mathematics for concentrators, which could also be used as service courses. Since they do not require any knowledge of physics or any other subject (including computing) outside of mathematics, they are not applied. Neither do they displace any existing courses.

I shall now outline two special areas of applied mathematics which seem to me suitable for new courses, to be widely taught by 1984. I think that the inclusion of these in the curriculum will help to remove the odor of sterile scholasticism from mathematics, an odor which some pure mathematics seems to me to have been acquiring during the past 30 years, partly under the influence of the prestigious M. Bourbaki.

The first of these proposed "applied" courses concerns what may be called discrete mathematics, the name of a course introduced over 10 years ago at Harvard by Howard Aiken, while director of our computation laboratory.

This course was given somewhat in the spirit of the Kemeny-Snell-Thompson "Finite Mathematics". But the topic of linear programming, treated in that classic, belongs to real and complex algebra and so is not strictly discrete. Rather, our course in discrete mathematics is intended to be a course in what computer scientists call non-numerical mathematics and symbol manipulation, and which corresponds roughly to "modern algebra" as envisaged by van der Waerden.

I might possibly describe the content of the kind of course I have in mind in an hour, but not in five minutes! In this short time, I can at best indicate its nature by giving a few references. In some sense, it represents an extension of the ideas described in the course CM3 on "Combinatorial Computing" of the proposed CUPM Program on Computational Mathematics. For this, the best introduction is probably still Beckenbach's "Applied Combinatorial Mathematics" [1].

However, the general nature of the area is better indicated by the word algorithm, a very central topic which will, hopefully, be given a reasonably encyclopaedic coverage by the seven projected volumes by Donald Knuth [6], of which two (dealing with algorithms) have already appeared.

In my opinion, the concept of algebra in the general sense of symbol manipulation is also near the heart of the subject. I have explained my ideas on the subject elsewhere [2], and shall not repeat them here. I have also written with Prof. T. C. Bartee a textbook [3] for the course on "Modern Applied Algebra" as currently taught at Harvard. This course emphasizes applications of modern algebra to the communication of digital information and the design of digital computers and artificial languages.

A central problem of communication theory concerns the optimal coding of binary information (expressed in strings of 0's and 1's). It may surprise you to learn that this optimization problem is equivalent to the following sphere packing problem, an n-dimensional analogue of the geometrical sphere packing problems described by Victor Klee in the MAA film "Shapes of the Future." The problem is simply to "pack" the largest possible number of spheres of radius r, centered at vertices of this n-cube, so that no two overlap!

8. Numerical Mathematics

The subject of numerical mathematics should provide plenty of material for another half-course in the "applied" aspects of mathematics. Before the advent of the computer, German technical universities already offered such a course under the suggestive name of "practical mathematics," as a kind of laboratory course in actually using mathematics as a tool for grinding out correct answers.

Such a course becomes infinitely more attractive when the student can tell the computer to do the work, only being careful to give correct and unambiguous instructions! This allows scope and motivation for accompanying the cook-book approach to algorithms (which is important!) with theoretical understanding.

Besides numerical algebra, including iterative methods, there is an enormous area of numerical analysis from which topics can be selected for study. This includes numerical quadrature; the approximation of numbers and functions; the numerical integration of ordinary and partial differential equations; the constrained and unconstrained minimization of functions; the numerical solution of integral, difference, integrodifferential and differential-delay equations, and so on.

9. Individual Study

If the preceding discussion fails to delineate ideal standard courses, to be taught uniformly in hundreds of classes over the country, perhaps from a master video-tape, I am glad. I think that diversity is one of the most important qualities in education. The only place for uniformity is in setting minimum standards of achievement and a reasonable norm from which individual instructors should feel free to digress in moderation.

I do not see the most fruitful evolution as taking place in giant leaps, during which herds of mathematics teachers are forced by slogans such as "the new mathematics" to climb docilely onto one bandwagon after another. Even if these leaps seem to be recommended by CUPM, SMSG, or other prestigious committees. Each institution has its own clientele and each individual has his own interests and problems. I see no surer road to mass unemployment than the mass-production of a large number of "mathematicians" having nearly identical skills.

Therefore, I hope that 1984 students will have opportunities for individual reading and thinking, supervised by one or more faculty tutors, and culminating in term papers or even undergraduate theses. For a qualified tutor, such supervision should require at most a half-hour per week per student, and it is usually educational for both parties concerned.

Through such deeper study, students should acquire a greater awareness of and respect for how much is known, as well as some sense of proportion as to what "research" means. More important, tutorial work helps students to learn how to read critically, to think for themselves, to evaluate their interests and capabilities, and above all, to express their ideas clearly. All of these capabilities are too often insufficiently developed among beginning graduate students. A thesis project may also help a student to decide on what profession or professional training is best suited to his needs and aspirations.

Of course, pure mathematics abounds in fascinating thesis topics for the intellectually curious student who is attracted by the precision and certainty of mathematical thinking. For those many students having more eclectic interests, however, applications of mathematics to real-world problems may have greater appeal as being more "relevant." Such students can also begin to get some idea of the power and limitations of computers by trying to see how much more can be accomplished by suitably constructed computer programs.

10. Scientific Computing

In particular, many good topics for individual study come from the area of what I like to call scientific computing: the making of exact predictions on the basis of suitable mathematical models of reality. This area could also provide a sequel to my proposed half-course on numerical mathematics. Such a course (or study) might well emphasize comparisons between mathematical predictions with experimental observations — I know of no better way in which to learn to appreciate the power and limitations of mathematics — or between theory and reality.

Scientific computing is an old field, as old as (exact) science itself; it dates back at least to the Babylonian astronomers. Even today, the construction of artificial satellites and spacecraft exploring the solar system has made calculations of orbits again timely. (See "Orbit Theory," G. Birkhoff and R. Langer, Proc. 9th Symp. App. Math., Amer. Math. Soc., 1957.) The verification of relativistic effects and the accurate determination of planetary masses offer other challenging topics for study. (See Science 174 (1971) 551-556.)

The intellectual challenge of scientific computing has been appreciated by such men as Newton, Euler, Gauss, Jacobi, and von Neumann. Their contributions include Newton's method for solving algebraic equations, Euler's methods for solving differential equations, Gauss elimination, and von Neumann's emphasis on pivoting scaling, and considering a "condition number" in using Gauss elimination.

The "sphere packing" problem which I mentioned at the end of Chapter 7 can be considered as a very difficult problem in scientific computing; so can the related question considered by Gauss, of locating n equal charges on a sphere (or a torus) so as to minimize $\Sigma_{i \neq j} 1/r_{ij}$, where r_{ij} is the distance from the ith point to the jth point. So are many problems from number theory, such as the determination of the number N(r) of lattice points (m,n) satisfying $m^2+n^2 \leqq r^2$, as a function of r. How much does this deviate from πr^2? (This question is discussed in [5].)

The preceding problems are fascinating from an algebraic and combinatorial standpoint. More typical of contemporary scientific computing, however, are the membrane eigenvalue problem and the Dirichlet problem: the problem of solving the Laplace equation $\nabla^2 u = 0$ in a general (plane or spatial domain), given the values of u on its boundary. These make especially good thesis topics, because they illustrate so many classic and modern mathematical and computational techniques whose study should help to give the student maturity.

Before attacking problems in scientific computing such as the preceding, students must of course acquire a considerable mathematical and physical background to appreciate what is involved. This background should include several traditional courses, including those mentioned in chapters 2-4 and junior-senior level courses in probability or statistics or differential equations. In addition, a solid course in numerical analysis and an ability to program are necessary. Finally, the student should have taken a course which makes clear the value and limitations of mathematical models, and have gone deeply enough himself into some field of application to appreciate the role of models in that field.

Besides, the student should have some background in the field of science to which the model is to be applied. In the past, the most successful and sophisticated mathematical models have been developed by astronomers, whose success is indicated in the expression "astronomical accuracy." However, problems from the newer areas of economics, biology, management science, and computer science itself are assuming an ever-increasing importance.

No matter what field of application is chosen, I think that a successful attack on a good problem in scientific computing provides excellent preparation for graduate study in applied mathematics or computer science or scientific computing — as well as for engineering science, actuarial work, and many other professions, including business and management science.

And by 1984, I think that our complex and highly technological society will need (and reward) many skillful practitioners in all these fields. I therefore hope that our colleges will provide the appropriate mathematical training, encouragement and sense of proportion. Finally, I think it will help very much in providing these, if college curricula contain the kinds of courses which I have tried to describe above.

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haphazard fashion. Hence, if the computer can assist as a tool for bringing the "good news of the gospel" to more people in a meaningful way, then the place of technology in the Church will have been worthwhile and significant. There are those who object to automation in Church administration, feeling it is too slick and businesslike and smacks somewhat of the market place. It would be a great interest to ascertain the reaction of such people if on entering one of our hospitals they were confronted with the medical technology of 1900.

Then too, some of the younger element of society is rather disenchanted with established institutions in general; they feel that automation in the Church is much like "the abomination of desolation in the holy place" spoken of by the prophet Daniel. Yet for all of the excellence of the ideals they espouse, there are apparently no alternatives that will result in the housing of the orphaned, the care of the aged, the instruction of the ghetto child or any of the other works of the Church. To work in such areas, the Church needs people and money, and presently both items are in desperately short supply.

Given the reality of diminishing resources and ever-growing needs, it is hoped that the modern techniques employed through data processing will assist in resolving the pressing needs of today and to develop meaningful plans for the future that will permit the Church to expend its resources in an effective manner. With such techniques, it is hoped that the free will offerings of contributions will be expended in a series of programs that will have great value and significance for members of the Church and for society in general. □

Good Management of Computer Operations:

1. The Whys and Why Nots of Facilities Management

2. Computer Operations: A Little Attention Can Yield a 30% Productivity Increase

ADL Systems, Inc.
A Subsidiary of Arthur D. Little, Inc.
Acorn Park
Cambridge, Mass. 02140

". . . recent experience with facilities management indicates a growing acceptance by users . . . Just as clearly, we find, facilities management certainly is not for everyone. . . . Like an old shoe, it must fit comfortably or it won't fit at all."

PART 1

"For the first time in ten years, I get what I want without having to hire, fire, threaten or listen to a million excuses. I never thought data processing could run so smoothly."

"Any manager who willingly turns over his company's most critical data to the hands of a total stranger is incredibly naive. What outsider can care as much?"

These two recent comments from senior managers illustrate the polarity of opinion that surrounds one of the fastest-growing sectors of the computer service field — facilities management.

At its most general, facilities management is a comprehensive information processing service in which an outside supplier assumes some level of line responsibility for the operation of a computer facility, over which he has, in effect, "hire-fire" control.

Our recent experience with facilities management indicates a growing acceptance by users of such a seemingly profound role for an outsider. Just as clearly, we find, facilities management certainly is not for everyone. Although adaptable to individual user needs and offering quantifiable benefits in most cases, facilities management requires on the part of the user an attitude of almost total acceptance. Like an old shoe, it must fit comfortably or it won't fit at all.

Here we will examine some of the benefits, risks and styles which characterize facilities management usage today and which users should be mindful of when considering such an approach.

What's in it for Me?

"I got serious about turning over our EDP operations when the level of pain just wouldn't subside." That's how a vice president of a large brokerage firm described his decision to arrange for a facilities manager.

His statement, like so many on the subject, suggests the most fundamental reason why computer users turn to facilities management: frustration. Or, put another way, a cumulative dissatisfaction with the results of in-house EDP efforts.

While such emotional and psychological factors often play a role as catalysts, very few decisions are in fact based upon them. More frequently, the justification for a facilities management decision is based upon one or more of four major anticipated benefits, including:

- General performance improvements
- Cost reduction or control
- "Permanent" solution to internal problems
- "Temporary" acquisition of specific skills

General Performance is Improved

By far, the desire to obtain a sustained improvement in EDP operation results is the major motivation. And substantial improvements often do result. Nearly three out of four users of facilities management have reported, in fact, that their EDP performance now, under a facilities manager, has improved "better than they expected."

The reasons for these improvements are several. First, a facilities manager can, in many cases, provide more professional and efficient management capabilities. This is achieved not only through the local site manager and his staff but also by the management skills, style and incentives of his parent organization.

Second, such a service can also provide ready access to a reservoir of highly skilled technical personnel who may be needed only occasionally or who can not be recruited because their professional interests are more in line with the activities of the facilities manager.

Third, many facilities managers maintain their own hardware configurations which, because they are shared by several users, can offer each individual user far greater performance capacity.

Costs can be Reduced

Savings, too, can be substantial. Often these cost improvements are not the result of direct savings, such as through eliminating equipment or personnel, but instead through the imaginative use of computer resources. The practice mentioned above of ownership by the facilities manager of all hardware enables the manager to distribute both costs and billings among several users, thus reducing expenses for each.

In addition, many firms offer incentives to clients, such as royalties or commissions on the sale of hardware time or software products or services, or fixed-fee arrangements with performance incentives that are attractive to both parties.

As a result, actual dollar savings often exceed 25 per cent. For companies spending $1-$5 million annually on EDP — the major target for facilities managers — such cost reductions are attractive indeed.

Problem-Solving a Lure

Very often internal problems lead to the facilities management decision. Staffing quality, high personnel turnover, chronic nonresponsiveness to needs and fundamental conflicts, both philosophical and practical, between user and EDP departments, are often overcome when an outside service enters the scene.

The "permanence" of these solutions varies, but since many facilities management suppliers offer a level of competence that few users can attain on their own, the promise of real and permanent improvement is an appealing cure to many potential facilities management users.

"Temporary" assistance with a major program that has urgent time requirements or special skill requirements is one of the most frequent routes to facilities management. Typically in such a situation, a user will retain an outside service to develop, implement and manage a distinct part of the EDP whole. Although the original intent is a start-up relationship, these "temporary" arrangements very often lead to permanent relationships.

Usage: As Varied as Individual Needs

Historically, facilities management began within the aerospace program and encompassed, in many instances, far more than just computer center operations. NASA, for example, turned over responsibility for entire support programs to firms such as Pan Am and Chrysler. More specifically, the computer facilities at Houston were operated under a facilities management agreement.

From these technology-related fields, facilities management has extended its reach into virtually every aspect of computer usage. As a result, facilities managers now offer a great variety of services, creating a market that today exceeds $200 million in annual revenue. Within this market, the types of services are as varied as the suppliers and their customers. For example:

- A small Northeast service center manages several System/3 sites, sells software it develops for those sites, and rebates a fee to its customers, most of which are small distributors.
- Several New York firms do the entire back-office accounting job for a host of brokerage houses whose attitude — "We are in the brokerage field, not the EDP business" — has created a very large facilities management market.
- In healthcare, a half dozen firms have been set up to deal exclusively with the massive task of claims and recordkeeping.
- A small software firm acts as a middleman for two large and competitive insurance firms, each of which shares an IBM 370/145 to perform specialized tasks perfected by the software house.
- A small manufacturer turned over his two separate computer operations, one run in-house for about half the company's divisions, the other run by an outside manager for several large divisions.
- A major aerospace firm, in an effort to leverage its computer capability and reduce overhead, services several dozen clients on a modified facilities management basis.
- Even service bureaus specializing in data preparation have entered the market. Numerous such firms now "manage" the entire data entry operations for their clients on a "turnkey" basis — in some cases rebating funds when error levels exceed a predetermined point.

What of the Problems?

Even with this rapid growth, performance expectations of users have been generally met. However, facilities management is new enough that many problems are just starting to surface, and there have been some disappointments.

Lack of sufficient depth and resources, the loss of key staff personnel, and financial failure are three of the most common problems of facilities management firms.

At the user's doorstep is the problem of improper preparation. This is most often evidenced by a continuing series of changes in direction, project priorities, and personnel interfacing — situations which create an almost intolerable strain on the relationship, regardless of the commitment of both groups.

Both parties contribute to certain other problems. For instance, poorly constructed contractual agreements, in the absence of a good faith commitment by either or both parties, have created both aggravations and detrimental operations in some reported instances.

In addition to these basic problems, there are other real and potential dangers which a user should consider in any evaluation of facilities management.

One of these, echoed in the opening quotation, is the user's loss of control. There is, in properly structured facilities management arrangements, a transfer of responsibilities from the client to the manager. This is at the heart of the service, and a user contemplating such a move must accept a shift of control as a principal fact.

There is also the problem of vulnerability. Because control is diminished — in effect, given up

— many users fear they are vulnerable to the imperfections and inadequacies of an organization whose performance, in many instances, they are unable to judge until it is too late.

Another problem centers on personnel. In some situations in which user and management firm staffs coexist for a common purpose, jealousies, in-fighting and communications breakdowns have occurred. This is a factor that requires management sensitivity before and during the relationship.

An additional issue is the potential lack of responsiveness. By necessity, the arrangements between client and manager must be defined in some detail; performance beyond these specifications can be difficult to obtain unless provision is made in advance — in terms of contract stipulations, incentives, and other forms of motivation — to assure responsiveness to new needs.

Are You a Candidate?

In the face of all these potential dangers, what leads a company to a facilities management relationship? The factors are numerous.

In many organizations, a fundamental dichotomy between data processing staffing levels and other operations is a principal cause. Often salary levels, career path problems, an "understanding gap," or basic organizational objectives create conflicts which facilities management can help overcome.

Mergers, acquisitions and other forms of amalgamations which require a blending of diverse EDP operations and talents into a centralized function, often within a limited time frame, are others.

Management emphasis is also a key factor. Increasing numbers of companies have concluded that data processing, while an important adjunct to their basic business, is a function that can and should be operated separately. This is especially seen in trade groups, quasi-public agencies, and in some multi-divisional organizations which rely on a central but separate activity for processing information.

Another factor is attitude. In many well-run firms, management accepts the need for data processing but refuses to develop it internally, preferring an outside service to be responsible. Often this attitude is based on a conviction that it can be done better outside, while avoiding dilution of management's central interest — further concentrating on its basic objectives. This has created major markets in retailing, discounting, brokerage firms, and in cooperative efforts in fields such as banking, utility data processing and food services.

What is the Outlook?

The costs and complexity of information processing systems continue to increase and despite these real and potential dangers mentioned above, facilities management continues to grow very rapidly. Aside from over-all performance improvements, cost reductions and controls, resolution of chronic problems or relief from temporary ones, the conviction of most companies who have turned to the concept seems to be, as expressed by the president of a West Coast manufacturing company:

"Our management skills and priorities are focused on making and selling instruments. For these we buy all sorts of components. We look for high quality at low costs. To us computer capabilties are like a component which we think we are better off buying than making."

PART 2

"It's the one part of my computer activities that is really tangible. But it's lots of unglamorous little things, so I find that I spend my time on the other issues and leave the routine matters to my managers."

The "it" in this case refers to what traditionally is considered the most mundane aspect of data processing — computer center operations. And the comment above, made by an airline EDP executive, comes close to summarizing management opinion on the subject.

But, in fact, machine operations produce the EDP "product." "It" is the production line of the information system function and there are strong similarities in the principles for efficient EDP operations and ordinary factory production. In many instances, more than a 30 per cent increase in productivity may result from additional management attention to this area.

Senior managers can play a significant role in improving computer center operations, especially those aspects relating to personnel, housekeeping, performance measurement and mechanics.

Defining the Operations Universe

Computer operations generally includes the following six "line" areas:

- Data preparation — converting source documents into machine-processable units such as punched cards, optically-read documents, and various forms of key-entered data.
- Data control — organizing data into forms and system flows so that it gets where it is supposed to in the proper format at the proper time.
- Scheduling and staging — assembling all of the needed data, in proper machine form, for orderly computer processing.
- Machine operations — managing data as it is processed, including console control, use of hardware devices, and proper machine handling.
- Output control — checking that the right data has been organized on files, on paper, and in proper order for dissemination and use within the organization.
- Work delivery — assuring that the output gets to the right department at the right time in an orderly sequence.

Achieving the full productive potential of today's EDP hardware requires careful attention to all of the "line" areas mentioned above. Timely and accurate data preparation is important. Staging of work is essential to avoid lost time later. Feeding the work through the machine is critical. Finally, careful distribution of output is necessary to avoid wasting the previous effort.

Hardware costs are a substantial portion of the EDP operations budget. Assuming that you have a balanced configuration matching your needs — an important but separate topic — it is then important to give attention to realizing the productive capability of this equipment. This is where people become important.

Therefore, a new look at your operations personnel might be in order.

Review Your Personnel

Start with the matter of career path. An old myth in the EDP business is that personnel should move along a career path from operations to programming and then to systems design. In the process, many fine operations personnel have been converted into marginal programmers.

The computer operations function is sufficiently critical that it should have a career path of its own, made attractive by the same status, policy, and incentive considerations given to other skills groups. This does not mean salary incentives or escalations alone; almost never, in our experience, have salaries been the only cause of general complaint. It does mean establishing methods of recognition, reward, and motivation.

Attitude plays a major factor in obtaining sound performance in the operations area. Incentives, career path planning, programs that insure stable staffing levels, training efforts, and broad review of personnel procedures and policies must be the starting point to realize such gains.

. . . And Then Tackle the Web of Detail

The checklist below lists some of the most common problems encountered in computer operations. If your organization reports some of these problems on a fairly regular basis, then you can be sure it is time to look into the performance of your operations group.

Operations Review Checklist

- ☐ There are regular delays in getting production-type work completed.
- ☐ There is a high level of job reruns in the computer center.
- ☐ There is a regular need to schedule extra machine time because of job overflow.
- ☐ There is a regular flow of requests for additional hardware components, or complaints about hardware inadequacies.
- ☐ There appears to be a general lack of orderliness in physical plant, report flow, and internal procedures.
- ☐ There is a relatively high rate of personnel turnover in the operations staff group.
- ☐ There is no development program or route of advancement for operations personnel.
- ☐ There is a relatively high, chronic level of keypunch or data entry errors.
- ☐ There is a high level of reported hardware failure or hardware maintenance problems.
- ☐ There are a limited number of internal performance measurement reports or procedures.

The checklist above lists some of the most common problems encountered in computer operations. If your organization reports some of these problems on a fairly regular basis, then you can be sure it is time to look into the performance of your operations group.

These key symptoms of operational disorder, we might add, are more likely to be found present in your organization than not. The real issue is the matter of degree. For example, a high level of reruns is an almost certain signal of difficulties, often caused by carelessness in operation. If overflow problems — most often represented by a backlog of jobs that demand machine rescheduling — occur frequently, it suggests operational difficulties, not user department difficulties.

And if your staff is constantly submitting requests for additional hardware components, justifying them on the basis of unforeseen workload increases, you might investigate utilization practices of existing equipment, and the ways in which your staff measures such utilization, before simply authorizing the addition of more equipment.

Most of these chronic problems are readily amenable to improved management because they deal in tangibles that are definable and easily measurable, with operation utilization and performance evaluation systems that are easily put into use.

You Can See Your Problems

Another step in determining areas of needed improvement is a tour of your computer room. It can tell you, very quickly, the level of management control that is being encouraged and exercised by your subordinates.

Take a walk into the machine room and observe the functioning of its personnel during a heavy job load period. Is there a great deal of motion? Are conversations loud? Are the personnel constantly on the telephone or intercomm systems? These are telltales of poor machine room layout, which is one of the principal causes of poor production efficiency. It has been said that kitchens have been studied more than computer centers for improved efficiency. A walk through most machine rooms would immediately confirm the fact.

Poor layouts strain personnel physically. They can require additional staffing. They create communications problems, such as illustrated by the console operator who must twist around in his seat, in the middle of a run, and shout instructions to his associate who, with his back to the console, is loading a disk pack some 50 feet away.

Equipment should be visible, organized in a manner that makes sight checks from a single location possible, and grouped for efficient face-to-face communications without shouting.

Check the physical flow of work from data preparation through scheduling and staging, machine input and output, and finally through output control and delivery. Are the tape and disk libraries convenient to the staging area? Are printer outputs, tapes, and disks properly routed for distribution or storage?

These questions may seem routine, but they have become more important with multi-programmed systems, commonly used today, where outputs may be generated long after the job has been completed as far as the central processor is concerned.

Even Little Things Can Help

Are the labels on tapes and disks legible and unambiguous? We have seen many which are undecipherable and cryptic, increasing the possibility for error. Do you have a means of displaying the particular job to which a particular peripheral is assigned? Such a procedure simplifies operations by reducing the conscious effort required for mounts and similar tasks.

Finish your tour by inspecting the storage areas of your operations center. Are supplies stored properly, with on-hand levels prominently posted? Poor stocking of cards, tapes, disk packs, paper in its many pre-printed forms, and other supplies has caused many hours of idle machine time. Most computer operators can recall instances such as the discovery, at 2:30 a.m., that there are no more printer ribbons to complete the eight-hour print-run then in process.

Do you have easy-access storage facilities for often-used tapes and disks, racks that make orderliness easy, labeling systems that are clear and enable differentiation, and binders that are durable and well-marked? Are change records, library checkout procedures, and neatness in evidence? What about simple things such as adequate storage to keep cards, tapes, and print-outs for different jobs from getting mixed up?

These are housekeeping items, to be sure, but they are a crucial part of the operation of your computer center. If a visual inspection shows inattention to these little items, you can be certain that it signifies lack of attention to larger, more significant details as well.

Next Check the Paperwork

Written communications are vital to coordinate machine operations and provide management controls. All too often EDP managers concentrate their systems analysis efforts on other departments, while ignoring their own needs. There are many cases where the adage "Physician, heal thyself!" applies.

Are the forms used for job control adequate? Do they properly identify inputs and outputs? What about special operator requirements, such as instructions for the night shift? Do the forms provide for recording of data on time-in/time-out for various stages? Think of the run request as analogous to a work order for shop operations, with its material requirements and operations specifications. Do you have a means of checking job status and expediting jobs if necessary, or do jobs get lost once they enter operations until they reappear at the other end?

Is your staff measuring itself and reporting these measurements on a regular basis? The functioning of a data processing center has never been more complex. Operations personnel must be more skilled than ever to be able to run equipment in a multi-programming environment, with the attendant problems of core fragmentation, priority scheduling systems, telecommunications demands, and exception conditions. They must understand and operate within complex software environments, and utilize hardware components with a wide range of performance capabilities.

The extent to which they do this well can be measured by internal reporting systems. Do they produce equipment utilization reports regularly? Do they compare current performance with previous periods? Are there workload forecasts and schedules, and are they compared — actual versus scheduled — on a routine basis? In the data preparation and control functions, are productivity reports a standard practice, and can supervisors trace these back to individual operators? Do you obtain regular comparative data on equipment performance?

Management feedback is a fundamental and valuable tool. Does your organization encourage it by displaying, on charts, graphs, posted listings, etc., the performance of individual groups? The types of visual indicators to look for are hardware performance charts — often by machine or hardware type — shift productivity trends, work flow schedules, properly displayed procedures and schedules, off-limits signs, and other imaginative graphic indicators that encourage pride and a higher level of performance.

Do you, or your key operations personnel, know the limiting link in your hardware configuration? That is the part of the hardware system that causes the next serious bottleneck as the workload increases. It might be I/O channels, core, printers, card input devices, or secondary storage. If your staff doesn't know this, it doesn't know its production system — a problem that would never occur in a manufacturing operation.

If your organization maintains a regular, orderly flow of self-measuring reports, it is likely to know what it's doing and have the pride to do it better. And the converse is also true. □

Guzy — *Continued from page 10*

Regulated or Free Economy?

In the final accounting, there are really only two choices for a country; a regulated economy or a free economy. The emerging national debate on the computer industry is to be encouraged and assisted so that viable alternatives to Government regulation and control can be brought forth. The goal which all of us seek is likely the same: an economy where the marketplace is the regulator. Gross imbalances in industrial power create unhealthy tensions within our economy, and feed the fears that opportunities no longer exist for the individual in our post-industrial society.

Within the context of the recent international discussions on currency values and national balances of trade, it has been widely accepted that artificially maintained currency exchange rates and large surplus balance of payments can have no place in an increasingly interdependent global economy. This point of view has been quite actively espoused by all major industrial states as well as our own government. I believe that it is an informed and correct point of view. But I might recommend that the same argument be extended into our domestic economy in this way: that no company, no industry, should continue to enjoy such a positive variance between its fair return on investment and its continued rate of growth.

It will take an informed American public and widespread cooperation from American business to bring about the readjustments necessary so that ordered and rational growth can proceed for the computer industry. □

Let's Break a "Time Honored" Rule

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One day when I was a little boy, I decided to be smart and wrote my homework that looked li ke this. The left margin and the right margin were as straight as the lines drawn with rule rs. It looked neat and I was very proud of my accomplishment. My pretty teacher was a very pleasant person. But when she saw my masterpi ece, she lost her usual mien. "Tom," said she , "you must not write this way. Haven't I to ld you many times that the first line of ever y paragraph must be indented and words should be separated only at the end of syllables? No w, you step to the blackboard and write your homework properly TEN times."

So I stepped to the blackboard and wrote my homework ten times in the proper way. The first line of what I wrote on the blackboard was indented as I was taught to do. I had no objection to that. A paragraph has a theme of its own and the indented line would indicate that it is different from the preceding paragraph. I liked the appearance of the left margin. It was as straight as I wanted. But the right margin looked like this and I wasn't a bit enthused about it. Although I didn't tell the teacher, I thought my method of aligning the right margin was better and neater than the way she wanted me to write.

After school that day, I had an occasion to look at a newspaper.I had,of course,seen newspapers before, but that particular afternoon, I noticed something I hadn't noticed before. Its left and right margins were as straight as this sample. And the strange thing about it was that the last letter of every full-length line was always aligned with the right margin; and where the last word was too long, it was cut only at the end of a syllable.

The next day, during recess, I asked my teacher how or why it was possible to print news columns with both margins straight as a ruler without splitting any syllable. Apparently she hadn't noticed or given a thought to it before. She studied the newspaper for quite awhile. Then she smiled and said, "These were set in movable types and it was possible for the typesetters to move the words to the right or to the left, or separate the words with wide or narrow spaces between them to make the right margin straight. Then the paper is printed. In our case, we write or type first. And once it is written or typed, we cannot move the words to align with the margin. Now, run along and be a good boy!"

Years have come and gone, but I still believe t-hat both the left and the right margins of our wri-ting or typing should be straight as this sample. I don't think that only the left margin should be st-raight while the right margin looks like something a goat has chewed off.

The right margin could be made straight if we w-ould split any word without regards to the integri-ty of the syllables. The rule requiring the divisi-on of words only between syllables and forbidding t -he splitting of any syllable is honored by custom and tradition, but has no merit. Why typists and t-ype-setters are required at the expense of their t-ime and labor to follow a rule that serves no cons-tructive purpose is difficult to understand.

Any rule, custom or tradition that ensures the n -eatness of written or printed matter, clarificati-on of expression or economy of space should be uph-eld; but one that burdens, makes the writing or ty-ping messy, and has nothing to contribute to the c-larification of expression or economy of space sho-uld be discarded. There is nothing sacred about the syllables or the rule concerning the syllables. Tr-adition or custom is not a sufficient excuse to pr-event any syllable from being split in a practical world that requires the greatest economy in writing , typing and printing time and paper space.

I, therefore, suggest that we make the right ma-rgin of our writing or typing as straight as the l-eft side by splitting at any point without regards to its syllables any word that might cross the rig-ht margin if left undivided. I also suggest that we use the traditional hyphen to divide the marginal w -ords except in a very rare case when a hyphen mig-ht cause a confusion. In the latter case, the use o -f a new symbol in the form of a dash and comma (-,) is suggested. The use of slash (/), the mathematic-al symbol of division is not recommended because it makes the margin look untidy and because it has be-en overused, abused, misused or too frequently inc-orporated into the names of commercial products and techniques and has become hackneyed.

Whenever any word ends with only one empty lett-er-space between it and the right margin, there is nothing that could be done but to leave it empty. J -ust as the left margin could permit the indentati-on of the first word of a paragraph and still rema-in straight, the right margin could also permit the indentation of one letter space and still maintain the overall straightness.

The suggestion made here may be disturbing to p-eople who are sentimental about old customs and tr-aditions. I, too, have a feeling for customs and t-raditions, but I am travelling, like the rest of th -e newer generations, toward the enlightened dawn o -f the Twenty-first Century, which, if God willing, I shall most likely see. I prefer to travel lightly by dumping the heavier and impractical customs and traditions and carry with me only the useful and en -nobling ones, so that when I shall see that glori-ous dawn of the first day of the next century I co-uld say, "Twenty-first Century! Here I come with my left and right margins as straight as the ruler!"

I do not recommend that we break the time-honor-ed rule at once or start writing, typing, or print-ing with the left and the right margins straight i-mmediately. There are several mechanical and manual difficulties involved in such a change-over. As in many other cases, there is nothing to gain by maki-ng any sudden or radical changes. Probably, we all could make the change gradually, extending through a decade or two. □

Analysis of the Autopsy on President John F. Kennedy, and the Impossibility of the Warren Commission's "Lone Assassin" Conclusion

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"In light of the obvious scientific inconsistencies and incomplete examinations it is indeed most puzzling why the government and representatives of the Kennedy family would not be eager to cooperate in a bona fide attempt to resolve these critical problems in a sound, objective and impartial medical fashion."

The assassination of President John F. Kennedy in Dallas nine years ago last week simply did not happen the way the Warren Commission said it did. I state this because it is clear to me, from a strictly scientific point of view, based on my examination of available records, that the commission failed to make its case.

Morever, it is my judgment that more than one person was involved in the shooting of President Kennedy. And I also believe that it is still possible to unravel the mystery — at least the scientific aspects of it.

The end of the thread is to be found in the assassination evidence in the National Archives, Washington, D.C. I was the first forensic pathologist — in fact, the first pathologist of any sort — outside the government to be permitted to inspect this evidence. I did so on August 23 and 24 of this year. Previous examinations were made only by the autopsy pathologists and a government-appointed panel in 1968.

However, I must emphasize at the outset that much of the autopsy evidence, including some of the most important material from the forensic standpoint, is not at the National Archives. For example, we know that the President's brain was preserved and that several sections were prepared for microscopic examination. Moreover, certain sections were taken through the skin at the supposed wounds of entry in the scalp and the upper back of the President. The preserved brain and these various brain and skin tissue sections were examined by the autopsy team about two weeks after the original autopsy, and additional photographs were then made. We know this because these items are described in the supplemental autopsy report included in volume 16 of the Warren Commission Exhibits. Yet, these items — the brain, the microscopic sections, and the supplemental photographs — are all missing from the National Archives.

Further, we know from testimony of Commander James J. Humes of the government autopsy team that color photographs were taken of the interior of the President's chest. These photos are crucial to a determination of the path of the bullet that purportedly entered the President's upper back. They are missing.

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All these items were supposed to have been turned over to the National Archives on April 26, 1965, by Admiral George Burkley, but they are not included in the inventory of items officially given by Mrs. John F. Kennedy to the United States government on October 29, 1966. There has been no accounting for this discrepancy, and I have received no reply to my written inquiries addressed to the official representative of the Kennedy family.

Yet, even without these vanished materials, the remaining evidence specifically discredits the "single bullet" theory of the Warren Commission Report. This evidence also underscores certain procedural discrepancies and omissions in the way the entire investigation was handled from a scientific, medical point of view.

In light of the available evidence, as scrutinized by a forensic pathologist, there are at least three reasons why the single bullet theory is implausible and scientifically untenable:

1. The bullet that is said to have struck both President Kennedy and Governor John B. Connally weighed, in its found state, approximately 159 gr. Such a 6.5 mm bullet in its pristine state weighs from 161 to 161.5 gr. Thus, the loss of substance in the found bullet was about 2 to 2.5 gr, or about 1.5 percent.

Yet this is the bullet that is alleged to have entered the right side of the President's back, coursing through the uppermost portions of the thorax and mediastinum and exiting from the midline of the anterior neck region at about the level of

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the knot of the tie. Thereafter, this same bullet is supposed to have entered the right side of Governor Connally's back, breaking his right fifth rib. It then exited from the anterior aspect of his right chest and entered his dorsal right wrist region, where it shattered the distal radius. Finally, it exited from the volar aspect of the wrist and entered his left thigh.

Now, an experienced forensic pathologist would expect a bullet that had done all this to have had a loss of substance much in excess of 1.5 percent.

Also, x-rays of the President's chest and the Governor's chest, right wrist, and left thigh show visible particles of material that everybody has agreed are metallic fragments from the bullet. Admittedly, these are quite small, but they are visible to the naked eye. It is my contention that it is simply not possible for a bullet to have left grossly visible, radiographically evident particles in four different anatomic locations in two human beings and to have emerged with a loss of substance of only approximately 2 gr out of a total of 161.

2. The bullet is fully jacketed in copper and measures about 3 cm in length. The upper 2 cm toward the nose of the bullet and the midportion of the bullet show no grossly visible deformities, areas of mutilation, loss of substance, or any other kind of significant scathing.

There is one small piece that was removed from the jacket by an FBI agent for spectrographic analysis, and the agent noted this in the records.

Otherwise, there is no deformity of the upper two-thirds of the bullet. The lower one-third shows minimal flattening, giving the impression that there was a slight squeezing of the bullet and a very minimal outpouring of the inner metallic core onto focal portions of the copper rim at the base of the bullet.

(If one can picture a volcano that has erupted slightly, with some of the lava coming up to the rim and congealing at certain points there, that is the general appearance of the bullet at its base.)

This is not the appearance of a bullet that has struck and fractured two bones, particularly the wrist bone. I say "particularly" because of that bone's thickness and density and the extensive fracturing that occurred.

A bullet that had caused such damage would have been more deformed and more mutilated (in a technical sense) and would have shown more markings and more loss of substance. Moreover, visual examination of this bullet shows that its copper jacket is completely intact. None of its weight loss, small as it is, could have come from any part of the bullet other than its base — that portion of the bullet that in normal flight is least exposed to fracture or impact forces during penetration of tissues. The nose of the bullet, the portion most exposed to such forces, is entirely smooth, except for the notch made by the FBI in taking a sample for spectrographic examination.

3. This single bullet, according to the Warren Report, came from the sixth floor window of the Texas School Book Depository Building. It therefore came on a definite angle of about 10 degrees from the right, as well as from above and behind the President. It entered the upper right side of the President's back and, again according to the Warren Commission, exited in the midline of the anterior neck, grazing the knot of the President's tie on the left side as it came out.

Also, traveling at this significant angle from right to left, states the report, the bullet struck no bone in the President's body and was not deflected by any kind of firm or rigid object either inside or outside the body.

However, Governor Connally, who was sitting directly in front of the President, as can be seen in the Zapruder film at the National Archives, was also supposedly struck by this same bullet. He was struck in the back near the right axilla, as all the testimony and exhibits show.

This means that the bullet, moving from right to left, entering the right side of the President's back and exiting from the midline of the neck anteriorly, had to have done a rather phenomenal thing: Just after exit, it would have had to make a fairly acute angular turn around the knot of the President's tie in midair, back toward the right, to enter the far right side of Governor Connally's back!

A diagramming of the course of the bullet clearly indicates that without this impossible turn, it would have passed the Governor on the left side.

If we take great liberties with the assumed position of Governor Connally, the bullet might have entered his back somewhere to the left of his vertebral column, but certainly not to the right of the midline.

I am surprised that only a very few people, even among the critics of the Warren Commission Report, have referred to this matter. And, of course, the commission's protagonists, defenders and apologists simply ignore it. It is the kind of thing that the commission never addressed itself to, never answered, never evaluated.

If confronted with the question, the commission people say: "Well, you can't be sure exactly what the President and Governor Connally were doing at the time; maybe the car lurched, and maybe somebody was thrown," and so on.

But there is no evidence that these things did happen, and much evidence that they did not.

These "maybe" defenses of the Warren Commission's conclusions are motivated by the same feeling of necessity that led to the single bullet theory itself. The fact that the alleged murder weapon, a sluggish, bolt-action, war-surplus rifle, could not be reloaded, reaimed and fired a second time in less than two and one-half seconds, plus the fact that Governor Connally was known to have been wounded less than two seconds after the President's first wounding, forced the commission to postulate that both men were hit by the same bullet.

That is the only way that one person, whether Lee Harvey Oswald or anyone else, could have done all the the shooting, and the commission needed that conclusion very badly. Because if one person could not have done the shooting, and there were two or more people involved, we have by legal definition a conspiracy — something much more sinister than the Warren Commission would have us believe.

I believe that there was a second assassin, most likely firing from the rear, but not necessarily from the Texas School Book Depository Building. So far as the available materials show, there might even have been shots fired from the front and right, from the so-called grassy knoll area.

The reason for this equivocation is that the bullet hole in the President's neck was described by physicians who observed it when they worked on him in Dallas as circular, symmetrical, small, uniform, etc. This led several of them who had seen a fair number of gunshot wounds to conclude that it was a wound of entrance, not exit.

Once it was determined that the bullet had ripped through the trachea, that wound was utilized, and understandably so, as the site of a tracheostomy. The pathologists who did the autopsy some seven to eight hours later at Bethesda Naval Hospital did not report having made any attempt to reconstruct the wound by pulling its edges together. As a matter of fact, they did not even realize at the time they did the autopsy that the tracheostomy had been superimposed upon a preexisting bullet hole!

Because of the missing autopsy materials, the autopsy findings do not stand on their own as scientific proof of a rear source of the shots. Instead, external data such as witness reports from Dealey Plaza had to be relied on to justify this conclusion. Indeed, a newspaper story is cited in the official autopsy report!

Likewise, because the microscopic autopsy slides were not available to me at the National Archives, I cannot determine whether all the shots were fired from the rear, or whether some were fired from the right front.

The missing slides could show microscopic characteristics of the epidermis and dermis that one sees with wounds of entrance and that are not found in wounds of exit. A forensic pathologist reviewing such a case as this should see such slides, if they exist. I find it rather disturbing that people who have previously reviewed the evidence have not commented on the absence of the slides and did not state that their unavailability seriously compromised any conclusions they reached.

As to the missing brain, photographs in the National Archives of the superior portions of the brain reveal a dark gray-brown object, generally parallelogram-shaped and measuring roughly 1/2 by 3/4 in. It has a slight focal shimmering effect in some pictures that could just be photographic artifacts or could be due to some light reflection caused by materials contained in the object.

Now, what the object is, I don't know. It could be a fragment of a bullet, or a brain tumor, or a vascular malformation. But, most amazing to me is that the autopsy pathologists, who could not have missed seeing it, never mentioned it! The review panel in 1968 did mention its presence and went on to say they could not tell what it was, but that was all.

Isn't such an item obviously significant in a case of gunshot wound(s) of the head?

The autopsy pathologists properly decided not to examine the brain in its "fresh," hemorrhagic state at the time of autopsy, but fixed it in formalin and went back to it for a supplemental examination exactly two weeks later.

However, at this time, they still didn't examine the brain, but simply took a few sections from the edges, stating in their report that "coronal sections of the brain are not made in order to preserve the specimen."

Especially in a case like this, coronal sections — parallel cuts spaced every 1/2 in. or closer from one side of the brain to the other — are the proper and routinely uniform way to examine a brain. In this manner, you can follow the bullet track(s), locate foreign objects, and so on. If you do not do this, you cannot know what the full extent of the pathology is in the brain.

To voluntarily omit such an examination is to be incompetent or a fool, and I do not believe the autopsy pathologists were either. I believe that they were instructed not to do a complete examination of the brain. The decision was not theirs.

So, without engaging in wild speculation, I think we can say that it is very clear that the brain should have been sectioned but was not, and that the brain was available at the time of autopsy but is not now.

Also, I think it is very clear that the autopsy pathologists did not comment on that object in the brain because, again, they were instructed not to.

I am disappointed that the review panel, which did see the object and did comment on it, but then passed it over, did not say in their conclusions: "We have to see the brain; we have to see the microscopic tissue slides. Unless we can examine these items of physical evidence, it is scientifically impossible for us to corroborate the conclusions of the Warren Commission Report."

I have requested from the official representative of the Kennedy family in this matter, in addition to his help in locating these missing materials, that they be made available, with the items already at the National Archives, to an independent team of experts.

I have specifically asked for the opportunity to go back to the Archives as a forensic pathologist with a group of specialists in neurosurgery, radiology, criminalistics, firearms investigation, and questioned document examination.

With all these people involved from a scientific viewpoint with this case, along with all the materials previously made available, and with several other tests that could be done, I think we would find the real answer to President Kennedy's assassination.

It is important to note here that two tests would answer some of the most urgent questions. Although spectrographic analysis was ordered — and presumably done — the results have never been made available. Also, neutron activation analysis — a test that was not performed — would enable us to match fragments of infinitesimal size with a known object. This could be done with the bullet (Exhibit 399) and the fragments still in the Archives. All this is vital information.

However, I am still waiting for a reply to my requests, which were made three months ago. In light of the obvious scientific inconsistencies and incomplete examinations, it is indeed most puzzling why the government and representatives of the Kennedy family would not be eager to cooperate in a bona fide attempt to resolve these critical problems in a sound, objective and impartial medical fashion. □

If It Had Happened Here

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People sometimes have difficulty visualizing the real significance of the statistics of a far-off war. With this in mind, Jane Kiely, with the help of John B. Casterline and Judith Wilson, all of whom are experienced in demographics, projected Viet Nam war statistics onto a map of the United States. Following is an explanation of their work.

Official statistics were transferred by percentage (rather than actual numbers) to the land and people of the United States. South Viet Nam rather than North Viet Nam, Laos, or Cambodia was used for the projection because more reliable data are available for South Viet Nam, and because it is the country the United States set out to protect.

Since statistics on war seem like just so many numbers, this map was designed to help Americans understand the magnitude of the Indochina war.

The ratio of the South Vietnamese population to the U.S. population is 1 to 11.3. This means that for every South Vietnamese killed or wounded or left homeless, 11.3 Americans are projected into the corresponding categories, in order accurately to reflect the impact of the war on a smaller population.

The land ratio is 1 to 55. That is, for every acre of land defoliated in South Viet Nam, 55 acres are projected onto the United States map, once again to reflect accurately the impact of the war on a smaller country.

Here are the statistics:

The total number of South Vietnamese killed during the war is 569,000 (U.S. equivalent, 6.4 million).

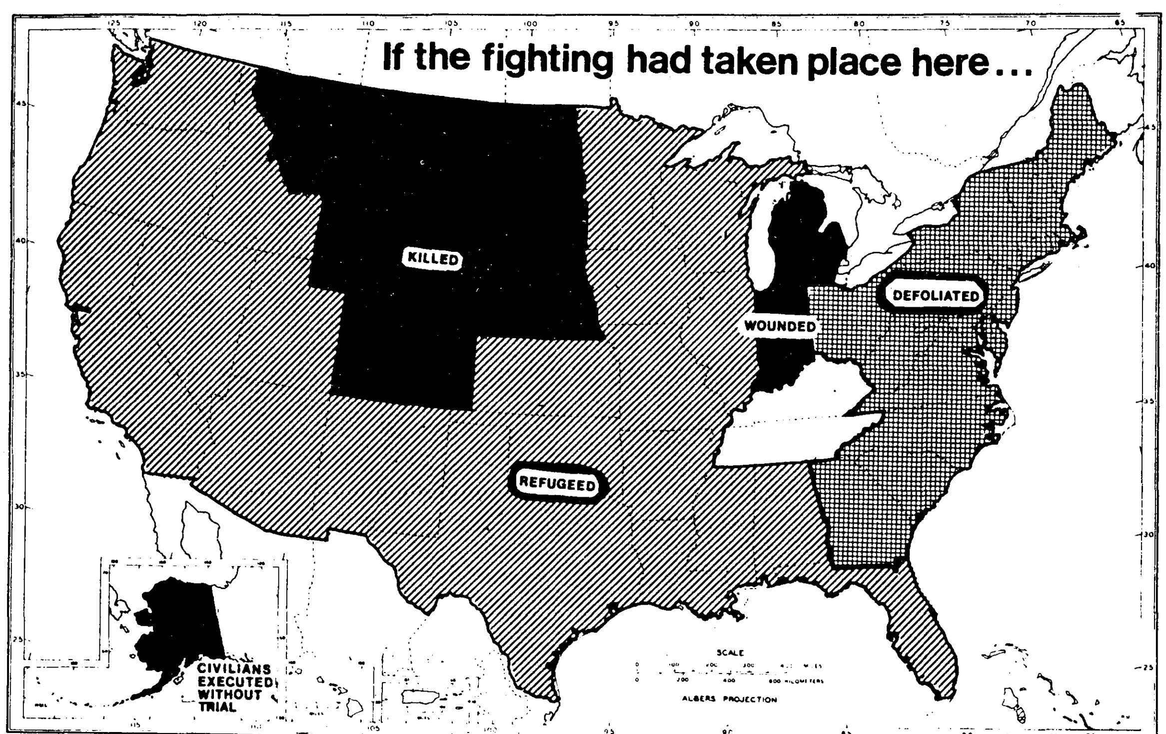
Forty thousand civilians were executed without trial under the Phoenix program (U.S. equivalent 452,000). And 8,000,000 South Vietnamese have been left homeless (U.S. equivalent, 90.4 million). These are all South Vietnamese Government figures.

The Stanford Biology Group reports that over 5 million acres — 12 percent — of South Viet Nam have been sprayed with defoliating chemicals (U.S. equivalent 275 million acres).

A few qualifications should be added. The map does not represent a realistic war picture; in war the forms of destruction would overlap, and many additional statistics would have to be added — children orphaned, cities destroyed, diseases spread, soldiers captured and tortured, conscription, service disruption — all the details of war.

In addition, it must be remembered that this data does not include the war's effects on the other peoples of Indochina, nor does it reflect the losses of the U.S. and other outside countries involved in the war.

The Indochina war is an example of the truth that it is civilians who bear the great weight of war. □



Figured on a percentage basis, this map shows what has happened to the people and land of South Viet Nam, as projected on a map of the United States. Casualties and refugees are shown by state populations. Defoliation is calculated in square miles of states. Only Kentucky, Tennessee, and Hawaii are left untouched. Sources for the data are the Department of Defense, the Senate Subcommittee on Refugees, the Republic of Viet Nam Ministry of Information, and the Stanford Biology Group (the latter on defoliation).

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U.S. Electronic Espionage: A Memoir

Part 1

Ramparts
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"The National Security Agency's operations here described reflect the drive of a nation to control as much of the world as possible; whose leaders trust no one and spy on their closest allies in violation of treaties they initiated themselves; . . ."

About thirty miles northeast of CIA headquarters in Langley, Virginia, right off the Baltimore-Washington expressway overlooking the flat Maryland countryside, stands a large three story building known informally as the "cookie factory". It's officially known as Ft. George G. Meade, headquarters of the National Security Agency.

Three fences surround the headquarters. The inner and outer barriers are topped with barbed wire, the middle one is a five-strand electrified wire. Four gatehouses spanning the complex at regular intervals house specially-trained marine guards. Those allowed access all wear irridescent I.D. badges — green for "top secret crypto", red for "secret crypto". Even the janitors are cleared for secret codeword material. Once inside, you enter the world's longest "corridor" — 980 feet long by 560 feet wide. And all along the corridor are more marine guards, protecting the doors of key NSA offices. At 1,400,000 square feet, it is larger than CIA headquarters, 1,135,000 square feet. Only the State Department and the Pentagon and the new headquarters planned for the FBI are more spacious. But the DIRNSA building (Director, National Security Agency) can be further distinguished from the headquarters buildings of these other giant bureaucracies — it has no windows. Another palace of paranoia? No. For DIRNSA is the command center for the largest, most sensitive and far-flung intelligence gathering apparatus in the world's history. Here, and in the nine-story Operations Building Annex, upwards of 15,000 employees work to break the military, diplomatic and commercial codes of every nation in the world, analyze the decrypted messages, and send on the results to the rest of the U.S. intelligence community.

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Far less widely known than the CIA, whose Director Richard Helms will occasionally grant public interviews, NSA silently provides an estimated 80 percent of all valid U.S. intelligence. So secret, so sensitive is the NSA mission and so highly indoctrinated are its personnel, that the Agency, twenty years after its creation, remains virtually unknown to those employees outside the intelligence community. The few times its men have been involved in international incidents, NSA's name has been kept out of the papers.

Nevertheless, the first American killed in Vietnam, near what became the main NSA base at Phu Bai, was an NSA operative. And the fact that Phu Bai remains the most heavily guarded of all U.S. bases suggests that an NSA man may well be the last.

The scope of NSA's global mission has been shrouded in secrecy since the inception of the Agency. Only the haziest outlines have been known, and then only on the basis of surmise. However, Ramparts was recently able to conduct a series of lengthy interviews with a former NSA analyst willing to talk about his experiences. He worked for the Agency for three and a half years — in the cold war of Europe and the hot one in Southeast Asia. The story he tells of NSA's structure and history is not the whole story, but it is a significant and often chilling portion of it.

Our informant served as a senior NSA analyst in the Istanbul listening post for over two years. He was a participant in the deadly international fencing match that goes on daily with the Soviet Union, plotting their air and ground forces and penetrating their defenses. He watched the Six Day War unfold and learned of the intentions of the major powers — Israel, the Soviet Union, the United States, France, Egypt — by reading their military and diplomatic radio traffic, all of it duly intercepted, de-coded and translated by NSA on the spot. As an expert on NSA missions directed against the Soviet Union and the so-called "Forward Countries" — Bulgaria, Hungary, Czechoslovakia, East Germany, Rumania and Yugoslavia — he briefed such visiting dignitaries as Vice President Humphrey. In Indochina he was a senior analyst, military consultant and U.S. Air Force intelligence operations director for North Vietnam, Laos, the northern-most provinces of South Vietnam and China. He is a veteran of over one hundred Airborne Radio Direction Finding missions in Indochina — making him thoroughly familiar with the "enemy" military structure and its order of battle.

With the benefit of the testimony he provides, we can see that the reason for the relative obscurity of NSA has less to do with its importance within the intelligence community than with the limits of its mission and the way it gets its results. Unlike the CIA, whose basic functions are clearly outlined in the 1947 law that created it, NSA, created in 1952, simply gathers intelligence. It does not formulate policy or carry out operations. Most of the people working for NSA are not "agents," but ordinary servicemen attached to one of three semi-autonomous military cryptologic agencies — the Air Force Security Service, the largest; the Naval Security Group; and the Army Security Agency, the oldest. But while it is true that the Agency runs no spies as in the popular myth, its systematic Signal Intelligence intercept mission is clearly prohibited by the Geneva Code. What we are dealing with is a highly bureaucratized, highly technological intelligence mission whose breadth and technological sophistication appear remarkable even in an age of imperial responsibilities and electronic wizardry.

So that not a sparrow or a government falls without NSA's instantaneous knowledge, over two thousand Agency field stations dot the five continents and the seven seas. In Vietnam, NSA's airborne flying platforms carrying out top secret Radio Direction Finding missions, supply U.S. commanders with their most reliable information on the location of communist radio transmitters — and thus on the location of NLF (National Liberation Front) units themselves. Other methods — the use of sensors and seismic detectors — either don't work or are used merely to supplement NSA's results. But the Agency's tactical mission in Indochina — intelligence support for U.S. commanders in the field — however vital to the U.S. war effort, is subsidiary in terms of men, time and material to its main strategic mission.

The following interview tells us a great deal about both sides of the NSA mission — everything from how Agency people feel about themselves and the communist "enemy" to the NSA electronic breakthroughs that threaten the Soviet-American balance of terror. We learn for example that NSA knows the call signs of every Soviet airplane, the numbers on the side of each plane, the name of the pilot in command; the precise longitude and latitude of every nuclear submarine; the whereabouts of nearly every Soviet VIP; the location of every Soviet missile base; every army division, battalion and company — its weaponry commander and deployment. Routinely the NSA monitors all Soviet military, diplomatic and commercial radio traffic, including Soviet Air Defense, Tactical Air, and KGB forces. (It was the NSA that found Che Guevara in Bolivia through radio communications intercept and analysis.) NSA cryptologic experts seek to break every Soviet code and do so with remarkable success, Soviet scrambler and computer-generated signals being nearly as vulnerable as ordinary voice and manual morse radio transmissions. Interception of Soviet radar signals enables the NSA to gauge quite precisely the effectiveness of Soviet Air Defense units. Methods have even been devised to "fingerprint" every human voice used in radio transmissions and distinguish them from the voice of every other operator. The Agency's Electronic Intelligence Teams (ELINT) are capable of intercepting any electronic signal transmitted anywhere in the world and, from an analysis of the intercepted signal, identify the transmitter and physically reconstruct it. Finally, after having shown the size and sensitivity of the Agency's big ears, it is almost superfluous to point out that NSA monitors and records every trans-Atlantic telephone call.

Somehow, it is understandable, given the size of the stakes in the Cold War, that an agency like NSA would monitor U.S. citizens' trans-Atlantic phone calls. And we are hardly surprised that the U.S. violates the Geneva Code to intercept communist radio transmissions. What is surprising is that the U.S. systematically violates a treaty of its own making, the UKUSA Agreements of 1947. Under this treaty, the U.S., Canada, the United Kingdom and Australia erected a white-anglo-saxon-protestant nation communications intelligence dictatorship over the "Free World". The agreement distinguishes between three categories of intelligence consumers: First, Second and Third Party consumers. The First Party is the U.S. intelligence community. The Second Party refers to the other white anglo-saxon nations' communications intelligence agencies: e.g. Great Britain's GCHQ, Canada's CBNRC, etc. These agencies exchange information routinely. Non-WASP nations, the so-called Third Party nations, are placed on short intelligence rations. This category includes all our NATO allies — West Germany, France, Italy, as well as South Vietnam, Japan, Thailand and the non-WASP allies in SEATO. But the idea of a closed club of gentlemanly white men gets quickly dispelled when we learn that the U.S. even intercepts the radio communications of its Second Party UKUSA "Allies". From the U.S. military base at Chicksands, for example, and from the U.S. Embassy in London, NSA operatives busily intercept and transcribe British diplomatic traffic and send it off for further analysis to DIRNSA.

We feel that the information in this interview — while perhaps not of a "sensitive" nature — is of critical importance to America for the light it casts on the cold war and the anti-communist myths that perpetuate it. These myths about the aggressive intentions of the Soviet Union and China and about North Vietnam's "invasion of a democratic South Vietnam," can only be sustained by keeping the American people as ignorant as possible about the actual nature of these regimes and the great power relationships that exist in the world. The peace of the world, we are told, revolves shakily on a "balance of terror" between the armed might of the Soviet Union and the United States. So tenuous is this balance that if the U.S. were to let down its guard ever so slightly, if it were, for example, to reduce the ever-escalating billions allocated for "defense," we would immediately face the threat of destruction from the aggressive Soviets, who are relentless in their pursuit of military superiority. Our informant's testimony, based on years of dealing with hard information about the Soviet military and its highly defense-oriented deployment, is a powerful and authoritative rebuttal to this mythology.

But perhaps an even more compelling reason requires that this story be told. As we write, the devastating stepped-up bombing of North Vietnam continues. No one can say with certainty what the ultimate consequences of this desperate act are likely to be. Millions of Americans, perhaps a majority, deplore this escalation. But it would be a mistake to ignore the other millions, those who have grown up in fear of an entity known as "world communism". For them Nixon's latest measures have a clear rationale and a plausible purpose. It is precisely this political rationale and this strategic purpose that the testimony of our informant destroys.

We are told by Nixon that South Vietnam has been "invaded" by the North which is trying to impose its will on the people of the South. This latest version of why we continue to fight in Indochina — the first version stressed the threat of China which allegedly controlled Hanoi, even as Moscow at one time was thought to control Peking — emphasizes Hanoi's control over the NLF. Our evidence shows that the intelligence community, including NSA, has long determined that the NLF and the DRV (Democratic Republic of Vietnam) are autonomous, independent entities. Even in Military Region I, the northern-most province of South Vietnam, and the key region in the "North Vietnamese" offensive, the command center has always been located not in Hanoi, but somewhere in the Ia Drang valley. This command center, the originating point for all military operations in the region, is politically and militarily under the control of the PRG (Provisional Revolutionary Government). Known as Military Region Tri Ten Hue (MRTTH), it integrates both DRV and NLF units under its command. Hanoi has never simply "called the shots", although the DRV and the PRG obviously have common reasons for fighting and share common objectives. All of this information NSA has passed on systematically to the political authorities who, equally systematically, have ignored it.

Nixon's military objective — halting supplies to the South through bombing and mining of North Vietnamese ports — turns out to be as bogus as his political rationale. Military supplies for the DRV and the NLF are stored along the Ho Chi Minh trail in gigantic underground staging areas known as bamtrams. These are capable of storing supplies for as long as twelve months, at normal levels of hostilities, according to NSA estimates. Even at the highly accelerated pace of the recent offensive, it would take several months (assuming 100 percent effectiveness) before our bombing and mining would have any impact on the fighting.

Taken altogether, the experience of our informant in Europe, in the Middle East, and in Indochina bears witness to the aggressive posture of the United States in the late 1960s. It is hard to see anything defensive about it. Our policy makers are well-informed by the intelligence community of the defensive nature of our antagonists' military operations. The NSA operations here described reflect the drive of a nation to control as much of the world as possible; whose leaders trust no one and are forced to spy on their closest allies in violation of treaties they initiated themselves; leaders, moreover, for whom all nations are, in the intelligence idiom, "targets", and who maintain the U.S. imperium around the world in large part through threat of actual physical annihilation.

At home, however, the favored weapon employed is ignorance rather than fear. Like NSA headquarters itself, the United States is surrounded by barriers — barriers of ignorance that keep its citizens prisoners of the cold war. The first obstacle is formed by the myths propagated about communism and about its aggressive designs on America. The second, and dependent for its rationale on the first, is the incredible barrier of governmental secrecy that keeps the most questionable U.S. aggressive activities hidden not from our "enemies", who are the knowledgeable victims, but from the American people themselves. The final barrier is perhaps the highest and is barbed with the sharpest obstacles of all. It is nothing less than our own reluctance as Americans to confront what we are doing to the peoples of the world, ourselves included, by organizations like the National Security Agency.

* * *

Q. Let's begin by getting a sense of the National Security Agency and the scope of its operations.

A. O.K. At the broadest level, NSA is a part of the United States intelligence community and a member of the USIB, the United States Intelligence Board. It sits on the Board with the CIA, the FBI, the State Department's RCI, and various military intelligence bureaus. Other agencies also have minor intelligence-gathering units, even the Department of Interior.

All intelligence agencies are tasked with producing a particular product. NSA produces — that is, collects, analyzes, and disseminates to its consumers — Signals Intelligence, called SIGINT. It comes from communications or other types of signals intercepted from what we called "targeted entities", and it amounts to about 80 percent of the viable intelligence the U.S. government receives. There is COMSEC (Communications Security), a secondary mission. This is to produce all the communications security equipment, codes, and enciphering equipment for the United States and its allies. This function of the NSA involves the monitoring of our own communications to make sure they are secure. But SIGINT is the main responsibility.

As far as NSA's personnel is concerned, they are divided into two groups: those that are totally civilian, and those like me who derived from the military. As far as the collection of data is concerned, the military provides almost all the people. They are recruited through one of the service cryptologic agencies. The three agencies are the U.S. Air Force Security Service (USAFSS), the Army Security Agency (ASA), and the Navy Security Group (NSG). These agencies may control a few intelligence functions that are primarily tactical in nature and directly related to ongoing military operations. But generally, DIRNSA, the Director of the National Security Agency, is completely in control over all NSA's tasks, missions, and people.

The NSA, through its sites all over the world, copies — that is, collects — intelligence from almost every conceivable source. That means every radio transmission that is of a strategic or tactical nature, or is related to some government, or has some political significance. NSA is powerful, and it has grown since its beginning back in 1947. The only problem it has had has come over the last few years. Originally it had equal power with the CIA on the USIB and the National Security Council. But recently the CIA has gained more of a hegemony in intelligence operations, especially since Richard Helms became director of the entire intelligence community.

Q. Does the NSA have agents in the field?

A. Yes, but probably not in the way you mean it. It is different from other intelligence agencies in that it's not a consumer of its own intelligence. That is, it doesn't act on the data it gathers. It just passes it on. Generally, there's a misconception all Americans have about spying. They think it's all cloak and dagger, with hundreds of James Bonds wandering around the world in Aston-Martins, shooting people. It just doesn't happen. It's all either routine or electronic. I got to know a lot of CIA people in my three and a half years with NSA, and it became pretty clear to me that most of them sit around doing mundane stuff. You know, reading magazines, newspapers, technical journals. Like some people say, they do a lot of translating of foreign phone books. Of course I did meet a few who were out in the jungles with guns in their hands too.

But as far as the NSA is concerned, it is completely technological. Like I said, at least 80 percent of all viable intelligence that this country receives and acts on comes from the NSA, and it is all from signals intelligence, strategic and tactical. I saw it from both angles — first strategic in working against the Soviet Union in Turkey and then tactical flying missions against the VC in Nam. Information gathered by NSA is complete. It covers what foreign governments are doing, planning to do, have done in the past; what armies are moving where and against whom; what air forces are moving where, and what their capabilities are. There really aren't any limits on NSA. Its mission goes all the way from calling in the B-52's in Vietnam to monitoring every aspect of the Soviet space program.

Q. In practical terms, what sort of data are collected by NSA?

A. Before going into that, I should get into the types of signals NSA collects. There are three basic areas. First is what we called ELINT, electronics intelligence. This involves the interception and analysis of any electronics signal. There isn't necessarily any message on that signal. It's just the signal, and it's mainly used by technicians. The only time I ever remember using ELINT was when we were tracing a Russian fighter. Some of them had a particular type of radar system. As I remember, we called this system MANDRAKE. Anyhow, every time this system signalled, a particular type of electronic emission would occur. Our ELINT people would be looking for it, and whenever it came up, it would let them positively identify this type of fighter.

The second type of signal is related to this. It is intelligence from radar, called RADINT. This also involves the technicians. Let me give you an example. There is a particular type of Soviet radar system known in NSA by a code name which we'll call SWAMP. SWAMP is used by the Soviet technical air forces, by their air defense, by the KGB and some civilian forces. It is their way of locating any flying entity while it's in the air. It had a visual readout display, so that, whenever a radar technician in the Soviet Union wanted to plot something on his map, he could do it by shooting a beam of light on a scope and then send it to whoever wanted to find out information about that airplane. Our RADINT people intercepted SWAMP signals in our European listening posts. From the data they got, NSA analysts were able to go back to the headquarters at Fort Meade and in less than eight weeks completely reconstruct SWAMP. We duplicated it. This meant that we were able to see exactly what the Soviet operators were seeing when they used SWAMP. So, as far as this radar was concerned, the upshot was that they were doing our tracking for us. We knew everything they knew, and we knew what they were able to track over their airspace, and what they weren't.

Q. Does this mean we can jam their radar?

A. Yes, part of the function of ELINT and RADINT is to develop electronic counter measures. There's a counter measure for every type of Soviet radar.

Q. You said there were three areas. You've gone over ELINT and RADINT. What's the third?

A. This is by far the most important. It's communications intelligence, COMINT. It involves the collection of the radio communications of a targeted entity. NSA intercepts them, reproduces them in its equipment and breaks down any code used to encipher that signal. I should say that what I call a "targeted entity" could be any country — NSA gathers data on them all — but in practical terms it's almost synonymous with the Soviet Union.

COMINT is the important function. It's what I was in, and it represents probably 95 percent of the relevant SIGINT intelligence. As a matter of fact, the entire intelligence community is also known as the COMINT community.

Q. It would probably be good to backpedal for a moment before we go into your experiences in NSA and get into the way you joined the organization.

A. Well, I'd been in college, was bored, and wanted to do something different. I come from the Midwest, and we still believed those ads about joining the military and seeing the world. I enlisted in the Air Force. Like everybody else, I was shocked by basic training, but after that, when it came time to choose what I'd be doing for the rest of my time, it wasn't too bad. I tried for linguist's training, but there weren't any openings in the schools. I was then approached by three people I later found were a part of the National Security Agency. They interviewed me along with four other guys and asked us if we'd like to do intelligence work. We took a battery of tests, I.Q. and achievement tests, and had some interviews to determine our political and emotional stability. They really didn't go into our politics very much, I guess because we were all so obviously apathetic. Their main concern was our sex life. They wanted to know if we were homosexual.

At this point, it was 1966, I suppose I had what you would call an analysis of the world situation. But it was primarily based on a belief in maintaining the balance of power. I really didn't see anything wrong with what our government was doing. Also, the few hints about what we might be doing in NSA were pretty exciting: world-wide travel, working in the glamorous field of intelligence, being able to wear civilian clothes.

After getting admitted, I was bussed to Goodfellow Air Force base at San Angelo, Texas. Originally it was a WAC base or something like that, but now it's entirely an intelligence school for NSA. The whole basis of the training was their attempt to make us feel we were the absolute cream of the military. For most GIs, the first days in the military are awful, but as soon as we arrived at school, we were given a pass to go anywhere we wanted, just as long as we were back in school each morning. We could live off base; there was no hierarchical thing inside the classroom.

Q. What sort of things did you focus on in school?

A. At first, it was basic stuff. For about two months we just learned primary analysis techniques, intelligence terms, and a rough schematic of the intelligence community. We learned a few rudimentary things about breaking codes and intercepting messages. A lot of people were dropped out of the program at this time because of inadequate school performance, poor attitude, or because something in their backgrounds didn't prove out. Actually, of fifteen people with me in this class, only four made it through. We had been given access only to information rated "confidential" all the time, but then we got clearance and a Top Secret cryptologic rating.

The first day of the second phase of school began when we walked into the classroom and saw this giant map on the wall. It was marked "Top Secret", and it was of the Soviet Union. For the next three months, we learned about types of communications in operations throughout the world and also in-depth things about the political and administrative makeup of various countries. The Soviet Union, of course, was our primary focus. And we learned every one of its military functions; the entire bureaucratic structure, including who's who and where departments and headquarters are located; and a long history of its military and political involvements, especially with countries like China and the East European bloc, which we called "the forward area".

We learned in-depth analysis — how to perform different types of traffic analysis, cryptic analysis, strategic analysis. A lot of the texts we used were from the Soviet Union, and had been translated by the CIA.

I'm not especially proud of it now, but I should tell you that I graduated at the head of the class. We had a little ceremony inside a local movie theatre. I was called up with two guys from other classes and given special achievement certificates. We were given our choice of assignments anywhere in the world. I chose Istanbul. It seemed like the most far-out and exotic place available. After that I left San Angelo and went to Monterey to the Army's language school for a month and a half. I learned a bit of very technical Russian — basically how to recognize the language — and then to Fort Meade NSA headquarters for a couple of weeks indoctrination about Istanbul, our operation there at Karmasel, and the whole European intelligence community.

Q. When did you get to Istanbul?

A. That was January 1967.

Q. What did you do there?

A. I was assigned to be one of the flight analysts working primarily against the Soviet tactical Air Forces and Soviet long range Air Forces. I had about twenty-five morse operators who were listening to morse signals for me, and about five non-morse and voice operators. It was a pretty boring job for them. A morse operator, for instance, just sits there in front of a radio receiver with headphones, and a typewriter copying morse signals. They would "roll onto" their target, which means that they would go to the frequency that their target was using. The list of likely frequencies and locations and the call signals that would be used — all this information was made available by the analyst as technical support to the operator. In return the operator would feed the copy to me; I'd perform analysis on it and correlate it with other intelligence collected there in Istanbul, and at the NSA installations in the rest of Europe.

Q. Where are the other NSA installations in Europe?

A. The major ones aside from Karmasel are in Berlinhof and Darmstadt, West Germany; Chicksands, England; Brindisi, Italy; and also at Trabesan and Crete. Some of these sites have the gigantic Feranine antennas. This is a circular antenna or ray, several football fields in diameter, and it's capable of picking up signals from 360 degrees. They're very sensitive. We can pick up hundreds of signals simultaneously. We pick up voices speaking over short-range radio communications thousands of miles away.

The whole Air Force part of NSA, the USAFSS units, is known as European Security region. It is headquartered at the I. G. Farben building in Berlin. The Army ASA has units attached to every Army installation in Europe. The Naval NSG has its sites aboard carriers in the 6th Fleet. But mainly it was us.

Q. What does this apparatus actually try to do?

A. Like I said, it copies — that is, intercepts for decoding and analysis — communications from every targeted country. As far as the Soviet Union is concerned, we know the whereabouts at any given time of all its aircraft, exclusive of small private planes, and its naval forces, including its missile-firing submarines. The fact is that we're able to break every code they've got, understand every type of communications equipment and enciphering device they've got. We know where their submarines are, what every one of their VIPS is doing, and generally their capabilities and the dispositions of all their forces. This information is constantly computer correlated, updated, and the operations go on twenty-four hours a day.

Q. Let's break it down a little. How about starting with the aircraft. How does NSA keep track of the Soviet air forces?

A. First, by copying Soviet Navair, which is their equivalent of the system our military has for keeping track of its own planes. And their Civair, like our civilian airports: we copy all of their air controllers' messages. So we have their planes under control. Then we copy their radar plotting of their own air defense radar, which is concerned with flights that come near their airspace and violate it. By this I mean the U.S. planes are constantly overflying their territory. Anyhow, all this data would be correlated with our own radar and with the air-to-ground traffic these planes transmitted and our operators picked up. We were able to locate them exactly even if they weren't on our radar through RDF — radio direction finding. We did this by instantaneously triangulating reception coming through these gigantic antennas I mentioned. As far as the Soviet aircraft are concerned, we not only know where they are; we know what their call signs are, what numbers are on the side of every one of their planes, and most of the time, even which pilots are flying which plane.

Q. You said that we overfly Soviet territory?

A. Routinely, as a matter of fact — over the Black Sea, down to the Baltic. Our Strategic Air Force flies the planes, and we support them. By that I mean that we watch them penetrate the Soviet airspace and then analyze the Soviet reaction — how everything from their air defense and tactical air force to the KGB reacts. It used to be that SAC flew B-52s. As a matter of fact, one of them crashed in the Trans-Caucasus area in 1968 and all the Americans on board were lost.

Q. Was it shot down?

A. That was never clear, but I don't believe so. The Soviets know what the missions of the SAC planes are. A lot of times they scramble up in their jets and fly wing-to-wing with our planes. I've seen pictures of that. Their pilots even communicate with ours. We've copied that.

Q. Do we still use U-2s for reconnaissance?

A. No, and SAC doesn't fly the B-52s anymore either. Now the plane they use is the SR-71. It has unbelievable speed and it can climb high enough to reach the edge of outer space. The first time I came across the SR-71 was when I was reading a report of Chinese reaction to its penetration of their airspace. The report said their air defense tracking had located the SR-71 flying a fairly constant pattern at a fairly reasonable altitude. They scrambled MIG-21s on it, and when they approached it, the radar pattern indicated that the SR-71 had just accelerated with incredible speed and rose to such a height that the MIG-21s just flew around looking at each other. Their air-to-ground communications indicated that the plane just disappeared in front of their eyes.

I might tell you this as a sort of footnote to your mentioning of the U-2. The intelligence community is filled with rumor. When I got to Turkey, I immediately ran into rumors that Gary Powers' plane had been sabotaged, not shot down. Once I asked someone who'd been in Istanbul for quite a while and he told me that it was reported in a unit history that this had happened. The history said it had been three Turks working for the Soviets and that they'd put a bomb on the plane. I didn't read this history myself, however.

Q. You have explained how we are able to monitor Soviet air traffic to the extent you've indicated, but it's hard to believe that we could know where all their missile submarines are at any given moment.

A. Maybe so, but that's the way it is. There are some basic ways in which we can keep track of them, for example, through the interpretation of their sub-to-base signals which they encode and transmit in bursts that last a fraction of a second. First, we record it on giant tape drops several feet apart, then it is played back slowly so that we get the signal clearly. Then the signal will be modulated — that is, broken down so we can understand it. Then the codes are broken and we get the message, which often turns out to contain information allowing us to tell where they are.

Another way in which we keep track of these subs is much simpler. Often they'll surface someplace and send a weather message.

Q. But don't submarines go for long periods without communicating, maneuvering according to some prearranged schedule?

A. Actually, not very often. There are times during a war exercise or communications exercise when they might not transmit for a week or even longer. But we still keep track of them. We've discovered that they're like all Soviet ships in that they travel in patterns. By performing a very complicated, computerized pattern analysis, we are able to know where to look for a particular ship if it doesn't turn up for a while. The idea is that they revert from that pattern only in an extreme emergency situation; but during such a situation they'll have to be in communication at least once. We know how many subs they have. And in practical terms, when one of them is not located, NSA units tasked with submarine detection concentrate all their energies on finding it.

Q. How do you know this? Did you ever have responsibility for submarine detection?

A. No. My information comes from two sources. First, the fact that there were analysts sitting right next to me in Karmasel who were tasked on subs. Second, I read what we called TEXTA. TEXTA means "technical extracts of traffic". It is a computer-generated digest of intelligence collected from every communications facility in the world — how they communicate, what they transmit, and who to. It is the Bible of the SIGINT community. It is constantly updated, and one of an analyst's duties is reading it. You've got to understand that even though each analyst had his own area to handle, he also had to be familiar with other problems. Quite often I would get — through my operators — base-to-base submarine traffic and I'd have to be able to identify it.

Q. The implications of what you're saying are very serious. In effect, it means that based on your knowledge there is no real "balance of terror" in the world. Theoretically, if we know where every Soviet missile installation, military aircraft and missile submarine is at any given moment, we are much closer than anyone realizes to a first-strike capacity that would cripple their ability to respond.

A. Check.

Q. How many NSA people were there at Istanbul and in the rest of the installations in Europe?

A. About three thousand in our operation. It would be hard to even guess how many in the rest of Europe.

Q. What were the priorities for gathering information on Soviet operations?

A. First of all, NSA is interested in their long-range bombing forces. This includes their rocket forces, but mainly targets on their long-range bombers. This is because the feeling is that, if there is conflict between us and them, the bombers will be used first, as a way of taking a step short of all-out war. Second, and very close to the bombing capabilities, is the location of their missile submarines. Next would be tasking generated against the Soviet scrambler, which is their way of communicating for all of their services and facilities. After this would be their Cosmos program. After that things like tasking their KGB, their air controllers, their shipping, and all the rest of the things tend to be on the same priority.

Q. All this time, the Soviets must be doing intelligence against us too. What is its scope?

A. Actually, they don't get that much. They aren't able to break our advanced computer generated scrambler system, which accounts for most of the information we transmit. They do a lot of work to determine what our radar is like, and they try to find out things by working on some of the lower level codes used by countries like Germany and the Scandinavian countries we deal with. Their SIGINT operation is run by the KGB.

The key to it is that we have a ring of bases around them. They try to make up for the lack of bases by using trawlers for gathering data, but it's not the same. They're on the defensive.

Q. What do you mean by that?

A. That they're on the defensive? Well, one of the things you discover pretty early is that the whole thing of containing the communist menace for expansion is nonsense. The entire Soviet outlook of their military and their intelligence was totally different from ours. They were totally geared up for defense and to meet some kind of attack. Other than strategic capacities relating to the ultimate nuclear balance, their air capabilities are solidly built around defending themselves from penetration. They've set up the "forward" area — our term for the so-called bloc countries of eastern Europe — less as a launching pad into Europe than as a buffer zone. The only Soviet forces there are are air defense forces, security forces. Put it this way: their whole technology is not of an offensive nature, simply, don't have the kind of potential for a tactical offensive that we do. They have no attack carriers, for instance. Soviet ships are primarily oriented toward protection of their coasts. Actually they do have carriers of a sort, but they are helicopter anti-submarine carriers. Another thing: they have a lot of fighters, but hardly any fighter-bombers. They do have a large submarine force, but given the fact that they are completely ringed by the U.S., this too is really of a strategic nature.

Everything we did in Turkey was in direct support of some kind of military operation, usually something clandestine like overflights, infiltrations, penetrations. If all we were interested in was what they call an "invulnerable deterrent," we could easily get our intelligence via satellite. We don't need to have these gigantic sites in Europe and Asia for this.

Q. You mentioned a few minutes ago that one of NSA's main targets was the Soviet space program. What sort of material were you interested in?

A. Everything. Obviously, one of the things we wanted to know was how close they were to getting a space station up. But we knew everything that went on in their Cosmos program. For instance, before I had gotten to Turkey, one of their rockets had exploded on the launching pad and two of their cosmonauts were killed. One died while I was there too. It was Soyuz 1, I believe. He developed re-entry problems on his way back from orbit. They couldn't get the chute that slowed his craft down in re-entry to work. They knew what the problem was for about two hours before he died, and were fighting to correct it. It was all in Russian of course, but we taped it and listened to it a couple of times afterward. Kosygin called him personally. They had a video-phone conversation. Kosygin was crying. He told him he was a hero and that he had made the greatest achievement in Russian history, that they were proud and he'd be remembered. The guy's wife got on too. They talked for a while. He told her how to handle their affairs, and what to do with the kids. It was pretty awful. Towards the last few minutes, he began falling apart, saying, "I don't want to die, you've got to do something." Then there was just a scream as he died. I guess he was incinerated. The strange thing was that we were all pretty bummed out by the whole thing. In a lot of ways, having the sort of job we did humanizes the Russians. You study them so much and listen to them for so many hours that pretty soon you come to feel that you know more about them than about your own people.

(To be concluded in the next issue.)

NUMBLES

Neil Macdonald
Assistant Editor
Computers and Automation

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

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

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

Andrew M. Langer
Newton High School
Newton, Mass.

NUMBLE 732

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Solution to Numble 731

In Numble 731 in the January issue, the digits 0 through 9 are represented by letters as follows:

L = 0	G = 5
N = 1	F,R = 6
O = 2	I = 7
E,P = 3	S = 8
H = 4	T = 9

The message is: Foresight spoils nothing.

Our thanks to the following individuals for submitting their solutions — **to Numble 7212:** T. P. Finn, Indianapolis, Ind.; David P. Zerbe, Reading, Pa. — **to Numble 7211:** T. P. Finn, Indianapolis, Ind.; W. John Walter, Montreal, Que., Canada.

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HOW NIXON LOOKS TO THE BRITISH

The Big Lie — Blitz Exposes Nixon's Deceit

Donald Wise
Correspondent for The Express
Saigon, Vietnam

At their present rate of success, the North Vietnamese need only keep firing their SAM missiles for another 233 days to shoot all President Nixon's B-52 bombers out of the sky.

The U.S. Strategic Air Command has more than 450 of the giant £3,500,000 bombers to fling into the battle. But since the North Vietnamese have to shoot literally clouds of Russian-made missiles ahead of each B-52 to bring it down, how long will it be before their SAM stockpile is exhausted?

Stalling at the Paris Peace Talks, Hanoi bought eight weeks' bombing pause. They rushed repair crews and missiles to their launching sites. The Pentagon readied its huge fleet of 240 B-52s in Asia. Then Nixon's order went out: Carry on bombing. Ten B-52s have been shot down since last Sunday.

Senior diplomats here cannot believe that Nixon's top adviser Henry Kissinger was joking, or had been fooled, when on October 27 he told the world: "Peace is at hand". So if he was not a fool then he must have been a knave. Under orders, and in his master's voice, he told a lie. The big lie. Such a big, bloody lie that, since his master's predecessor, George Washington, could never tell even a small one, Nixon's was believed. It was the lie he needed to clinch the election, of course.

Nixon had Kissinger make that statement when Hanoi would sign nothing until Saigon signed. Kissinger had been tripped up in Hanoi by accepting the North Vietnamese peace proposals IN ENGLISH. When the South Vietnamese translated it they pointed out that, in their language, the terms looked absolutely different. So the Americans stalled, claiming "clarification" was needed. With such a good precedent the North Vietnamese, in their turn, stalled, and Kissinger returned to Washington.

Two days later Kissinger told a Press conference "Peace can be near". Almost within minutes of the TV lights on him being switched off, Hanoi started getting its Christmas goodies from the air.

A very senior ambassador told me that Nixon is now behaving like a North Vietnamese: Fight and talk. Talk and fight. Cajole and clobber. Lie and cheat — to your enemy.

But Nixon has lied and cheated to his own people. We know now that the basic chasm of difference between Hanoi and Washington is whether the two Vietnams are really one country divided by civil war; or two separated by the Demilitarised Zone along the 17th Parallel. The South's President Thieu believes, and Washington supports him, that there are two Vietnams — his and Hanoi's. Hanoi, whose men over-ran the Demilitarised Zone in the April offensive this year, will not have it restored. It was a roadblock of gigantic size.

Nixon ordered Kissinger to drive round it with the big lie, and win the election. Meanwhile, he prepared his B-52s to deliver their goodies — for Christmas, as it turned out.

(From *The Express*, London, an issue of first week in January, 1973)

Unsettling, Disturbing, Critical . . .

Computers and Automation, established 1951 and therefore the oldest magazine in the field of computers and data processing, believes that the profession of information engineer includes not only competence in handling information using computers and other means, but also a broad responsibility, in a professional and engineering sense, for:

- The reliability and social significance of pertinent input data;
- The social value and truth of the output results.

In the same way, a bridge engineer takes a professional responsibility for the reliability and significance of the data he uses, and the safety and efficiency of the bridge he builds, for human beings to risk their lives on.

Accordingly, Computers and Automation publishes from time to time articles and other information related to socially useful input and output of data systems in a broad sense. To this end we seek to publish what is unsettling, disturbing, critical — but productive of thought and an improved and safer "house" for all humanity, an earth in which our children and later generations may have a future, instead of facing extinction.

The professional information engineer needs to relate his engineering to the most important and most serious problems in the world today: war, nuclear weapons, pollution, the population explosion, and many more.

Secrecy About Air Crashes: Typical Reactions of the Bureaucrats

Murray Seeger
Los Angeles Times
Los Angeles, Calif.

The crash in November near Moscow of a Soviet Ilyushin-62 airliner with 176 dead making it the worst civil aviation accident on record, raised questions anew about the operation of the world's largest, most secretive airline and the aviation industry upon which it is founded.

The Soviet Union, without issuing any safety records and only sketchy technical data has been trying to sell more of its planes in the world market outside the Communist bloc, and to expand the Aeroflot operating network.

Since May, Aeroflot has had three and possibly five major crashes of which only two have been publicly acknowledged. In addition, the previous biggest single-plane civil air crash — outside Berlin on Aug. 14 — involved another IL-62 operated by Intedflug, the East German airline.

There are few details about any Soviet crashes because the government will not disclose basic information. The latest crash occurred so close to Moscow and involved so many foreigners that more details than usual have circulated on the city's busy grapevine.

The flight apparently had trouble finding the Shermetovo Airport runway and circled the field two or three times before making a final approach. According to one story, the ship blew up at low altitude; according to another, the four motors stalled.

In any case, the aviation Ministry did not acknowledge the tragedy until a day later by which time Western news agencies had already reported it on the basis of unofficial tips.

The Tass statement did not identify Aeroflot as the carrier nor did it name the model of aircraft. It said nothing of the passenger list and reported only that a government commission had been named to investigate.

The four embassies representing the international victims were told about the dead but were provided with only vague identification. Reportedly, rescue workers made no effort at the scene to identify the victims but simply scooped up plane and human remains and carted them away in three truckloads.

On Oct. 3, when a smaller, four-motored turboprop IL-18 crashed shortly after takeoff from the Black Sea resort of Sochi, the government made no announcement. Reliable sources said 100 died in that crash.

An older, high-wing, four-turboprop Antonov-10 crashed outside Kharkov on May 18, killing 108. The government belatedly acknowledged that accident without supplying any details.

All AN-10 models were grounded after the Kharkov wreck and have not been returned to service.

Aeroflot has a monopoly on domestic service within the Soviet Union.

Aeroflot carried 78 million passengers last year. It carried two million on its international routes that reach 65 cities.

All U.S. scheduled airlines in 1970 carried 170 million passengers.
(Based on a report in the Boston Globe, November 23, 1972)

Divide and Rule

1. From: Bill Zimmerman
Medical Aid for Indo-China
474 Centre St.
Newton, Mass. 02158

I am writing to thank you for reprinting my article "North Vietnam and American Bombing: Six American Government Lies", in "Computers and Automation", for September 1972, p. 33, and for sending me three copies of your publication.

As a former scientist, it was gratifying to find articles like mine and Bill Kunstler's being printed in a technical journal.

One of the reasons I left science was the compartmentalizing and separation of scientific and social/political issues. I found the contradictions of performing scientific work, the results of which were owned and controlled by military and corporate interests, too severe. It's good to see attempts being made to overcome these problems, especially after spending the last two years doing some writing and a lot of political work in various projects designed to politicize and radicalize scientific workers.

Thank you again, and keep up the good work.

2. From the Editor

The compartmentalization and separation of science from social and political issues is not necessary nor desirable nor logical nor scientific.

This compartmentalization and separation which is conventional in the United States today is a strategy of establishments in general, and is a modern version of the great principle of the Roman empire: "Divide et impera", "divide and rule".

Averting the Sonic Boom

William A. Shurcliff, Director
Citizens League Against the Sonic Boom
19 Appleton St.
Cambridge, Mass. 02138

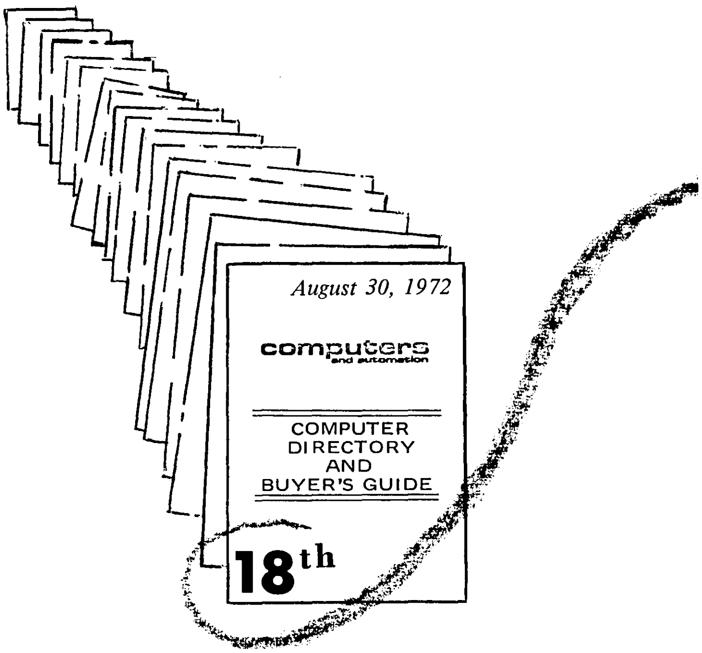
Threat. The threat of the Anglo-French Concorde SST (Supersonic Transport) continues. Sixteen production-type Concordes, bigger and "boomier" than the prototypes, are being built. The first is nearly ready for testing. BOAC has ordered 5, Air France 4. Actual service could start in 1975, if the program is not halted.

Sonic Boom. The plane's boom is worse than had been predicted. The typical overpressure is 2.0 to 2.5 psf, with occasional booms of 4 to 8 psf. Flights over Cornwall, Wales, etc., produced a flood of protests and damage claims. Damage payments totaled £35,622 ($85,000) — $100 per mile of flightpath.

Noise at Takeoff and Landing. The Concorde prototype is "the noisiest civil aircraft in the world" per Electronics Today of Sept. '72. Its "perceived noise" (PN) is 125 to 135 PNdB. The (modified) production plane will produce 120 to 125 PNdB — more than 20 PNdB noisier than the subsonic (boomless) DC-10, L-1011, A-300B. One Concorde is equivalent to a hundred L-1011's taking off simultaneously.

Pollution of Stratosphere. The threat that a fleet of Concordes would pose to stratospheric ozone looks increasingly grim. See recent reports by the National Academy of Science and by the Department of Transportation.

Opposition to Concorde. The opposition is led by B. Lundberg in Sweden, the Anti-Concorde Project in England, and Citizens League Against the Sonic Boom in America, and is thriving. Only two airlines have placed firm orders: BOAC and Air France. Three airlines (United, Air Canada, Sabena) have canceled their options. Pan Am and TWA may cancel too — because of the environmental nuisances and also the whopping price of the plane: about $59,000,000 with spare parts, etc. (This is more than twice the cost of a DC-10-30, which holds twice as many people, flies 50% farther, and uses only 1/3 as much fuel per passenger-mile.) CLASB has been sending to airline heads, government officials, etc., a steady stream of factual reports and pamphlets on the Concorde's offending features. CLASB's leadership in opposing SSTs is given top billing in a major article "Public Interest Science" in the Sept. 29 Science. Note: We are keeping a wary eye on White House spokesmen [euphemism for President Richard M. Nixon] who predict that a new, more costly ($5 billion U.S. SST program will be undertaken.



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ACROSS THE EDITOR'S DESK

Computing and Data Processing Newsletter

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APPLICATIONS

BUREAU OF CUSTOMS USES COMPUTER IN BATTLE AGAINST DRUGS AND SMUGGLING

Corporate Public Relations
Burroughs Corp.
Detroit, Mich. 48232

More than four tons of marijuana seized, 315 arrests made, and over a million illegal pills confiscated.

This is just part of the impressive record being compiled by CADPIN, a computer-based intelligence network used by the Bureau of Customs in its battle against narcotics traffic and other smuggling activities. CADPIN (Customs Automated Data Processing Intelligence Network) provides virtually instantaneous information on smugglers, enabling Customs officers at border crossings and airports to handle most investigations and enforcement quickly, safely and efficiently. CADPIN also benefits thousands of innocent travelers by enabling them to proceed through Customs inspections with a minimum of delay.

CADPIN is in operation around the clock, checking every vehicle at border crossings in the computer network. Within one or two seconds of each inquiry, the computer responds with the necessary data elements. If a positive response is made, the Customs inspector is given all the information he needs to take proper action.

The heart of the network is a Burroughs B 5500 computer system. The computer is linked to 160 teletype terminals located at Customs inspection areas along the entire 2,200-mile Mexican border as well as 42 other key points. These include major crossings on the Canadian border, selected international airports, and Customs field offices throughout the country. CADPIN currently processes between one-third and one-half million queries from primary terminals per week — or as many as one every 1.3 seconds. During periods of peak traffic at border crossings, the rate is even higher. The exceptional speed and message-switching capability of CADPIN was illustrated last year when two persons were arrested in Texas just minutes after their names were entered into the network's data base.

From the beginning of its operation in April 1970 through December 1971, the network produced 625 "productive hits" — an average of about one per day. In addition to the 315 arrests made, numerous vehicles, including airplanes, have been seized. Not all of CADPIN's results are related to smuggling. It helped deliver an emergency message to a man to see a doctor because he had been exposed to spinal meningitis.

In any application of the network, the security and proper use of the data base are of prime importance to the Bureau of Customs. Use of CADPIN data is restricted to law enforcement organizations with a legitimate need for it. The data is released to such agencies only by special agents in charge, chiefs of the Bureau's Sector Intelligence Units, or the Bureau's Intelligence Division. It is then released only with the understanding that the information will not be given to a third agency without prior consent of Customs.

COMPUTER USED TO AID RESEARCH PRODUCTIVITY IN POPULATION ANALYSIS

Prof. James A. Sweet
Prof. Halliman Winsborough
Center for Demography and Human Ecology
University of Wisconsin
Madison, Wisc. 53706

The University of Wisconsin's Center for Demography and Human Ecology has combined population studies with computer techniques to break new ground in analyzing U.S. census figures. The computer has opened up research areas that social scientists used to dream about but never considered practical because of the massive amount of information involved.

Now it will be possible for scholars to do more than skim the surface of a U.S. census. Population analysts are within striking distance of making the $200 million investment in census yield a quantum jump in knowledge.

Using its own computer the center's staff has:

- Completed in three months a complex study on income by race. (Previous methods would have required two years.)
- Determined the degree of residential segregation two years after the 1970 census. (In the past, this information was not available until five years after the census.)
- Combined for the first time fertility surveys from the most recent 20 year span that are expected to give the most accurate understanding of the recent decline in the birth rate.

In addition, numerous studies in various aspects of population, such as distribution of medical doctors, racial disturbances, rural poverty, and working wives, have been completed.

One of ten similar centers in the United States funded by the National Institute of Child Health and Human Development, Wisconsin's is the only one using its own computer for population analysis. Most of that work has been done on an IBM System/360 Model 30, recently replaced by System/370 Model 135. The Center has undertaken a number of projects which, without a computer of this sort, would otherwise have been impractical, costly and a waste of resources.

COMPUTERS ASSIST IN GROWING SHARE OF UNIVERSITY PROJECTS IN HUMANITIES FIELD

Michael M. Maynard
Sperry Univac
P.O. Box 500
Blue Bell, Pa. 19422

Computers are usually thought of as vast "number crunchers" capable of solving horrendous equations within a few seconds that would normally take an army of clerks, using only paper and pencil, several years to complete. More recently, however, the computer has also been proving its worth beyond the mathematical and scientific areas in the humanities field.

At the University of Wisconsin, for example, a number of projects in the humanities have been utilizing the services of a UNIVAC 1108 system in the Computer Center at the main campus in Madison. One of the most interesting of these projects is one directed by Professor Menahem Mansoor, Chairman of the University's Department of Hebrew and Semitic Studies, who just completed and published the first two of a three part "Political and Diplomatic History of the Arab World 1900-1967 — A Chronological Study".

The first part consists of a chronological history of about 120,000 events relating to the Middle East. This is contained in five volumes with two additional volumes constituting the index. These seven volumes were published last May by NCR — Microcard Editions, hardbook cover. The second part, which is now in press, is a Biographical Directory of the persons involved in the events occurring in this period. The third part will consist of about 10 volumes, each with approximately 300 pages, containing abstracts of the documents referred to in the chronological history, and general information about the documents such as title, source and present location.

Professor Mansoor started his History of the Arab World in 1960. Since then, he and his staff have made at least two trips each year to government archives throughout the Middle East, Great Britain, and Europe to obtain source material. They also poured through U.S. State Department and United Nations records to obtain additional data. Some 300 persons, mostly graduate students of the University of Wisconsin, assisted in the research over the past decade examining documents, books periodicals, declarations, memoranda, minutes, and treaties in many languages and stored in libraries and other educational institutions throughout the world.

Items submitted for the History were carefully checked, then keyed onto punch cards and entered into the UNIVAC 1108 system for storage on magnetic tape. To prepare the index of the 120,000 events, 35,000 documents and 18,000 individuals mentioned in the History, at least four key or stop words were selected from each entry in the History to give researchers the benefit of the most comprehensive cross indexing possible.

A special computer program for the project was prepared by Dr. Richard Venezky, William Lagerroos and Nathan Relles of the Computer Science Department of the University. The actual printing of the volumes was done directly from magnetic tape. "By using the computer, we were able to really make headway with the project; without the UNIVAC 1108, it could have taken another 20 years to complete and doubled the required budget and staff," Professor Mansoor explained.

Looking into the future, Professor Mansoor believes that there is a real need for similar Histories to be prepared for other regions of the World. "This approach will save countless hours of mechanical search," he pointed out, noting that "A researcher today usually spends about 70 percent of his time getting material and 30 percent analyzing it. I would like to reverse that order".

NEW PRODUCTS

UNIVERSITY COMPUTING COMPANY TO MARKET MAGIC

University Computing Company
1500 UCC Tower
P.O. Box 6228
Dallas, Texas 75222

University Computing Company has been licensed to market the Modern Analytical Generator of Improved Circuits (MAGIC), the first general purpose electronic circuit optimization program in the public domain. The license was granted by Scientific System Technology, Incorporated, a Dallas-based computer software developer.

M. F. Sivinski, UCC vice president and general manager of Network Services, said MAGIC will be marketed through the company's 1108 centers. "MAGIC is the result of more than twenty years of effort and has been marketed publicly for over a year," Sivinski said. "In addition, it is continually being improved and expanded and is fully supported by Scientific System Technology."

MAGIC assists the design engineer by performing circuit optimization in that it goes beyond conventional computerized circuit analysis. In analysis the user specifies a circuit and set of element values and the computer calculates various circuit responses. With optimization the user also specifies the desired response and the circuit elements are automatically adjusted to best obtain this response.

ROBOT THAT 'SEES' BY HITACHI

Secretary Office
Hitachi, Ltd.
New Marunouchi Building 1-5
1-chome, Marunouchi, Chiyoda-ku
Tokyo 100, Japan

A new industrial robot system that functions like the human eye has been developed by Hitachi, Ltd. It is capable of automatically recognizing and then selecting specific objects from an intermix of a variety passing by on a conveyor belt.

Called the Hitachi Visual Image Processing Robot (HIVIP), it is expected to further minimize and eliminate a wide range of presently monotonous and boring job functions in production, inspection, sorting and distribution procedures.

The system uses a television camera connected to a computer in which 32 different object images are presently stored. This capacity can be expanded. In the selection process the camera scans and feeds back to the computer the object images. The image recognition range is similar to the human eye in that it can discern shape, size, position and posture of the objects. The images are then quickly compared with the patterns filed in the computer and a predetermined action order activates a handling mechanism. Objects can be recognized at a speed of approximately one per second.

In the present Hitachi development, the object selected is picked up by a vacuum device at the end of a servo-type 'arm and hand'. Other methods can be integrated into the system for the pick-up or object repositioning function.

Components of the new Hitachi system include an ITV camera, control computer, input-output device of visual images, servo control and conveyor.

RESEARCH FRONTIER

AUTOMOBILE ANTI-COLLISION AUTOMATIC BRAKING SYSTEM

W.M. Adams
GM Public Relations
General Motors Corp.
General Motors Building
Detroit, Mich. 48202

A set of equations for controlling an automobile anti-collision automatic braking system has been worked out by a General Motors Research Laboratories engineer. The equations are designed to be fed into an on-board computer that gets its information from a radar mounted in the front of the automobile. The radar would determine vehicle speed, distance to the object ahead and the relative speed between the object and the vehicle. These measurements would be transmitted to the computer, which would then determine the proper application of brakes and signal the braking system to stop the vehicle before a collision could occur. While development of such a system is still in the prototype stage, the formulae provide the basic guidelines for designing an effective anti-collision braking system.

Norman W. Schubring of GM Research Laboratories presented the results of his calculations at the Vehicle Technology Group Conference of the Institute of Electrical and Electronics Engineers. Simply stated, Schubring's formulae compare what can be controlled (speed, distance and closing rate) with what can't be controlled (gravity and friction) and keeps the vehicle on the safe side of the comparison. The formulae were applied in three driving situations: moving toward a stationary object; overtaking another car; and meeting another vehicle head-on, where both vehicles have an automatic braking system.

Each of these situations were calculated for straight and level surfaces as well as for sloping surfaces. Schubring predicts that theoretically the automatic braking system can be faster, more accurate and safer than a human driver because the time between recognizing a situation immediately ahead and applying the brakes is essentially reduced to zero.

Automatic braking can also eliminate panic stops and skids by providing a smooth and natural deceleration which is factored into the equations. Defining the principles of this automatic proximity braking is the first step, according to Schubring; that may lead to safer and more efficient travel on the highways.

DRIVERLESS TAXIS CONTROLLED BY HONEYWELL MINICOMPUTER

Honeywell, Inc.
60 Walnut St.
Wellesley Hills, Mass. 02181

In Farnborough, England, the Department of the Environment, with the help of the Royal Aircraft Establishment, is doing experimental work on an urban transportation system using driverless taxicabs.

"Cabtrack," as the project is called, would use four-seater driverless cabs automatically guided along tracks. Passengers would buy a ticket for their destination at a cab stop. The ticket would be magnetically encoded so that once inserted in the vehicle, it would direct it to the required station.

Using a model of the proposed system, consisting of a 50-foot-diameter track and 10 cabs, a Honeywell minicomputer built into the control logic is investigating the practicability of the operation. The computer diverts cabs from the traffic stream into stops, pauses to load and unload passengers, and merges cabs back into the mainstream.

A full "Cabtrack" system of personalized, unscheduled travel is not expected to be operational before the late 1990s.

MISCELLANEOUS

A QUIET REVOLUTION FOR THE TYPIST

Management Communications Services
34 Astor Ave.
Toronto 17, Ontario, Canada

A quiet revolution to change the face of North America's typewriters is in new flower.

Camwil Inc. of Honolulu, maker of special-purpose Selectric elements, is now wooing mail-order sales for its just-produced Dvorak Simplified Keyboard (DSK) unit — which incorporated a restyled, efficiency-prone keyboard — for changeable-face typewriter models. Camwil's new typing element* is a giant step forward for the DSK. (A recent article, "The Dvorak Simplified Keyboard: Forty Years of Frustration" was published in Computers and Automation, November, 1972, pp 18-25.) [*see p 39]

Another step in the quiet revolution: Ryerson Polytechnical Institute, Toronto, has this year inaugurated a night instruction course in the DSK typing method, the first of its kind in years. The course caters to the private typist more than to the steno pool typist.

The "QWERTY", our usual keyboard, originated at the time the first typewriter was invented in Springfield, Ill., in 1873. The keys on that first machine, an unsophisticated model, clogged together when used at full speed. To remedy this, the inventor, Christopher Sholes, isolated the popular characters — to deliberately slow down the typist. After 99 years, the same keyboard prevails.

The DSK was developed in 1932 after 20 years of intensive time motion typing analyses by Dr. August Dvorak, then of the University of Washington in Seattle. In brief, the Dvorak keyboard acts to distribute the typing work load equitably among the fingers, and to put more typing on the home row keys. Tests have shown it works. Among experienced typists, the DSK ups efficiency from 30% to 50% — the gain is greater still for less skilled typists. In 1965, the U.S. National Bureau of Standards called an end to further DSK testing: the product, it said, was unquestionably superior.

Yet, over the years, the DSK has never managed to overcome the ingrained status of the "QWERTY". Dr. Dvorak's patent rights have since expired; Chief DSK advocate in North America today is Robert Parkinson, president of Motivational Communications Corp. (MCC). Persons interested in obtaining more information and/or materials may write to him at MCC, P.O. Box 544, Mississauga, Ontario, Canada.

TWENTY-FIVE YEARS OF TRANSISTORS

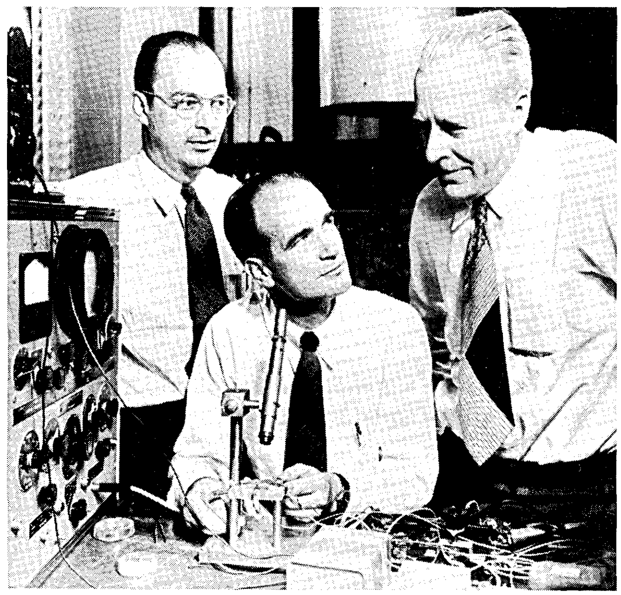
Don Schroeder, Editor
Bell System News Features
American Telephone and Telegraph Co.
195 Broadway
New York, N.Y. 10007

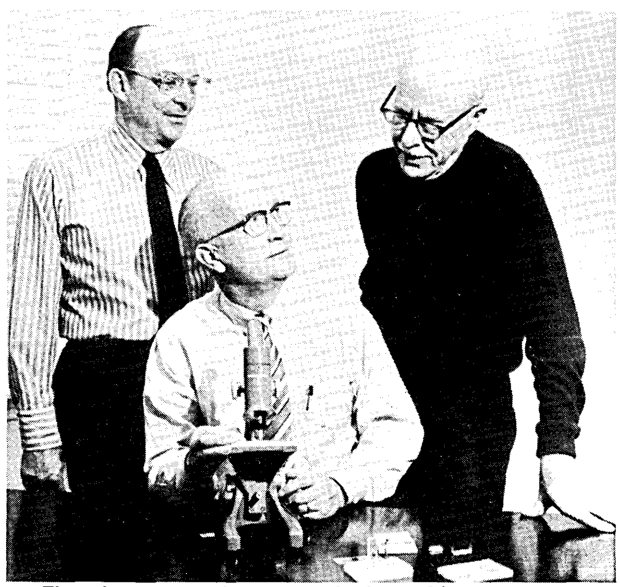
The transistor — the invention that started the computer revolution and the space age, and created a multi-billion dollar industry — is twenty-five years old.

Originally developed as a solid-state replacement for vacuum tubes in telephone applications, the Nobel Prize-winning invention has become virtually ubiquitous in American life. Most people are never more than a few feet away from a transistor. The high reliability, small size, and low power needs have made transistors ideal for wrist watches, home appliances, telephones, boat and airplane radios, desk calculators, and manufacturing equipment. They make possible the computers that are used in credit card systems, banking, airline flight reservations, and thousands of other areas.

Man would probably not have landed on the moon without the transistor; it makes possible visual and aural communication between Earth and the astronauts, is used in the complicated and vital guidance equipment and in all manner of data-logging equipment. Some of this data-logging equipment monitors the heart beats and other body functions of the astronauts; and similar instruments are now widely used in the field of medicine. Pace-makers, and the radio pill which can tell the doctor the "inside story" of his patient's health, would be impossible without the transistor.

Nobel Prize winners, Drs. John Bardeen, William Shockley and Walter H. Brattain (left to right) are shown in the top photo at Bell Telephone Laboratories in 1948 with the apparatus used in the investigations which led to the invention of the transistor. The inventors, who received the Nobel Prize in 1956 for their transistor work, are shown in the bottom photo at a 1972 reunion marking the 25th anniversary of their invention which has revolutionized the electronics industry.





The three men who started the solid-state age now are teaching at universities. William Shockley is a professor of engineering sciences at Stanford University; he also is an executive consultant at Bell Labs. John Bardeen, who teaches graduate physics at the University of Illinois, recently was named to receive

(please turn to page 49)

NEW CONTRACTS

TO	FROM	FOR	AMOUNT
Burroughs Corp., McLean, Va.	Military Traffic Management and Terminal Service, Washington, D.C.	Fixed-price contract for lease/purchase and maintenance of ADPE equipment at three Military Traffic Management and Terminal Service (TMTS), locations; at Headquarters, Eastern Area MTMTS, Brooklyn, N.Y. and Headquarters, Western Area MTMTS, Oakland, Calif., and Headquarters, MTMTS, Falls Church, Va.	$12,120,505
System Development Corp., Santa Monica, Calif.	Air Force Satellite Control Facility (AFSCF)	Continuing as computer program in ·ration contractor for Air Force Satellite ontrol Facility (AFSCF)	$10.3 million
Autonetics Div., North American Rockwell (NR), Anaheim, Calif.	Air Force Aeronautical Systems Div., Wright-Patterson Air Force Base, Ohio	Production of 105 master computers for SRAM (short range attack missile) program	$9.9 million
Mohawk Data Sciences Corp.	Atomic Energy Commission	Supply terminals for AEC's new SACNET Communications System to link AEC's operations in continental U.S. with Commission's central headquarters (Germantown, Md.)	$4.3 million
Sperry Univac Holland Blue Bell, Pa.	Netherlands Social Fund for the Building Industry (SFB), Amsterdam, Holland	A UNIVAC 1106 system to be installed in new headquarters building in 1974	$2.5 million
National Cash Register Co., Dayton, Ohio	National Bank of North America, West Hempstead, N.Y.	2 NCR Century 300 systems for additional processing power and data storage capacity	$2.4 million
Sperry Univac Div. of Sperry Rand Ltd., Blue Bell, Pa.	Surry County Council, County Hall, Kingston-on-Thames, England	A UNIVAC 1106 system; applications will involve areas of finance, property and planning, personnel and inventory functions; also data processing services for civil engineers and District Councils in the County	$2.4 million (approximate)
Sanders Associates, Inc., Nashua, N.H.	U.S. Navy Air Systems Command	Contract modifications (two) for interim engineering services on U.S. Navy's moored surveillance system (MSS)	$1.2 million
Computer Sciences Corp., Los Angeles, Calif.	Navy Purchasing Office, Washington Navy Yard, Washington, D.C.	Computer system support services for naval tactical data systems using a "third-generation" computer now being installed on ships of U.S. Navy	$1.1 million (approximate)
EMR Computer, Minneapolis, Minn.	Police Department, Los Angeles, Calif.	EMR 6145 Twin Computer System for use in city's law enforcement communications network; delivery scheduled for July '73	$1 million (approximate)
Computer Transceiver Systems, Inc., Paramus, N.J.	Litton Industries, Litton ABS Division	About 550 CTSI Model 1200 terminals over one year; under terms Litton markets terminals exclusively to OEM and other Litton divisions; CTSI continues to market to end users. Litton has options for about $15 million worth of Model 1200's over 5 year period	$1 million
International Computers Ltd., London, England	State Planning Committee, Gosplan, USSR	A second System 4-70; will provide almost complete back-up for existing machine, and the new configuration will provide a logical breakdown of work for each machine	$1 million
Memorex Corp., Santa Clara, Calif.	TESLA, Prague, Czechoslovakia	Computer peripheral equipment consisting of disc storage systems; TESLA personnel are currently being trained in use of Memorex equipment in Czechoslovakia, Belgium and England by Memorex technical personnel	$1 million
Datacraft Corp., Ft. Lauderdale, Fla.	The Boeing Company	Four DC 6024/5 24-bit computers for use in real-time simulators for B-1 bomber program	$169,842
Data Card Corp., Minneapolis, Minn.	Pitney Bowes, Stamford, Conn.	Development and manufacture of encoding equipment printing Pitney Bowes machine-readable black and white bar code, called CODABAR, on plastic credit and data cards; under agreement, Data Card also has right to sell or rent CODABAR encoders to retailers and other credit card issuing or encoding organizations	—
Interdata, Inc., Oceanport, N.J.	Servo Corp. of America, Hicksville, N.Y.	3-year OEM purchase agreement; first orders, under agreement, involve 13 New Series Model 50 communications processors, each with 24K bytes of memory, at a combined cost of more than $100,000	—
National Information Systems, Inc., Los Angeles, Calif.	Jet Propulsion Laboratory Pasadena, Calif.	Developing a machine independent design for MBASIC (advanced version of BASIC)	—
Philips Data Systems Small Computer Group, Eindhoven, The Netherlands	Not released	Multi-million pound OEM agreement for P850m minicomputers; it is believed 5000-6000 minicomputers may be installed throughout Australasia; deliveries have begun and will continue through 1975	—
Systems, Science and Software, Inc., La Jolla, Calif.	Martin Marietta Aluminum Co., Torrance, Calif.	A minicomputer interactive graphics system for preparation and check-out of N/C machine tapes	—
University Computing Co., Dallas, Texas	Security Bank & Trust Co., Southgate (Detroit), Mich.	A six-year computing facilities management program	—

NEW INSTALLATIONS

OF	AT	FOR
Burroughs B 1700 system	Daycon Management Consultants, division of Daycon Investors Associates, Inc., Buffalo, N.Y.	Providing a blend of computer technology with business technology to serve clients (system valued at $145,000)
	DECOA, Inc., Tampa, Fla.	An in-house business management data processing system that will serve its 19 dental supply houses and four laboratories (system valued at $100,000)
Burroughs B 6700 system	American Micro-Systems, Inc., Santa Clara, Calif.	Integral part of the manufacturing of micro-circuits for electronic programmable products (replaces a B 3500); scientific applications include circuit analysis, logical simulation, test sequence generation and validation, test conversion programs, circuit placement and routing, and sort testing (system valued at $1.6 million)
	Ford Motor Co., Detroit, Mich.	Communications link between Ford plants, suppliers, and rail carriers, becoming the central computer in Ford's Supply on-line Management Information System (SOLMIS)
	Westinghouse Electric Corp., Marine Division, Sunnyvale, Calif.	Engineering and business applications in the production of propulsion equipment for commercial and government contracts (system valued at $1.8 million)
Control Data 3170 system	Studentsamskipnaden (Student Union of Oslo), University of Oslo, Oslo, Norway	Business data processing applications supporting such activities as a health service, travel agency, sports facilities, restaurants, hotels, student housing, kindergartens and the University Press (system valued at $470,000)
DECsystem-10	First Data Corporation, Waltham, Mass.	Augmenting First Data's PDP-10 time-sharing service in Boston, Mass., New York City, and Washington, D.C.
Honeywell Series 6000 system	Caisse Regionale du Credit Agricole Mutuel de l'Ille et Vilaine, Rennes, France	Institution's data processing needs for the next 10 years, eventually establishing a communications network that will provide most of 60 branch offices with the benefits of a large-scale system
IBM System/3 Model 10	Guaranty Bank and Trust Co., Gretna, La.	General ledger, demand deposits, savings, proof and transit and payroll, installment loans, commercial loans and portfolio analysis
IBM System/370 Model 135	Beltone Electronics Corp., Chicago, Ill.	Comprehensive internal control including manufacturing operation's bookkeeping and accounting procedures and sales analysis
ICL 1902S system	Marine Midland Bank of New York, London, England	Foreign Exchange, Eurodollar and Branch Accounting (called FEEDBAC), to be provided by ICL Dataskil
NCR Century 200 system	Arundel Hospital, Annapolis, Md.	In-patient accounting and post-discharge accounts receivable as well as monitoring out-patient accounts and handling payroll
	Lutheran Hospital, Fort Wayne, Ind.	Inventory control, fixed asset accounting and payroll and personnel accounting as well as for patient billings
	Lynchburg General Hospital, Lynchburg, Va.	Budgetary accounting and medical audit statistics in addition to in-patient accounting and post-discharge accounts receivable
	Maine Medical Center, Portland, Maine	Accounts payable, labor distribution accounting and payroll in addition to patient billings
	McRae's Department Store, Jackson, Miss.	Processing data, collected at point of sale terminals, to generate the desired management reports
UNIVAC 1106 system	Assicurazioni Ausonia of Milan, Milan, Italy	Contracts processing in real-time as well as the immediate checking of premiums and other financial characteristics of new contracts; also for routine business tasks such as general accounting, payroll processing, printing payment requests and receipts (system valued at $1.7 million)

ADVERTISING INDEX

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

MONTHLY COMPUTER CENSUS

Neil Macdonald
Survey Editor
COMPUTERS AND AUTOMATION

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

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

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

The following abbreviations apply:

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

SUMMARY AS OF JANUARY 15, 1973

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Part II. Manufacturers Outside United States							
A/S Norsk Data Elektronikk	NORD-1	8/68	2.0	0	95	95	26
Oslo, Norway	NORD-2B	8/69	4.0 (S)	0	20	20	X
(A) (Jan. 1973)	NORD-5	-	-	0	1	1	0
	NORD-20	1/72	3.5 (S)	0	9	9	10
A/S Regnecentralen	GIER	12/60	2.3-7.5	0	40	40	0
Copenhagen, Denmark	RC 4000	6/67	3.0-20.0	0	19	19	3
(A) (Jan. 1972)							
Elbit Computers Ltd.	Elbit-100	10/67	4.9 (S)	-	-	325	10
Haifa, Israel							
(A) (Nov. 1972)							
GEC Computers Ltd.	902	5/68	-	0	17	17	0
Borehamwood, Hertfordshire	903, 920B	12/65	-	1	464	465	19
England	GEC 905	5/69	-	0	77	77	1
(A) (Nov. 1972)	GEC 920M	7/67	-	0	130	130	103
	GEC 920C	7/68	-	0	19	19	0
	Myriad I	1/66	-	0	47	47	0
	Myriad II	11/67	-	0	32	32	0
	GEC M2140	10/69	-	9	21	30	0
	GEC 2050	6/72	-	0	5	5	32
International Computers, Ltd. (ICL)	Atlas 1 & 2	1/62	65.0	0	6	6	X
London, England	Deuce	4/55	-	0	2	2	X
(A) (Sept. 1972)	KDF 6-10	9/61	10-36	0	34	34	X
	KDN 2	4/63	-	0	1	1	X
	Leo 1, 2, 3	-/53	10-24	0	43	43	X
	Mercury	-/57	-	0	4	4	X
	Orion 1 & 2	1/63	20.0	0	10	10	X
	Pegasus	4/55	-	0	9	9	X
	Sirius	-/61	-	0	8	8	X
	503	-/64	-	0	18	18	X
	803 A, B, C	12/60	-	0	107	107	X
	1100/1	-/60	5.0	0	13	13	X
	1200/1/2	-/55	3.9	0	11	11	X
	1300/1/2	-/62	4.0	0	82	82	X
	1500	7/62	6.0	0	35	35	X
	2400	12/61	23.0	0	3	3	X
	1900-1909	12/64	3-54	2	2200	2202	-
	Elliott 4120/4130	10/65	2.4-11.4	0	100	100	X
	System 4-30 to 4-75	10/67	5.2-54	0	200	200	-
Japanese Mfrs.	(Mfrs. of various models include: Nippon Electric Co., Fujitsue,						
(N) (Sept. 1970)	Hitachi, Ltd., Toshiba, Oki Electric Industry Co., and Mitsubishi					Total:	Total:
	Electric Corp.)					4150 E	800 E
N.V. Philips Electrologica	P1000	8/68	7.2-35.8	-	-	105	39
Apeldoorn, Netherlands	P9200	3/68	-	-	-	300	25
(A) (Oct. 1972)	P9200 t.s.	3/70	-	-	-	5	1
	P880	9/70	-	-	-	29	16
	P850/55/60	9/70	-	-	-	40	290
	ELX	5/58	6-21	-	-	42	-
	DS 714	-/67	-	11	22	33	19
	DS 18	9/72	-	-	-	-	9
	PR 8000	1/66	-	-	-	23	-
Redifon Electronic Systems, Ltd.	R2000	7/70	-	1	19	20	4
Crawley, Sussex, England	R2000A	-	-	-	-	-	1
(A) (Jan. 1973)							
Saab-Scania Aktiebolag	D21	12/62	7.0	0	38	38	-
Linkoping, Sweden	D22	11/68	15.0	0	34	34	2
(A) (Jan. 1973)	D220	4/69	10.0	0	17	17	3
	D23	-/73	25.0	0	0	0	5
	D5/30	12/71	1.0	0	10	10	4
	D5/20	5/71	0.6	0	50	50	2000
Seelenia S.p.A.	G-16	7/69	10.9 (S)	0	136	136	51
Roma, Italy	GP-160	-	5.6 (S)	-	-	-	250
(A) (Nov. 1972)							
Siemens	301	11/68	0.9	-	-	103	15
Munich, Germany	302	1/68	2.1	-	-	30	7
(A) (Oct. 1972)	303	4/65	2.7	-	-	70	2

NAME OF MANUFACTURER	NAME OF COMPUTER	DATE OF FIRST INSTALLATION	AVERAGE OR RANGE OF MONTHLY RENTAL $(000)	NUMBER OF INSTALLATIONS In U.S.A.	Outside U.S.A.	In World	NUMBER OF UNFILLED ORDERS
Siemens (Continued)	304	5/68	4.5	-	-	81	13
	305	2/68	6.1	-	-	119	16
	306	6/70	7.9	-	-	29	5
	2002	6/59	16.4	-	-	41	-
	3003	12/63	15.8	-	-	32	4
	4004/15/16	10/65	6.1	-	-	96	4
	4004/25/26	1/66	10.0	-	-	78	16
	4004/35	2/67	14.2	-	-	202	51
	4004/135	10/71	20.5	-	-	73	48
	4004/45	7/66	27.3	-	-	354	36
	4004/46	4/69	41.0	-	-	16	1
	4004/55/60	7/66	35.0	-	-	27	-
	4004/150	2/72	49.0	-	-	33	50
	4004/151	3/72	61.0	-	-	7	3
	404/3	4/71	2.1	-	-	31	12
	404/6	10/71	4.5	-	-	54	33
						Total: 1476	Total: 312
USSR (N) (May 1969)	BESM 4	-	-	-	-	C	C
	BESM 6	-	-	-	-	C	C
	MINSK 2	-	-	-	-	C	C
	MINSK 22	-	-	-	-	C	C
	MIE	-	-	-	-	C	C
	NAIR 1	-	-	-	-	C	C
	ONEGA 1	-	-	-	-	C	C
	URAL 11/14/16 and others	-	-	-	-	C	C
						Total: 6000 E	Total: 6000 E

Across the Editor's Desk — *Continued from page 44*

his second Nobel Prize for Physics. He shared the 1972 prize with two others for their work on superconductivity. And Walter Brattain teaches undergraduate physics at his alma mater, Whitman College in Walla Walla, Washington.

COMPUTER IMPACT ON BANKING PROMISES A "NO MONEY" SOCIETY

Henry Berler
Frost & Sullivan, Inc.
106 Fulton St.
New York, N.Y. 10038

"The market for computerized banking information systems and services, now $1 billion, will soar to $3 billion by 1982. By far the most important influence on the market for banking information systems over the next ten years will be the transition to 'checkless' and 'cashless' transactions. Banking is undeniably moving in this direction; the only questions are by what route and in what time frame?"

This is how a study by Frost & Sullivan, a market research firm, sizes up the impact that computer information systems will exert on the banking business over the next decade. The report, entitled "Banking Information Systems — The Checkless Society," provides some of the answers to the questions it poses.

According to a survey conducted by the firm, one quarter of the respondants reported that they expect the trend to a "checkless" society to affect their automation requirements within two years; half said they would feel the impact before 1977. (The survey consisted of a mail questionnaire with follow-up telephone queries, conducted in September 1972, expressly for the report.) Overall, the study notes that the growth in the market will "rival that of all other electronic data processing sub-markets, except those for medical and hospital EDP".

According to Frost & Sullivan, this imminent change in the way money is transferred will "fundamentally alter" the markets for banking systems and software, opening up important new opportunities to suppliers, particularly the smaller computer peripheral and terminal firms.

C.a PROBLEM CORNER

Walter Penney, CDP
Problem Corner
Computers and Automation

PROBLEM 732: SEANCE SEATING

The first thing Bill asked when Mike came in the office was, "How did the seance go last night?"

"Fine. We tried to call up the spirit of Fermat to ask him about that theorem."

"Any success?"

"No, we spent so much time with the seating arrangements we didn't have much chance."

"Don't you just sit at a round table and hold hands?"

"Yes," said Mike. "There were several couples and first we decided to have men and women alternate, but there was some objection to that."

"Not from you, I'll bet."

"No, that's right. Anyway we finally decided to let anyone sit anywhere."

"Must have been a lot more choice then."

"I'll say! In fact there were ten times as many possibilities, as I calculated later," said Bill. "That's what took so much time. Everyone was changing his partners and it took a while for things to settle down."

"How many couples were there?"

"You ought to be able to figure that out — and without writing a program."

Solution to Problem 731: A Simple Solution

The maximum of two numbers X and Y can be determined by the formula $\frac{(X + Y) + |X - Y|}{2}$.

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

CALENDAR OF COMING EVENTS

Feb. 20-22, 1973: Computer Science Conference, Neil House, Columbus, Ohio / contact: Dr. Marshall Yovits, 101 Caldwell Lab., 2024 Neil Ave., Ohio State Univ., Columbus, OH 43210

Feb. 24, 1973: 6th Annual Systems Seminar, Association for Systems Management, Sheraton Nashville Motor Inn, Nashville, Tenn. / contact: Charles H. Preuett, Life & Casualty Tower, Nashville, TN 37219

Feb. 27-Mar. 1, 1973: COMPCON, 7th Annual IEEE Computer Society International Conference, Jack Tar Hotel, San Francisco, Calif. / contact: Dr. Sidney Fernbach, Computation Dept., L-61, Lawrence Livermore Laboratory, P.O. Box 808, Livermore, CA 94550

Mar. 4-9, 1973: SHARE Meeting, Denver, Colo. / contact: D.M. Smith, SHARE, Inc., Suite 750, 25 Broadway, New York, NY 10004

Mar. 7-8, 1973: 1973 Annual Spring Conference of the Association for Systems Management, Royal York Hotel, Toronto, Ontario / contact: Mr. R. H. Crawford, Comptroller's Department, Imperial Oil Limited, 825 Don Mills Rd., Don Mills, Ontario, Canada

Mar. 7-9, 1973: 6th Annual Simulation Symposium, Tampa, Fla. / contact: Annual Simulation Symposium, P.O. Box 22573, Tampa, FL 33622

Mar. 9, 1973: 4th Annual AEDS Conference on the Development and Evaluation of Educational Programs in Computer Science and Data Processing, St. Louis, Mo. / contact: Ralph E. Lee, P.O. Box 951, Rolla, MO 65401

Mar. 12-14, 1973: A Programming Language (APL), Goddard Space Flight Center, Greenbelt, Md. / contact: Cyrus J. Creveling, Code 560, Goddard Space Flight Center, Greenbelt, MD 20771

Mar. 26-28, 1973: Data Processing Institute's Conference and Trade Show, Skyline and Holiday Inn Hotels, Ottawa, Canada / contact: Derek Hasler, Conference/73, Box 2458, Ottawa, Canada K1P 5W6

Mar. 26-29, 1973: IEEE International Convention (INTERCON), Coliseum & New York Hilton Hotel, New York, N.Y. / contact: J. H. Schumacher, IEEE, 345 E. 47th St., New York, NY 10017

Mar. 27-29, 1973: 1st Conference on Industrial Robot Technology, University of Nottingham, England / contact: Organising Secretary, CIRT, Dept. of Production Engineering and Production Management, University of Nottingham, Nottingham NG7 2RD, England

Mar. 29-31, 1973: 10th Symposium on Biomathematics and Computer Science in the Life Sciences, Houston, Texas / contact: Office of the Dean, The University of Texas Graduate School of Biomedical Sciences at Houston, Division of Continuing Education, P.O. Box 20367, Houston, TX 77025

April 2-5, 1973: SOFTWARE ENGINEERING FOR TELECOMMUNICATION SWITCHING SYSTEMS, University of Essex, Essex, England / contact: Mrs. Penelope Paterson, Institution of Electrical Engineers Press Office, Savoy Place, London WC2R OBL, England

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

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

April 24-26, 1973: I.S.A. Joint Spring Conference, Stouffer's Riverfront Inn, St. Louis, Mo. / contact: William P. Lynes, c/o Durkin Equipment, 2384 Centerline Ind. Dr., St. Louis, MO 63122

April 30-May 2, 1973: Ist Symposium on Computer Software Reliability, Americana Hotel, New York, N.Y. / contact: David Goldman, IEEE Hdqs., 345 E. 47th St., New York, NY 10017

May 2-3, 1973: 18th Annual Data Processing Conference, Tuscaloosa, Ala. / contact: C. E. Adams, Director, Conference Activities, University of Alabama, Box 2987, University, AL 35486

May 3-4, 1973: 10th Annual National Information Retrieval Colloquium, Independence Mall Holiday Inn, 400 Arch St., Philadelphia, Pa. / contact: Martin Nussbaum, Computamation, 2955 Kensington Ave., Philadelphia, PA 19134

May 13-16, 1973: 1973 International Systems Meeting, Hilton Hotel, Denver, Colo. / contact: R. B. McCaffrey, Association for Systems Management, 24587 Bagley Rd., Cleveland, OH 44138

May 14-17, 1973: Spring Joint Computer Conference, Convention Hall, Atlantic City, N.J. / contact: AFIPS Hdqs., 210 Summit Ave., Montvale, NJ 07645

June 4-6, 1973: 1973 8th PICA Conference, Radisson Hotel, Minneapolis, Minn. / contact: IEEE Hdqs., Tech. Svcs., 345 E. 47th St., New York, NY 10017

June 4-8, 1973: National Computer Conference and Exposition, Coliseum, New York, N.Y. / contact: AFIPS Hdqs., 210 Summit Ave., Montvale, NJ 07645

June 22-23, 1973: 11th Annual Computer Personnel Conference, Univ. of Maryland Conference Center, College Park, Md. / contact: Prof. A. W. Stalnaker, College of Industrial Management, Georgia Institute of Technology, Atlanta, GA 30332

June 26-28, 1973: Workshop of Computer Architecture, Université de Grenoble, Grenoble, France / contact: Grenoble Accueil, 9, Boulevard Jean-Pain, 38000, Grenoble, France

June 26-29, 1973: DPMA 1973 International Data Processing Conference & Business Exposition, Conrad Hilton Hotel, Chicago, Ill. / contact: Richard H. Torp, DPMA International Hdqs., 505 Busse Highway, Park Ridge, IL 60068

July 17-19, 1973: Summer Computer Simulation Conference, Queen Elizabeth Hotel, Montreal, Canada / contact: Stuart Trask, Sun Life Assurance Co. of Canada, P.O. Box 6075, Montreal 101, P.Q., Canada

July 20-22, 1973: 1973 International Conference of Computers in the Humanities, University of Minnesota, Minneapolis, Minn. / contact: Prof. Jay Leavitt, 114 Main Engineering Bldg., University of Minnesota, Minneapolis, MN 55455

July 23-27, 1973: 3rd Annual International Computer Exposition for Latin America, Maria Isabel-Sheraton Hotel, Mexico City, Mexico / contact: Seymour A. Robbins and Associates, 273 Merrison St., Box 566, Teaneck, NJ 07666

Aug. 13-17, 1973: SHARE Meeting, Miami Beach, Fla. / contact: D. M. Smith, SHARE, Inc., Suite 750, 25 Broadway, New York, NY 10004

Aug. 20-24, 1973: 3rd International Joint Conference on Artificial Intelligence, Stanford University, Stanford, Calif. / contact: Dr. Max B. Clowes, Laboratory of Experimental Psychology, University of Sussex, Brighton, Sussex BN1 9QY, England

WILL YOU HELP?

Yes, *you.* It may come as a surprise that you'd be asked . . . but as a reader of *Computers & Automation* you are in a unique position to help us.

NAMES . . . people, institutions, companies who should be interested in 1) the computer industry and/or 2) seeking truth in information are very much needed to join you as readers of *C&A*.

Will you tell us who they are? And perhaps even more, will you let us use your name in writing to them? But with or without your name (we'll only use it if you grant permission) we need to know those *you* think might be interested in also reading *C&A*.

*** * * * *reprint from***
computers and automation

Science and the Advanced Society, by C. P. Snow, Ministry of Technology, London, England (April 1966)
The Information Revolution and the Bill of Rights, by Dr. Jerome B. Wiesner, M.I.T. (May 1971)
Employment, Education, and the Industrial System, by Prof. John Kenneth Galbraith, Harvard Univ. (Aug. 1965)
Computers and the Consumer, by Ralph Nader, Washington, D.C. (Oct. 1970)

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