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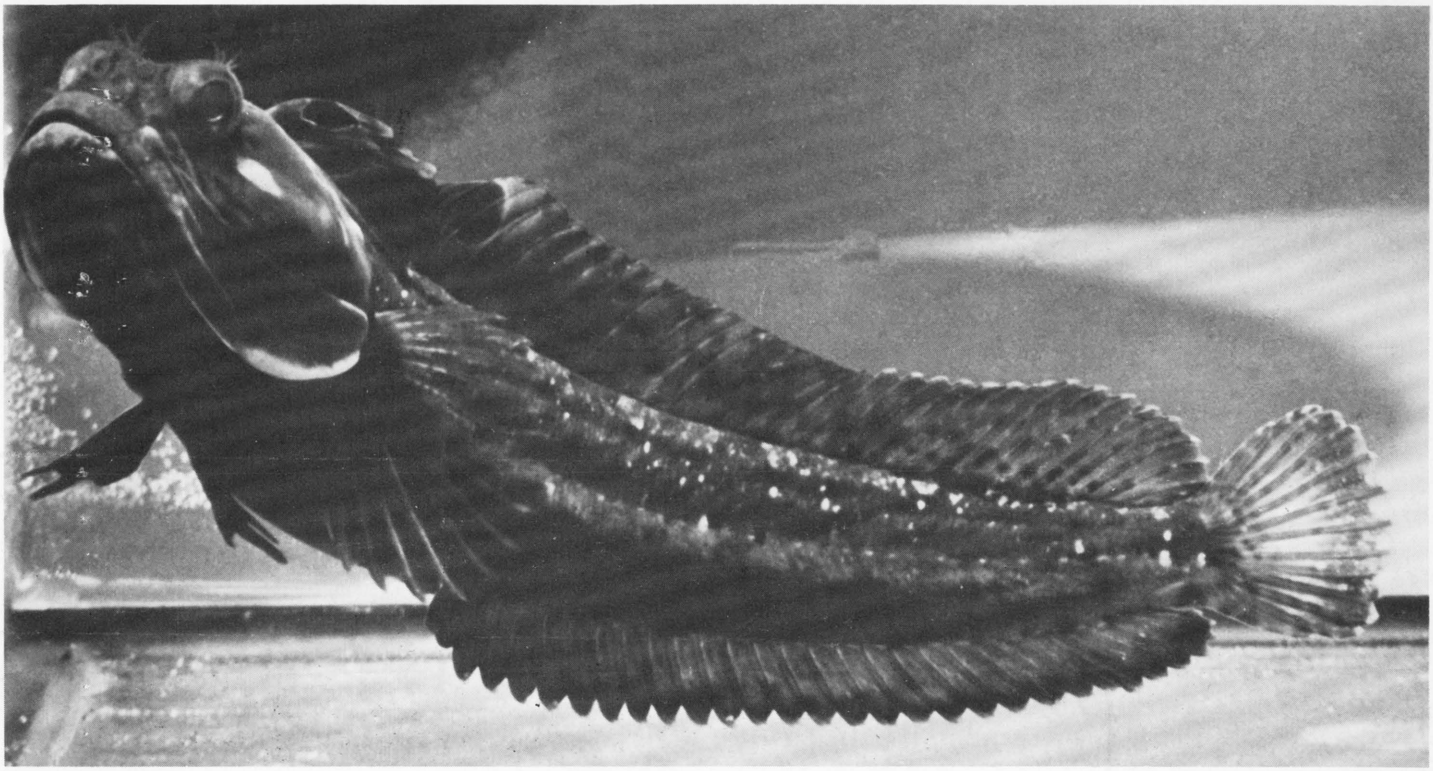

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computers and people

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

Front Cover Picture

The Front Cover shows a "sarcastic fringehead," one of the types of fishes included in a study by Southern California Edison Co. using a computer. They are seeking to determine the effects of warm water from the power plant on the local marine life. It has been found that marine animals thrive in the warmer water, and in fact can often reach maturity in less than half the time needed in the naturally cool waters. See the story on page 25.

Key

[A]	–	Article
[C]	–	Monthly Column
[E]	–	Editorial
[F]	–	Forum
[N]	–	Newsletter
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EDITORIAL

Robots, Microprocessors, and the Future

Here are some recent comments on robots, from an article "Robots: We Needn't Worry that They will Replace Us," by Robert W. Tinsley, in the magazine "TWA Ambassador" for Nov. 1976. The average robot, says the author:

"... shows somewhat less intelligence than most insects;
... is capable of doing only the most simple uncomplicated industrial tasks, like picking something up from one place, and placing it somewhere else;
... is apt to resemble an animated tank turret with an arm and a simple mechanical hand instead of a gun barrel;
... contains over 50,000 feet of wire and 130,000 memory cells;
... can be programmed to reach over 2 quintillion distinct points in space;
... costs on the average $35,000;
... is used generally in those jobs which are too dangerous or too boring for a man to do efficiently;
... if used in a house, would require marked changes of design in the house including probably special power outlets, no stairs, no doorknobs, etc."

It seems to me that this is a remarkably limited view of a very small class of possible robots. In the same way, the first limited view of man flying through the air, pictured man as having wings like a large bird and flying by flapping the wings. We have now escaped that view -- held by Icarus and Leonardo da Vinci and many other men up through the 1800's. How did we escape?

Men divided the problem into parts, solved the parts separately, and then put together the solutions in new ways. This resulted in producing gliders, balloons, propeller planes, jet aircraft, helicopters, man-carrying kites, spacecraft, and so on.

A robot is essentially a system of sense organs, thinking organs, and acting organs, and behaves as if it were a living system -- except that the functions of self-repair and self-reproduction may not be present.

Millions of buildings already contain a robot: the thermostatic control system over the heat. The mind of the thermostat robot contains one binary "yes/no" of information: too hot or too cold. If the building is too cold, the robot brain (thermostat) transmits a message to the furnace flame, "turn on." If too hot, the thermostat transmits a message to the furnace flame, "turn off." Additional control signals increase safety, such as a stack sensor. If the stack is not hot enough when the furnace has been on for a little while, they system turns off the furnace flame, because something is surely wrong. If the stack becomes too hot, the system turns off the furnace flame, because something is surely wrong.

As for robots displacing human beings and being a threat to their employment, this happens over and over. The automatic (or robot) elevator arrived in the decade of the sixties; in New York alone, it put 40,000 elevator men out of work. The men had no lobby, no effective organization. They sank into the unemployment pool with hardly a ripple. And as soon as they gave up hunting for a new job suited to "x years of experience as an elevator operator," the U.S. Dept. of Labor index of employment forgot about them.

It is a mistake to think of a robot as a system connected physically or spatially in one piece, like an animal. 50,000 feet of wire is absurd: instead there should be electronic communication, like the walkie-talkie, between the various extended or remote parts of the robot. All that is necessary is that diverse part of the robot system be able to communicate suitably.

<u>Acting Organs</u>. The acting organs available for robots are, it seems to me, in rather a high state of technological development. Over and over again an industrial process handling materials or a business process handling information has been equipped with brains, and becomes automatic and robot-like. Often the brains will be a minicomputer or a microcomputer, with specialized software.

<u>Thinking Organs</u>. The resources for the brains of robots are in rapid development; smaller, faster, more reliable, more capacity, cheaper, etc. I have been told that IBM has already placed IBM 360 and 370 computers on silicon chips. If this is not yet true, it is likely to be true soon, for it is an obvious development. An almost unlimited amount of thinking capacity (information processing capacity) is now or soon will be available for robots.

<u>Sensing Organs</u>. A large collection of one dimensional sensing devices are already available. They include many senses (infrared, ultra-violet, etc.) which men do not possess.

<u>Feedback Chain</u>. The major present bottleneck, it seems to me, is the design of simulation of two-dimensional vision and feedback. When this bottleneck is broken, the full chain of vision and feedback, which millions upon millions of animals use for their functioning , should become available for use in robots.

For example, a man reaches to pick up a pencil on his desk, and takes it in his hand. This is something so easy for us biased observers to do that hardly anyone thinks about it. But if the man's eyes are shut, and he has no feelings in his fingers -- he can't pick up the pencil. This chain, I believe, will be successfully simulated rather soon, and then this bottleneck too will vanish. In the same way, the microprocessor computer is making giant computers vanish.

The robots of today will soon seem as archaic and limited as species of life of 500 million years in the past.

Edmund C. Berkeley

Edmund C. Berkeley
Editor

Data Communications: Policies Developing In the United States

Richard E. Wiley, Chairman
Federal Communications Commission
Washington, DC

"We must continue to strive to provide an environment in which all segments of society can freely contribute."

Computer communications has a vast potential for impact on the developed nations of the world. Here I wish to sketch in broad terms the policies toward data communications which we are pursuing in the United States, and second, to briefly describe the industry I envision developing under such policies.

The Information Sector

It is now widely recognized that there exists in the economy of the United States a sizeable and growing "Information Sector." Researchers in this area have estimated that about 46 percent of our Gross National Product is devoted to the production, processing or distribution of information goods and services. This 46 percent is roughly divided between market-type information activities such as consulting services and non-market activities such as in-house financial accounting. Moreover, it is estimated that over one-half of our total wage bill is devoted to the information sector. The importance of these observations to national policy in general — and to telecommunications policy in particular — can hardly be overstated.

Change to an Information Society

This transformation to an information society has the potential, for good or bad, to affect all aspects of our daily lives — including our jobs, our education, our entertainment, our privacy, our political institutions, and ultimately our personal freedom as well. In sum, it can affect the very essence of the quality of life.

Here it is not possible to explore all the social and economic ramifications of these developments, particularly those extending into areas far outside of telecommunications. It is encouraging to note, however, that this area of study is receiving increased attention both nationally and internationally. One conclusion that already emerges is that future productivity gains in the post-industrial age must come increasingly from the information sector of the economy. In other words, future improvements in our standard of living depend upon our ability to produce, process, disseminate, and use information in a more efficient fashion.

Based on a talk at the Third International Conference on Data Communications, Computer Communications, Toronto, Canada, August, 1976.

Complex Structure

The information sector of the economy rests on a complex technological infrastructure that includes the computer and telecommunications industries. Hence, productivity gains in the information sector depend significantly upon developments in communications and data processing. Energy and natural resource constraints appear to be less critical in an information-oriented economy than in an industrial society. Thus, improvements in our standard of living can be achieved without a concomitant increase in the consumption of natural resources. It is also fortunate that in both computers and communications — and in the combinations thereof — we are moving from an era of scarcity to an era of plenty. Computer and communication services are already pervasive in our society. Sophisticated public and private line communications offerings span the continental United States, while satellite technology is extending such capabilities to Alaska, Hawaii, Puerto Rico, and the Virgin Islands. Increasingly powerful electronic calculators, minicomputers, and time-sharing computer services are bringing data processing power to all walks of life. The technological options seem virtually boundless. The prognosis for achieving further productivity gains in the information sector seems excellent — if we can achieve the proper institutional and regulatory framework.

Office Automation

In two areas I believe the benefits from the combination of computers and communications will be particularly striking. The first example is in office automation. The office, after all, is the information society's equivalent of the factory in the industrial society. Public and private offices consume a great proportion of the total amount of labor and capital devoted to the information sector and, yet, the productivity in the typical office is only marginally greater than it was twenty years ago. We are already witnessing successful applications of word processing equipment in many offices. New applications of computer assisted communications are on the horizon. These systems include powerful text editing facilities for the preparation of messages, reports, and letters. Drafts, for example, can be edited by several people simultaneously and the results made instantaneously available to the intended recipients. On-line filing and retrieval of the text allows easy access from even the most remote locations. These and other developments, such as rapid facsimile transmission, promise to revolutionize the office of the future.

As a regulator, I am an individual who is literally inundated with data. A typical rate case involving a common carrier tariff change generates volumes of cost information and expert testimony and the resulting decision can easily run several hundred pages. In many instances, we must utilize voluminous information on demand, cross-elasticities of demand, costs as a function of demand, and so forth, in order to arrive at decisions that are fair to both the consumers and the carriers. We are at an extremely rudimentary stage in our use of advanced information processing technology for handling the existing volume of paperwork. Our agency is a prime example of an information sector activity which can significantly benefit from these advances.

Home Electronic Services

A second area that will substantially benefit from the combination of computers and communications involves electronic services for use in the home. As I see it, the development of the home computer center will be an inevitable result of two strong forces that are already at work.

One force is home entertainment. The combination of inexpensive microprocessors, rudimentary controls, and the ordinary TV set as a display device has led to the development of elementary "ball and paddle" video games aimed at the general consumer market. These first generation devices are already being superseded by second generation systems that greatly expand the number and sophistication of the games that can be played. These "smart" video games already allow the user to compete with the machine and even express some creativity through electronic play on the TV screen. Such devices have attracted both television and computer manufacturers but the emphasis has been primarily on entertainment features. There are, however, already tradepress accounts of systems under development to provide interactive learning, mathematical calculations, information storage and retrieval, as well as the more sophisticated games. Other serious applications are sure to follow.

Electronic Computer Hobbyists

Second, we are witnessing the rapid expansion of electronic hobbyists into computers. The same developments in microprocessor technology that led to the video games are making it possible for these hobbyists to harness an enormous amount of computer power at the cost of only a few hundred dollars. Retail stores already exist specializing in serving the computer hobbyist market. There is also a rapid growth in clubs and publications serving the group. It is not difficult to visualize their use of the telephone network to exchange messages, data, and software in digital form. I firmly believe that this growing body of hobbyists can develop low-cost software and new applications of digital technology for home and small business use. An example might be in the control of heating and air conditioning equipment to minimize energy consumption. One only has to observe the public's apparent love for tinkering with electronic gadgetry and the past contributions of another group of hobbyists — radio amateurs — to reach the conclusion that such aplications will result.

Areas that will increase the productivity of the information sector include also, for example, Electronic Funds Transfer Systems and electronic mail. Nearly all of these areas rely heavily on telecommunications.

Computer Data Networks

Telecommunications is obviously a prime concern because it lies at the very core of the information infrastructure. Further development of the information sector is dependent upon the evolution of the telecommunications industry, in particular that part of the industry dealing with computer communications. In a post-industrial society, these computer data networks provide the same crucial integrating function that canals, railroads, and highways did in the earlier phases of our development.

Policy: "Freedom"

If I had to characterize current U.S. policies towards data communications in a single term, I would choose the word freedom. We are allowing freedom of entry into the data transmission market by new terrestrial and satellite carriers. We have ordered that customers be allowed to have the freedom to connect their own properly certified terminal equipment directly to the lines of the established carriers. We are allowing entrepreneurs to lease basic transmission capacity from established carriers and to tailor that basic capacity to the specialized needs of their own customers. We are giving otherwise unaffiliated users the freedom to share private line services in order to take advantage of special rates or to gain network efficiencies. We are giving subscribers the option of using the international switched voice network for dataphone service. Finally, we are committed to giving the established carriers the freedom to compete fully and fairly in the specialized data communications markets.

Basic FCC Decisions

The series of basic FCC decisions that produced these policies — the <u>Specialized Carrier</u> and <u>Domestic Satellite</u> decisions, <u>Carterfone</u>, <u>International Dataphone</u>, and the recent <u>Resale and Shared Use</u> decisions — represent a reasoned evolution from past policies. These decisions — and the competition that stems from them — are the result of the phenomenal changes in electronic technology outside the control of the monopoly carriers and the dissatisfaction of specialized users with the regular services offered by these carriers.

Rather than call it contrived competition, as some critics have, I would call it inevitable competition. It was inevitable because in the post-industrial era there are growing numbers of specialized applications of telecommunications that can improve our standard of living on the one hand and, on the other hand, there are growing numbers of firms and individuals with ideas and products to satisfy these needs. This is particularly true in the digital world of the future where data processing and communications both rely on the same digital technology. It was these forces, rather than some whim of the regulators, that produced and sustained the move toward increased competition.

Even though these decisions have been upheld by the courts, supported by other agencies of the government such as the Office of Telecommunications Policy and the Department of Justice, and widely hailed by users and other parts of the industry, the established carriers have strongly opposed them.

The Carriers Argue "Side-Effects"

Recently at least, the arguments used by the carriers in opposing these developments have not centered on the basic concepts I have outlined thus far. Since we are not proposing competition in the provision of traditional monopoly supplied local exchange or message toll telephone service, their principal opposition is based on the possible side effects of this limited competition. The carriers maintain that these policies will destroy existing patterns of cross-subsidies that have allegedly served to hold down rates paid by residential and rural subscribers for these basic services.

Internal Cross-Subsidies

There is little doubt that a series of internal cross-subsidies have built up over the years in the telephone industry, although the real direction and extent of those subsidies has yet to be determined. It is equally clear that, without barriers, competition will seek out those areas which are overpriced relative to cost. There is no evidence, however, to suggest that rates for basic service have been perceptibly impacted by the meager amount of competition introduced to date. I am entirely confident that there are adequate remedies available for dealing with any possible prospective adverse effects long before they could occur. These remedies include making changes in toll separations procedures, imposing special network access charges for certain types of terminal equipment, and a host of other options that do not involve destruction of the competitors. By limiting competition to specialized areas and careful selection from among these options, we will be able to reap the benefits of competition while maintaining existing or more rational patterns of cross-subsidy <u>if</u> they are deemed to be in the public interest.

Since the established carriers have been largely unsuccessful in their legal appeals of these decisions, they have now turned to the Congress where legislation has been introduced which would — in effect — eliminate the limited amount of competition that we have permitted. The FCC, of course, welcomes the opportunity to present its views to the Congress.

Policy: "Conscious Flexibility"

In broad terms then, the current — but challenged — U.S. policy toward data communications is one of conscious flexibility. We are relying on the economic and technical judgements of the marketplace to aid in the selection between packet switching and circuit switching, between satellite and terrestrial transmission mediums, between general purpose and specialized networks, and between different terminal devices.

I would like to briefly outline the industry that I see developing under such policies. Of course, projections are extremely hazardous because of the rapid changes in technology — but let me venture to gaze into the crystal ball anyway.

First, I see the massive local exchange and public message toll markets continuing to be supplied on a monopoly basis. In fact, I believe these markets will be greatly stimulated by the types of developments I described earlier. However, I do see the extensive development of complex private, shared, and public networks for specialized applications. It may develop that transmission, switching, multiplexing, network management and other carrier supplied services will be unbundled to enable the end user or an intermediary (such as a valve added carrier) to assemble their own networks for such applications.

Specialized Switching

Specialized switching — be it packet or circuit switching — and other network services should be highly competitive, with the possible exception of the supply of basic transmission capacity. The prospect for extensive competition in this market is still uncertain because it is not clear whether economies that result from specialization can overcome the apparent economies of scale that result from very large systems designed with broader objectives in mind. If the economies of scale do prevail, competition in the provision of specialized services can still survive on a "value-added" basis. In these situations, the established firms would act as a carrier's carrier. Nevertheless, it is evident that the established carriers will remain a strong force in most of the specialized markets by virtue of their established market position, their vast R & D resources, their competence and efficiency, and their technological advances that are already on the drawing boards.

Since some of the specialized markets may involve substantially greater risks than basic telephone service, the established carriers may find it in their own best interest to set up separate subsidiaries in order to compete in these markets. Not only would such an approach provide an appropriate opportunity for more speculative ventures on the part of the carriers, it would also aid in the prevention of undesirable cross-subsidies and minimize the unnecessary extension of regulation.

Boundary Problems

Of course, there are many issues yet to be resolved. Consider, for example, the important boundary problems that exist between the regulated communications common carrier industry on one hand and the activities of the U.S. Postal Service in the electronic transmission of mail on the other. Another example of a boundary problem is the interface between U.S. carriers and network users and their foreign counterparts. Even though I am totally committed to the U.S. policies which I have described, I recognize that other countries — at different stages of economic development, at different stages in communications development, and with different economic, political and institutional interests — may well adopt a different approach. This may create some impediments to the development of computer communications networks that cross international boundaries. With the increased importance of these networks, we must all intensify our efforts to coordinate international facilities to the fullest extent while respecting the policies and traditions of all countries concerned.

A final example of an issue is the boundary between regulated common carrier activities and unregulated data processing. Just last week, the Commission voted to reopen the Computer Inquiry which was concluded in 1970 with a statement of policy and promulgation of rules. The issues of that investigation are even more crucial today. They center around (1) the nature and extent of regulation which could and should be applied along the continuum from pure data processing to pure communications and (2) whether, and under what circumstances and subject to what conditions or safeguards, should common carriers be allowed to provide data processing services. In 1970,

(please turn to page 21)

The Privacy Act of 1974: A Look at it From a Combined Technical and Legal Perspective

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McLean, Virginia 22101

"The Privacy Act of 1974 applies indirectly to the use of computers as a contibuting factor in the violation of the individual's right to privacy. The Act contains technical ambiguities which create problems in litigation resulting from noncompliance."

Introduction

Legislative responses to the emerging importance of technology in the social, economic and political activities of our society require the integration of technical and legal expertise. Without this integration the legislation may contain irreconcilable technical ambiguities (e.g., terminology which fluctuates with changing technology) which affect the ability of responsible parties to comply with the law. In addition, a law lacking the necessary legal and technical coordination may omit important technical considerations (e.g., the significance of technology design and development phases in safeguarding against computer misuse) which impair the law's effectiveness.

The Privacy Act of 1974 (PA) is such legislation. It applies indirectly to the use of computers as a contributing factor in the violation of the individual's right to privacy. The Act contains technical ambiguities which create party identification problems in litigation resulting from noncompliance. Also, the Act omits negligence liability which affects not only the nature of agency liability for noncompliance, but the effectiveness of the Act in providing adequate civil remedies for agency noncompliance.

This article deals with the need to combine technical and legal perspectives to the problems being addressed by the Privacy Act, and discusses ambiguities in and omissions from the Act and analyzes their potential ramifications on litigation.

In additon, this article seeks to combine a novice's knowledge of the law with the trained soothsayer's instincts of a systems analyst, in order to highlight several legal issues dealing with party identification and agency liability which may arise out of suits brought under the act.

Ambiguities

Discussions on apparent ambiguities in the Act have been restricted to the definitions of subsection 3(a) (i.e., definitions for agency, maintain, record, system of records, routine use, and statistical record). If expanded to include phrases other than those specifically defined in the Act, the discussions have concentrated on their technical significance and their implications for the operations of an information system. Since previous analyses have usually been presented in the context of compliance requirements, they have failed to recognize the significance of those words and phrases of the Act which identify the subject matter (i.e., systems of records) and the defendants (i.e., federal agencies) in litigation resulting from noncompliance.

Editorial Note: All footnotes and references have been omitted from this version of the article. For a copy of the article including all footnotes and references, please write to the author. – ECB

The terms and phrases of the Act that pose potential problems are "maintain," "control," and "responsible for" in subsections PA 3(e), PA 3(c), and PA 3(e)(4)(F), respectively. The basic concerns that arise from their use are as follows: (1) Whether to apply the common interpretation or the technical meaning of these words and phrases; and (2) Whether inconsistent and interchangeable application of these words and phrases in various provisions of the Act will create a party identification problem.

Common vs. Technical Meaning of the Terms

In determining whether to use the common or technical meanings, each alternative has its own shortcomings. Common usage definitions may fail to describe a phrase in terms of the activities being performed on the subject matter in question (i.e., systems of records). It is difficult to obtain operative and consistent definitions of "control," "maintain" or "responsible for" in an information systems environment without mentioning the operations of update, access, retrieval, use, etc., that are being performed on the information.

The shortfall of using technical definitions is that a change in technology may impose a different interpretation, if not a different definition, for the terms. Computer definitions are largely the terminology for concepts or things invented on the run, and the birth and mortality rate of the terminology on technology will, in turn, either broaden or narrow the scope of the subject matter (i.e., systems of records), modify the set of defendants (i.e., agencies) in any litigation resulting from the Act, and may alter the consistency of the case law pertaining to the Act. The following paragraphs illustrate some of the basic problems of using technical definitions for the terms "maintain," "control," and "responsible for."

Maintain

The definition of "maintain" set forth in the Act in subsection 3(a)(3) states that "the term 'maintain' includes maintain, collect, use, or disseminate." Applying this definition to subsection 3(e), Agency Requirements, it is possible, depending on the technology employed in the information system, to arrive at a different set of agencies that would be subject to the same compliance requirements for the same system of records. For example, in an information system containing systems of records collected from agencies X, Y and Z by agency X and using a centralized batch update process at agency X, only agency X is subject to the compliance requirements of subsection 3(e). On the other hand, if the information system employs an on-line update capability allowing agencies X, Y and Z to update on-line, agencies X, Y and Z could all be subject to the compliance requirements of 3(e).

Control

Depending on the type of technology used in an information system, the agency(ies) subject to the provisions of 3(c), Accounting of Certain Disclosures, may vary. Suppose one adopts a definition of "control" which includes granting access permission to the information system. If this definition is applied to an information system containing systems of records from agencies X and Y with access granted by a guard employed by agency X, agency X would be subject to 3(e). However, when applying this same definition to an information system utilizing a software controlled access list capable of being modified by agencies X and Y, both agencies are subject to the accounting provisions.

Responsible For

Another phrase in the Act which poses similar agency identification problems is the "responsible for" phrase of subsection 3(e)(4)(F), Agency Requirements. This provision requires the agency to publish in its annual notice the title and business address of the agency official who is responsible for the system of records. Again, depending on the definition of "responsible for" selected (e.g., source data automation, distributed maintenance) the number and identity of the individual(s) to be reported in accordance with this provision may vary. This lack of clarity has very definite effects on the party identification aspect of litigations because presumably the complainant will look to this provision to identify the defendant(s).

Inconsistent and Interchangeable Usage of Terms

The terms "control" and "maintain" are used inconsistently and apparently interchangeably throughout the Act. This usage makes it highly feasible that the compliance requirements for a particular system of records could be distributed among several different agencies. For instance, the compliance requirement for an accounting of certain disclosures (PA 3(e)) pertains to the agency which <u>controls</u> the system of records. The provisions on access to records (PA 3(d)), agency requirements (PA 3(e)), and civil remedies (PA 3(g)(1)), pertain to the agency which <u>maintains</u> the system of records. Therefore, it is conceivable that under a system of records employing distributed maintenance (e.g., remote online update or source data automation) and centralized control (e.g., physical security techniques to control access to the system of records) technologies, one agency could be responsible for compliance with respect to disclosure accounting and, for the same system of records, another agency responsible for agency requirements provisions. In additon, depending on the technologies employed, an agency could become a party to a civil action under subsection 3(g)(1) without being answerable for the compliance requirements of the system of records in question.

Legal Ramifications

The issue with respect to incorporating technical definitions into the law is whether the law will change with changes in the definition or interpretation of the technical term. That is, will the group of defendants (i.e., agencies) and the set of subject matter (i.e., systems of records) defined by the Act change with fluctuating terminology. This fluctuation of the law is not an uncommon occurrence when the law attempts to incorporate the jargon and terminology of the technologist or scientist. In fact, such a situation arose when the criminal law incorporated the psychiatrist's definitions of mental disease and mental defect into the Durham Rule for the insanity defense.

The previous discussions on ambiguous terms and phrases pointed out the possibility of changing interpretations of technical phrases depending on the technology utilized. This clearly indicates the potential of a situation similar to the criminal law's insanity defense evolving in the case law pertaining to the Privacy Act.

Party identification in litigations resulting from noncompliance with the Act may become contentious due to the inconsistent use of the terms "control," "maintain" and "responsible for" in subsections PA 3(c), PA 3(e) and PA 3(e)(4)(F), respectively. In a civil action for noncompliance the complaining party will have to decide whether the defendant(s) is:

- the agency which maintains the system of records,
- the agency which controls the system of records,
- the agency which is responsible for the system of records, or
- all or some of the above agencies.

The possible legal consequences of the ambiguous defendants are misjoinder and failure to join an indispensable party. Misjoinder could result in a delay in litigation (i.e., complainant is required to amend the complaint) or a judgement against the complainant because of his failure to prove the allegations against the agency(ies) joined. Failure to join an indispensable party could result in the dismissal of the action at pretrial.

Undoubtedly, there may arise more complex legal issues from the ambiguities and inconsistencies in the party and subject matter identifying terminology of the Act than those presented above. However, the above discussions illustrate the need for closer scrutiny of the terminology of the Act from an integrated technical and legal perspective.

Omissions

The most noticeable omission from the Act with respect to civil remedies is civil liability for an agency's negligent failure to comply with the Act which has adverse effects on an individual's rights under the Act. The statement of purpose, (PA 2(b)(6)), requires Federal agencies "to be subject to civil suit for any damages which occur as a result of willful or intentional action which violates any individual's rights under this Act." The provision on civil remedies states in subsection 3(g)(1)(C) or (D) of this section in which the court determines that the agency acted in a manner which was intentional or willful, the United States shall be liable to the individual ..." Since other civil liabilities under the Act, subsections 3(g)(1)(A) and (B), can only occur as a result of intentional or deliberate acts, the Act does not provide for agency liability due to negligence.

Negligent failure to comply with the Act can occur in two instances: (1) in the design and development of the information system, and (2) in the operation and management of the information system. The following comments on the possible reasoning behind omitting negligence liability from the Act and the potential consequences of its hypothetical inclusion are presented with respect to the two instances where negligent noncompliance can occur.

Negligence Liability in the Operations of Information Systems

The basic types of negligence that are most probable during the operation of an information system are negligent failure of operations personnel to act according to the rules and procedures promulgated by the agency in compliance with the Act, and negligent failure to comply with the provisions of the Act. Negligent failure to sign off a computer terminal, and negligent failure to lock the desk or file drawer containing information permitting unauthorized access to the system of records are both examples of negligent noncompliance with possible rules instituted to satisfy requirements of the Act. Negligent failure to update a system of records in a timely manner resulting in the dissemination of inaccurate data to the detriment of the individual about whom the information is maintained is an instance of negligent noncompliance with the Act.

Basis for Omission

It is well established that the greatest threat to the security and integrity of information, especially in an automated system, comes from simple errors of omission and commission by totally honest and dedicated individuals. These types of errors would be the genesis of the bulk of negligence actions resulting from noncompliance with the Act during the operations of systems of records. This is perhaps the primary reason for the omission of this type of negligence from the Act. The inclusion of negligence liability could be extremely burdensome on the agency maintaining the system of records in that it could (1) result in a large number of litigations which would be time consuming and potentially result in substantial payment of damages, and (2) drastically inhibit the expeditious flow of information by requiring extensive policing by the agency and making agency personnel everly cautious.

Another possible reason for the absence of negligence liability during operations is that it was not the purpose of the Act to impose quality assurance measures on agencies in the management of their systems of records. The intent was to deter the intentional or willful violations of an individual's privacy by a Federal agency. This intent is made explicit in subsections 2(b)(6) and 3(g)(4) of the Act. Also indicative of this intent is the requirement that criminal penalties, (PA 3(i)), for employees or officers of the agency for violation of the Act be contingent upon their knowledge of wrongdoing.

Legal Ramifications of a Hypothetical Inclusion

The type of negligence actions which could result from noncompliance with the Act during the operation of a system of records (e.g., failure to comply with administrative procedures) are the typical malpractice variety. They deal primarily with the administration of the system and have very little impact on the technology of the system and the technologist who develops the system. Therefore, the legal significances, aside from those mentioned in the previous paragraphs, are not the concern of this article.

Negligence Liability in the Design and Development of Information Systems

The types of acts that would be the subject matter of negligence during design and development of a system of records are: (1) failure to use the common or accepted standards of technology being employed by the system design and development community; and (2) conformance to the common or accepted standards which happen not to be the "best" technological procedures available. In the first instance, custom or the state-of-the-art establishes the standard of care. In the latter, a new standard of care is being established which may require the use of forefront technologies. An example of the former might be the failure to use packet-switching in the design of a computer network. The use of physical security techniques in lieu of a security kernel approach to multi-level security is an illustration of the latter.

Basis for Omission

To ascertain the possible basis for the omission of negligence liability in the design and development of systems of records, it is particularly important and beneficial to examine the legislative intent in the area of the Act pertaining to design and development (i.e., establishing "appropriate safeguards"). In addition, the provisions of the Act should be closely examined to provide insight into possible reasons for the omission of this particular type of negligence liability.

The legislative intent regarding the establishment of "appropriate safeguards" can be discerned from two separate discussions in Senate Report 93-1183 which accompanied Senate bill S. 3418. The importance of Senate Report 93-1183 as a source for interpretation of the legislative intent is enhanced by the fact that many sections of S. 3418 were incorporated into the final version of the Privacy Act (e.g., S. 3418 section 201(b)(6) became subsection 3(e)(10) of the Act).

The basic philosophy behind the requirement to establish "appropriate safeguards" as discerned from Senate Report 93-1183 is an attempt to institutionalize good information management practices. The committee intended that an agency in complying with the requirement of establishing safeguards should incorporate a standard of reasonableness. In doing so, the agency should "refer to those safeguards which represent current state-of-the-art procedures at any given time, despite any weaknesses that may exist in the technology at that time." The legislators allowed "for a certain amount of 'risk management' whereby administrators weigh the importance and likelihood of threats against the availability of security measures and the consideration of the cost." Thus in establishing custom or the state-of-the-art as the standard of care, the Senate committee recognized the huge expense which would be involved if an agency were required to adopt (i.e., by being subject to negligence actions for its negligent failure to adopt) all available safeguards including those on the forefront of technology.

On the other hand, there are ample passages in Senate Report 93-1183 which would support the inclusion of this type of negligence liability (i.e., failure to use state-of-the-art or forefront technologies) in the Act. For example, while stating that employing state-of-the-art technology is the intent of the phrase "appropriate safeguards," the committee makes the following assessment about the use of new technologies:

"... given present cost factors and considerations of economy, such an approach (use of current state-of-the-art) suggests that we (the committee) could look forward to increasingly higher standards of 'reasonableness' as new technologies are further developed to make our systems progressively more secure. But it (the approach) would also permit the immediate application of all these techniques where they can contribute — even in their present form — to better protection of data confidentiality and individual privacy."

The common thread in these two seemingly contradictory statements about the standard of care is the cost factor. Therefore, it is apparent from the legislative history of the Act that the expense of establishing a standard of care different from customary practices is the overriding basis for the exclusion of negligence liability during the design and development of systems of records.

Many provisions of the Act seem to imply the establishment of manual controls rather than technological controls for safeguarding an individual's privacy. With significance attached to manual approaches, the exclusion of negligence liability for failure to use "appropriate" technology is understandable. Therefore, in spite of the legislative intent discerned from Senate Report 93-1183, this apparent emphasis on manual controls lends credence to the possibility of an oversight (by the committee) of the significance of the design and development phases in providing safeguards for an individual's rights.

Legal Ramifications of a Hypothetical Inclusion

Aside from the very obvious ramification of incorporating negligence liability during design and development, (i.e., expansion of the scope of civil liability for noncompliance), the most significant impacts would be: (1) the establishment of a standard of care which may be different from accepted practices of the computer system design and development industry; and (2) the thrusting of the computer systems specialist into the role of expert witness in negligence actions.

There is legal precedence in negligence actions for establishing a standard of care different from customary practices of the industry. In Marsh v. Babcock the court ruled that a manufacturer was required to make a metalographic examination of steel even though a hydrostatic test was the customary practice of the industry. Ford Motor Co. v. Zahn extended the requirement to exercise reasonable care from component testing to the process of manufacturing. Finally, in Boeing Airplane Co. v. Brown the scope of the reasonable care standard was broadened to now apply to the design phase.

As in discussions on the legislative intent it is noted that the use of forefront techniques must be tempered by cost factors and economic considerations. In doing so, one may employ the standard of care measure, B v. PL, suggested by Judge Learned Hand, where B is the expense of the new technology, P is the likelihood of a violation of an individual's rights under the Act, and L is the magnitude of the injury to the individual. However, the following quote from the Act, "the right to privacy is a personal and fundamental right protected by the Constitution of the United States" — PA 2(a)(4), seems to indicate that L would always be very large. Therefore, applying B v. PL, (i.e., if B is less than or equal to PL, then institute new technologies, otherwise use customary practices) in conjunction with the above quote may, in most instances, result in B being less than PL. Hence, the use of new technologies would be required.

The use of computer specialists as expert witnesses in civil actions to establish the standard of care has more significance to the computer specialist than on the litigations. This is so because the court system and the legal profession have adequately addressed, if not satisfactorily resolved, the matter of science in the courts. However, since the author is a member of the computer profession, the inclusion of some comments on the subject seemed appropriate.

A basis for the requirement of expert testimony, if negligence liability were included into the Act, can be found in Senate Report 93-1183. The committee states that the notice or report which a Federal agency must submit to the Privacy Commission, the General Services Administration, and to the Congress, when establishing a personal information system or file, must include: (a) "what administrative and technological features and measures are deemed necessary to protect the security of the information ..."; and (b) "the formal and informal actions, negotiations, and representations and their outcome, undertaken to obtain necessary features. This should include accounting of any consultation with computer and system experts, including the agency's own staff members and representatives of the National Bureau of Standards ..."

The possibility of being thrust into the position of expert witness raises a series of questions and concerns with which the computer profession must come to grips. These are:

(a) Who is a computer expert? This may cause increased interest in the certification requirements for computer professionals.
(b) What are the customary practices in the industry? Many people still consider software engineering an art. Such a notion can only complicate establishing customary practices.
(c) Is the customary practice for hardware development and standards of hardware that which is employed and developed by IBM? Many computer users and system implementers would say yes.
(d) When is forefront technology ready for operational usage? The cost and likelihood of success of forefront techniques must be weighed against the likelihood of failure of customary practices and the cost (i.e., damages) of such failures.

Summary

The increased predominance of technology on the social, economic and political functioning of our society has necessitated legislative responses. The Privacy Act of 1974 is only the tip of the iceberg. This article points up the need for the technologist and the legalist to integrate their talents to provide for more technically operative and legally viable legislation to deal with the increasing application of technology on our everyday lives.

□

An Appropriate Management Information System For A Kingdom

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"Let's start with the overview. Information is a prime kingdom resource. Without information a kingdom is highly reactive to short-term conditions and its performance is spasmodic and compulsive. ..."

Once upon a time, there was a famous emperor who presided over a small but happy kingdom. Now this emperor would occasionally visit with his other emperor friends to discuss running their kingdoms, and the emperor began to notice that all his emperor friends were installing Management Information Systems to help them run their kingdoms more efficiently. Now this emperor didn't know anything about Management Information Systems, or about plain, ordinary computers, for that matter. So he put out the word (through his personnel department) that he needed someone with expertise in Management Information Systems to consult with.

Systems Experts

Quicker than a wink, two fellows showed up on the emperor's doorstep with three-page resumes which proved that they were Management Information Systems Experts. (They had diplomas from IBM courses, too). The emperor was so impressed with their credentials that he hired them on the spot. "Teach me about Management Information Systems that I may impress my people with my vast store of knowledge on the subject," said the emperor, "to say nothing of my high intelligence."

"All right," said the Experts, "but there is just one thing. What we are about to tell you will seem nonsense to anyone unworthy of his position. You understand? Only those deserving of their positions are able to make any sense out of Management-Information-System-talk."

Management Information Systems

"Proceed," said the emperor, fully confident that he, obviously well equipped to handle the responsibilities of emperorship, should have no trouble understanding about Management Information Systems.

"All right," said the first Expert. "Let's start with the overview. Information is a prime kingdom resource. Without information, a kingdom is highly reactive to short-term conditions, and its performance is spasmodic and compulsive. With information, a kingdom can control itself, grow in an intelligent manner, maximize its efficiency and effectiveness, and sustain profitability."

Expansion in Complexity

"As kingdoms grow and the socio-economic environment in which they exist evolves, they expand in size and complexity. A modern kingdom is highly sensitive to external changes, and requires an elaborate series of planning-and-control systems to survive and prosper. The ability to utilize information about its own performance and the characteristics of its market is a prime determining factor between kingdom success or failure. The kingdom data processing department exists to build systems which help the organization achieve its goals. Thus a good system is not just one which optimizes the utilization of hardware, or employs the latest technical methodology; it is a system which contributes effectively to kingdom profitability."

Well! The emperor had never heard such grand and eloquent talk as this before; and although its exact meaning eluded him somewhat, it sounded so right, and so impressive, that it made him feel good, and warm inside, and confident in the expertise of his two newly-hired Experts. The emperor nodded sagely, not wishing to risk a comment so early in the game which might give any hint of uncertainty or misunderstanding on his part.

Basics of Design and Programming Technology

"To continue," continued the second Expert, "before we can discuss MIS, you must learn the basics of design and programming technology. You see, more rapid assimilation of advanced design and programming technology throughout the kingdom is advocated in order to reduce the total life-cycle costs of computer based systems and improve their reliability and ease of operation as seen by users."

"I see," said the emperor, not quite sure that he really did see, but having full confidence in his ability to catch on, once the strangeness of the new language had worn off.

"Quite so," resumed the first Expert, "you see, presently, on-line systems, greater computerized business activity, consolidation of functions, and greater kingdom information demands are increasing the interdependence of previously autonomous systems."

"Really?" said the emperor, becoming just a bit more alarmed by the realization that he was not catching on, but on the contrary, beginning to actually lose ground in understanding what the Experts were saying. But uppermost in the emperor's mind was the warning the Experts had given him, that not being able to understand MIS-talk was a sign of unworthiness for one's position. Not daring to even hint of this possibility, the emperor nodded again. "Please continue," he said.

The Data Base

"Before we can discuss the essence of MIS," resumed the first Expert, "we must familiarize you with the concept of the data base. Now a data base is a synchronously maintained nonredundant collection of interrelated data items processable by one or more applications."

"In other words," chimed in the second Expert, "it is a structured collection of data which is essentially non-redundant, and which provides a constant logical view of that data under a wide variety of physical realizations, thereby providing a high degree of data independence."

Well, needless to say, the emperor was beginning to be overwhelmed by a sense of panic; but remembering the Experts' admonition, he decided that the best course was to brazen it out and feign understanding.

Control Programs

For months and months the Experts tutored the emperor on the mysteries of Management Information Systems. Each day they met for seven hours in the emperor's garden, and each night the king went to bed with a headache from trying to remember the great wisdoms expounded by the two consultants, even though he had not the slightest inkling what it all meant. They covered IMS ("a control program designed to facilitate the implementation of medium-to-larger-scale data bases in a multiapplication environment"), and SCP ("whose overhead is usually manifested in high CPU utilization which is the result of the interaction of many functions").

Data Base Administrator

Now one of the recommendations made by the consultants in the course of their discussions with the king, was that he appoint a Lord High Data Base Administrator to oversee something or other which apparently was critical to the successful implementation of a Management Information System. The Lord High Data Base Administrator was to be installed at a grand ceremony to be attended by all the Emperor's subjects.

So while the two Experts planned the ceremony, the Emperor practiced memorizing the speech they gave him to read before all the people of the kingdom. Each night, instead of going to sleep, the Emperor memorized his lines, until he could say them without notes, and with extreme force and conviction.

The Data Processing Trend

"To begin at the beginning, information is a prime kingdom resource. Without information, a kingdom is highly reactive to short-term conditions, and its performance is spasmodic and compulsive."

Well, the subjects had never heard such talk before, and were totally lost from the very outset. But the warning of the two Experts, that lack of comprehension implied unworthiness, had spread far and wide, and of course none of the emperor's subjects wanted to give even a hint of unworthiness. Besides, the emperor spoke with such force and conviction, that each person felt it must be he alone who was so unworthy as not to understand what was being said.

The emperor continued. "The data processing trend is toward data base technology. To derive full advantage of this concept, the role of the Data Base Administrator has emerged as an important function in the definition, organization, protection, and documentation of the data base within the perspective of kingdom data processing goals."

Someone Had not Heard the Admonition of Unworthiness

Now it so happened that among the emperor's subjects assembled before the palace was a small boy, who, as luck would have it, had not heard the two Experts' admonition about being unworthy, etc. And as the emperor finished his line about the kingdom's data processing goals, the boy said quietly to his father, "But the emperor is talking gibberish."

Now several of the adult subjects standing close by heard the boy say this, and they whispered to their neighbors what the boy had said. Soon there was a general hum among the assembled subjects, and here and there a titter broke the stillness. "But the emperor <u>is</u> talking gibberish," repeated the boy a little louder.

"The emperor is talking gibberish," said each subject to his neighbors. "The emperor is talking gibberish."

The Nightmare of Being Laughed At

Now the emperor began to perceive what was happening, and here and there outright laughter broke out among the crowd. But the emperor, unprepared for such a nightmare as being actually laughed at, continued with his lines, forcefully and with great conviction. "To assure the successful implementation of data base oriented systems, the Lord High Data Base Administrator will function as the focal point for information collection and dissemination."

With each new word from the emperor the laughter of the assembled subjects grew louder. Jeers rang out. "The emperor is putting us on," shouted one subject. "The emperor is ripping us off," shouted another. "Quit conning us, you phony!" raged a third.

The Credibility Gap

Finally, the emperor, seeing that his charade had cost him all credibility with the crowd, gave up and retreated to the security of his castle. The two Management Information Systems Experts were quietly sent on their way, and the still uninstalled Lord High Data Base Administrator returned to plowing his fields.

The emperor stayed on as emperor (having been born to the position), but he had learned his lesson. After six months or so had passed, he gathered up enough courage to venture outside his palace, and walk again among his people. He would stop anyone who would listen and assure them that never again would he be taken in by the fancy language of itinerant MIS Experts. Never again would he be too in-

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Minicomputers: Their Expanding Role

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"The key to tomorrow's systems architecture is the flexibility, economy, and efficiency with which computer power can be delivered to more people in more remote locations."

The role of the minicomputer is ever-expanding. It is expanding in both dedicated and general-purpose markets. In fact, one can hardly pick up an industry publication today without reading about some technological development that brings another new application of minicomputers closer to reality.

The checkless payroll and checkless payments for utility and department store bills already are a reality for many of us. As point-of-sale and electronic-funds-transfer systems develop to a greater degree, more minis will be required — as front-end processors, as terminal and peripheral controllers, and as remote terminal systems with local processing power.

Home Computer Terminals

Home computer terminals are predicted for the late 1980s, complete with such possibilities as electronic library services, electronic newspaper delivery, and educational home-tutoring services.

In business, additional minis will be needed for more highly automated factories, refineries and transportation systems. Mini-based systems will be needed for optimizing decision-making processes and reducing the amount of work involved in everyday transactions.

Doctors, Cities, Offices

The forecasters inform us that doctors will be using more computer-based medical diagnostic aids; that more cities will be utilizing computerized traffic control systems; that offices will have computer-based electronic files and communications systems. They say that as distributed processing networks become more widespread, data transmission becomes more efficient and costs decrease. They maintain that as microprocessors are incorporated into mini-based systems, maintenance will be simplified and the systems will become more automated.

The outlook is indeed bright. And with such a promising technological forecast, it probably is not unexpected that marketeers are talking about a "revolution" within the computer industry.

Much of that talk is well-founded. Transaction processing, for example, is bound to grow significantly, with terminals and minis extending computer power to more people at the source of the transaction. We already are hearing success stories about applications in hospitals and in point-of-sale transactions. More sophisticated distributed systems are evolving.

Replacement of Main Frames?

What about the futurist's claim that small and medium mainframes will be replaced by minis? That minis at one end and super computers at the other will squeeze out the traditional general-purpose systems? That price erosion factors in the OEM market will lead to cost reductions so great the mini processors will be included free with purchase of memory, storage and software?

I think that some great changes are ahead for the industry, and that some major restructuring is going to occur. But as for the revolution? I have my doubts. I see changes coming, but I see them being implemented in a more evolutionary than revolutionary manner.

Let's take a look at what has happened in the minicomputer market recently, and what seems likely to develop.

Fantastic Growth in Minicomputers

Fantastic growth in the minicomputer industry has occurred. In 1976 the value of mini shipments is expected to increase about 35 per cent over 1975. The general-purpose market, meanwhile, will be hard pressed to reach a 15 per cent increase in shipment value.

While the installed value of general-purpose computers is expected to increase at an annual rate of 11 per cent to more than $90 billion by 1980, minicomputers will be growing at a strong 20 per cent average annual rate. Their installed base will increase from about $5.4 billion in 1975 to nearly $15 billion in 1980.

During that period traditional mini applications will continue to form the bulk of the minicomputer shipments, but their proportion will be decreasing. In the United States alone we expect data monitoring and systems control applications to account for close to $750 million, or nearly 40 per cent of the mini shipments, by the end of the decade. Last year they

Based on a talk at the Honeywell Minisystems Conference, Boston, April, 1976.

accounted for about $450 million, or about 50 per cent. Shipments for communications support applications are expected to stay around the 30 per cent figure, but rising from 1975's $300 million to almost double that, or nearly $600 million by 1979.

The remaining 30 per cent of shipments is expected to go to the small business market, which will grow significantly as hardware costs decrease. This market constituted about 20 per cent of 1975 mini shipments, with a value of about $200 million, and this is expected to triple. By 1979 its market share is expected to be valued in excess of $600 million.

Microbased Computers

At the low end of this market, the capabilities of minis will be enhanced by microprocessors and microbased computers. We see a great opportunity for the use of micro technology in the design and architecture of all types of computers, particularly of less expensive minis. While there may be some displacement, micros will tend to be used for simple, dedicated tasks, and minis will be required for more complex, general applications.

Established General-Purpose Systems

What will be the effect of the mini boom upon general-purpose systems?

I doubt there will be complete replacement of traditional mainframes by minis. When you consider the installed base and amount invested, it is just not realistic to expect minis to squeeze out established general-purpose systems. The cost of conversion, the risks involved and the general difficulty of convincing customers to leave traditional mainframe suppliers who provide them with software, support, services and so on — such factors all tend to work against the argument that established mainframes will be quickly replaced. In fact, we believe there will be at least another generation of mainframes along the same lines as those in use today.

Yet, as both traditional general-purpose systems and minis evolve to meet the requirements of future markets, I think we will see changes in both of them.

General-purpose systems, for example, will incorporate more of the technology that has tended to be used first in minis. That technology will either be directly integrated or used as building blocks of general-purpose systems — for instance front-end, peripheral and communications processors, and terminal controllers are applications that now employ minis in general-purpose systems.

Support and Services for Minis

At the same time, we expect that as mini manufacturers get more into the end-user oriented markets, they will act more like mainframe manufacturers. They will be expected to provide more support and services, either directly or indirectly through systems houses. Their marketing programs will have to be reoriented. Their businesses will necessarily become more complicated and involved as their need for financial and organizational resources grows. As some mini manufacturers have already discovered, this role is not an easy one to assume.

Price Erosion

With the growth of the minis, I think we can also expect price erosion in the OEM market, although not at the 15 to 20 per cent a year of the recent past. But don't expect any free processors; even if the processors got to be very inexpensive, the I/O equipment still will be a major portion of the total system requirement.

We also look for an increased use of telecommunications networks, as minis, common carrier competition, and improved technology all combine to drive costs down.

Distributed Systems

For a wave of the future, one must look toward distributed systems — both in terms of designing a system from the ground up and in evolving a system through a step-by-step process. By upgrading their terminals, first to remote job-entry terminals and then to small business systems, a number of companies have combined limited local processing with remote batch and data inquiry capabilities.

Completely distributed systems — that is, systems with processing and information storage resident within the various operating components of an organization, and with each application program accessible by programs at other sites — are still largely experimental.

Centralized Systems

Distributed systems are an interesting contrast to the totally centralized systems we began to develop in the '60s.

At that time we were hearing predictions that the centralization concept would lead to a computer industry comprising very small systems and terminals connected with very large central systems. There supposedly wasn't any place in that scenario for medium systems. While the greatest growth is occurring in the small and large areas, there is still a substantial market in medium systems. And we believe there will continue to be a need for systems of all sizes to meet the varying requirements of customers.

The key motivating factors for centralized systems were economics and organization control. The complex systems required teams of highly skilled experts. The systems were to provide greater coordination and control for top management. They were to take advantage of economies of scale — of systems and facilities, as well as staff.

It is interesting to note that some of those same factors now are spurring development of distributed systems.

Upgrading Centralized Systems with Distributed Systems

For example, it may become increasingly cheaper to add new small systems or minis for new applications than to upgrade a large central system. A bank in Stockholm, Sweden has done just that, and with good results. The bank is using several Honeywell System 700 minis, with each dedicated to a different function. The minis communicate through another 716 to a host system. This is appropriate because the application at the remote site can be run fairly independently from the central system.

It is also a real possibility that telecommunications costs will be less with distributed systems than with centralized systems. However, the tradeoff will be influenced to a large degree by prices charged by common carriers; also, much systems work is needed to determine the relative savings for different applications.

Distributed systems may also be more modular and easily expandable to accommodate new operations or applications without complex conversions or major upgrades that would disrupt centralized operations. The systems could more closely pattern the nature of an organization's information flow. Local groups could get better response times, higher system availability and enhanced throughput. The risk of total system failure diminishes with the distribution of processing power and data bases over several components. And this latter point of distributed systems being able to be more easily changed also needs study. Of course, we in management have always been impressed by the difficulty of getting changes made in large systems. If we can develop systems where changes can be made easily, that will be highly desirable.

Implementation of Distributed Systems

Implementation of distributed systems isn't going to occur overnight. In fact, one reason its implementation will be evolutionary rather than revolutionary is because it is so different from the centralized system. We have found over the years that there will be some resistance by centralized organizations to a decentralized structure.

It will take time for users' organizations to select those languages, applications packages, and data base capabilities that they will utilize. New designs will have to be implemented for over-all monitoring and control of the entire distributed system. New organizational controls will have to be implemented, and new audit trails developed. Many questions will have to be answered regarding such things as the expertise required to run the over-all network and the costs involved in decentralizing programming and operating functions to the user departments.

The Advanced Research Projects Agency Network

The longest successfully operating distributed data base system is the ARPA network, which uses Honeywell minis for its nodes. This network has proved the technological feasibility. The ARPA model is being incorporated into a large number of communications networks around the world. Some of these are already operational. But the majority are still several years away from commercial success.

Expectations and Predictions vs. Realities

In some respects the distributed systems revolution, if you will, reminds me of MIS — the Management Information System revolution of the '60s that promised to provide any information instantly to anyone who needed it.

Looking back, if we compare the original expectations of MIS with its accomplishments, we would have to call it less successful than was forecast. We did, of course, develop forms of MIS that were practical and were successfully implemented — just as we will with distributed systems concepts. But if we learned anything from trying to implement MIS it was this: you cannot expect a system to be all things to all people instantaneously, and that you cannot expect to implement it at one stroke.

The key to tomorrow's systems architecture is the flexibility, economy, and efficiency with which computer power can be delivered to more people in more remote locations.

The Minicomputer as a Vital Element

We do see the minicomputer as the vital element in these communication-oriented systems, and thus have given them a high priority over the past several years in our development plans. Not only will they aid us in making improvements to centralized systems, but they will provide users with a greater choice in the way they want to structure their networks. Such networks will link information processing systems of all sizes and types.

Within the industry, in the next few years we can expect to see more standard distributed system product offerings. We can expect to hear more talk about this "wave of the future." But we must remember it will be five years or more before distributed systems become a substantial part of the data processing mainstream. There are many challenges yet to be met. Software for completely distributed systems, for example, is largely in the design stage. Manufacturers must develop common communications protocols that will provide the user more flexibility in designing a system. And the protocols must meet industrywide standards so they are not too restrictive for users.

None of these things will happen very quickly. They require considerable study by users and vendors. The technical, economic and organizational challenges should not be underestimated.

It is easy to be overly optimistic in projecting what might be readily accomplished in a business that offers as much potential as the minicomputer industry.

One Last Prediction

The traditional mini is only 12 years old; the computer industry, about 20. If I were to make just one prediction about the future of the mini, it would be that before long it will become less distinguishable. Minis will become more like what we call mainframes and the mainframes will become more like minis. As an implementation of general digital technology, the minis will become a part of the total data processing array. I will predict that it will be hard to tell a mini from a maxi. □

Martin *–Continued from page 15*

timidated to admit his own incomprehension of what was being said. And never again would he put his reputation on the line over something he didn't really understand.

In Real Life

Postscript: Of course this story is a fairy tale. In real life, the small boy who first noticed that the emperor was talking gibberish would have been spanked and sent home to bed with no supper, while the rest of the loyal subjects continued to nod sagely at the emperor's remarks.

Of course, in real life the whole project to install a Management Information System for the emperor eventually would go down the tubes, being based on specs nobody could understand, (but they didn't want to say so, lest they be thought unworthy of their positions), but that would be after many hundreds of thousands of dollars had been disbursed from the kingdom's treasury. □

The Division of Labor in the Computer Field —Part 2

Joan Greenbaum
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Bronx, N.Y.

"The division of labor among computer workers has relieved them unwillingly of their skills and left increasing numbers of them high and dry on the labor market."

(Continued from "Computers and People" for November, 1976, page 17.)

The Advent of Coders

The outcome is a hierarchical structure which requires a large number of coders whose task it is to take pre-planned specifications and code them into a proper format, and a few specialists who plan the application. Even the systems analysts who design the applications now produce their specifications within a framework of narrowly defined job steps.

During this process, as skill or craft work was abstracted from each task, programmers hid behind the myth of "professionalism" which kept them from organizing into unions and actually seeing the changes for what they were. Indeed, strong evidence suggests that the impetus to professionalism has come from management and not from the workers themselves. Trade journals and computer associations, both overwhelmingly management organs, have strongly pushed the concept. /15/ It seems likely that programmers, feeling the tide of job degradation, only too gladly clung to the belief that they were professional. Computer operators would often boast that while programmers had status, they, the operators, made more money with their overtime pay included.

The Molding of the Operator Job

Operators were in some ways harder than programmers to mold. This was probably due to the fact that the decisions and control over their work had already been removed from their jobs. Additionally, an "insubordinate" operator could easily wreak havoc on the daily operations of a computer room by slight infringements of the rules. An operator who mounted the wrong data tape for the processing of an accounting system, for example, could cause direct injury to the corporation's pocket. The effects of programming mistakes, on the other hand, were slower to come to notice and usually less costly.

There is also a noticeable class difference between the two job categories. While programmers were drawn from the college-educated middle class and were paid annual salaries, operations positions required only a high school diploma and were paid hourly wages comparable to factory workers. Typically, operators were young men of working-class families who saw the computer field as a step toward middle-class status, although this was never reflected in their wage structure or their job duties. As Braverman explains: "The training and education required for this job may perhaps best be estimated from the pay scales, which in the case of a Class A operator are on about the level of the craftsman in the factory, and for Class C operators on about the level of the factory operative." /16/

In terms of job duties, operators are involved in seeing that the throughput of data is properly loaded into the various pieces of computer machinery. Computer operators are, in fact, machine operators who load the equipment with data and press the appropriate controls for its processing. Early operators, like their programming counterparts, had to know the working of all parts of each machine and be familiar with a range of machines.

Much of Operating Included in the Computer

But this type of job diversity and skill requirement was eliminated on the larger machines. The typical IBM 360 computer center saw the subdivision of operators into categories where each operator tended only one equipment component of a computer system. Thus data for the punched-card reader was handled by the "specialist" in charge of that device, and tape and disk devices were tended by what the trade called "tape jockeys." Console or main-panel operators required more skill, for they were to keep an eye on the total machine processing. Under almost no circumstances, however, were even they allowed to repair a machine part (the job of the technician) or to modify a program (the job of the programmer). After the mid-sixties, pay scales reflected the division of labor in the machine room so that each function was paid according to the lowest rate. Computer operators Class C, the beginners who manned the data devices, earned an average of \$105 per week, while Class A operators, or those assigned to the console, could average about \$150. /17/ Although different wages for different experience levels had always been present, by the late sixties experience levels became firmly equated with specific machines, thus routinizing the tasks.

When it became apparent that it was difficult to bend the worker to further demands of the machines, the machines were recast to alleviate work steps. Again collaboration by upper and line management played a role. Since IBM advertised its tape drives as processing 156,000 characters per second, management became disenchanted with workers who would take several minutes to load a tape on a drive. Imagine the frustration of managers whose equipment was capable of processing the entire contents of a book in several seconds, when confronted with operators who failed to act with comparable speed! In an effort to make the total machine processing more continuous, tape drives were introduced which would load magnetic tapes on devices automatically. Technically, the new devices did not represent a departure from the old. In fact the operation of tape drives had been similar to threading a home tape recorder, and the new modification made it resembe cassettes rather than individually wound reels.

Schools Turning Out Computer Workers

It was during this period when skills were removed from both operations and programming jobs that the schools were beginning to turn out skilled computer workers. Universities were only too glad to respond to management pleas for more standardized programmers, and private institutions were quick to jump at the opportunity to make a profit with their matchbook and TV advertisements for computer operations training. Until the mid-sixties, management had been almost totally dependent on providing their own training, for few college or commercial training programs existed. It was the joint demands for performance standards and an increased number of computer workers that pushed the colleges to start computer science programs. Once begun, they churned out a large body of disciplined future workers, giving management a larger pool of labor power from which to choose.

Oversupply of Computer Workers: 1970-1975

The results of the process outlined above were beginning to appear by the time the recession hit the computer field in 1971. The number of computer science graduates and technical training school students was beginning to flood the labor supply with potential talent beyond the level of skills required. A 1972 article in "Business Automation" recalls: "Remember the people problem? It was a prime topic of conversation through the 60's, but it seemed to fade away in the past year or so. The job-hopping programmer or systems analyst will continue to be a rarity." /18/ The article then goes on to outline the results, stating that (1) personnel costs are stabilizing, (2) turnover is slackening, and (3) supply is approaching demand. The following year, the director of the Association of Computer Programmers and Analysts noted that in addition to the growing number of available programmers, the skills required for applications programming were becoming less each year. He complained that "these pressures work together to lead some people to believe that programmers are being treated in a manner somewhat above their station. Instead of being treated like scientists, they should be treated more like bookkeepers." /19/

Salaries Reflect Oversupply of Programmers

Indeed, programmers' salaries began to reflect this trend for entry level positions. Breaking a long-standing upward curve, the average starting salary for programmers stayed at $8,500 between 1970 and 1972. /20/ To add insult to injury, a private survey conducted by the Robert Half Personnel Agency, found that overall programmers' salaries in large installations rose only 2 percent in 1975 over the previous year. /21/ It should be added that large computer installations usually showed the higher salaries and most growth.

Surplus Programming Workers

Despite the flood of articles discussing this turnaround in programmer supply, schools and career counselors have continued the production of the now surplus programming population. Perhaps the best summary of the changing events was offered by A.P. Ershov, head of the Information Division of the USSR Academy of Sciences. Writing with an outsider's perspective about the U.S. situation he said:

> The volume of work to be done is increasing, and wages less so. The romantic aura surrounding this inscrutable occupation is, if it ever really existed, beginning to fade....Even the claim of programmers to be a special breed of professional employee has come to be disputed. Still more significant, authority over the freewheeling brotherhood of programmers is slipping into the paws of administrators and managers — who try to make the work of programmers planned, measurable, uniform, and faceless. /22/

Centralization

In addition to the impact of stricter management control, and increased number of trained entry-level workers, the 1970s have witnessed a movement toward greater centralization among firms engaged in data processing. Starting with the recession in 1971, many of the smaller service bureaus have closed their doors, leaving computer workers on the job market. Even huge corporations like RCA and Honeywell have given up the struggle against IBM and closed their computer manufacturing divisions. As the less-capitalized firms give up to their bigger competitors, the larger data processing establishments are centralizing their operations for greater efficiency.

Remote Terminals

Whereas a corporation may have previously maintained several computer centers for different business functions, today the push is toward one central facility with remote "time-sharing" terminals in corporate offices around the country. The advent of remote terminals means, in effect, that any desk within reach of a telephone can transmit data over phone wires to a distant computer. Retail stores have begun to use these services for up-to-the-minute inventory reports, as clerks key in information on each sale. Banks, insurance companies, credit-reporting firms, and supermarkets are all tapping the new potential. The introduction of automated supermarket checkout counters this year is expected to break new ground in large scale use.

Fewer and Fewer Workers

The results for computer workers are, of course, major. A central computer facility for each company, or in many cases, groups of companies, requires fewer operators and programmers. And while some of the more sophisticated remote terminals need computer operations personnel, these devices are relatively simple to run. A recent article in "Computerworld," the computer industry's weekly newspaper, prophesied that these trends indicate the industry will need only a few "hot shot" programmers, for users are now performing their own data processing via terminals. /23/ Computer operators appear to face the same fate. The 1975 salary survey mentioned earlier reported no increase in operators' salaries between 1974 and 1975, indicating that this was due to the "greater influx of entry-level people." /24/

Ex-Computer Workers Left High and Dry in the Labor Market

It is beyond the scope of this analysis to project the impact of these trends on workers outside the data processing field. Data processing operators and programmers will still be needed to meet the needs of expanded computer use. Their tasks, however, have changed over the last decade, and it appears that their salaries are also reflecting these changes. The Computer Manpower Outlook, published in 1974 by the Department of Labor states: "Employment in computer occupations is expected to grow more slowly over the 1970-1980 period than during the past decade, and the distribution of workers among computer jobs is expected to change." /25/ Citing labor costs and technological change as the prime ingredient in this process, the authors argue:

> Because costs of computer manpower are a major part of computer user costs, manufacturers have a strong incentive to reduce the manpower needed to use their equipment by incorporating functions that currently are being performed by computer personnel into the hardware (equipment). Also the technological innovations that enable workers in other occupations to interact directly with computers and thus eliminate costly data processing specialists are expected to be stressed. /26/

It is interesting to note that steps toward job degradation begun little more than a decade ago, have so rapidly produced results. The division of labor among computer workers has relieved them unwillingly of their skills and left increasing numbers of them high and dry on the labor market.

Footnotes

/1/ Harry Braverman, Labor and Monopoly Capital (New York, 1974), p. 329.
/2/ "Survey and Study of the Computer Field," "Computers and Automation," January 1963, p. 23.
/3/ Ibid.
/4/ "A Profile of the Programmer," a study by Deutsch and Shea, Inc., New York, "Industrial Relations News," 1963, pp. 8-31.
/5/ "Survey and Study of the Computer Field," p. 23.
/6/ Dick Brandon and Fredrich Kirch, "The Case for D.P. Standards," "Computers and Automation," November 1963, pp. 28-31.
/7/ Ibid.
/8/ Karl Marx, Capital, Vol I, (New York, 1967, 1974), p. 423.
/9/ "The Case for D.P. Standards," p. 29.
/10/ See Gerald W. Brock, The U.S. Computer Industry: A Study in Market Power (Cambridge, Mass., 1975), for an extensive view of IBM's market power.
/11/ "A Profile of the Programmer," p. 3.
/12/ A.P. Ershov, "Aesthetics and the Human Factor in Programming," "Communications of the ACM," Vol 15, no. 7 (July 1972), pp. 503-504.
/13/ "A Profile of the Programmer," p. 21.
/14/ Ibid., p. 6.
/15/ Philip Kraft, "Pushing Professionalism, Programming the Programmer," "Science for the People, " Vol. 3, no. 4 (July 1974), pp. 26-29.
/16/ Braverman, Labor and Monopoly Capital, p. 330.
/17/ "1967 Report, EDP Jobs and Salaries," "Business Automation," June 1967, pp. 40-49.
/18/ "The 70's: Retrospect and a Look Ahead," "Business Automation, January, 1972.
/19/ T.D.C. Kuch, "Unions or Licensing? or Both or Neither," "Infosystems," January 1973, p. 42.
/20/ Occupational Outlook Handbook, 1970-71 edition, 1973-74 edition, U.S. Department of Labor, Bureau of Labor Statistics.
/21/ "Computerworld," September 3, 1975, p. 4.
/22/ "Aesthetics and the Human Factor in Programming," p. 501.
/23/ "Remote Maintenance: Trend of the Future," "Computerworld," August 21, 1974, pp. 1-2.
/24/ "Computerworld," September 3, 1975, p. 4.
/25/ "Computer Manpower Outlook," U.S. Department of Labor, Bureau of Labor Statistics, Bulletin 1826 (1974), p. 3.
/26/ Ibid. □

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Wiley – *Continued from page 9*

the Commission resolved the first issue by defining a "hybrid service" as one which combined data processing with message switching to form an integrated service. Oversimplifying the decision a bit, the Commission said it would not regulate such a hybrid service if the message switching were only incidental to the provision of the hybrid service but would regulate it if the opposite were true.

Technology Change: Faster and Faster

Since that decision, however, technology has changed even faster than could have been expected. Rather than numerous large machines with remote access using relatively simple terminal devices, we see data processing capabilities being distributed throughout computer networks — including within the terminal devices themselves. We observe microprocessors and minicomputers being used in such applications as multiplexing, error control, signal processing and in communications controllers and concentrators. In the same way, the carriers are using microprocessor and minicomputer technology throughout their networks, especially in their new software controlled digital switches. This means that carriers very conveniently can offer special processing services. It is obvious that these developments in distributed processing, switching, and terminal equipment have put a severe strain on the definitions and rules that were laid down in an era of centralized data processing and electromechanical switching.

(please turn to page 26)

Surveying Computer Programming and the Power of Interactive Communication

Edmund C. Berkeley, Editor of "Computers and People,"
and
Dr. Leonard Myers, Head
Computer Science Department
Univ. of Wisconsin – Platteville
Platteville, Wisc. 53818

> Editorial Note: One of the most satisfying by-products of being an editor is the unsuspected turnings in a path of editorial action. In this case, we sent out a survey form, and received 69 completed replies (we shall summarize the results in another place). But here is a round by round account of an interaction with someone who saw no good reason to reply to the survey at the time he received it, and argued with us, which is so appropriate in an open society. ECB

1. Form Letter to Director, Computer Center, Univ. of Wisconsin, Platteville, (among others)

RE: SURVEY OF COMPUTING PROGRAMMING LANGUAGES IN USE

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

We have not heard from you.

The responses we have so far indicate some fascinating information. For example: The estimated cost of training a new programmer ranges from $400 to $7500.

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

Yours sincerely,
Edmund C. Berkeley (signed)
Editor

2. Survey Form Enclosed

SURVEY OF COMPUTER PROGRAMMING LANGUAGES IN USE

Dear Friend,

We are seeking to put together a report on computer programming languages in use at a sample of computer installations in major universities and colleges. We plan to publish this report in the "1976 Computer Directory and Buyers' Guide," 22nd annual edition. Would you please help us by answering the following survey questions? (If you would like a copy of the report when put together, please say so.)

With much appreciation for your help,
Edmund C. Berkeley, Editor (signed)
Computer Directory and Buyers' Guide

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

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

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

( ) FORTRAN, about ____ percent
( ) COBOL, about ____ percent
( ) BASIC, about ____ percent
( ) ____________, about ____ percent
( ) ____________, about ____ percent
( ) ____________, about ____ percent
( ) ____________, about ____ percent
( ) ____________, about ____ percent

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

a. Programming Language ____________________
b. Time: ____________________weeks
c. Cost: $____________________

4. Would you like to be able to program a computer or modify computer programs in ORDINARY NATURAL LANGUAGE such as a manager uses to instruct a clerk, if this were possible?

( ) Yes.
( ) No.
( ) We request literature from Berkeley Enterprises about the possibility of programming in ordinary natural language.

5. Any remarks or comments?

Filled in by: Name____________________
Title____________________
Organization____________________
Address____________________

When completed please send to: Edmund C. Berkeley, Editor, Berkeley Enterprises, Inc., 815 Washington St., Newtonville, MA 02160

3. From Dr. Leonard Myers, Head Computer Science Dept. University of Wisconsin – Platteville:

I have received another of your requests for information. The reason you did not receive any response previously is that your intentions are so unclear that we felt it wiser to return no information.

Your letter has always been directed to the DIRECTOR of the computer center. Yet you state that you selected us as one of about 200 "computer science departments." The center and the computer science departments are two very different groups.

Secondly, I have no idea what you want for the time and training of programmers. Do you wish to ask about the paid pregrammers in the computer center or are you concerned with the cost of educating our computer science students?

Thirdly, I believe that any claims for the ability to program freely in ORDINARY NATURAL LANGUAGE are unrealistic and misleading to the uneducated.

Finally, if you want our director to fill out your form, please send him a specific letter to that effect so that he'll quit sending the darn thing to me.

4. From the Editor:

Thank you for your stimulating letter.

We sent out about 200 letters and have received 69 completed questionnaires to date. I enclose samples of three. There is a fair amount of very interesting information in the 69 replies and we shall publish a summary of the information we have obtained. It did not seem to me when I devised the questionnaire and survey form that there was anything very difficult or obscure about it. I am sorry that it seemed that way to you.

In regard to programming in ordinary natural language, we are actually doing it on our own computer. See the enclosed preprint of an article now printed in our September issue. If you ever come near here, and could sit at our PDP 9, and try our system for programming in ordinary natural language, I would be delighted. Just let me know beforehand so that I can be sure to be here instead of somewhere else such as New York or San Francisco, etc.

5. Sample 1 – From the University of Wisconsin at Milwaukee:

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

( ) FORTRAN, about 60 percent
( ) COBOL, about 5 percent
( ) BASIC, about 5 percent
( ) SNOBOL, about 15 percent
( ) LISP, about 5 percent
( ) UNIVAC ASSEMBLER, about 10 percent

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

a. Programming Language FORTRAN
b. Time: 12 weeks
c. Cost: $ 2400

4. Would you like to be able to program a computer or modify computer programs in (a restricted subset of) ORDINARY NATURAL LANGUAGE such as a manager uses to instruct a clerk, if this were possible? (( ) supplied by U of W)

(XX) Yes.
( ) No.
( ) We request literature from Berkeley Enterprises about the possibility of programming in ordinary natural language.

6. Sample 2 – From the University of Oklahoma at Norman, Okla.:

1. What is your estimate of the number of programs you use? 1000

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

( ) COBOL, about 100 percent

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

a. Programming Language COBOL
b. Time: 26 weeks
c. Cost: $ 5000

4. Would you like to be able to program a computer or modify computer programs in ORDINARY NATURAL LANGUAGE such as a manager uses to instruct a clerk, if this were possible?

(XX) Yes.
( ) No.
( ) We request literature from Berkeley Enterprises about the possibility of programming in ordinary natural language.

5. Any remarks or comments? Only if proposed language had the potential of becoming a standard.

7. Sample 3 – From the University of Iowa at Iowa City:

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

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

(XX) FORTRAN, about 50 percent
(XX) COBOL, about 10 percent
(XX) BASIC, about 25 percent
(XX) SNOBOL, about 2 percent
(XX) PLI, about 10 percent

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

a. Programming Language FORTRAN
b. Time: 4 weeks
c. Cost $ 1000

4. Would you like to be able to program a computer or modify computer programs in ORDINARY NATURAL LANGUAGE such as a manager uses to instruct a clerk, if this were possible?

(XX) Yes.

(XX) We request literature from Berkeley Enterprises about the possibility of programming in ordinary natural language.

8. From Leonard Myers:

Aw, c'mon. Programming in natural language is the idea that a user sits at the terminal and uses any English words in the same way he would with his colleagues to describe his intentions to the computer. Programming using natural language can, of course, be much less.

If you ever get near Platteville, and I'm not somewhere else such as Shullsburg, Gratiot, Hazel Green, or even in such "big" towns as Dubuque or Madison, let's grab a student out of the halls and let him arbitrarily send some English commands through our terminals into your system. (You pay the phone bill?)

However, I do imagine that there are some people who find the services you've made available to be satisfactory for their needs.

The replies are interesting. However, the art of programming involves far more than the coding of instruction. As Dijkstra notes, it is the "art of organizing complexity."

9. From the Editor:

I am starting to want very much to see you and talk to you. You disagree with me. You challenge me. You try to kid me. It must be great fun to argue with you.

Please tell me where is Platteville, and how I get there. I have to take trips from time to time, and maybe I can make a stop at O'Hare and visit Platteville, and return to O'Hare reasonably well.

We have taken (to begin with) a special case of ordinary natural language instruction (a) to a clerk in the calculation section of a life insurance company (my environment 1930-48), and (b) to a computer. The manager gives three things to a clerk: instructions which he hopes are clear; numerical examples of the calculation to be made; a layout for calculation and a layout for reporting, usually in the form of the last time the calculation and the report were made. The manager wants to get work out of the clerk; and he does not want to have to tell the clerk what to do in any fancy language like BASIC or FORTRAN or COBOL. Now it seems to me that it is fair and reasonable to choose this situation to get started with.

Notice that I am not saying programming (in the sense of designing an algorithm) is either trivial or easy or not complex. I am saying once the manager knows what he wants the clerk to do, he would be happy to use ordinary English to tell the clerk what to do.

Now it is your move again. (Do you play chess?)

10. From Leonard Myers:

Touché!

You have at least temporarily disarmed me. I am delighted by your gentlemanly response and flattered by your interest in us. (You've no doubt discovered that academia cultures enormous egoes.)

Unfortunately, Platteville is not easy to reach from Chicago. We are situated in southwest Wisconsin, about 25 miles from Dubuque, Iowa, and 70 miles from Madison, Wisconsin.

If you ever have plans to be in either of those cities, give me some advance warning; and I'll see if we can arrange a meeting somehow.

If possible, I would like to have you talk to some of our students about your present English programming system and especially your thoughts on related programming systems 10 years from now. We would be extremely interested in how much comprehension you foresee being built into future systems before they run into the kinds of semantic problems currently thwarting natural language systems in AI.

Now that I understand the purpose of your system, I no longer see a reason for attack. My chess is quite rusty. If you've seen the Viewpoint from the August issue of Digital Design, you'll note the kind of programming in "natural" language with which some of us are concerned.

11. From the Editor:

Thank you for your very nice letter. I judge the sensible way to come to Platteville is via Dubuque, and probably the sensible way to come to Dubuque is via O'Hare. I shall do my best to come — with due forewarning — but the time is very uncertain.

I would much like to talk to you and to your students about computer programming using ordinary natural language, and about computers and people, and computers and society, and some other subjects. I enclose my resume, so that if you have any loose invitations for speakers, you can pick up one out of the pile, and see if it fits me.

I foresee unlimited comprehension by computers of human discussion. I suggest that you look at "Part 2, The Discussing Computer, pp. 87-134 in my book "The Computer Revolution" (published by Doubleday and Co., New York, 1962, 249 pp.). I do believe that most artificial intelligence investigators currently are making some fairly simple problems into very hard problems, perhaps because they need very large funds to keep them investigating in the style they would like to be accustomed to.

I have not seen "Viewpoint" in the August issue of "Digital Design" and I would much appreciate a copy.

I am delighted to have made friends with you. □

Computing and Data Processing Newsletter

WATERWAYS THROUGH ICE PACKS IN OCEANS AND LAKES FOUND BY ICE INFORMATION SYSTEM USING RADAR, INFRARED, AND SATELLITES

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National Aeronautics and Space Administration
Washington, DC 20546

Guiding cargo ships safely through treacherous ice-laden waters of the Arctic Ocean is another example of how space technology is being used to help solve problems on Earth. A successful three-week demonstration of an all-weather ice information system was recently completed along the western and northern coasts of Alaska in a joint program involving the U.S. Coast Guard, National Weather Service, the Lewis Research Center of the National Aeronautics and Space Administration, and the U.S. Navy.

The Northern Slope region was selected for this demonstration because it suffers serious shipping problems 60 per cent of the time due to thick ice. In many cases barges have been weathered in at ports or have had to turn back from their destination, with their cargo having to be shipped by other, more expensive means. Due to difficulties in the summer of 1975, many barges were trapped in the Arctic ice and others fled south to ice-free waters. The additional expense of transporting this equipment was estimated at between $30 and $50 million in direct cost for 1975 alone. A test demonstration of NASA's remote sensing ice information system was scheduled to determine whether it would be able to alleviate this problem.

A Coast Guard C-130B plane equipped with NASA's Side-Looking Airborne Radar System (SLAR) flew over the Arctic sea lanes obtaining daily ice data. The system provides microwave imagery similar to black and white photographs. Unlike photography, however, SLAR is able to determine the type and distribution of ice, even through dense cloud cover and in just about any kind of weather. As the plane flew over the Arctic the SLAR system, along with other appropriate electronic equipment, was able to collect and transmit imagery of coastal shipping lanes approximately 70 miles wide. These data were relayed to a geosynchronous satellite (GOES), to a receiver located at Wallops Island, Va. and on to the NASA's Lewis Research Center in Cleveland, Ohio, where the images appeared in real time. After rapid processing, the images were re-transmitted from Cleveland via the joint U.S.-Canadian Communications Technology Satellite (CTS), to Barrow, Alaska. There Navy ice interpreters assisted in providing interpretive navigation charts. These charts were then used as an aid in scheduling and directing vessel movement through and around offshore ice.

The data were also transmitted to the NOAA National Weather Service/Fleet Weather Facility in Suitland, Md., where an ice forecast was prepared.

After the shipping season ended, the system was used farther north in the Arctic to assist the Coast Guard's ice breaker U.S.C.G.C. Glacier. With the aid of SLAR, the Glacier was able to operate through ice in conditions where there was no visibility at all. In both demonstrations, the SLAR system was considered to be a complete success.

The ice information system came about as a result of a request from Congress to see whether the Great Lakes could be kept open all year. Virtually all Great Lakes shipping formerly ceased from December 15 through April. In 1972 Congress named 12 federal agencies, including NASA's Lewis Research Center, to the Winter Navigation Board. The Board was responsible for finding out how season extension would affect the environment and economy; how much it would cost, and how much it would benefit commerce by being able to keep the lakes open all year. Once it had been determined that it would be advantageous to keep the lakes open, many technical problems had to be handled. For ice information, problems such as identifying what the microwave system actually sees, recognizing the different types of ice, and determining the fastest method of relaying the information to the vessel masters had to be dealt with.

Since the SLAR system was put into use over the Great Lakes it has aided in keeping the shipping season open for two full seasons, the first time in history, at an estimated eventual gain of hundreds of millions of dollars per year. The shipping season of 1976-77 will be the third and final demonstration year of the SLAR system. NASA plans to deploy a similar microwave imaging system on the Seasat A satellite which is presently scheduled for launch in 1978.

A UTILITY USES A COMPUTER TO ANALYZE A POWER PLANT'S IMPACT ON MARINE LIFE

Kevin Muench
Southern California Edison Co.
Redondo Beach, CA 90277

(See the front cover, and note on page 5)

In our marine laboratory, we are using a computer to study fish and other kinds of sea life to see how they adjust to warmer water near the shoreline, where sarcastic fringeheads live.

Our research teams are analyzing the effects of returning sea water to the ocean after using it to cool condensers at our coastal power plants. Information from Redondo Harbor analyzed by a computer indicates that starfish, sea urchins and other marine animals are thriving near the plant.

The scientists in our laboratory hope to demonstrate that the warmed waters can accelerate growth in certain marine creatures, such as lobsters from Maine. They use the computer to keep track of such factors as growth rates, reproductive cycles and incidence of disease. Preliminary findings indicate that the lobsters can be grown to marketable size — about one pound — in two to three years, compared to seven years in unwarmed waters.

Our utility serves about 7.5 million people in Southern California, and is one of the largest privately owned utilities in the United States. The computer system in use is an IBM System 370 Model 168. Only a small portion of its capacity is applied to the research problem.

COMPUTER PROGRAM TEACHES MEDICAL DIAGNOSIS

Lydia Dotto
The Globe and Mail
Toronto, Ontario

"Done — at last," the computer tartly informed the doctor, who finally ordered a treatment for his patient that he should have thought of long before.

Fortunately, the patient — a little the worse for wear as a result of the delay — was not flesh and blood. The patient was a computer — one of many whose programmed ailments were used this weekend to test doctors seeking to specialize in pediatrics.

Wayne Osbaldeston, an Edmonton program analyst who wrote the computer programs that simulate patients' symptoms, played the role of doctor in a demonstration of the system. He deliberately left out an important procedure to show how the computer assesses a doctor's ability to diagnose and treat an illness.

The computer tests are part of the pediatrics certification examinations sponsored by the Royal College of Physicians and Surgeons. They will be held at the Hospital for Sick Children in Toronto, as well as in Vancouver, Edmonton, Winnipeg and Ottawa. Similar tests will be held in Montreal.

The computer programs are written so that the "patient" deteriorates or improves depending on the procedures and treatments ordered by the doctor.

At the end of the test, the doctor will be given a score, which the computer will determine by comparing his responses with the treatment recommended by a panel of experts.

The candidates work at a computer terminal with a keyboard and small screen. First, a description of the situation is presented — a car accident, for example, or the delivery of a baby. Then, the patient's condition and vital signs — blood pressure, pulse, or respiration — are displayed on the screen. A second screen is also available for additional information, such as charts, diagrams and figures. A stethoscope attached to a tape recorder can give audio information, such as heart rate.

The candidate is presented with a number of treatment options. As he selects them, the computer tells him what results they accomplish and how his patient is doing. A correct procedure might be rewarded with the statement: "Condition improves remarkably." On the other hand, the computer can also say: "Your patient just died."

Mr. Osbaldeston said the pediatrics tests were not programmed with the patient death scenario, but some MD exams have been and he has witnessed one case where a patient "died" on a student. "The student let out a little cry and then sat back and just stared at the screen," Mr. Osbaldeston said. He said the computer exam cannot evaluate a doctor's ability to actually perform the necessary procedures, but it can determine whether he knows what to do, what tests to order and what drugs to use. It assesses the doctor's judgement and decision-making abilities, reaction time and knowledge of medical procedures.

Mr. Osbaldeston said the Royal College is considering making computer patients available to practicing doctors for self-evaluation; they could use the terminals on a voluntary basis to determine where they need improvement. Mr. Osbaldeston said the terminals might be set up at the college's annual meeting. A recent survey of doctors indicated that 97 per cent would be interested in having the computers available at medical centres across the country.

Mr. Osbaldeston is a computer specialist employed by the University of Alberta's faculty of medicine and the McLaughlin Examination and Research Centre. □

Wiley – *Continued from page 21*

Notice of Inquiry and Rulemaking

In the new Notice of Inquiry and Rulemaking we released recently, we are seeking comments on a proposal to delete the concept of "hybrid services" and substitute a positive definition of data processing. We are proposing to define data processing as "the use of a computer for the purpose of processing information wherein: (a) the semantic content, or meaning, of input data is in any way transformed, or (b) where the output data constitute a programmed response to input data." By defining data processing in terms of what it is, rather than by exception as we have done previously, we hope to more sharply define this regulatory boundary. I believe that this will stimulate further technological and marketing developments by removing ambiguities in the earlier definition.

Many other examples could be given of issues that must be addressed with regard to the evolution of industry structure in computer communications. I have not even attempted to discuss the broader issues of social policy that these developments portend.

An Environment of Free Contribution

In conclusion, I firmly believe that computer communications lies right at the very heart of mankind's next great advance in economic and social development.

Because of its importance, we must continue to strive to provide an environment in which all segments of society can freely contribute — from the largest corporation to the basement hobbyist. Through decisions over the past ten years we have devised a regulatory environment in which basic telephone service is both protected and nurtured but which allows innovative contributions from all. Refining this regulatory environment remains the major challenge of U.S. policy toward data communications. □

GAMES AND PUZZLES for Nimble Minds – and Computers

Neil Macdonald
Assistant Editor

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

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

NAYMANDIJ

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

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

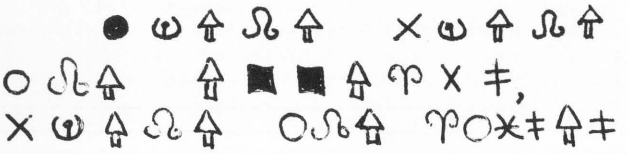
NAYMANDIJ 7612

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

MAXIMDIJ

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

MAXIMDIJ 7612



NUMBLES

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

NUMBLE 7612

```
          M E N
  x     M U S T
  -------------
        R M H T
      R E U E
    M N M C
  H U N R
  -------------
= R N U E F U T
```

69008 24971

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

SOLUTIONS

NAYMANDIJ 7611: Make diamond of eights.

MAXIMDIJ 7611: The best is yet to be.

NUMBLE 7611: Do as you preach.

Our thanks to the following individuals for sending us solutions: Byung Sun Choung, San Diego, CA: Numble 7610 – Frank DeLeo, Brooklyn, NY: Namandij 7610; Maximdij 7610; Numble 7610 – T.P. Finn, Indianapolis, IN: Numble 7610; Maximdij 7610 – Diane Huard, Des Plaines, IL: Naymandij 7610; Maximdij 7610; Numble 7610 – Jim Pate, Burmingham, AL: Naymandij 7610; Maximdij 7610; Numble 7610 – Gus Strassburger, Atlanta, GA: Numble 7610.

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

by Edmund C. Berkeley, Author and Anthologist

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

The Fly, the Spider, and the Hornet

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

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

The Fox of Mt. Etna and the Grapes

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

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

The Fire Squirrels

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

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

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

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

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

Missile Alarm from Grunelandt

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

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

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52 parables (including fables, anecdotes, allegories)
23 never published before
27 authors
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