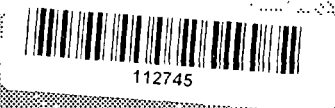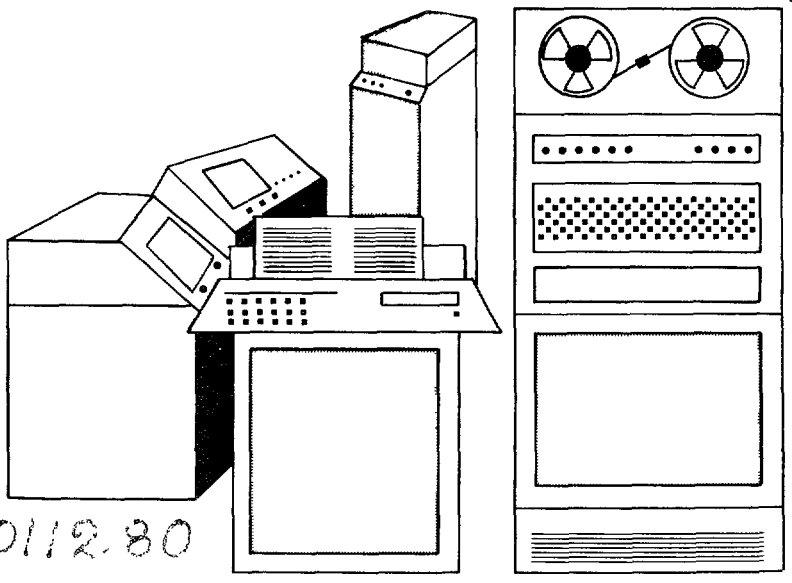# COMPUTERS IN GOVERNMENT:

We
Couldn't
Do
Without
Them

THIS BOOKLET TELLS IN LAYMAN'S LANGUAGE
HOW VITAL COMPUTERS ARE TO GOVERNMENT
OPERATIONS AND GIVES SOME THOUGHTS ON THE
MORE IMPORTANT COMPUTER ISSUES OF TODAY
AND TOMORROW.

FOR EXAMPLE, THE BOOKLET RUNS THROUGH HOW
DEPENDENT THE GOVERNMENT IS ON COMPUTERS,
HOW IT CAME TO DEPEND SO MUCH ON THEM,
WHAT BENEFITS IT HAS OBTAINED FROM
COMPUTERS, WHAT PROBLEMS IT MUST CONCERN
ITSELF WITH, AND WHAT THIS MEANS FOR THE
FEDERAL GOVERNMENT AND SOCIETY IN THE
FUTURE.

By the Comptroller General of the United States

JUNE 1980

i

SOME FACTS ABOUT GOVERNMENT

YEAR 1950	COST	YEAR 1980 (Estimated)

BUDGET

$175 BILLION
(Constant 1979 Dollars)
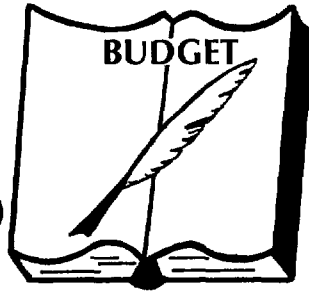
$525 BILLION
(Constant 1979 Dollars)

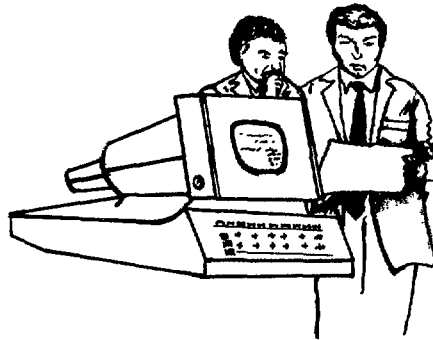## FEDERAL WORKERS

2.4 MILLION

2.8 MILLION

COMPUTERS INSTALLED

TWO

15,800

FOREWORD

It is hard to conceive of how our Government could perform its vast and diverse tasks without computers. Virtually all the Government's many record-keeping functions depend on them.

The development and widespread use of computers in Government operations has been a giant step forward in man's use of a new technology as a means to progress and development of his knowledge.
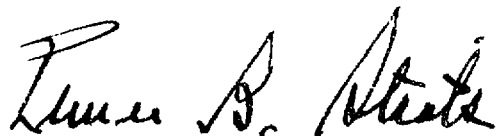
One of its effects has been to increase Government services without large increases in total costs. An effect which is probably even more important in the long run is the ability to do things which could not be done at all without computers, either because they could not be done in time to be useful or because they would have cost too much to be practical. The most pervasive effects of computers on Federal operations, however, have been the changes in ways and methods which have become necessary to take full advantage of a whole set of new technological capabilities.

But with great benefits have come corresponding risks. The failure of a computer system or the breakdown of a computer project (like monitoring atomic energy plants) could harm many people or severely disrupt Government operations with consequential damage to the people, country, and to the well-being of the United States.

Despite the fundamental changes in the way the Government now runs its business, we believe that the automation of Government services has not kept pace with mechanization in other fields, like production-line developments in the factory.

Great opportunities and challenges still lie ahead for the use of computers to help Government workers increase their productivity.

Government is still faced with some pressing issues arising from computer use. It needs safeguards against misuse of computerized data and must resolve concerns about privacy, security, and better use of computers. Better management, control, and training of personnel in the use of these resources are essential.

Comptroller General
of the United States

What's In The Booklet

Contents

CONTENTS

Computer Diagram

Control

Processing

Input

Input

Output

Program
Plan

Print

Remember

Translates human
language into
machine language
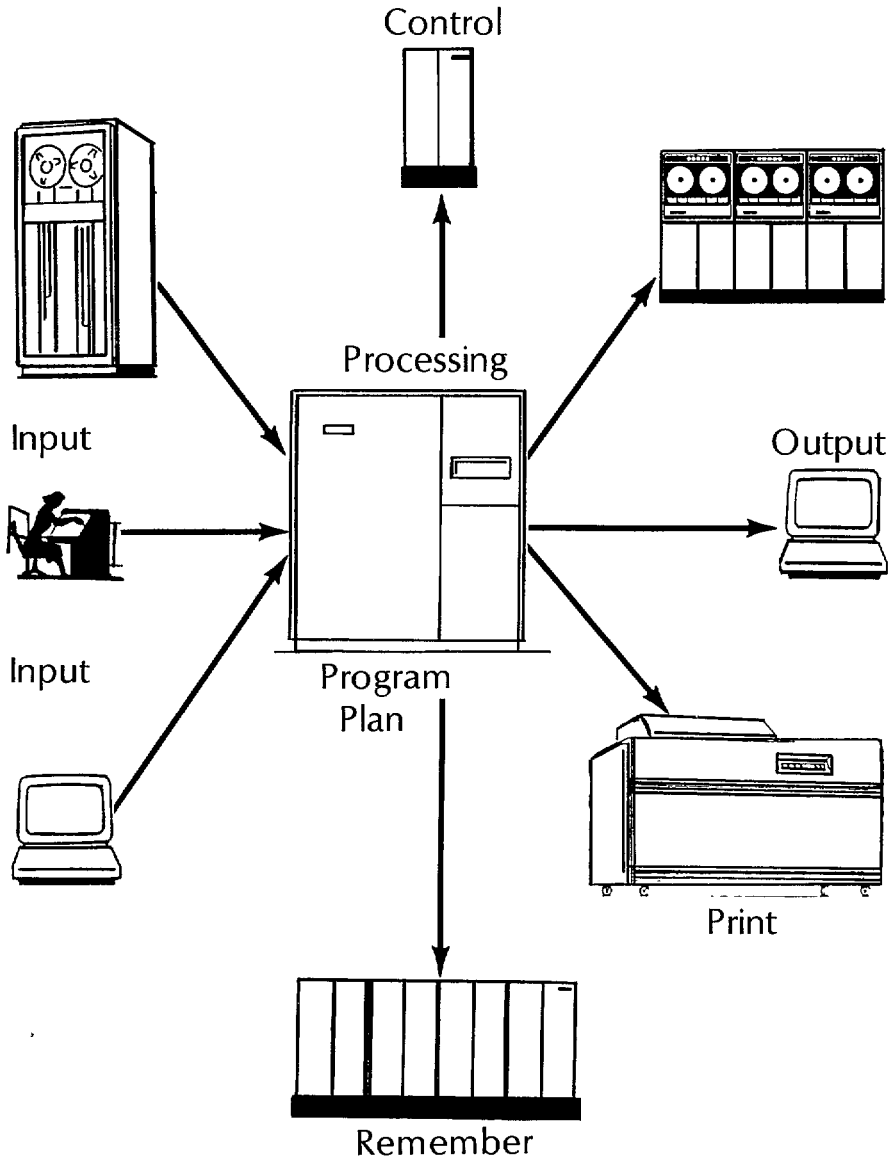
Converts machine
language into
human language

WHAT IS A COMPUTER?

The dictionary defines "computer" as an automatic electronic machine capable of accepting information, applying prescribed processes to the information, and supplying the results of these processes to a device, a machine, or a human being. It usually has input and output units; storage, arithmetic, and logical parts; and a control unit to monitor its operations. See page vi for a computer diagram.

There are two kinds of electronic computers—analog and digital. Analog computers use voltage levels to represent quantities and perform their operations by simulating the physical phenomena being considered. In digital computers, all programs instructions and data are recorded as electrical impulses in a coded form.

Inputing data to a digital computer is similar to communicating with another person by letter. The information to be conveyed must be reduced to symbols. In our language, these are the alphabet, numbers, and punctuation. Therefore, communicating with a computer requires that the data be reduced to symbols that can be read and interpreted by the machine.

Digital computers function in what is called a binary mode. This means that the machine can indicate only two possible states or conditions. For example, the ordinary light bulb operates in a binary mode; it is either on, producing light, or it is off, not producing light. The binary mode of operation is a set of signals to the computer, just like the presence or absence of light from an electric light bulb is to a person.

Data is represented within a computer by assigning or associating a specific value to a binary indication. For example, a device to represent numeric values could be designed with four electric light bulbs and switches to turn each bulb on or off.

The bulbs would be assigned numeric values of 1, 2, 4, and 8. When a light is on, it represents the numeric value associated with it. When a light is off, the numeric value is not considered. With such an arrangement, the single numeric value represented by the four bulbs will be the sum indicated by the lighted bulb.

For example, the figure on page 2 shows the number 5 in a digital computer by having the 4 and 1 lights on and the 8 and 2 lights off. The numeric value 0 is represented by all all lights off; the value 15 by all lights on.
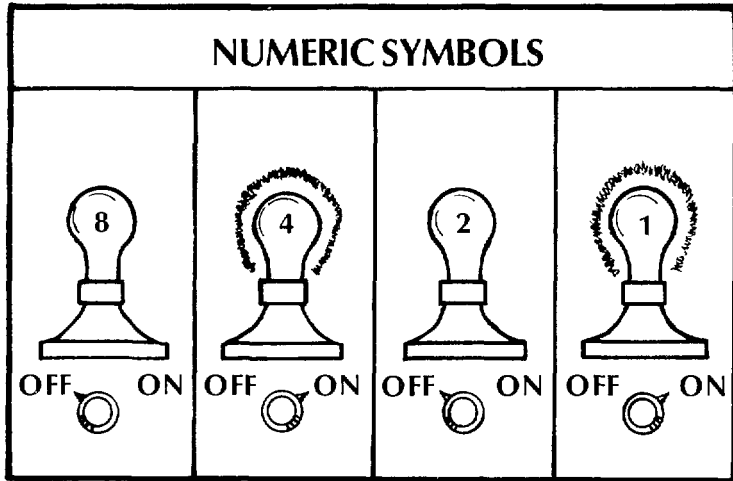
1

HOW IS DATA REPRESENTED?

COMPUTER LANGUAGE   0   1   0   1

NUMERIC SYMBOLS			
8	4	2	1
OFF ON	OFF ON	OFF ON	OFF ON

HUMAN LANGUAGE   4   +   1 = 5

The method used to symbolize data in a computer is known as a code. In our computer example, the code relates data to a fixed number of binary symbols. Computers in use today use codes to represent numeric and alphabetic characters by seven or eight positions of binary indications. By the proper arrangement of the binary indications (light, no light), all characters can be represented by a different combination of lights or symbols. The example on page 2 shows the place value of binary numbers in a typical computer.

Many types of digital computers are used in Federal programs and they vary in size, complexity, speed, cost, and application. But regardless of the job to be done, computer systems involve at least three basic considerations. They are:

1. The source data, or input entering the system.

2. The orderly, planned processing within the system.

3. The end result, or output from the system.

Input may consist of many types of data; business, accounting, scientific, statistical, engineering, and so on.

Processing is carried out in an established sequence of instructions that the computer follows automatically. The plan of processing is always of human origin. By calculation, sorting, analysis, or other operations, the computer arrives at a result that may be used for further processing or recorded as reports or files of data.

Computers are usually designed to perform specific types of operations. They are directed or told to do each operation by an instruction. The instruction defines the operation to be performed and identifies how the machinery will carry it out. The overall plan, or series of instructions (machine routines), needed to complete a given procedure is known as a computer program. Another term, "software," refers to all the programs which can be used on a particular computer.

But what does all this mean? First, a computer is a machine that can carry out arithmetical and verbal tasks. It can follow a long sequence of logical instructions. It can ask and answer questions. It learns rapidly and remembers well. A computer can even show the ability to think (by comparing) and to communicate. However, it must be told what to do and how to do it. Therefore, in simple terms a computer can be viewed as the perfect idiot. It does precisely what it is told to do—no more, no less.

3

GROWTH TRENDS IN COMPUTERS, FEDERAL EMPLOYMENT, AND SERVICES

FEDERAL EMPLOYMENT PER $100 OF
PER CAPITA INCOME (IN 1,000)

PERCENTAGE OF POPULATION RECEIVING
GOVERNMENT BENEFITS

NUMBER OF COMPUTERS PER $10,000
OF PER CAPITA INCOME (IN 1,000)

YEARS

4
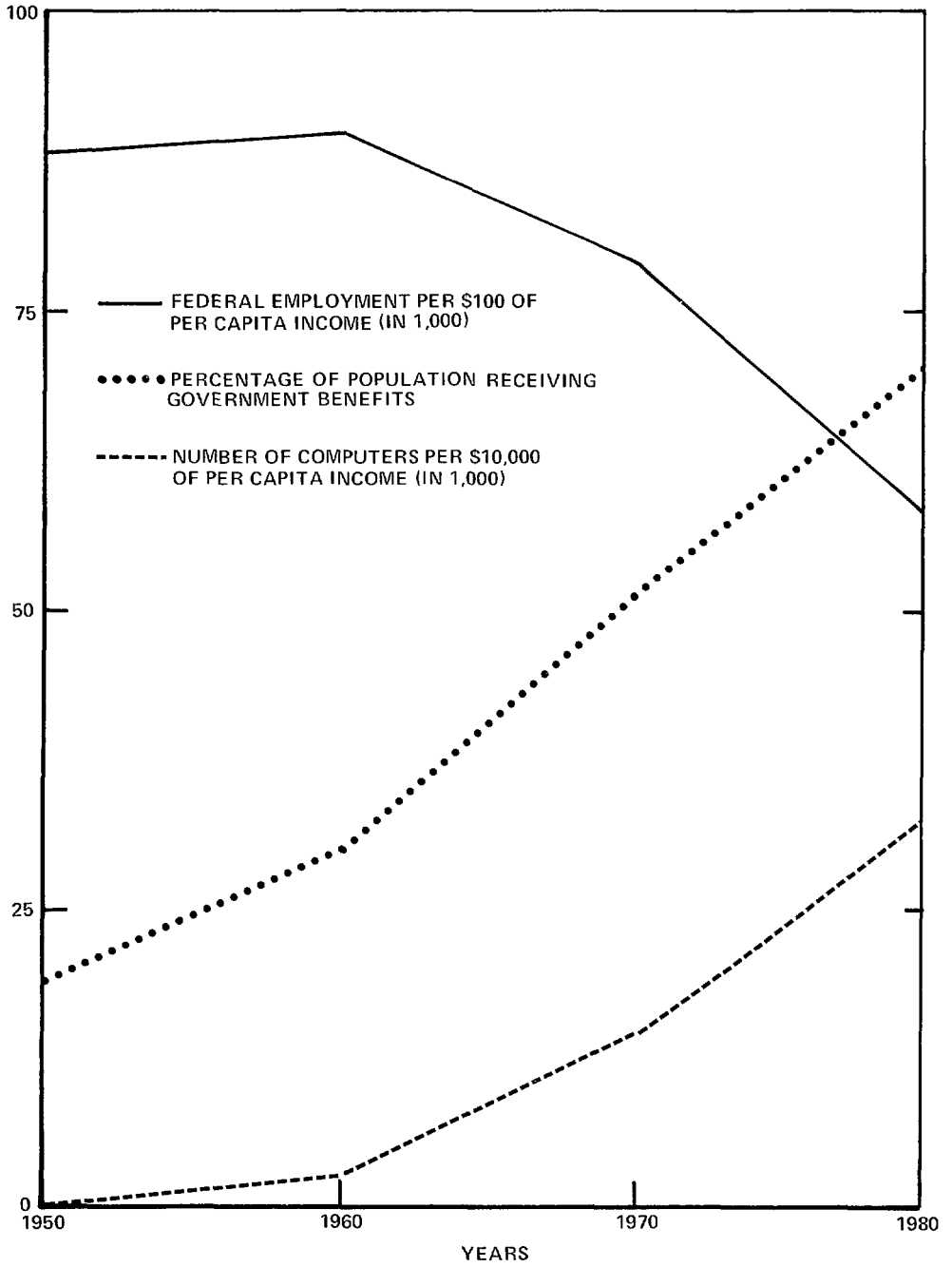
HOW DID THE GOVERNMENT GET TO BE A LARGE USER OF COMPUTERS?

The Federal Government got to be a large user of computers because of increases in Government services, population growth, and concern for efficiency and effectiveness.

INCREASES IN GOVERNMENT SERVICES

The Constitution and the Congress, wars, depressions, inventions, other events, and the will of the people brought about a greatly enlarged role that the Federal Government plays in the life of the Nation. At the close of the 19th century, it became obvious that Government could not operate effectively and efficiently without new ways or techniques to handle new or expanded Government services. While machinery was widely used in manufacturing, manual methods were still being used to run the Federal Government.

The genesis of automating Government operations was the 1890 census. Data and information from the 1880 census were still being worked on when it was time to take the 1890 census. Unless a fast, accurate form of processing data could be found, the scope of the 1890 census would be limited. The Census Office held a competition to select an efficient census-taking system. Herman Hollerith won the contest with his method for representing information as holes in a punched card. Hollerith developed a way of punching holes in a card to record the census information in a form that was readable by machines.

During the next 50 years the punched card technology was applied to many Government administrative tasks. Also during the 1930s and 1940s great changes took place. New large-scale social programs appeared on the horizon. World War II was fought. Science became an ever-increasing part of human activity. Research in ballistic calculations for the military led to the development of the electronic calculating and statistical machines, which were later used by the office worker. New concepts and ideas in the 1940s brought about a new technology—called the computer, which used programs, or instructions, stored inside the machine.

After World War II service industries multiplied. Presidents and the people wanted more Government services but didn't want to increase the Federal workforce. The patterns of Government services and programs grew and grew.The chart on page 4 shows the growth trend in services, computers, and Federal employment.

5
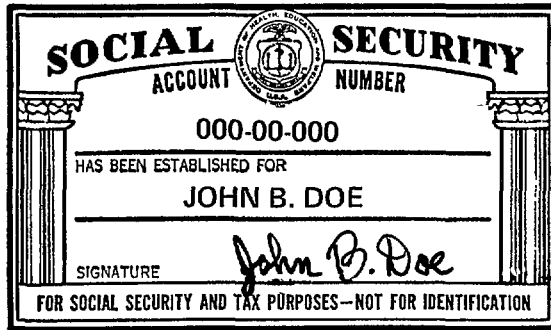
The Social Security Act made it necessary to maintain records on <u>26</u> million workers in 1935 and <u>200</u> million in 1980.
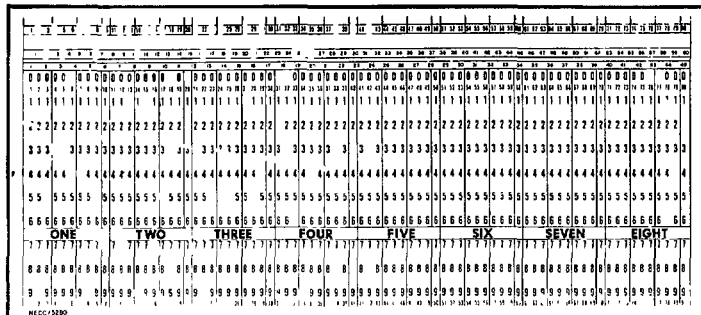
Machines were invented and people were needed to keep the records and pay the benefits.

It is estimated that in 1980 <u>36</u> million people will receive <u>$115</u> billion in benefits.

The agency maintains about a <u>trillion</u> records.

As these changes gained force, they manifested themselves in many ways. Informational needs greatly increased. Data and recordkeeping assumed new importance. Clerical tasks multiplied. Paper-handling tasks appeared as if they would overwelm all service activities.

The Social Security Act of 1935 is a good illustration. This act required the Government to maintain employment records of all working people and set up one of the world's biggest bookkeeping jobs.

Acts relating to income tax also caused new large-scale recordkeeping systems to be set up. They required the Treasury to keep detailed tax and withholding records on millions of taxpayers and handle hundreds of millions of checks annually.

Additional large recordkeeping jobs required by laws include:

● keeping records of millions of veterans' insurance and benefits;

● keeping records of agriculture, commerce, resources, and environmental agencies; and

● running the national health and defense programs of the Federal Goverment.

POPULATION GROWTH

Next,the population of the United States increased at a rate of over 10 percent each decade since 1900. We went from a population of about 80 million in 1900 to about 220 million in 1980.

With more people came the need for more information and more programs and laws to govern and serve. To mobilize for wars and to serve the people, laws were passed to give the people running the Government extraordinary powers. Public agencies were set up to:

● Control transportation and communication.

● Fight wars and service veterans.

● Predict weather; explore space; and service the poor, the ill, and the elderly.

7

HISTORICAL AND PROJECTED GROWTH IN COMPUTERS, FEDERAL EMPLOYMENT, POPULATION, AND SERVICES PROVIDED BY GOVERNMENT

Legend:
- — — — CUMULATED PUBLIC ACTS PASSED (IN 100)
- ———— FEDERAL EMPLOYMENT (IN 10,000)
- ■ ■ ■ BENEFICIARIES OF SERVICES PROVIDED BY SELECTED GOVERNMENT PROGRAMS (IN MILLIONS)
- ———— NUMBER OF COMPUTERS IN USE (IN 100)
- • • • • POPULATION (IN MILLIONS)

X-axis: YEARS (1950, 1960, 1970, 1980)
Y-axis: 0 to 400
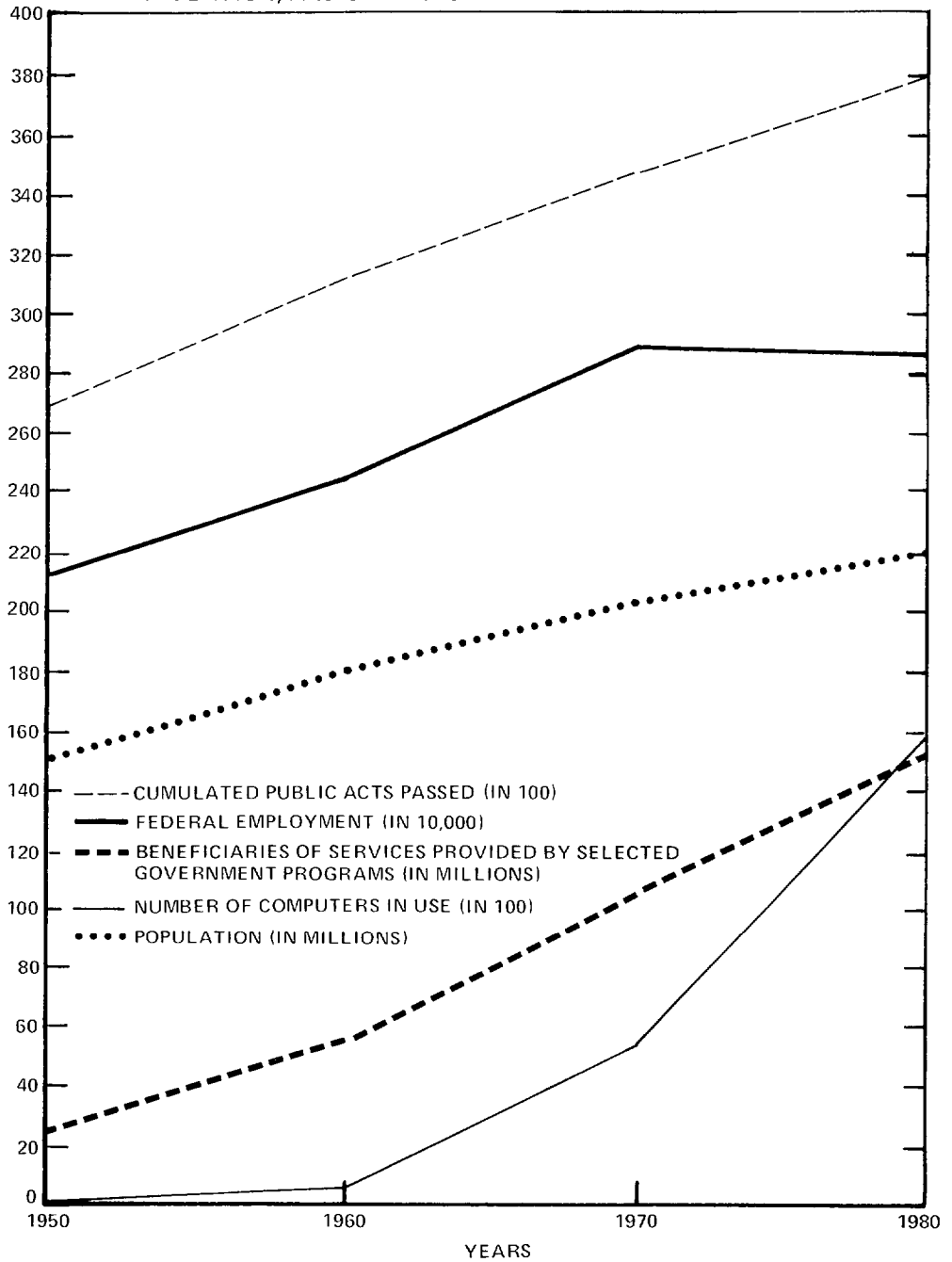
With new services, a population increase, and changes in customs and attitudes, the size and the complexity of day-to-day operations of the Federal Government has increased greatly since the depression of 1929. For example, the Government has one of the largest inventory and supply management operations in the world. Consider issuing and controlling over 3.5 million items of supplies valued at $200 billion. How about paying and keeping records and information on 2.8 million Federal workers? Clerical tasks and other administrative functions create billions of documents and transactions each month, which in turn contribute to a need for more and more computer services. The chart on page 8 shows the historical and projected growth in computers, laws passed, Federal employment, and population, along with the services provided by the Goverment.

FACTORS THAT AFFECT FEDERAL EMPLOYMENT

MILLIONS   THOUSANDS

FEDERAL EMPLOYMENT

TO RISE
- WARS
- DEPRESSIONS
- POPULATION GROWTH
- PUBLIC LAWS FOR
  MORE SERVICES

TO FALL
- COMPUTERS
- OTHER TECHNOLOGIES
- LESS SERVICE TO OTHERS

COMPUTERS

2.9

2.8

2.4   2.4

1.8

15,800

8,600

0.6

5,200

(left hand scale)

2,400

(right hand scale)

0.2

900

2
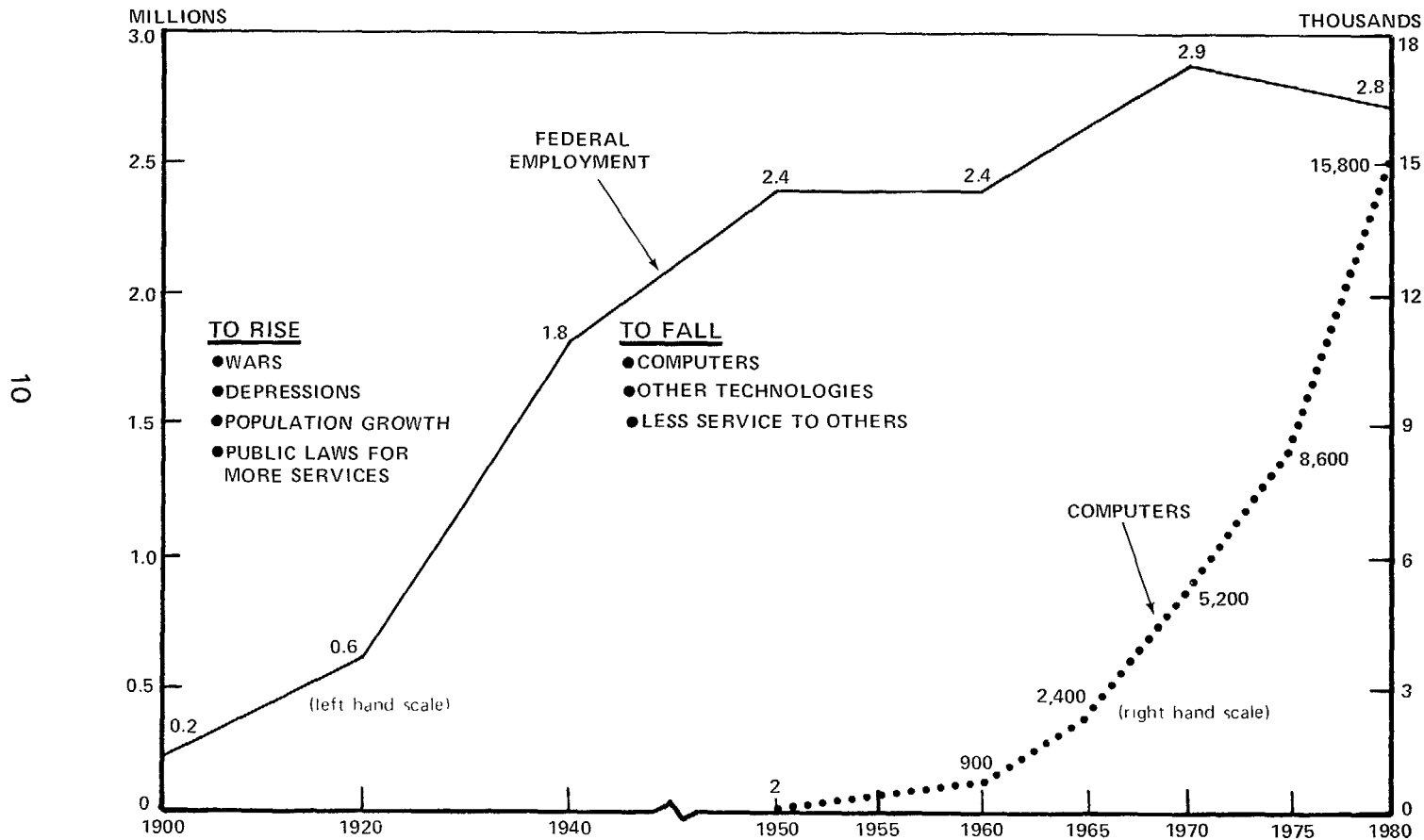
CONCERN FOR EFFICIENCY AND EFFECTIVENESS

The thirst for more services and more information has to be tempered by increased efficiency in organization and information processing, if Government services are to be kept within reasonable bounds of costs and speed of action.

About the turn of the 20th century, efficiency was achieved by a division of labor; i.e., large operations were broken down into a series of steps handled by a machine or person. Assembly-line techniques used in the factory were copied to process information. However, there was no hope of achieving large personnel savings until a new method was invented for keeping records automatically.

In addition to a growing need for automation of clerical routine and management procedures, there was an expanded need for information processing to match a new rate of technological growth and scientific research. The demand for information and paper processing were and still are enormous.

The old punched-card technology represented a step in the right direction, but this kind of equipment was slow and had very limited ability. To operate more effectively the Government needed rapid access to lots and lots of data.

The invention of the modern computer in the late 1940s helped solve the problem, and large numbers of computers were acquired and installed. Computers were installed to provide more, better, and faster public services without increasing the Federal workforce size.

The chart on page 10 shows some factors that affect Federal employment. Wars, recessions, population growth, public laws for more services, and the political party in office cause civilian Federal employment to rise. On the other hand, computers and other technologies, along with the transfer of services to States, cause Federal employment to fall.

11
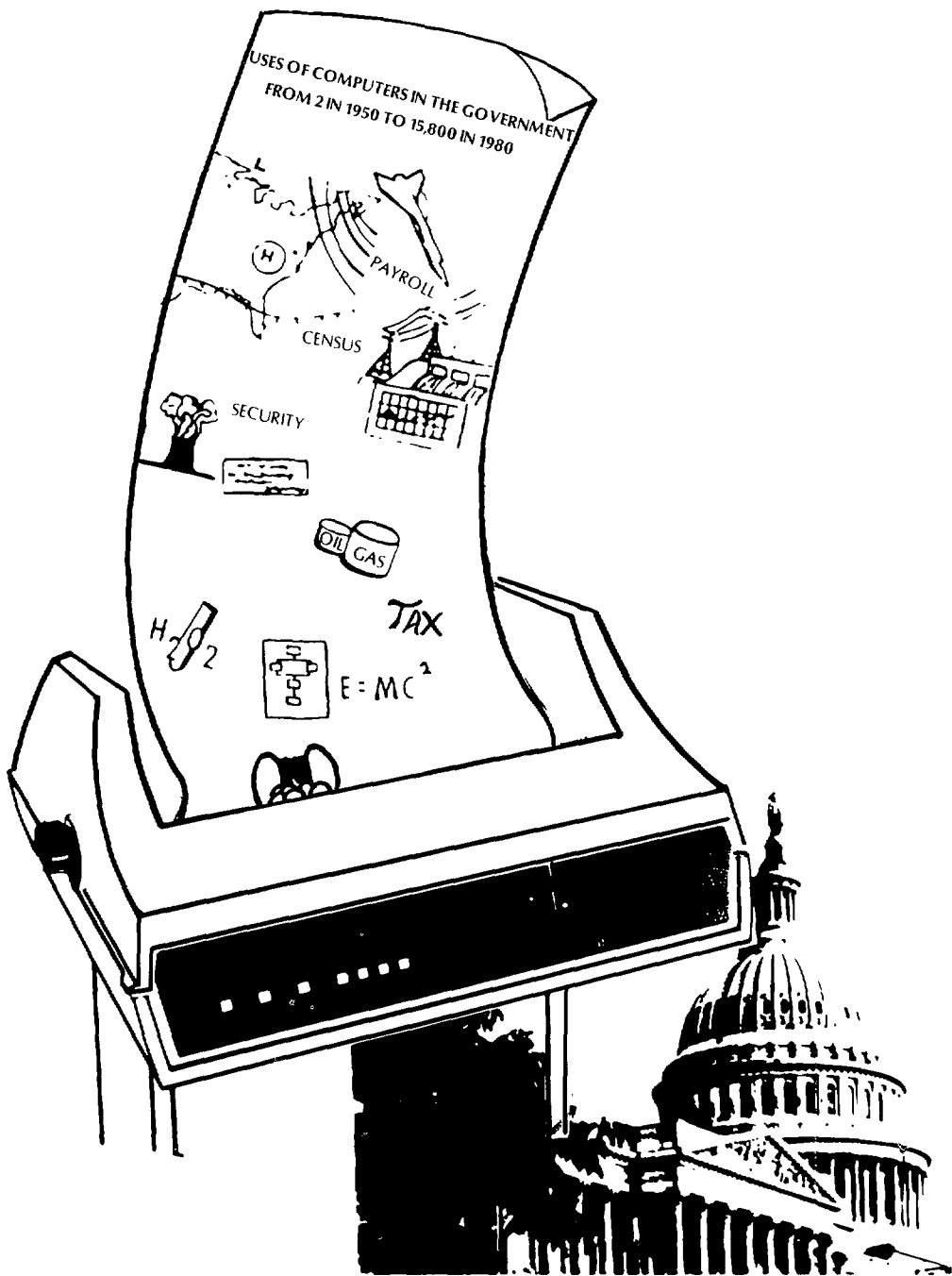
WHAT ARE SOME OF THE MAJOR BENEFITS ACHIEVED THROUGH COMPUTERS?

The press tells us about all the bad things caused by computers, but little mention is made of the benefits. There is a solid record of achievements in setting up some of the Government's large and small computer systems. Let's go over a few.
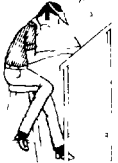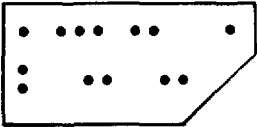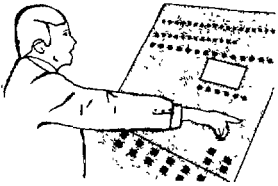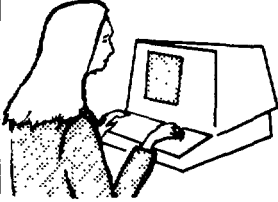
BEING ABLE TO PROVIDE MORE, BETTER, AND FASTER SERVICES

One of the biggest benefits of computers is their ability to provide more and better services. Some services—such as processing claims and paper processing—are well-known examples of Government activities that depend highly on computers. However, the scope of activities and services relying on computers today include such lesser known activities as

- predicting crop levels;

- processing personnel statistics and supply transactions;

- managing numismatic operations;

- paying people, governments, and corporations for goods and services; and

- helping hospitals care for the sick.

More examples which show computers being used to provide more and better services are shown on page 12. Also many lives, dollars, and even property are saved each year by telling the public in advance when castastrophies such as floods, earthquakes, and windstorms are coming.

Progress In Work Processing
At The Census Bureau

Time	Method used	Unit of work	Compile census
Before 1890	Clerk with pencil and paper	1	7-9 years
1890	Manual puchcard	5	3-4 years
1950	Electric punchcard	40	2-3 years
1951	First computer	80	2 years
1980	Modern computer	20,000	less than 1 year

BEING ABLE TO DO THINGS WHICH COULD
NOT BE DONE WITHOUT COMPUTERS

Let's stop and think for a moment where we would be without computers or what could not be done if computers had not been invented.

First, as noted on page 14, taking a census within a 10-year period was almost impossible without automation. The early censuses took 7 to 9 years to do little more than count tens of millions of people. Today, in less than 1 year's time, we take the census and develop meaningful information about the people and our country's land, labor, and wealth.

Another example is the need for computers in our space programs.Scientists tell us that we would not have had a man on the moon without the use of computers. They are used in almost all space and research endeavors, such as

- developing the space shuttle for manned orbital flights,

- conducting deep space astronomy and investigating the Earth's magnetic fields, and

- developing and orbiting communications satellites.

Next comes the use of computers by the military.The military tells us that in modern warfare a hostile missile could not be shot down without a computer. Computers identify hostile aircraft by comparing the information picked up on radar with the flight plans of friendly planes stored in its memory. Other military functions include logistics, communications, commanding operations, and administrative functions. The military is the largest user of computers in the Government.

Computers are essential in designing and constructing our atomic power capabilities. They monitor and control our atomic energy powerplants.

FEDERAL EMPLOYMENT
(THOUSANDS)

IMPACT OF COMPUTERS ON FEDERAL EMPLOYMENT

FEDERAL EMPLOYMENT
WITHOUT COMPUTERS

FEDERAL EMPLOYMENT
WITH COMPUTERS

4,000

3,000

2,000

1,000

0

1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980

YEAR

16
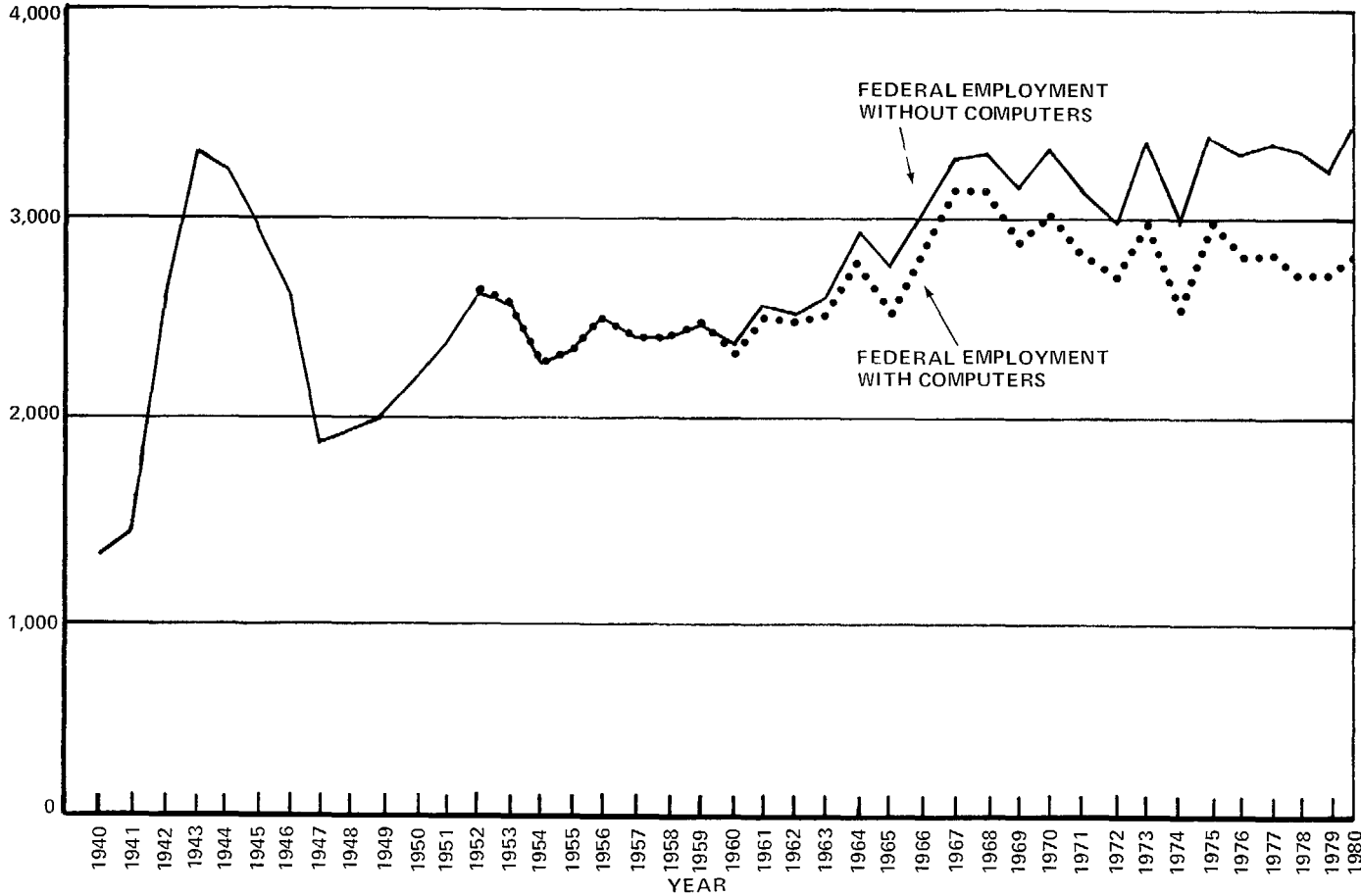
BEING ABLE TO PROVIDE SERVICES AT
LESS COST OR WITH FEWER PEOPLE

By and large most of us know what the Government does and how it has grown during the last three decades. As the Government workload increased, more work was necessary to perform the services, keep the records, and issue and account for the checks. The electronic computer helped do this additional work with far fewer people than would have been needed if computers hadn't been used.

A good example is the Treasury check operation. Before the installation of a computer system in 1956, the Government employed about 600 clerks to issue and reconcile about 300 million treasury checks each year. The reconciliation process under the old manual system took months to accomplish. Today only a few employees using computers handle about 750 million checks issued annually. Check-issue and payment information on magnetic tapes is fed into computers to automatically reconcile check-issue and payment data, eliminating almost all the manual work previously required. In addition, reconciliation is usually completed within a few weeks after receipt of the cashed checks. About $100 million has been saved by having the computer perform this operation for the last 23 years.

Another example where computers are used to provide service at less cost is in the social benefit programs.

Bigness, change, and expansion explain the history of this country's social insurance programs. The Social Security Administration has had to respond to frequent legislative changes which have not only modified the original Social Security Act but also, in some cases, have considerably expanded the agency's basic mission. The agency has had to quickly implement legislative changes with little advance notice and very little increase in staff. For example, in 1965 massive health insurance programs were enacted and the agency had to have the new programs working within a year. Without computers this could not have been done.

ESTIMATE OF THE NUMBER OF ADDITIONAL FEDERAL JOBS THAT WOULD
BE NEEDED TO PERFORM EXISTING SERVICES WITHOUT COMPUTERS

FEDERAL JOBS
SAVED (THOUSANDS)

YEARS
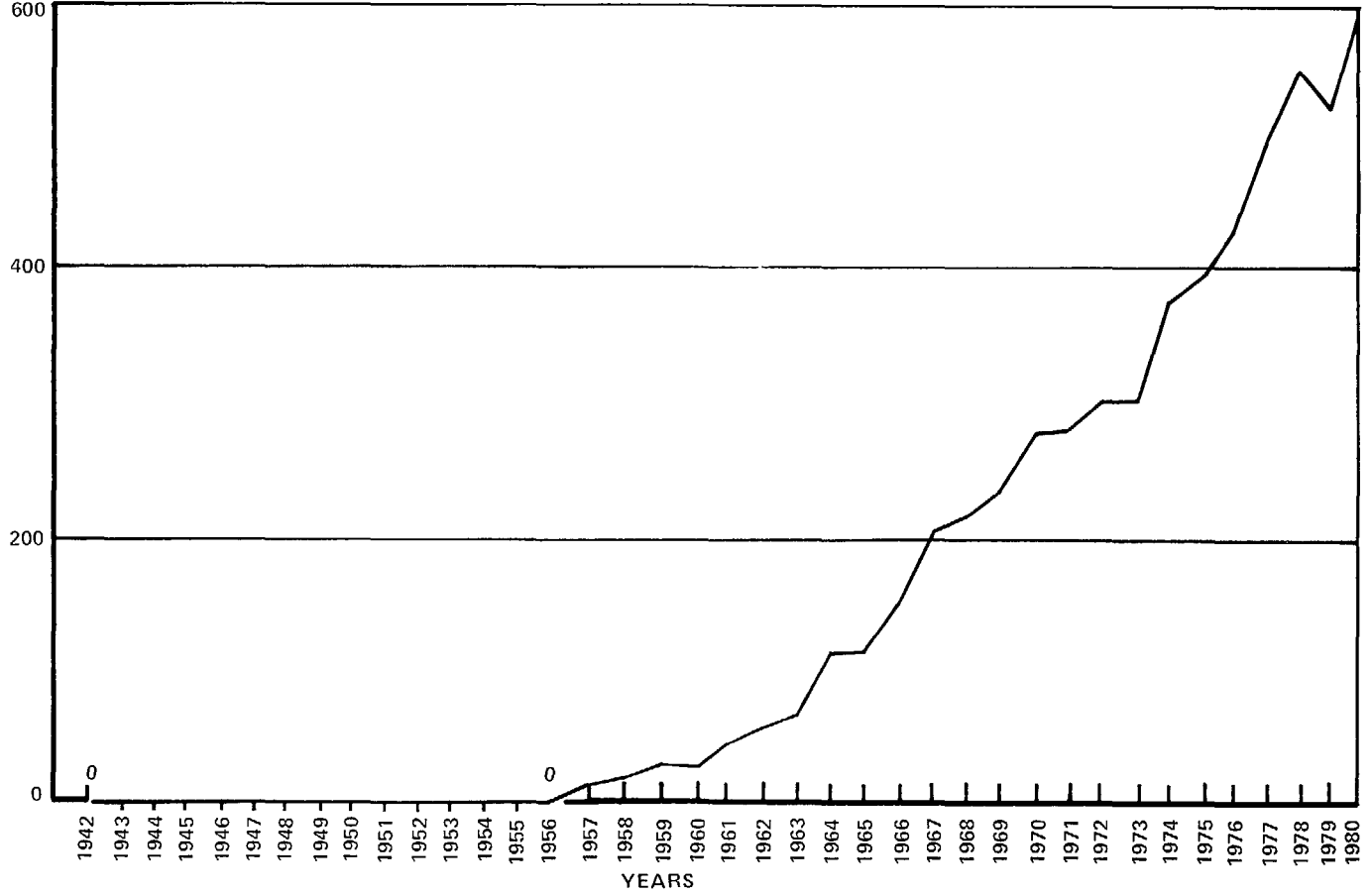
Lastly let's compare some well-known facts about Government and try to estimate how computers have cut costs and saved money. The costs of Government services in 1980 increased by about 300 percent over those in the 1950s. However, the Federal workforce increased only about 15 percent while the number of computers installed increased almost 8,000 percent.

What would have happened if the computer had not been invented? Would we need a corresponding 300-percent increase in civilian Federal employment to run a $525 billion operation? Probably not, but we wouldn't be doing as much work either.

To estimate what civilian Federal employment might have been in 1980 without computers, we identified and collected data on several significant factors that would influence the size of the Federal workforce. Next an econometric technique was developed and used by our computer to estimate what Federal employment would be with and without computers. The same mode was used to estimate all the data used in this booklet for the years 1979 and 1980. In our analysis we used data on population, number of computers, unemployment rate, real per capita disposable income, whether we were at war or peace, the political party in power, and other factors that could increase or decrease Federal employment. The factors used account for about 86 percent of the variation in employment during the period. The results estimate that computers have enabled the Government to do its work with about 600,000 fewer employees in 1980 than would be needed if we didn't have computers. The graph on page 16 shows Federal employment with and without computers for the period 1950-80. The chart on page 18 shows the 600,000 estimated jobs saved in 1980 by using the computer.

WHAT
ARE
THE
IMPORTANT
ISSUES!
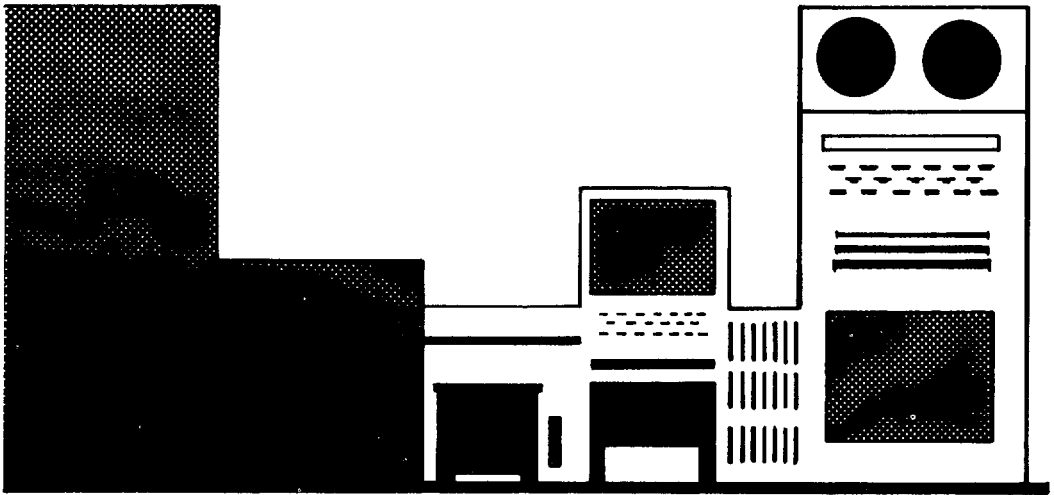
WHAT ARE SOME OF THE MOST IMPORTANT COMPUTER ISSUES OF TODAY?

Over the years the General Accounting Office and the Congress have focused attention on issues dealing with acquiring, managing, and using computers in the Federal Government. Some progress has been made in solving some of the acquisition issues, like: Should we buy the equipment or rent it? Do we need our own computers or can we share someone else's? However, much remains to be done in other problem areas. The most pressing computer issues facing the Goverment today are:

- Need for safeguards arising from dependency on computers.

- Conflict between the Government's need for information and citizens' loss of privacy.

- Need for better protection over computer resources.

- Barriers to stop the free flow of computerized information.

- Need to use computers to help solve today's pressing problems.

- Need for better management and control over computers.

- Need for better trained people to manage this new resource.

- Computers and competition versus communication and regulation.

HOW DEPENDENT ARE COMPUTERS TO GOVERNMENT OPERATIONS?
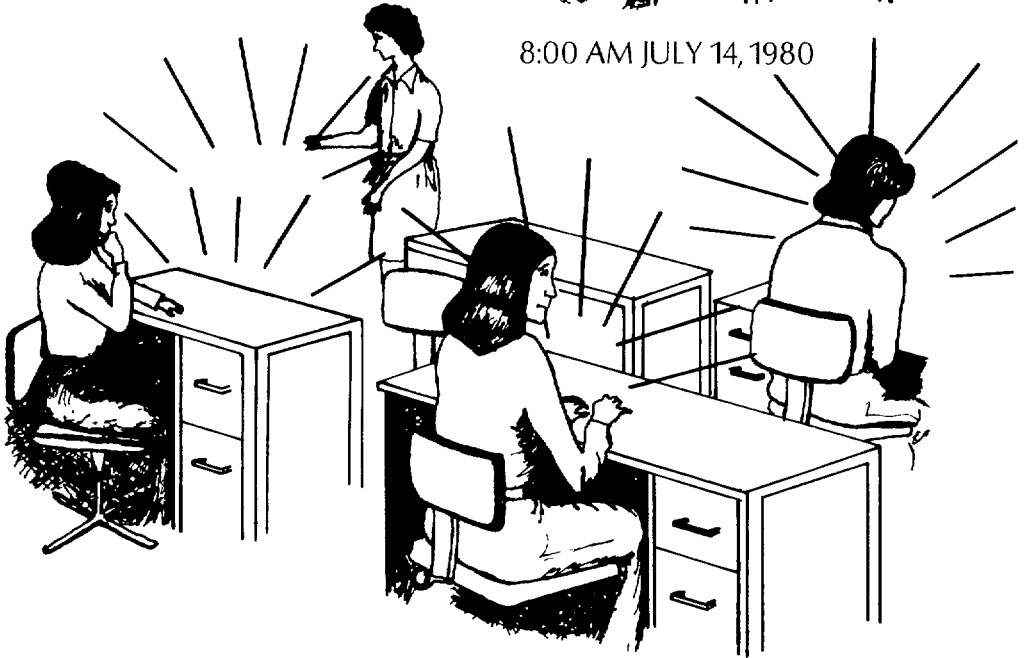
NEED FOR SAFEGUARDS ARISING
FROM DEPENDENCY ON COMPUTERS

There is now a computer at the core of almost all Government administrative operations. Most Government payments are made by computers. Computers make small decisions themselves and help managers make large decisions. They are used in research and scientific operations. It is reasonable to conclude that the good design and smooth functioning of computers are now crucial to many essential Government services, and dependence upon them is bound to increase.

But how dependent is the Federal Government on computers and what are the consequences of this? Let's consider for a moment what could happen.

At 8 a.m. on July 14, 1980, all 15,800 computers installed in the Federal Government magically disappeared, and the Federal Government had *no* computers to run its operations.

At that very moment there would be about 1,300 commercial airplanes in the air over the United States. Hundreds more would be taking off and landing. The air traffic control system computers of the Federal Aviation Agency could not track and control these aircraft. To keep the airplanes from bumping into each other would be almost impossible with the limited personnel available. Catastrophe would probably result.

COULD WE OPERATE TODAY
WITHOUT COMPUTERS?

At the time of the computer disappearance, there would probably be six spacecraft in the air being completely controlled by computers. In addition to the possible loss of millions of dollars for the airborne spacecraft, the whole space exploration and research program would be halted.

An earthquake that could affect the entire west coast is always a possibility. A hurricane could be 100 miles off the coast of Florida heading toward the east coast. However, without computers, weather people could not predict where or when these disasters would hit the States.

The Social Security Administration would not be able to issue checks to over 50 million Americans who are old, disabled, or otherwise deserving.

This inability of the Government to operate would result in chaos and massive citizen protests.

Scenario after scenario like these can be played to vividly demonstrate that Government agencies could neither perform their missions nor provide some basic services citizens need and expect.

Because of their size, complexity, information needs, and time requirements, some Federal programs depend almost totally on computers. Many important programs simply could not be carried out without them. Computers are not only an integral part of Government programs, but computers also prepare budgets and store data. For example, computers are widely used in accounting, auditing, mathematical modeling, and developing statistics.

Computers Control Machines, People Lives, And Things
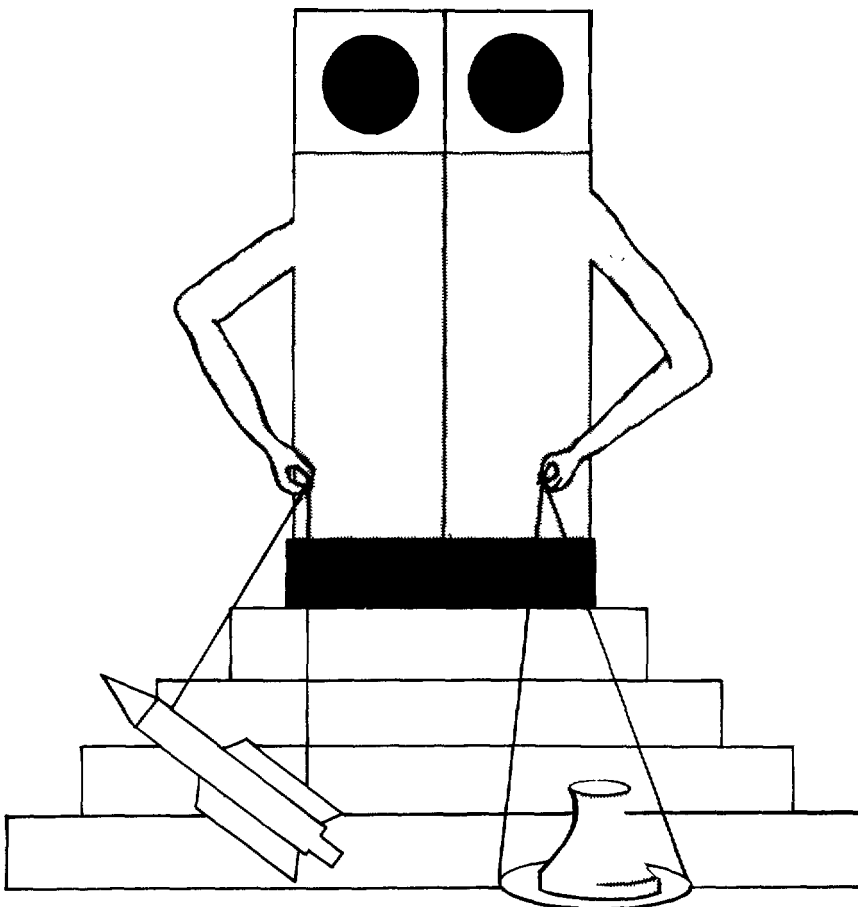
In addition to program execution, the Federal Government depends on computers for most of its bookkeeping. Consider, for example, the impact on the Federal workforce if the Federal Government had no computers to process its payrolls. Not only would additional staff be needed, but there would be innumerable difficulties in trying to pay so many in a timely manner. Similarly the recordkeeping for control and accountability over funds, supplies, and materials requires that agencies use computers because of the sheer bulk of transactions.

Finally, the Government depends on computers to do many things, such as controlling the flow of water in rivers, controlling machines, controlling weapons systems, and helping planners build better communities that will serve all citizens more effectively.

Some safeguards against computer failures are being developed, such as using management people to run the system in case of strikes and using standby generators in the case of power failures. Another safeguard could be to fall back on manual methods, if possible, to provide minimum service in the event of serious disasters. Some work is underway to explore how far standby arrangements can be made to maintain computer services in emergencies or when it is impossible to go back to manual methods. But the necessary measures can be costly, and a balance has to be struck in all cases between the costs and risks involved.

AUTOMATED DATA BANKS

TAX DATA

WAGE DATA

MEDICAL DATA

INTELLIGENCE DATA

LOAN DATA

CRIMINAL DATA

LICENSE DATA

STATISTICAL DATA
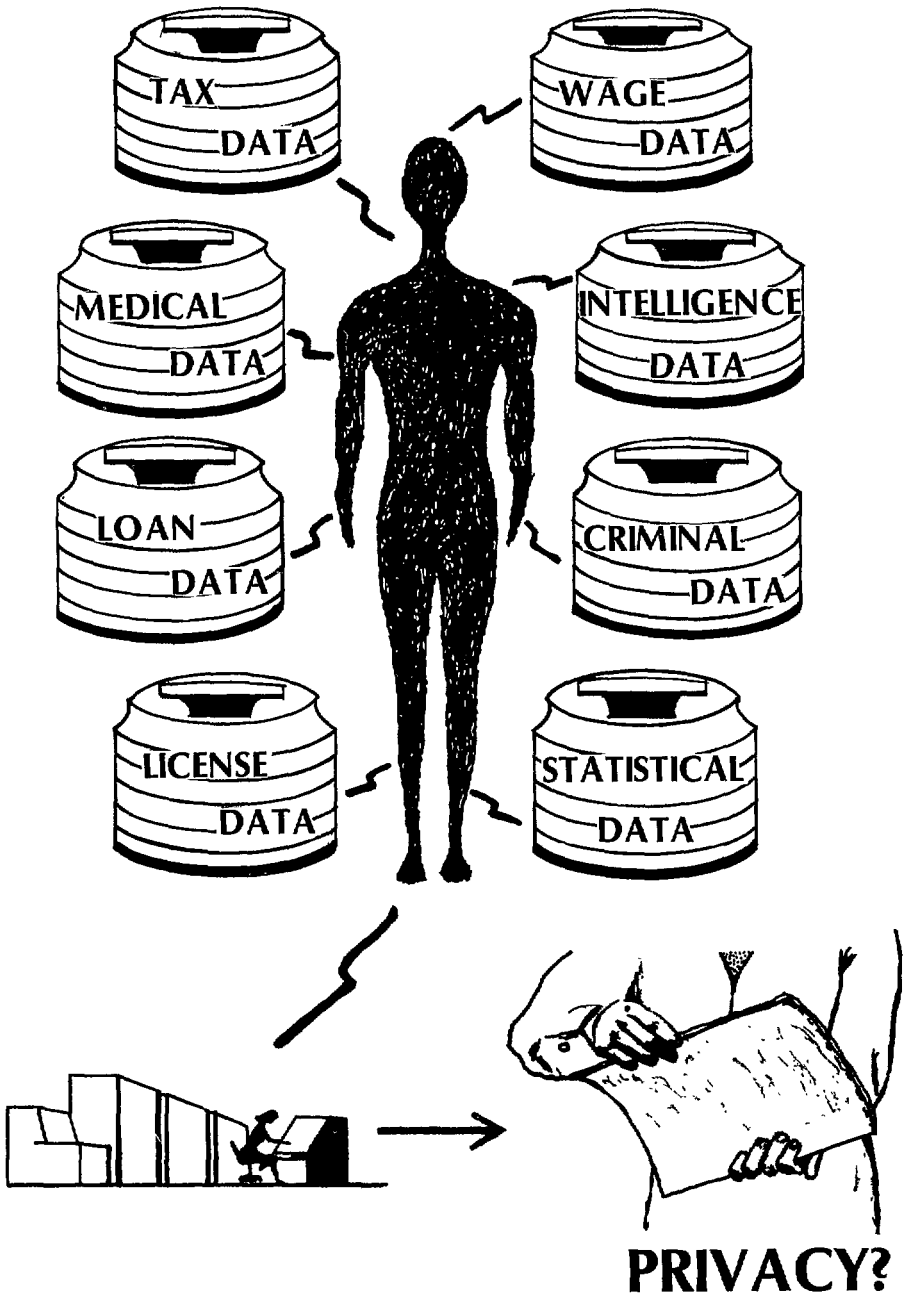
PRIVACY?

CONFLICT BETWEEN THE GOVERNMENT'S NEED FOR INFORMATION AND THE CITIZEN'S LOSS OF PRIVACY

Today computers linked through high speed communications networks have become the principal medium for making, storing, and using records about people. There is much concern that computerized records and data banks on individuals present a serious potential for harmful consequences, including infringement on basic human liberties.

The Privacy Act of 1974, the Fair Credit Reporting Act, and the act creating the National Commission on Electronic Fund Transfers are actions by the Congress to respond to changed circumstances arising primarily from computers.

Paperwork continues to plague both the Government and industry. Moreover, paperwork costs are rising rapidly. Internal Federal paperwork costs an estimated $50 billion annually.Paperwork impact on businesses and individuals costs another $65 billion annually. Innovations in computer data bank record-keeping technology, when properly used, are a powerful paperwork cost-cutting tool. Their capacity for timely retrieval and analysis of complex personal data can automate the Government decisionmaking process in providing increased services to the public without more paperwork and for less cost.

Access to Government information by the public, as set out in the Freedom of Information Act, along with the ease to penetrate a computer's recordkeeping system, continues to raise controversial questions. For example: Will individual privacy be affected by agencies' exchange or matching of personal data to prevent fraud, abuse, and error? Will confidential data provided by businesses to agencies be appropriately safeguarded? Will public access to investigative agency records cause a reduction in information from informers? How much personal information should be required for a person to be eligible for Federal benefits?

The issues being discussed today in the Congress, State governments and countries of the world is how much efficiency can be satisfied to protect people's privacy? Or to put it another way, how much privacy can be sacrificed to promote governmental efficiency? The pervasiveness of these issues worldwide is indicated by the many bills introduced and by discussions and articles in newspapers and magazines.

The protection of personal and proprietary data by Federal agencies and contractors from authorized recipients remains a concern to many people and groups. Indications are that not enough is being done to protect computer systems against erroneous entries and unauthorized use of recorded information.

Federal Computer Resources
Are
Valuable And Need Protection
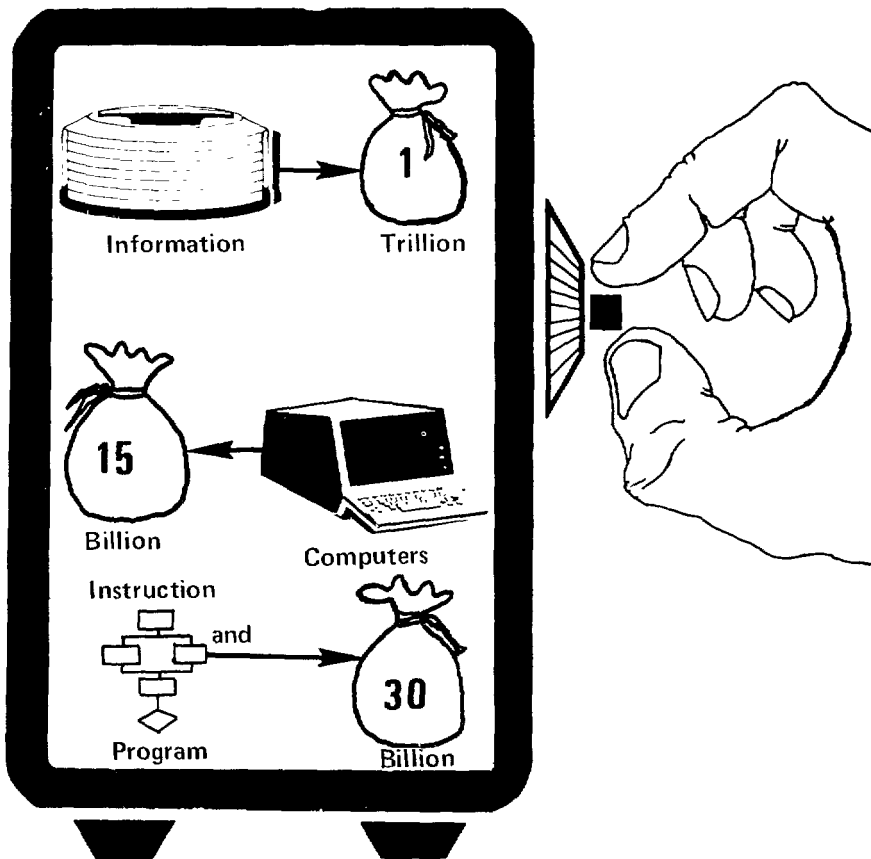
NEED FOR BETTER PROTECTION OVER
COMPUTER RESOURCES

Computerization in the past tended to centralize more Government record-keeping and information processing activities, thus making the information and the facility more vulnerable to destruction or alterations than ever before.

Catastrophic losses to Government computer installations, such as the loss of human lives and of irreplaceable data, records, and equipment, have occurred because of inadequate protection. Poor security practices make the installations susceptible to losses caused by sabotage, fires, floods, frauds, thefts, embezzlements, and human errors.

More management attention and responsibility are needed when making security decisions, along with contingency plans to provide for continuity of operations in times of need or in the event of a loss. Next, some form of risk assessment should be done; that is, a formal assessment of the resources to be protected versus the cost to protect them and whether the cost involved is worth it.
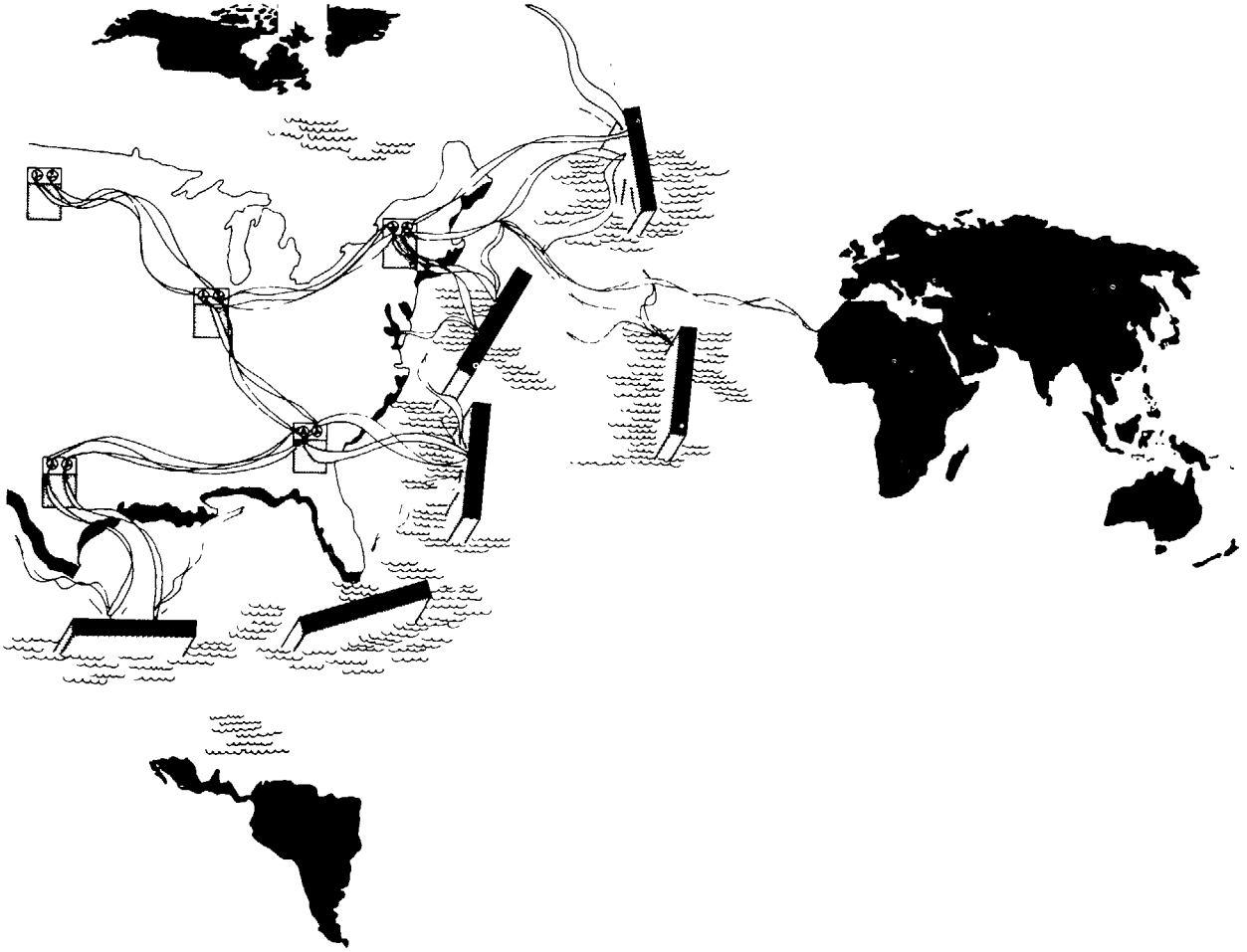
BARRIERS TO STOP THE FREE FLOW
OF COMPUTERIZED INFORMATION

The Dutch built dikes to stop water from flooding their lands. Just like the Dutch, States, countries, and nations are building dikes to stop the transmission of computer data across national and international boundaries. The dikes are laws dealing with the privacy, security, and the free flow of data and information from one country to another.

Trying to define the main issues here presents a problem. Much confusion now exists because no one really knows what types of data and in what amount are actually flowing across national borders. Another problem is whether data is to be considered as a product. If so, then it may be subjected to many of the product export and import controls of many nations. Also, when entering or leaving a country, should data be cleared through Customs like products?

Next, six countries, France, Sweden, Norway, Denmark, West Germany, Canada, and the United States have national privacy acts. The European countries which have enacted privacy legislation are seeking to extend this protection to data transmitted and processed outside their boundaries.

It is hard to see what the problem is that regulations of transborder data flow are trying to solve. Some fears now range from the threat of loss of human privacy to the loss of national sovereignty. Others believe the issue to be economic, that is, the development of the local economy and the fear of being left behind as other nations reap the benefits of a new asset. No one seems to know what protection the new laws will bring against what abuses and by what national or international actions.

While the United States has been developing its own domestic privacy stance, it has not taken a leadership role in global developments. However, a position is being considered by an interagency task force. There is also a Public Advisory Commission on Transborder Data Flow.

Recently there have been several conferences on the international barriers to data flows, and a background report was prepared by the House Committee on Interstate and Foreign Commerce. The theme of the report is that neither the U.S. Government nor the business community understands or fully realizes the scope of the transnational data flow problems.
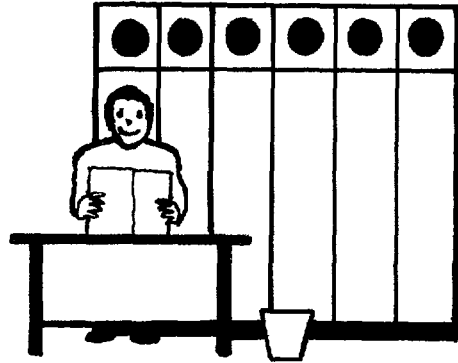
HOW IS YOUR COMPUTER USED?

LIKE

THIS   OR THIS

NEED TO USE COMPUTERS TO HELP
SOLVE TODAY'S PRESSING PROBLEMS

Computers cannot do everything. Or to put it another way, they can do only what people tell and program them to do. However, computers can help identify and define the real problems facing us today, as distinct from what appear to be the problems, both current and oncoming.

Complex problems in energy uses and development, inflation, atomic and solar power sources, better health care, and other national problems need solutions. Computers can be used as powerful design tools; to index and catalog information; to find and retrieve specific facts; and to help doctors, engineers, scientists, and Government managers make the right decisions to solve current complex problems.

The Government is big and has big problems. Computers can be large or small, scientific or business oriented, and can do small and big things. The modern Government computer is much more than a high-powered adding machine, even though some people believe that it is being used like one by some Government agencies.

In Government, performing scientific work continues to be one of the most successful areas of computer use. Although computers are vital for scientific uses, engineers and scientists tell us that scientific uses account for only a small amount of the Government's computer power.

There are many disciplines, professions, and programs where computers have become of central importance. In others, such as auditing, printing and typesetting, medical monitoring and diagnosis, legal and medical research, and the solving of energy and pollution problems, important beginnings have been made. It is clear to us that we need computers to play a more dominant role in these areas.

The extent to which the advantage of computers will be realized in these areas depends on many factors, such as the readiness by management and operational staff to look at new ways to do things, the presence of trained and experienced people, the availability of good data, and the design and testing of new systems. When these prerequisites are met, computers will do better things, produce better products, and help the Government provide new and better services.

35

Management Usually Does Not Care About Designing Computer Systems
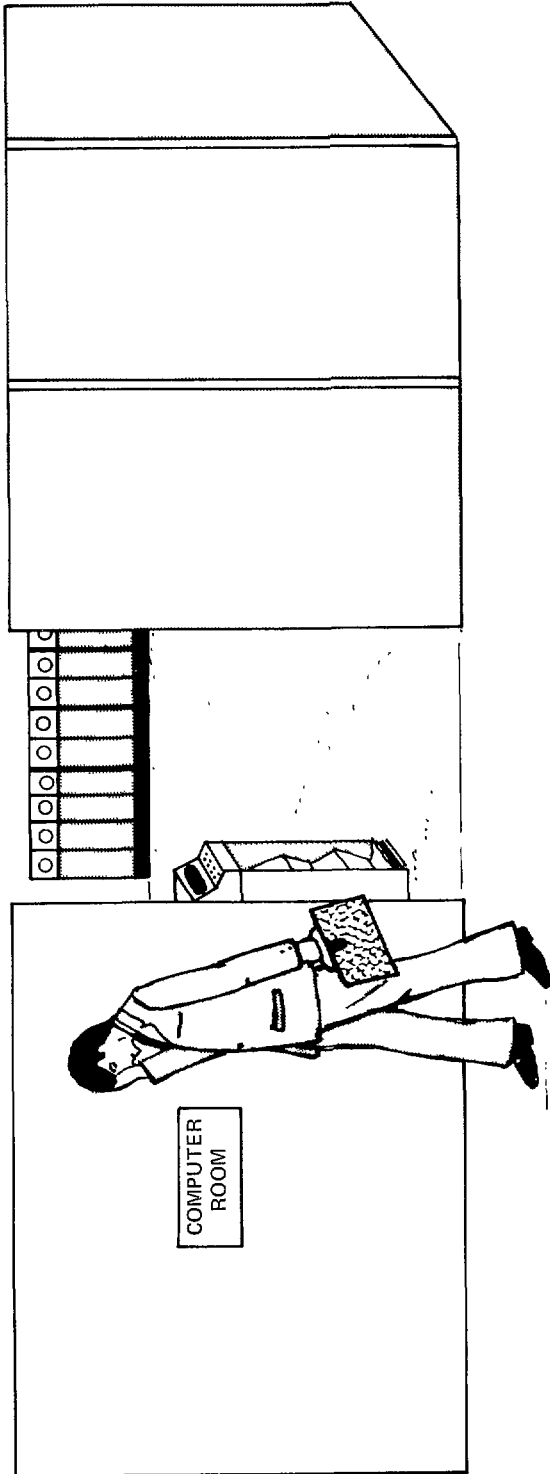
COMPUTER ROOM

NEED BETTER MANAGEMENT AND
CONTROL OVER COMPUTER SYSTEMS

Good planning, management, and control of Government computer resources are critical to Government services and program objectives. Much has already been accomplished in setting up and running some of the large and small Federal programs. However, some agencies are experiencing problems in these areas. When problems do occur, newspaper headlines usually cry out that Government plans to reduce costs in military or civil programs through automation have turned into a billion dollar boondoggle. The most common element causing these boondoggles is management inadequacy in controlling computer operations.

Historically, most Government computer operations began as a substitute for manual systems. In the early days most manual systems were converted to computers without determining what computers could do or what users wanted them to do. The new automated computer systems were usually planned and designed by computer people who knew computers but not systems or management.

The whole question of top-level management involvement and participation in computer activities has been a subject of considerable discussion within the computer profession for many years. In the past, and even today, many key decisions are being made by technicians and by computer operations managers who lack the perspective that top management can bring to bear on controlling these machines.

Let's look at it logically. If an agency is planning to develop a new manual accounting system, it is reasonable to assume that the top accountant should be involved. Or if the agency is planning for the development of a new manual legal system, it is reasonable to assume that the general counsel should be involved. If management and users are excluded from planning and designing new manual systems, it is reasonable to assume that the new systems will probably be incomplete, or unacceptable, or half done for administrative and management purposes. It is the same way with computer systems. Management and users must be in on the system design.

TODAY THE COMPUTER IS
NO LONGER REMOTE
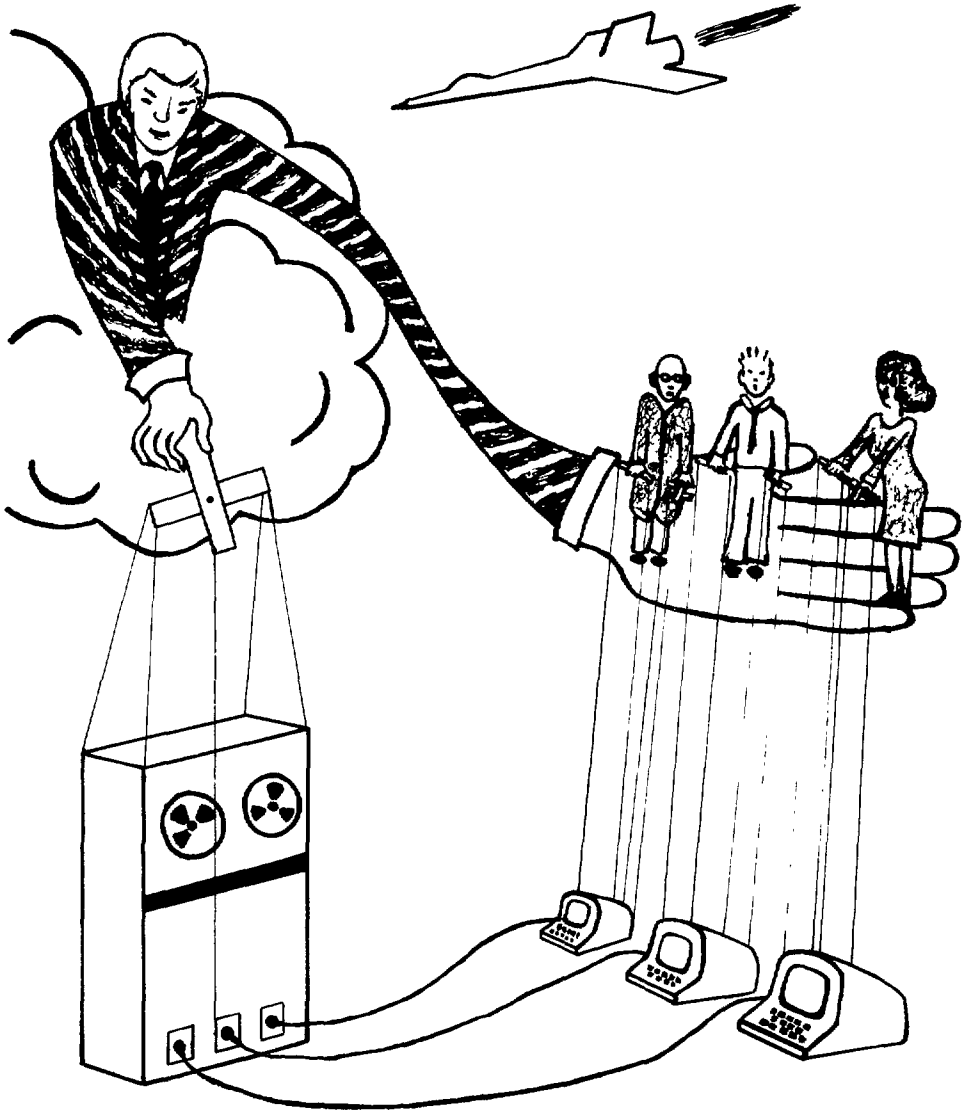
Today the computer is no longer remote and mysterious. Its use in all agencies and its use by clerks, professionals, and managers rather than only computer people has changed the working methods of the Government worker.

There is much need for the development of computer systems which will help managers, professional, and clerical staffs do a better job. But if these systems are to be planned, developed, and used, top management must be better acquainted with the benefits and limitations of computers and the people designing these systems will need an insight into how top management runs and arranges its business.

THE NEW MANAGERS
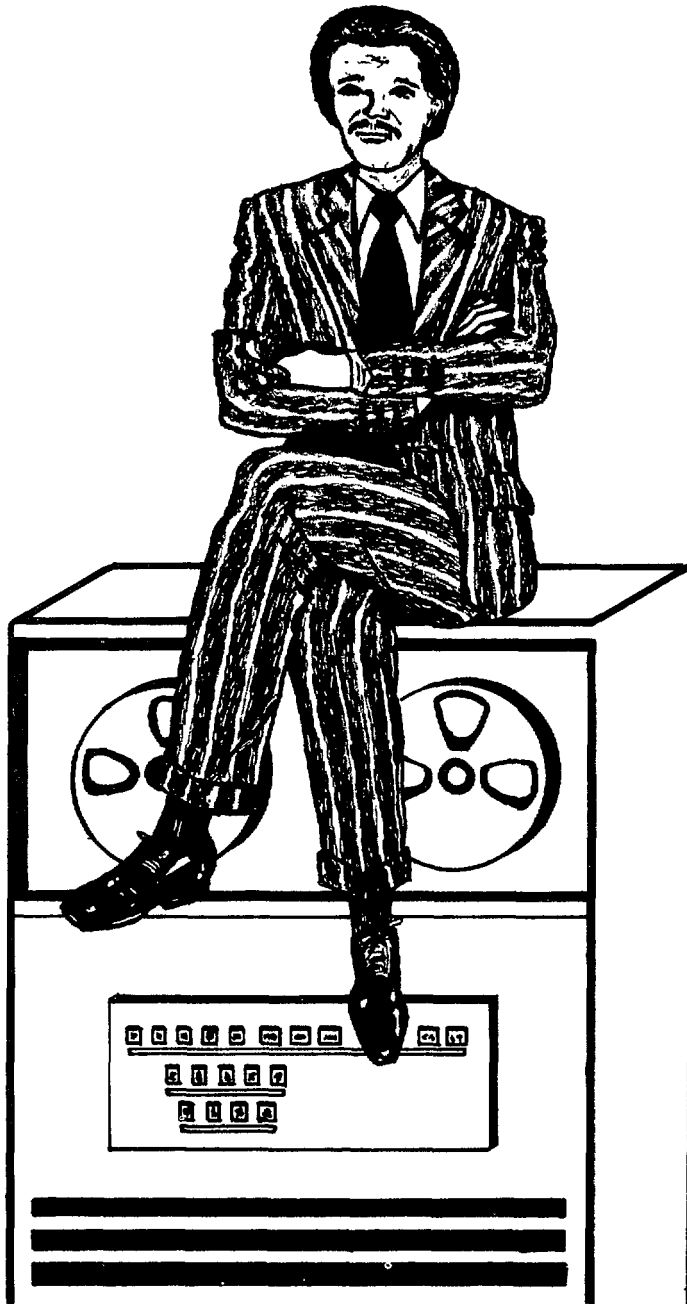
NEED BETTER TRAINED PEOPLE TO
MANAGE THIS NEW RESOURCE

Training in computers for executives has consisted mostly of brief seminars by computer companies which cover elementary concepts. Some of the new crop of young executives have received some training in computers as part of their formal education.

While this "brief brush" with computers provides some understanding of the new technology, it has to be viewed as only a half step in the right direction. On the other hand, some well-run Federal computer agencies require that top executives serve tours in computer departments before being initially considered for top management positions.

Top management is usually very busy, so busy that the daily pressures do not allow them to take time off to receive the necessary training. Executives should be better trained in computer technology during their formal training years and then they should be required to serve tours in computer and functional departments before being considered for top executive slots. Some well-known universities now require extensive training in computers before granting degrees in management or business.
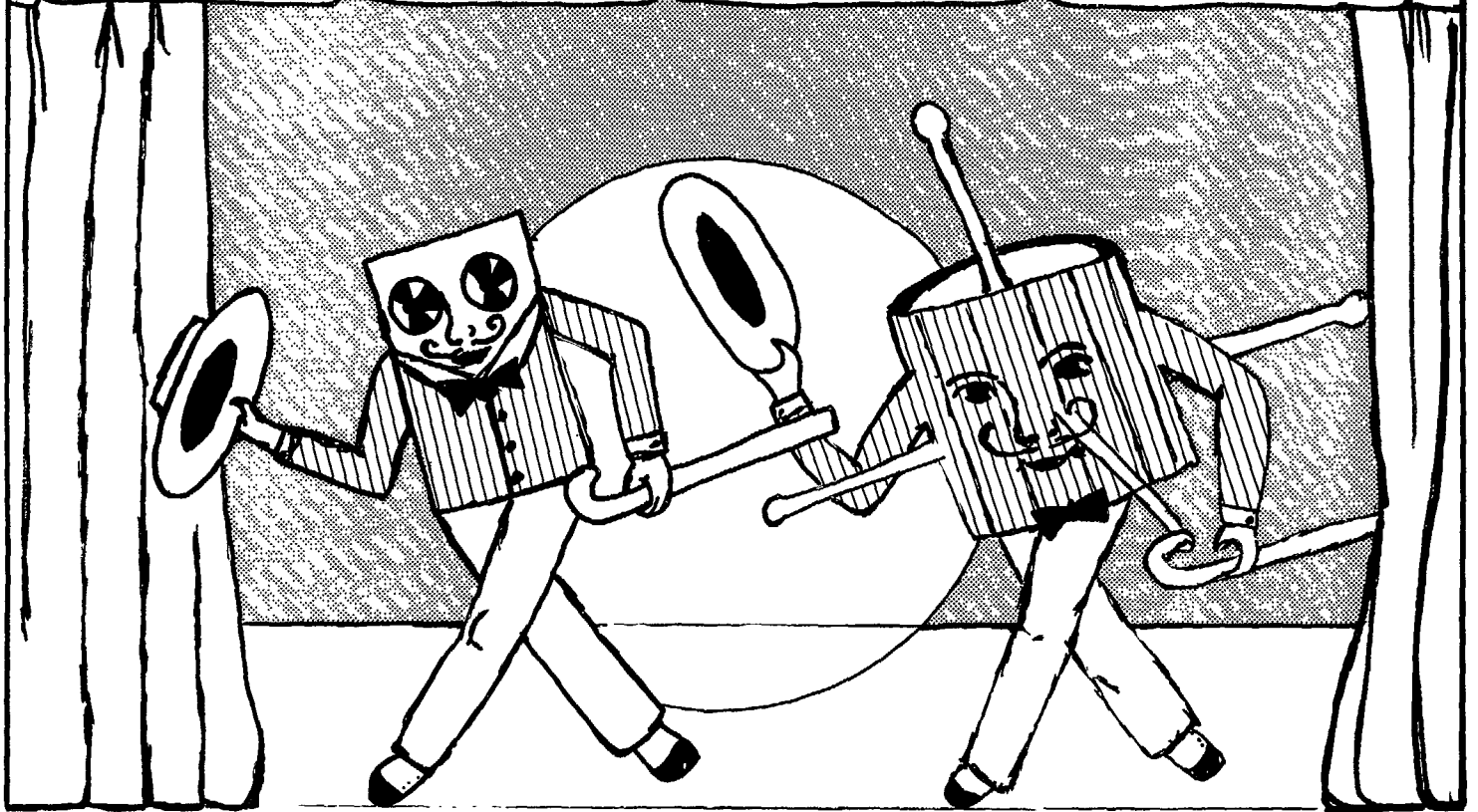
COMPUTERS AND COMPETITION VERSUS COMMUNICATIONS AND REGULATIONS

In the past, communications networks were built for the telephone, the telegraph, and broadcasting. Now they are built not only to service these three industries but also to send and receive all the data the world could possibly use. Data can also be transmitted and received over radio circuits by electromagnetic signals. This process is called telecommunications. The technology of communications is changing in ways which will affect the lifestyles of the people of the world.

New communications technology can now connect computers, television, and other machines with people to change our work patterns, the way we educate people, and the way we run our businesses and Government.

It is often said that if a better mousetrap or a pocket computer is invented, it is likely to reach the marketplace very fast. However, with new communications technology this may not necessarily be so, because many complex laws govern communications and telecommunications systems. Lawyers tell us that they do not know how this new technology will fit into the many laws and regulations that now exist governing the communications industry.

History and experience show that when a new technology is introduced, large organizations that are committed to an older technology can get hurt or go out of business. For example, the Pony Express Company went bankrupt 2 years after Western Union built the first telegraph system to the west coast. It is easy to see then why there is much debate in the Congress over new communications legislation on how to restructure the telephone system and the telecommunications network in a way that will promote greater competition and innovation in the marketplace.

An important new industry is forming in which computers and communications technology will come together and merge. Experts tell us that the main debate over the new communications legislation concerns whether monopoly and competitive service should be allowed by major communications carriers. Because the communications industry is regulated, the conditions under which it is allowed to offer new services will depend on Federal, State, and local policy decisions.

These decisions will determine where this new industry is going and how and when it will get there. The well-being of some companies will be at stake and could affect U.S. companies' sales in foreign markets. Service, costs, and growth of a new industry are at stake.
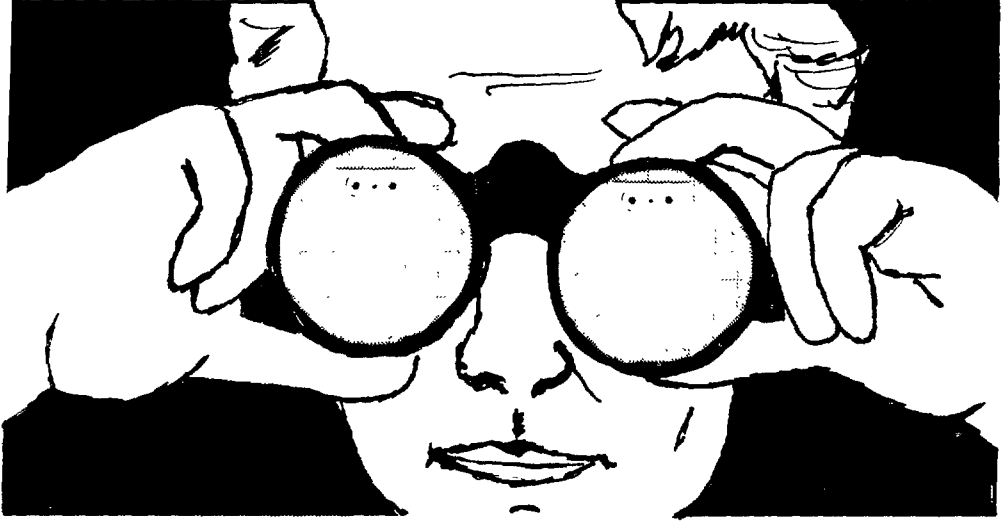
HOW WILL COMPUTERS AFFECT THE FEDERAL GOVERNMENT AND SOCIETY IN THE FUTURE?

Forecasting the future is risky, at best. However, by examining the views of futuristic experts, we can develop some viewpoints which seem logical.

Computers will be cheaper, smaller, and simpler and will be in use everywhere in all Government offices and in cars, planes, homes, etc. Some will be bigger, more powerful, and more expensive.

Computer processing power will become so cheap that Government hardware cost will be insignificant. Software (programs), services, communication networks, and display devices will be the items which increase costs. After the turn of the 21st Century, it is likely that every Government employee will have a computer terminal to work with or that employee's work will be done by computer.

Other happenings and technologies could affect computer development in the Federal Goverment, like new modes of transportation and communications, new types of power sources, and advances in computer and communications technologies.

There will be a great variety of new uses, some already widespread, others beginning to be introduced, still others yet to be born. Travel reservations, electronic transfer of moneys, point-of-service transactions, conferencing by computers, voice storage and redistribution, facsimile and image processing, interactive graphics, text editing and document distribution, electronic services via television—are all examples of what's coming.

Next, there seems to be no viable alternative to the use of computers as a means of holding costs down while Government operations expand. So the Government's dependence on computers will probably increase as fast as it has in the past.

RISKS AND THREATS TO COMPUTERS

FIRE

THEFT

STORM

SABOTAGE

WHAT ARE SOME OF THE FUTURE RISKS?

The Government now depends heavily on computers to carry out mission and administrative operations, and this dependence will increase to all areas of Government operations. With increasing dependence on computers will come a proportionate increase in the degree of risks assumed. Some risks will be of great concern to the Government and its people.

Government operations that depend on computers are more vulnerable to catastrophic losses than manual systems. Because of the nature of computer technology and the large size of some programs, some agencies will continue to centralize their computer operations into large centers. Others will decentralize their information processing into many small, separate systems (called minicomputer systems). However, while this decentralization usually implies a decrease in the size of centralized hardware, it normally implies some form of centralized control and/or centralized information-processing activity.

Centralization generally increases the potential for major thefts, frauds, misuses, or catastrophic losses. The threats the center faces usually relate directly to its purpose and use, its location, the workforce, and so forth. Furthermore, the relative risks of a center can change over time because of changes in Government policies, laws, and conditions or even changes in the environment or physical situations. Such changes might be due, for example, to war, changes in the attitude of the American people, or economic conditions. In any event, changes in Government policy or even the environment and the people can change the posture of a Government computer installation, which can increase or decrease the threats against it.

The Government, when assessing computer threats, will face difficult questions regarding what risks it can assume. Even more difficult will be deciding on what should be done to protect against the risks.
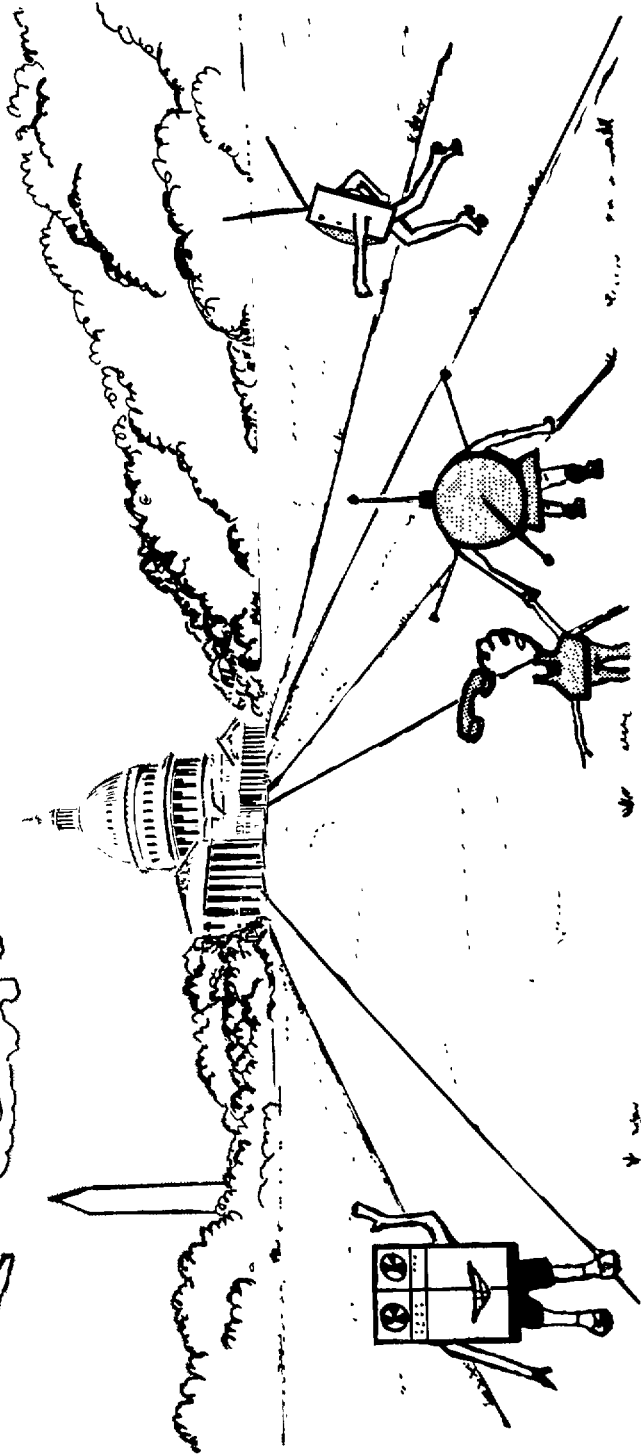
SOME THOUGHTS ABOUT THE FUTURE

For better or worse the Federal Government will find more uses for computers. It is also sure that it will follow the lead of some of the largest private companies and devote more attention to discovering new ways to process information more quickly and efficiently.

The Government has many solid computer achievements to its credit, but this is not to say that the use and quality of its systems and programs cannot be improved.

Computer technology is changing at great speed. Other technologies that go with computers, like communications and television technologies, are also changing. Government offices and the homes of its executives now have vast numbers of television sets and telephones. When these three technologies merge, there is no telling what could happen with Government operations.

Today the British Post Office plans a merger of the three mediums. Electronic circuits have been added to the television set which connect it to the telephone network. The user also has a small keyboard about the size of a pocket calculator which will be connected to the television set to access the computer, many miles away.

For a local telephone call, the user can gain access to Post Office computer systems which store information and programs. Billions of pages of information become immediately available to the user, each designed to be displayed in color on the television screen. The home user can look at news reports, weather forecasts, stock market figures, sports results, and so on. Business people can look at business information, while Government people can look at data banks about Government information.

Experimental systems using cable television networks are in use today in the United States.

What other types of changes are possible? Let's say that a larger Federal agency had to expand because of new laws and considered constructing another building next to its downtown Washington location where office and parking space was expensive. Government management analyzed the extent to which computers and communications systems could be substituted for

HOW LONG WILL IT TAKE FOR SOME FUTURE USES TO BE IMPLEMENTED?

Future uses	1980	85	1990	95	2000
Paperless Government			▨		
Government managers have terminals in their homes linked to work computers		▨			
Provide information and service to the public in a few minutes' time			▨		
Help medical scientists develop replacement parts for the human body					▨
Electronic mail Government agencies Public and General use	▨ ▨				
Have terminal in home for public use and for Government service			▨		
Use computer robots to do office work					▨

50

the centralized operations. With communications and computer costs rapidly decreasing and transportation costs rapidly increasing, the decentralization of the operation into remote work centers—located closer to the work force and linked by communications—was the way to go.

Furthermore, the philosophy of bringing work to the people rather than the people to work appeared to have many social benefits, such as

- decreased energy consumption,

- decreased air pollution,

- employment of people who had been excluded from the labor force by inability to commute, and

- bringing the service close to where the people live.

The chart on page 50 also estimates some future uses for Government computers.

Finally, we believe highly trained computer staffs will be needed to take full advantage of future computer uses. Effective designing of future systems will need much care and expertise. Unless adequate safeguards are provided, there can be a strong case for delaying future computer uses and achievements. However, we feel sure that the issues and problems discussed in this booklet will be solved and adequate safeguards will be built into future computer systems. Computers will make Government service better, and our lives in this country will be richer.
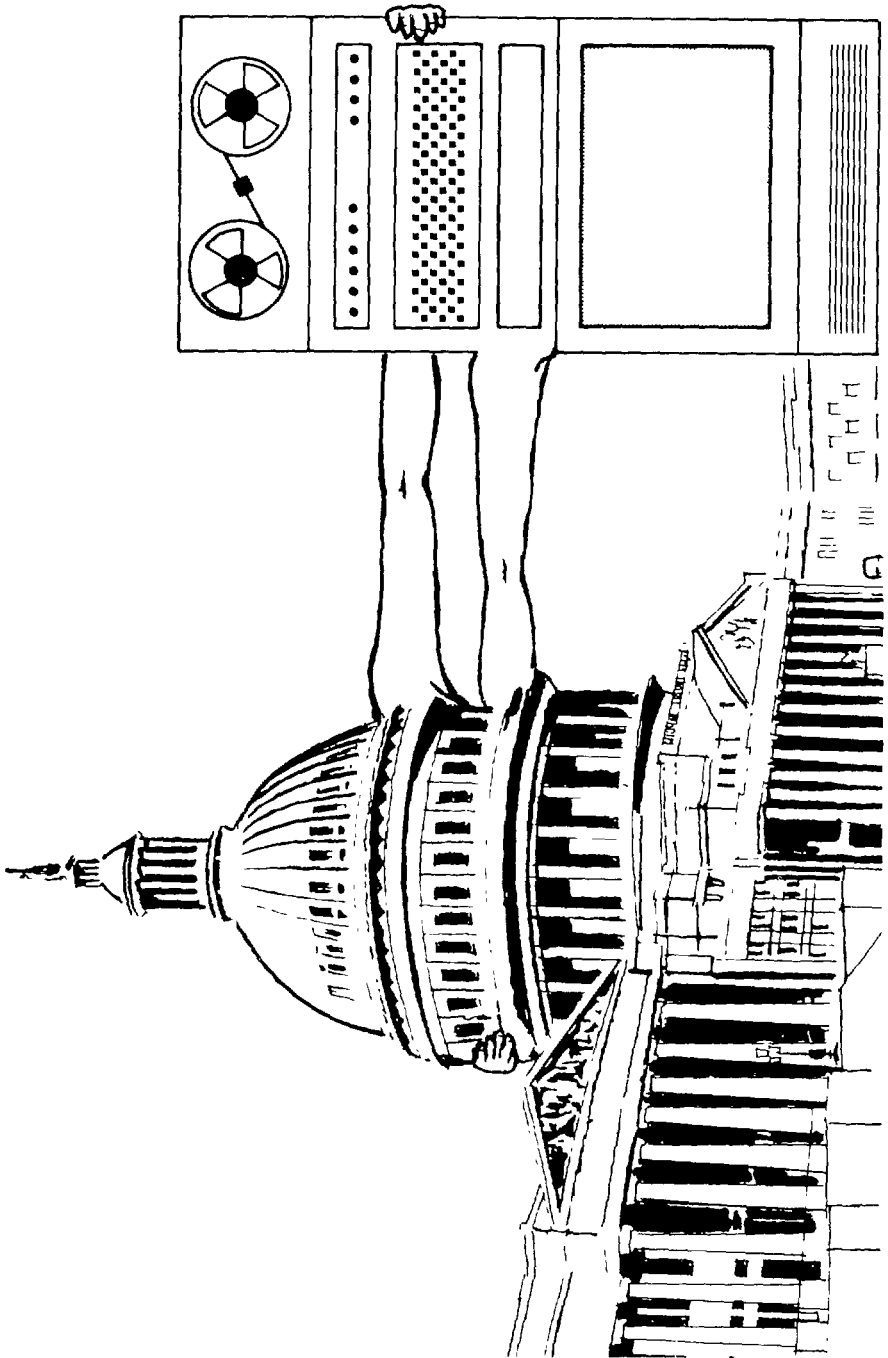
CONCERNS ARE OFTEN VOICED ABOUT COMPLICATED SUBJECTS WHEN PEOPLE DO NOT FULLY UNDERSTAND THEM OR KNOW SOMETHING ABOUT THEM.

THE GOAL OF THIS BOOKLET IS TO PROVIDE A SIMPLIFIED EXPLANATION OF WHAT COMPUTERS MEAN TO YOU AND ME AND THE PEOPLE WHO RUN THE GOVERNMENT.

WE HOPE WE MET THIS GOAL AND WIPED AWAY SOME OF THE CONCERNS ABOUT A VALUABLE RESOURCE.

ELMER B. STAATS

This bibliography annotates 24 sources of information on the international petroleum trade. The selected titles are a representative sample of the most commonly known publications of private, governmental, and international organizations in the field of petroleum statistics. Unless otherwise noted, the Technical Information Sources and Services Branch receives each item.

CONTENTS

United States Imports and Exports: sources that give information on the international petroleum trade as it affects the United States, mainly in the form of imports, but also providing information on U.S. petroleum exports, consumption, and prices.

-API Weekly Statistical Bulletin
-DOE Monthly Energy Review
Monthly Petroleum Statement
P.A.D. Monthly
Monthly Petroleum Statistics Report

Important Periodicals: a number of journals that concentrate on international petroleum matters, have special issues on various aspects of the industry, and have consistently reliable statistics.

-Oil & Gas Journal
-Petroleum Economist
-Offshore
-World Oil
-CIA International Energy
   Statistical Review
-Petroleum Intelligence Weekly

International Organizations and Worldwide Coverage: major sources published by international organizations such as the UN and OECD giving information about the petroleum trade, consumption, prices, etc. for many different countries. Also some good sources not published by international agencies but which contain comprehensive data.

-IEA Quarterly Oil Statistics
-OECD Energy Statistics
-OECD Oil Statistics
-UN World Energy Supplies
-UN Monthly Bulletin of Statistics
-WEC Survey of Energy Resources
-DOE International Petroleum Annual
-20th Century Petroleum Statistics

Area Studies: a number of publications giving comprehensive data on specific areas of the world, with emphasis on the Middle East.

-International Petroleum Encyclopedia
-Quarterly Economic Reviews of Oil*
-OPEC Annual Statistical Bulletin
-Arab Oil and Gas*
-Arab Oil and Gas Directory*

ALPHABETICAL LISTING

*Currently not received by the Technical Information Sources and Services Branch.

ABBREVIATIONS:

API   American Petroleum Institute

DOE   Department of Energy

EEC   European Economic Community (Belgium, Denmark, France, Ireland, Italy, Luxembourg, Netherlands, United Kingdom, West Germany)

IEA   International Energy Agency (Austria, Belgium, Canada, Denmark, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, West Germany)

OAPEC   Organization of Arab Petroleum Exporting Countries (Algeria, Bahrain, Egypt, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, Syria, United Arab Emirates)

OECD   Organization for Economic Cooperation and Development (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, West Germany)

OPEC   Organization of Petroleum Exporting Countries (Algeria, Ecuador, Gabon, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates, Venezuela)

A NOTE ON COMPARING STATISTICS

Most of the figures for crude oil and petroleum products used by DOE and U.S. publishers are expresed as a measure of volume--the 42 gallon barrel. This unit is often expressed in aggregates of 1,000 or as barrels per day. Most European statistical publications give measurements in terms of weight i.e., metric tons. This form of measurement has been termed more accurate than volume equivalents because energy values of different petroleum products do not differ as much on a weight basis as they do on a volume basis. A third system of measurement, and the most scientific, is the precise energy unit expressed as the calorie (cal), the joule (j), the British thermal unit (Btu), and the Kilowatt hour (kwh). Some statistics are also expressed in terms of another energy source. For example, the United Nations uses the metric ton of coal equivalent to compare different fuels.

Various tables and formulae exist for calculating a common unit of measure, to be used when changing metric tons to barrels per day, changing barrels per year to tons per year, finding Btu equivalents of liquid fuels, etc. These systems involve applying to one measurement a specific conversion factor to arrive at another measurement; for example, to convert metric ton units of gasoline to barrel units, multiply the metric ton figure by a factor of 8.5 to arrive at the number of barrels.

An excellent text explaining the details of determining energy values is Energy Interrelationships: A Handbook of Tables and Conversion Factors for Combining and Comparing International Energy Data, published by the Federal Energy Administration in June 1977 (available from NTIS as PB-269 034). The introductory material to the United Nation's World Energy Supplies (Series J) also contains valuable conversion tables.

Weekly Statistical Bulletin. American Petroleum Institute,
Department of Statistics. Washington, D.C., 1920-

        The Weekly Statistical Bulletin published by the American
Petroleum Institute is a useful source of information for very
recent figures on foreign crude oil and petroleum products im-
ported into the United States. Although the Bulletin is de-
voted primarily to statistics on U.S. refining operations and
petroleum stocks, it does include daily averages in 1000
barrel units for imports of crude oil and 14 refined products.
The source of imports is not given, only total figures. The
time period covered is the last 4 weeks (weekly averages are
given) prior to publication date and the corresponding current
week of the previous year. The Bulletin is very up-to-date--
each issue is current through the previous week. Statistics
presented in the Bulletin are estimates made by API based on
data collected from reporting companies. This weekly data
from API is used by DOE to form the basis of their DOE
Petroleum Demand Watch.

Monthly Energy Review. United States Department of Energy,
Energy Information Administration, Washington, D.C., 1974-

     The Monthly Energy Review is important because the
figures presented are official Department of Energy statis-
tics and are often cited by other statistical sources. The
Review covers the entire range of domestic energy statistics--
consumption, price, trade, petroleum, natural gas, oil and
gas development, nuclear power, electricity, and coal--as
well as the international aspects of some of these subjects.

     The executive summary of the Review gives an overview
of crude oil and refined products imported into the U.S.
Total figures are presented in terms of quadrillion
Btu and thousands of barrels per day. The dollar value of
energy imports and exports in relation to overall trade is
indicated along with a section dealing with U.S. dependence
on petroleum imports. Dependence is expressed two ways--as a
percentage of petroleum demand supplied by foreign sources,
and as the volume (thousands of barrels per day) of direct
imports in relation to the daily volume of domestic demand.

     Other tables of the Review deal in a more detailed
fashion with imports and exports, including data on strategic
petroleum reserve (SPR) stocks. Imports into the U.S. are
broken down by source--most OPEC countries and seven major
non-OPEC petroleum suppliers. The volume of imports in re-
lation to domestic demand for gasoline, jet fuel, fuel oil,
and natural gas liquids is thoroughly treated. Also covered
is the price (in dollars per barrel) of crude oil imports
from selected OPEC/non-OPEC countries.

     The international section of the Review briefly presents
the latest energy consumption figures for the major free
world industrialized countries, and the crude oil production
figures for OPEC, Canada, and Mexico.

     The Review presents data going back in most cases to
1973. The current year is included, but there is generally
a lag of 2 to 4 months in reporting the latest month's
figures. For the 2 most recent years, coverage is on a
month-by-month basis. The Review includes charts to illustrate
the statistical tables, definitions of terms, and explanatory
notes.

Monthly Petroleum Statement: Crude Petroleum, Petroleum
Products, and Natural Gas Liquids. United States Department
of Energy, Energy Information Administration. EIA-0109.
Monthly P.A.D. District Supply/Demand. EIA-0134.
Monthly Petroleum Statistics Report. EIA-0011.

    These publications feature data on the U.S. and foreign
petroleum trade. The Monthly Petroleum Statement gives
figures for imports into the U.S. for crude oil and 20
finished products. The crude oil figures are broken down by
supplying country and Petroleum Administration for Defense
(P.A.D.) District destinations. Imports of finished products
are not broken down by source country. U.S. export figures
for crude and refined produts are given in 1000 barrel units.
The annual compilation of this title gives export figures
with countries of destination. The time period covered by
the Monthly Petroleum Statement consists of the current month,
previous month, cummulative figure for year to date, and data
for previous year to date and previous year's current month.
The annual edition gives a month-by-month breakdown for the
entire year. The "current month" in this publication is
usually 4 to 6 months behind the actual date of publication.

    The second title, P.A.D. District Supply/Demand Monthly,
further develops the import data found in the Monthly Petroleum
Statement. Imports into the U.S. of petroleum products (gaso-
line, jet fuel, fuel oils, etc.) are listed by foreign source.
Imports from Canada are detailed by type as well as imports
from OPEC. The annual compilation is more detailed in terms of
the variety of finished products reported on. The P.A.D.
Monthly presents data for the current month (usually 4 to 6
months behind the actual date of publication) and the year to
date.

    Similar but more current DOE data on imports can be found
in their Monthly Petroleum Statistics Report, which is only 2
months behind publication date. This publication gives a
breakdown of imports of crude oil and petroleum products from
OPEC and other major non-OPEC suppliers. Figures are given
in total amounts as well as computed on a barrels-per-day basis.

Oil and Gas Journal.   Petroleum Publishing Company.   Tulsa,   .
Oklahoma, 1902–

In the final December issue of each year, Oil and Gas
Journal publishes its authoritative worldwide report. A com-
bination of text and statistics, the worldwide report gives
recent production and refining figures for 110 foreign
countries.

The report opens with a narrative account of the world
petroleum situation with emphasis on regional developments.
Following this is a two-page chart summarizing each country's
oil and gas production and refining totals in 1000 barrel
units. Figures are current and include the present year.
This chart also gives Oil and Gas Journal's estimated proved
reserves of oil and gas for each country. These are the same
figures used by the DOE for presentation in their Interna-
tional Petroleum Annual.

The remaining section of the report is divided into two
detailed tables. The worldwide production table gives data
for 53 countries, and for each country identifies its oil-
fields, their discovery date, and depth; indicates the number
of wells and type, whether flow, pump, gas lift, or shut in;
and the API rating for each field. Barrels per day (b/d)
average production as well as cumulative barrel production
for the first 6 months of the present year is given.

The worldwide refining table lists refinery locations
and operating companies for each nation, and its barrels per
day output by refining process (i.e., thermal cracking, hydro-
processing, etc.). Specialty products and processes such as
asphalt production and coking are also indicated.

Throughout the year, Oil and Gas Journal publishes
numerous special issues on different countries or products.
The mid-year report, issued in July, gives the year's world-
wide production and U.S. imports to date. The forecast/review
issue, appearing in January, gives current import figures.

<u>Petroleum Economist</u>. Petroleum Press Bureau Ltd. London,
1934-

    An international monthly published in London, the
<u>Petroleum Economist</u> is printed in three editions: English,
French, and Japanese. <u>Petroleum Economist</u>'s mission is to
give "...a balanced account of all that is happening in the
fast moving world of oil and energy, with a particular
emphasis on the economic implications".

    Standard statistical features found in each issue in-
clude selected crude oil prices in U.S. dollars per barrel
for 20 major world crude oils; product prices in U.S. cents
per gallon; tanker freight rates; price of bunker oil in
three U.S. and seven foreign cities; and world crude oil
production. The world crude oil production table gives
figures for each OPEC country and nine selected non-OPEC
countries (includes U.S., U.S.S.R., Canada, and Mexico).
Production is in 1000 barrel units with the reporting period
going back 7 years. The production figures give monthly
totals for the last 2 years and are about 2 months behind
publication date. The other tables mentioned above are
also only 1-2 months behind, so the <u>Petroleum Economist</u> has
the advantage of being quite current compared to most other
printed sources.

    The <u>Petroleum Economist</u> usually devotes two or more
articles each issue to specific countries. Energy data is
presented to back up the text and often forecasts are
made of future market, production and exploration trends.
Special issues throughout the year present lead articles on
tankers, refineries, and consumption.

    The <u>Petroleum Economist</u> includes a complete yearly
index with the December issue.

Offshore. Petroleum Publishing Company. Tulsa, Oklahoma, 1954-

Subtitled the "Journal of Ocean Business", this monthly covers all aspects of offshore oil and gas production. A special issue on worldwide drilling and production, published each June 20th, is divided into two parts: overall statistics and regional/country analyses.

The statistical section gives figures for the year prior to publication date. Tables include offshore gas production for 21 major countries for the past 5 years; number of active offshore platforms planned and installed; offshore daily average crude production for the past 5 years for 35 countries; total worldwide production, both onshore and offshore; number of offshore wells by type for various countries plus a list of the world's 100 largest offshore fields giving discovery date, average daily production, and number of wells in the field. Special tables give detailed U.S. offshore statistics.

The special analyses section gives further information for 17 of the world's most important offshore regions with notes on current production, exploration, and future prospects.

Offshore is published by the Petroleum Publishing Co., which also issues Oil and Gas Journal.

<u>World Oil</u>. Gulf Publishing Company. Houston, Texas, 1916-

        <u>World Oil</u>'s international outlook issue, published
annually on August 15th, is a good source of information on
crude production and drilling development worldwide.

        The special issue opens with a table summarizing crude
production and the number of producing oil wells for each of
60 major countries. The figures are current through the
year prior to issue date. A second table gives the number
and type of wells drilled (including dry holes) for each
country, along with the forecast for the current year's
drilling activity. Both of these tables give total figures
for major regions in addition to specific country summaries,
and note the percentage change from the previous reporting
year.

        The bulk of this special issue is devoted to exploration,
drilling, and production reports for approximately 100
countries. Accompanying the reports are color maps identi-
fying oil and gas wells and fields, both onshore and offshore.
A typical country report might include comments on political
and economic considerations affecting drilling activity, re-
cent discoveries, major companies active in the area, and
future production rates.

International Energy Statistical Review. United States
Central Intelligence Agency, National Foreign Assessment
Center. Washington, D.C., 1976-

     The International Energy Statistical Review is an un-
classified CIA monthly review of the world energy situation.
The Review gives detailed coverage to OPEC, OAPEC, U.S.S.R.,
Eastern Europe, the U.S., and many OECD countries.

     Each issue of the Review opens with a section of highly
visual colored charts summarizing recent trends in production,
consumption, and imports. The charts present data for some
of the geographic areas already mentioned plus the "big
seven" -- Japan, West Germany, France, Italy, Canada, the
U.S., and the United Kingdom. Much of the data is compara-
tive; for example, one of the charts plots out free world vs.
U.S.S.R. oil production.

     The remaining portion of the Review presents statistical
tables relating to world production, imports, exports, con-
sumption, and prices. Most of the production and trade
figures are given in thousands of barrels per day and in-
clude natural gas liquids (NGL). The Review used to include
the CIA's estimate of worldwide oil and natural gas reserves,
but this feature has been deleted; these figures now appear
in table 86 of their annual Handbook of Economic Statistics
and in special country studies.

     Extensive tables present data on imports and exports of
crude oil by country and source for the "big seven" nations,
both in thousands of barrels per day and in dollar value.
Consumption figures are given on a month-by-month basis for
approximately 15 OECD countries, as well as their supplies of
oil stocks.

     The Review includes a section giving the spot market
price (F.O.B. Rotterdam and Italy) of fuel oil, gas oil, and
premium gasoline. Also given are product prices in selected
developed countries and crude oil prices in OPEC nations.

     The Review concludes with an extensive analysis of
U.S.S.R. and Eastern European oil production and usuage. A
final table briefly outlines the energy situation in the
Peoples' Republic of China.

An interesting feature of the Review is the table devoted to OPEC crude oil production capacity. Capacity is defined on three levels. "Installed" or design capacity includes all aspects of crude oil production, processing, transportation, and storage; this is the highest capacity estimate. "Maximum sustainable" capacity is the maxium production rate that can be maintained for several months, usually 90-95 percent of installed capacity. "Available" capacity is defined by quotas or production ceilings established by some OPEC nations to limit annual output, usually the lowest of the three measures of capacity. Capacity limits for each OPEC nation are listed, along with the latest post-embargo peak production month and current production levels.

The International Energy Statistical Review generally has coverage back to 1972-73. Yearly and monthly figures are given. Current figures are 2-3 months behind the date of issue. The Review is available through liaison channels to U.S. government officials. Requestors outside the government are directed to the National Technical Information Services (NTIS) or the Library of Congress.

<u>Petroleum Intelligence Weekly</u>. Petroleum & Energy Intelligence Weekly, Inc. New York, 1962-

    <u>PIW</u> is an outstanding source of current information on the international petroleum market. <u>PIW</u> presents data and special analyses in a comprehensive and objective manner usually before being published in other news services. The publisher maintains offices in New York, Paris, and London, and has a far-reaching network of industry contacts. A typical issue is 12 pages and gives particularly strong coverage to OPEC price and production developments, the major oil companies, and significant petroleum news. A special section gives country-by-country coverage. Billed as a newsletter for "oil executives around the world", <u>PIW</u> is the most expensive publication in this listing -- $780 annually.

Quarterly Oil Statistics. Organization for Economic Cooperation and Development, International Energy Agency. Paris, 1977–

Quarterly Oil Statistics is published by the International Energy Agency (IEA), an autonomous body of the Organization for Economic Cooperation and Development founded in 1974. The purpose of Quarterly Oil Statistics is to "provide rapid, accurate and detailed statistics on oil supply and demand in the OECD area".

The publication is current through the quarter preceding issue date. Figures are broken down by quarter for the last 2 years and annual figures are given for the last 3 years. All figures are in 1000 metric ton units, except for natural gas, which is given in millions of cubic meters.

Quarterly Oil Statistics begins with a helpful section of definitions and notes, explaining product categories reported on and describing individual tables. The main body of the publication is divided into three parts: oil supply, natural gas supply, and trade.

The oil supply section presents data for each of the 24 OECD countries, the EEC, and OECD total. Each country or area is represented by tables on production, output, imports, exports, stock changes, use, and consumption in the following categories: crude, NGL, and feedstocks; total products supply; naphtha; LPG; total gasoline; motor gasoline; total kerosene; aviation kerosene; gas/diesel oil; and heavy fuel oil (residual).

The second major section of Quarterly Oil Statistics deals with natural gas, and for each of the OECD countries a table outlines production, imports, exports, stock levels, and consumption of this commodity.

The third and final section of Quarterly Oil Statistics deals with trade (exports and imports) in much greater detail than presented in parts one and two. Each OECD country's imports from a list of 46 other countries (including OPEC nations) and regions is indicated as well as its exports to as many as 29 destinations. This trade data is given for the following categories: crude, NGL, and feedstocks; total products; naphtha; total gasoline; gas/diesel oil; and heavy fuel oil.

- 15 -

Energy Statistics. Organization for Economic Cooperation and.
Development. Paris, 1966-
Oil Statistics. Organization for Economic Cooperation and
Development. Paris, 1961-

A publication of the Organization for Economic Coopera-
tion and Development, Energy Statistics gives data on produc-
tion and consumption of major energy sources by OECD coun-
tries. Totals are given for OECD, OECD-North America, OECD-
Europe, and the European Economic Community (EEC). Energy
sources covered include solid fuels (coal, coke), natural
gas, electricity, crude petroleum, and seven major petroleum
products. Production figures for petroleum are given in 1000
metric ton units. Each annual volume of Energy Statistics
covers 3 years, the most recent year being 2 years behind
publication date. (The 1979 edition covers 1975-1977).

Energy Statistics presents a detailed breakdown of how
energy is consumed in the 24 OECD countries. Consumption is
accounted for by five categories. The "transformation"
sector accounts for the quantity of crude, diesel oil, or
other energy product transformed into another form of energy.
For instance, this category would indicate the quantity of
crude used to produce petroleum products. The "energy"
sector details how much energy, and in what form, was used
by energy facilities such as refineries and gas works to
operate during the reporting period. The "transportation"
sector includes air, rail, and road transport use. The "in-
dustry" sector gives total industrial consumption plus de-
tailed figures for the iron, steel, chemicals, and petro-
chemicals industry. The final sector shows consumption by
the agricultural, commercial, public services, and commer-
cial areas.

This detailed accounting of consumption primarily dis-
tinguishes Energy Statistics from IEA's Quarterly Oil Statis-
tics. The latter gives only a gross, undefined figure.
Energy Statistics also includes nonpetroleum sources and
gives prices for petroleum products in the OECD countries.
The price charts cover an 8 year period.

Energy Statistics has a companion volume entitled
Energy Balances, which gives the same information but in a
common unit of measurement (tons of oil equivalent) for
each energy source. An historical volume of Energy Statis-
tics covers the years 1960-1974 (out of print).

OECD also publishes an annual volume solely devoted to
oil and petroleum products, entitled Oil Statistics. Oil
Statistics is the most detailed of the OECD publications

dealing with petroleum. In addition to crude oil and feed-stocks, the publication deals with 17 finished products.

Oil Statistics includes no price data but concentrates on consumption and trade (exports and imports). All figures are in 1000 metric ton units. Generalized tables for crude oil and finished products plus individual product and country tables show consumption for each nation. Consumption is broken down into 27 categories. Less detailed tables indicate petroleum supply and disposal for each country. "Supply" is made up of several categories, including indigenous production and imports. "Disposal" categories include inland consumption, marine bunkers, and exports.

Oil Statistics contains extensive tables on each nation's imports, from both OECD and non-OECD sources, and exports by destination. The data in Oil Statistics is 2 years behind publication date; the edition published in 1979 has final figures for 1977.

<u>World Energy Supplies 1950-1974</u>. United Nations Statistical
Office, Statistical Papers, Series J, Number 10. New York,
1974-

     This is a massive volume (825 pages) of historical
statistics devoted to world coal, petroleum, natural gas,
electricity, and nuclear fuels for 202 countries and areas.

     The work begins with a table covering production of
commercial energy by country and area, with data on trade
(exports and imports) and consumption (total and per capita).
All figures are in metric tons of coal equivalent, a popular
form of measurement with the UN, which is used for attaining
comparability among diverse energy resources, such as crude
petroleum and hydroelectricity.

     The petroleum section of <u>World Energy Supplies</u> begins
with table 6, which gives production figures for each nation
and area for crude petroleum and natural gas liquids. The
amount of petroleum retrieved offshore is indicated, along
with exports, imports, refinery capacity, and supply.
Figures are in million metric tons. All of these tables are
quite extensive (30-110 pages) owing to the large numbers of
countries covered and years included. Figures are given for
each year between 1950 and 1974 for each country.

     Table 7 is a matrix showing world movements of crude
petroleum between exporters and importers. Next is table 8,
listing total refinery output for all products for each
country. The remaining tables expand on this, beginning
with a listing of production of non-energy petroleum products:
naptha, asphalt, lubricating oil, petroleum coke, paraffin,
and solvents. Other tables cover production, trade, and
consumption of energy petroleum products: liquified petro-
leum gases, aviation gaoline, motor gasoline, jet fuel,
kerosine, and residual and distillate fuel oils.

     <u>World Energy Supplies</u>, 1950-1974 is an excellent source
of historical petroleum statistics. The volume contains a
chart of coefficients and conversion factors for converting
metric tons into other units, and a compendium of data
sources for energy statistics -- general, regional, and
national. <u>World Energy Supplies</u> is updated annually. The
update published in 1979 gives the figures through 1977 and
includes the previous 4 years (1973-1977). Also, an earlier
volume covers the years 1929-1950.

<u>Monthly Bulletin of Statistics</u>. United Nations Statistical
Office.   New York, 1947-

    Published by the United Nations, each monthly issue of
this title includes crude petroleum statistics for 60
countries. Monthly average production figures are given for
the current and previous 7 years. Figures are in 1000 metric
ton units, with instructions on how to convert to thousand
barrel units. The specific gravity of each nation's crude
is also indicated. Figures are within 3-5 months of publi-
cation date in most cases.

    Also included is a similar chart showing the monthly
average production (in teracalories) of natural gas for over
40 countries. The calorific value of each nation's gas is
shown.

    Four times a year, in January, April, July, and October,
the <u>Bulletin</u> publishes production figures for petroleum pro-
ducts of over 60 countries. Yearly production figures in
1000 metric ton units are given for gasoline, kerosine and jet
fuel, distillate and residual fuel oils. Figures are generally
3-4 quarters behind publication date.

Survey of Energy Resources. World Energy Conference.
London, 1962-

   A comprehensive collection of data on world energy re-
sources, this volume covers crude oil, natural gas, and
natural gas liquids as well as solid fuels, oil shale and
sands, hydraulic, nuclear, and other renewable resources
(tidal, wind, etc.). The Survey of Energy Resources is pub-
lished by the World Energy Conference, an international
organization composed of 69 national committees.

   Petroleum resources are accounted for in great detail
for approximately 70 countries. Resources, in the context of
this volume, covers several categories. These categories in-
clude proven recoverable reserves, or quantities of fuel
that have been proven recoverable based on the present state
of technology; proven unrecoverable reserves based on the
present technology; and possible recoverable reserves based
on probable extensions of known resevoirs, proven areas, or
geologically favorable regions. The Survey gives figures on
world reserves of crude oil and natual gas based on its own
investigations, and presents figures of leading forecasters.
The world reserve tables also cite many of the publications
discussed in this bibliography.

   This volume concentrates mainly on resources and does
not go into trade, price, or distribution. One major
table compares reserves with production to arrive at the
reserves-to-production ratio, or the number of years that a
nation's reserves might suffice if usage continues at the
given production rate. The Survey also gives an historical
record of crude oil production and consumption by country
for the period 1921-1970. There is a lengthy, but easily
understandable text on petroleum geology, historical develop-
ment, technology, and petroleum resource appraisal.

   The Survey of Energy Resources is published every 6
years and is updated every 2 years. The latest update (1978)
revises figures from the 1974 edition and gives details of
proved reserves, additional resources, and current consump-
tion.

International Petroleum Annual. United States Department of
Energy, Energy Information Administration. Washington, D.C.,
1965-

    Published in June by the Department of ENergy, the Inter-
national Petroleum Annual (IPA) is a valuable and unique
source of information. The IPA is the only U.S. publication
that compiles data for approximately 120 nations--developed
countries, developing countries, and the Sino-Soviet area.
Some of the more important sources used to produce this
volume include figures from the UN, OECD, OPEC, OAPEC, foreign
government reports, oil company information, and Department
of State correspondence.

    The IPA begins with a brief analysis of major develop-
ments in international petroleum during the past year,
followed by tables summarizing petroleum production and trade
by geographic region. The bulk of the publication is devoted
to detailed tables giving information for 121 countries, from
large producers like Saudi Arabia to small importers like
Fiji and Laos. The IPA details production of crude petroleum,
output of refined products, imports, exports, bunkers, and
domestic demand for each country. Production figures are
given for each of the previous 10 years. ALl figures are
given in thousands of barrels.

    The IPA includes a chart listing world crude oil re-
serves, number of producing wells, and refining capacity for
100 countries. The final table in the publication gives re-
tail prices (in cents per U.S. gallon) in 55 major cities
throughout the world for gasoline, kerosine, motor oil, and
fuel oils.

    The IPA gives price and reserves data for the year pre-
vious to publication. All other data is 2 years old (i.e.,
the edition published in 1979 gives the figures for 1977).
This is due in large part to the problem of compiling
authoritative figures for 120 different countries -- a time
consuming process.

    A number of different sources, discussed separately, can
update portions of the IPA, though not for every country. One
DOE publication of interest is the World Crude Oil Production
Annual, also issued in June and listing production figures for
76 countries and regions. Figures are expressed in 1000
barrel units and show the percent change in production for
the last 2 years prior to publication.

- 21 -

Twentieth Century Petroleum Statistics. DeGolyer and
MacNaughton, Dallas, Texas, 1945-

    Published in Dallas by the petroleum consulting firm of
DeGolyer and MacNaughton, Twentieth Century Petroleum Statis-
tics was originally prepared for the Navy Department in 1945,
and has been updated annually since then.

    The volume is made up of over 100 statistical tables,
each table illustrated by a suitable colored graph. Although
Twentieth Century Petroleum Statistics concentrates on the
U.S., coverage is given to international production, demand,
and reserves. Data is presented for 60 countries. The colored
charts are very well done and give a graphic sense of propor-
tion when comparing figures. Another valuable aspect of the
work is that historical statistics are given. Figures are
complete in many cases back to 1918, and cover every year
since then. The tables are current through the year prior
to publication. This book has a complete subject and country
index.

    Twentieth Century Petroleum Statistics is a compilation
of data gathered from four major sources: the American
Petroleum Institute, Oil & Gas Journal, World Oil, and the
U.S. Department of Energy.

International Petroleum Encyclopedia.   Petroleum Publishing
Company, Tulsa, Oklahoma, 1967-

    This is an annual volume presenting text, maps, and
statistics on the world petroleum market. A major feature
of the IPE is the country summaries, analyzing recent produc-
tion, exploration, and trade data along with maps of each
nations' oil fields and distribution lines. All of the
world's regions are covered, including extensive reports on
the U.S.S.R., China, and Eastern Europe. The country summa-
ries might be best used in conjunction with the similar
studies found in the international outlook issue of World
Oil (August 15) for an up-to-date view of any particular
area's petroleum statistics.

    The IPE is published by Petroleum Publishing Company.
Consequently, some of the major statistical charts appearing
in the volume (such as the worldwide refining survey, re-
serves data, oil production, major fields by country) appear
in the company's other publications, principally the Oil &
Gas Journal's worldwide report issue.

    The IPE is valuable for its coverage of a wide variety
of petroleum related subjects. Statistical charts and tables
abound. In addition to those mentioned, a very partial
listing of charts and tables includes data on offshore rigs
in operation, well completions, enhanced recovery projects,
gas processing, historical refining figures, physical prop-
erties of the world's major oils, and oil company explora-
tion expenditures and production figures. The IPE contains a
number of special studies and includes an international
directory of petroleum agencies around the globe.

<u>Quarterly Economic Reviews of Oil</u>. (Five editions).
Economist Intelligence Unit, Ltd. London, 1976-

     The Economist Intelligence Unit, Ltd. in London publishes
81 economic reviews covering over 160 countries. Each review
is issued four times a year with an annual supplement. Five
of these reviews are of particular interest: <u>Quarterly</u>
<u>Economic Review of Oil in the Middle East</u>; <u>Latin America</u>
<u>and the Caribbean</u>; <u>Far East and Australasia</u>; <u>North America</u>;
<u>and Western Europe</u>.

     Each quarterly issue is a summary of latest intelligence
concerning prices, exploration, production, refining, and
company news for the respective areas. A statistical section
is included, in most cases devoted to a quarter-by-quarter
breakdown of crude production and trade for the preceding
2 years.

     The annual supplement generally gives a background
summary for each region with an indication of future produc-
tion trends. The <u>Quarterly Economic Review</u>'s are excellent
capsule summaries of petroleum facts and figures for these
five areas.

<u>Annual Statistical Bulletin</u>. Organization of Petroleum Ex-
porting Countries. Vienna, 1966-

An official OPEC compendium of statistics regarding
member country's oil and gas industry, the <u>Bulletin</u> covers
the basic subjects of production, crude oil exports, and
oil revenues. Each member country's production is given
for each year since production began. Daily, total, and
cummulative averages are given in 1000 barrel units. Exports
of each country are given in thousand barrels per day with
yearly averages for the last 6 years. Destinations are
also given. Historical statistics are presented tracing
the oil revenues of each member country, as well as the
financial situations of the world's major oil companies.

In addition, the <u>Bulletin</u> gives figures on tanker
freight rates, world exports and imports of oil and gas,
and world consumption of refined products. Data in the
<u>Bulletin</u> is current through the year prior to publication.
The inclusion of such current figures is a result of OPEC
obtaining data directly from its member Secretariats,
rather than secondary sources.

Arab Oil & Gas Directory. Arab Petroleum Research Center.
Paris, 1974-
Arab Oil & Gas. Arab Petroleum Research Center.
Paris, 1971-

        The Arab Oil & Gas Directory, published by the Arab
Petroleum Research Center in Paris, is probably correct in
claiming it "provides more information and data on Arab oil
and gas than any other publication in the world".

        This annual volume of over 400 pages devotes itself to
19 Middle Eastern and North African Arab countries.* Each
country is the subject of an extensive analysis of informa-
tion regarding its oil and gas development, reserves, pro-
duction, refining, exports, prices, revenues, transport, and
the position of oil and gas relative to general economic
planning and development. Maps showing each country's oil
and gas fields and pipelines are included. The Directory is
one of the best sources of statistics for any aspect of the
oil and gas industry in these countries. The Directory is
also strong on the historical growth of each nation's in-
dustry. Special sections analyze the genesis and development
of the various national oil companies and sets out important
bilateral agreements with other countries and international
oil companies. The Directory concludes with a short section
of international oil and gas statistics and an index of oil
and gas service companies operating in the Middle East and
North Africa.

        The Arab Petroleum Research Center also issues a
periodical every 2 weeks entitled Arab Oil & Gas. This is
an intelligence report analyzing the latest political, in-
dustrial, and economic developments in the Arab oil pro-
ducing countries. Special studies and documents by OPEC,
member countries, and world oil authorities are included in
each issue. Frequent statistical sections are devoted to
a specific country or subject, such as the production figures
for the Arab world's major offshore oil fields. Arab Oil &
Gas closely scrutinizes present and future OPEC oil pricing
activities.

*Algeria, Bahrain, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon,
Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria,
Tunisia, United Arab Emirates, North Yemen, South Yemen.

OTHER BIBLIOGRAPHIES OF INTERNATIONAL PETROLEUM STATISTICS

Baade, Patricia. Directory of International Energy Statis-
     tics. Washington: IES Publishing Company, 1976.
     (Updated with 1977 supplement)

Pieper, F.C. SISCIS: Subject Index to Sources of Comparative
     International Statistics. Beckenham, England: CBD
     Research Co., 1977. (Distributed in the United States by
     Gale Research Co., Detroit)

Wasserman, Paul and O'Brien, Jacqueline, Statistics Sources. 6th ed.
     Detroit: Gale Research Co., 1980.

For very recent information, see the American Petroleum Insti-
tute's Petroleum/Energy Business News Index. This is a monthly
index of news and statistical material appearing in sever major
periodicals: Middle East Economic Survey, National Petroleum
News, Oil and Gas Journal, Oil Daily, Petroleum Economist,
Petroleum Intelligence Weekly, and Platt's Oilgram News.