86th Congress }
2d Session }
JOINT COMMITTEE PRINT

NEW VIEWS ON AUTOMATION

PAPERS SUBMITTED TO THE SUBCOMMITTEE ON AUTOMATION AND ENERGY RESOURCES

JOINT ECONOMIC COMMITTEE
CONGRESS OF THE UNITED STATES

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LETTERS OF TRANSMITTAL

OCTOBER 12, 1960.

Members of the Joint Economic Committee:

Transmitted herewith for use of the Joint Economic Committee and other Members of the Congress is a collection of individual papers submitted to our Subcommittee on Automation and Energy Resources, dealing with the progress of automation and rapid technological change in the current situation as viewed by the labor leaders, businessmen, and economic, engineering, and scientific experts who testified several years ago at subcommittee hearings on this subject.

PAUL H. DOUGLAS,
Chairman, Joint Economic Committee.

SEPTEMBER 20, 1960.

Hon. PAUL H. DOUGLAS,
Chairman, Joint Economic Committee,
U.S. Senate, Washington, D.C.

DEAR SENATOR DOUGLAS: The annual report of the Joint Economic Committee, filed with the Congress on February 29, 1960 (S. Rept. 1152), asked this subcommittee to continue its study of automation (in accordance with its recommendation of January 1956, S. Rept. 1308, 84th Cong., 2d sess.). It was suggested that the subcommittee focus attention at this time expressly upon the developments during the interim since the several hearings held in October 1955, December 1956, and November 1957, by getting the current views of the businessmen, labor leaders, and professional men who testified at the previous hearings. These previous witnesses have again been most cooperative in responding and their present views (in a few instances the new views were submitted by successors in office in the organizations or groups represented in the earlier studies) are presented herewith. These papers, it is believed, will give the committee, Members of Congress, and others concerned with the impact of automation upon stability of employment and economic growth a solid foundation upon which to appraise once more recent trends and developments.

WRIGHT PATMAN,
Chairman, Subcommittee on Automation and Energy Resources.

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INTRODUCTION

"The problems of automation are by no means negligible or settled." Our Subcommittee on Economic Stabilization came to this conclusion and so reported to the Congress on the basis of hearings in the fall of 1955—the first congressional recognition of this important postwar trend (see "Automation and Technological Change," S. Rept. 1308, 84th Cong., 2d sess.). Having this finding in mind and in keeping with its responsibility under section 5(b) of the Employment Act of 1946 for making continuing studies of matters relating to employment, production, and purchasing power, the Joint Economic Committee in the intervening years has periodically inquired into the changing impact of technological change and automation on long-run employment and investment levels.

The committee, in its annual report, February 29, 1960 (S. Rept. 1152, 86th Cong., 2d sess.), accordingly asked the Subcommittee on Automation and Energy Resources to obtain and make available the current views of interested professional men, Government agencies, and representatives of industry and labor, on recent developments. It did so, not in any belief that the problems have been worsened—much less been solved—since earlier investigations. The continuing purpose has been to keep currently informed lest the increasing productivity to be obtained through automation, and which is sought and welcomed by all segments of American life, carry with it excessive personal hardships or set up adverse forces which will hamper future economic stability and growth.

The committee has made these inquires also in the conviction expressed by contributors to the present study that the dissemination and exchange of ideas and experiences of persons who are continually dealing with automation problems will do much to promote public understanding, so essential to maintaining the economic climate which will assure flexibility needed to adjust to rapid technological change.

There are, of course, many industries and many aspects of technology which might usefully be studied in this connection. The committee will inquire into more of these in the future. It seems, however, particularly fruitful at this time in providing something of a progress report or new benchmark to hear so far as possible from the same experts who had testified at the previous hearings on this subject.

Members of the subcommittee accordingly approved in mid-April a general type of letter (subject to appropriate variation as to details) to these individuals, or, in a few cases, to successors in office where organizational or personnel changes had occurred.

The hearings in question at which these earlier statements were made—frequently referred to in these later statements—have previously been published as:

"Automation and Technological Change," hearings, Subcommittee on Economic Stabilization (Oct. 14, 15, 17, 18, 24, 25, 26, 27, and 28, 1955). (Government Printing Office, sale price, $2, reprinted September 1959, presently out of print.)

"Instrumentation and Automation," hearings, Subcommittee on Economic Stabilization (Dec. 12, 13, and 14, 1956). (Government Printing Office, sale price, 75 cents.)

"Automation and Recent Trends," hearings, Subcommittee on Economic Stabilization (Nov. 14 and 15, 1957). Government Printing Office, sale price, 30 cents.)

The general pattern of the inquiring letter for the present revisiting of witnesses follows:

> DEAR MR. ———: In keeping with its responsibilities under the Employment Act of 1946, the Joint Economic Committee has been making a continuing study of the impact and problems of automation and rapid technological change on employment levels and economic stability. In its annual report, filed with the Congress on February 29, 1960 (S. Rept. No. 1152, 86th Cong., p. 27), the committee stressed the desirability and need for bringing previous hearings up to date. We are particularly anxious to get the present thinking and views on interim and current developments by the labor leaders, businessmen, and engineering experts who testified previously.
>
> At hearings held in October 1955, you and your organization gave the committee valuable and much appreciated testimony on the then status and outlook for automation and technological development. The printed record of the hearing testimony, including your statement, has proven of great public interest and has helped to furnish the basis for the committee's reports to the Congress.
>
> We are again asking your help in bringing the information up to date. In doing so, we hope that you will give as generously of your thought and time as you did on the previous occasion. We want to minimize the inconvenience to you and accordingly plan that personal appearances of the witnesses be passed over for the present time, although we realize that we will thereby miss the benefits of questioning and direct oral discussion with you. We hope, however, that this will allow you time for a thoroughgoing reconsideration of the problem and permit the submission of a statement of content and length similar to your previous one. This, along with those of other witnesses, will give us a solid foundation upon which to judge what further ought to be done, if anything, so that the objectives of the Employment Act can be met in this important area where the problems are obviously neither negligible nor settled.
>
> Specifically, we would like to have information as to (1) the amount of automation which has, to your knowledge, taken place in the intervening period since your previous testimony; (2) the amount of new investment which may come in the foreseeable future as a result of further developments in the field; (3) the extent and types of employee displacement which may have resulted and which seems to you to be in prospect from automation; (4) how the problems of retraining and reallocation of workers have been and should, in your opinion, be solved; and (5) what the policy of Gov-

ernment in respect to this development should be. We would, of course, welcome your comments on any other aspects of the problem that your knowledge of the field suggests. Please feel free to discuss wherein you feel that events have reinforced your earlier views and where your views may have changed in the light of current trends.

If any questions arise in your mind as to the content of your testimony or the committee's objectives, please feel free if you wish to call or write Mr. William H. Moore, staff economist for our subcommittee (CApitol 4-3121, extension 5171). We would like to be able to assemble this material by July 1.

While unavoidable delays prevented reaching all of the respondents and the collection of all the material as promptly as had been scheduled, the subcommittee cannot help but be gratified at the near universal response represented by the accompanying reply.

The cooperation from so many who had already once given of their time is a commentary on not only their spirit of public service, but a demonstration of the interest and concern of professional men, labor leaders, and businessmen. They obviously concur in the view of this committee that automation, instrumentation, and technology are subjects deserving of continuing and recurrent study and watching. The awareness and thoughtfulness on the part of those dealing with the problems which these statements reflect should go a long way toward assuring progress in productivity with a minimum of personal hardship and social costs.

VIEWS OF INDIVIDUAL SPECIALISTS

STATEMENT OF ROGER W. BOLZ, PUBLISHER-EDITOR OF AUTOMATION MAGAZINE

Altogether too many self-appointed prophets have created a misleading picture of automation as an uncontrolled ogre of giant proportions. For our own good, we must remove automation technlogy from the realm of science fiction and reveal it for what it really is—nothing more than a down-to-earth continuation of our basic manufacturing tools and methods. Under today's world competition it is a necessity for supplying more and better goods and services to fulfill the continuing demand for a better life.

At the outset of this significant decade of the 20th century, perhaps it is desirable to take another searching look at our technological advance. Preparation for the critical years ahead make it imperative that we fully understand our position, nationally and internationally. In no wise is automation a small part of this picture. Developments to date indicate a distinct need for broader knowledge of our potentials and pitfalls that may be present. There is a basic need for broader and more practical understanding of automation and its opportunities for advancing our position as a nation and our well-being as a people.

To realistically evaluate the technology of automation at the outset of the 1960's calls for recognition first that it is a valuable tool, a culmination of developments over more than a century of manufacturing effort. A comment by Col. George S. Brady in the May–June 1960 issue of Ordnance perhaps best sets the stage for such considerations. He states the issue pointedly:

> About 80 years ago, when the industrial age was first getting into high gear, Matthew Arnold, the "Apostle of Culture" at Oxford, wrote: "The greatest men of culture are those who have had a passion for diffusing, for carrying from one end of society to the other, the best knowledge, the best ideas of their times; who have labored to divest knowledge of all that was harsh, uncouth, difficult, abstract, professional, exclusive—to humanize it and make it useful outside the clique of the cultivated and learned."
>
> Electronic machines are "brains" only in their ability to store information and sift and assemble it rapidly. You cannot get anything out of the machine that is not put into it. Without competent men of broad analytical minds to digest and fragmentize the data into simple, generally understandable units to be fed into the machine, the electronic brain is of very limited use.
>
> Thus, we have now a far greater need for these "great men of culture" than at the time of Arnold. I sometimes feel that even the manufacturers of the machines do not yet realize the great possibilities, especially the great need for a new type of professional man who can divest the data of all that

is "abstract, professional, exclusive," and make them useful to the hundreds of thousands of nonscientist executives, engineers, and workers who have the job of producing goods and equipment in our factories.

In this vein it is encumbent upon us to divest automation of the "abstract, professional and exclusive" and make a careful evaluation of the technology from a practical overall standpoint.

Forces at Work

Automation is a result of forces at work today. It is not the cause. A look at the critical forces active in today's busines world provides a clear-cut picture of the real push creating greater need to automate.

Study of these forces shows two major areas of pressure driving all industry to seek the opportunities possible only through automation techniques. Included in the first area are these forces of broad national and international character:

1. International technological competition;
2. Demand for higher living standards;
3. Pressure of population increase;
4. Expanding horizons of scientific knowledge;

while in the second are these active everyday business forces:

1. Rising capital and overhead costs;
2. Need for higher product quality, uniformity, and reliability;
3. Increased manufacturing competition;
4. Growing business volume and complexity.

Under the relentless impact of this powerful array of forces, automation is indeed inevitable. Just to maintain our past rate of progress, it is estimated that a productivity gain of 35 percent will be necessary by 1966 and 66 percent by 1976 (see exhibit 10).

In the fast-moving era of the 1960's there can be no turning back. Only through expanded use of automation will the United States maintain its world leadership and standard of living.

One only need look abroad to see the rise of competitive technology. Regardless of wage rates, foreign manufacturing its rapidly becoming automated. A recent movie [1] made in Japan provides a dynamic picture of a level of automatic manufacturing surprising to say the least. Developments in other countries show equally impressive accomplishments. To expect to compete with the output of these plants in local or foreign markets calls for even greater accomplishments here. The tools are available but much study and development is necessary.

Facing today's world conditions and realistically facing our accepted foreign policy, it is imperative to recognize that concerted effort is necessary to employ automation technology to keep up. Management, engineering, and labor cooperation is a must for satisfactory accomplishment.

[1] "Toshiba in Progress"—available from Nomura Trading Co., Ltd., New York branch office, 52 Broadway, New York, N.Y.

Research in this field by Stanford Research Institute puts sharp focus on the direction necessary with this comment:[2]

> The prospects are that efficient production methods based on modern science and technology will continue to spread to new countries during the next decade, probably more rapidly than in the past. Indeed, it is an important aim of the U.S. foreign policy that they should spread rapidly to countries now economically underdeveloped. The spread of improved production methods will, however, raise additional trade problems that will require policy decisions by the United States * * * American producers could exert themselves to keep one step ahead of the competition, shifting out of less promising lines and into expanding ones. Among the latter will be new products and processes, equipment of types needed in development, and types of consumption goods and services which will be wanted by peoples enjoying higher income levels.

Lippincott and Margulies, Inc., in a recent publication,[3] has this extremely pertinent statement:

> Perhaps the time has come for U.S. manufacturers to stop trying to match their high-priced labor against low-cost labor, and instead lead from the great U.S. strength: mass-production. Especially, automated mass-production.
>
> This requires engineering products specifically for automation. But it also requires the best design talent available to make sure the vital element of consumer appeal is not lost somewhere along the electronically operated production lines. Clearly, such products will have to be "cleaner" and simpler in design—will have to go sparingly on the use of such hand-applied details as escutcheons, trims, textures, and similar nonfunctional addenda. In sum, the designer is essential in order to balance production realities with design esthetics and come up with products that can be both made and sold.

These are no idle comments. The problem is serious in many areas. As competition becomes keener by the month, U.S. industrialists are looking abroad more and more. This trend to establish plants abroad and import the products made cannot be looked upon as unimportant to this whole development. It is imperative that U.S. productivity compete with incoming products on an adequate basis or jobs will gradually move abroad.[4]

Industry recognizes that protective tariffs have no permanent place in free world markets and provide little real protection. They recognize that the only good protection is the self-reliance of higher pro-

[2] "Possible Nonmilitary Scientific Developments and Their Potential Impact on Foreign Policy Problems of the United States," study prepared by Stanford Research Institute at the request of the Committee on Foreign Relations, U.S. Senate, U.S. Government Printing Office, Washington, 1959, p. 63.

[3] "Design for World Markets," Design Sense 18, Lippincott & Margulies, Inc., industrial designers, 430 Park Ave., New York, N.Y.

[4] "Let's Go Global," a paper by H. E. Humphreys, Jr., U.S. Rubber Co., at the 88th annual meeting of the Manufacturing Chemists Association, Inc., June 9, 1960.

ductivity—hence the unequivocal need to automate without unnecessary delays.

The way is clear and automation techniques, if properly understood and developed to fulfill the need, can help tremendously to keep American manufacturers in the forefront both at home and abroad. Necessarily here are: Direct encouragement through Government regulations; technical assistance to small and medium-size manufacturers in a practical way; and stimulus in promoting automated production facilities through special depreciation allowances as well as through special allowances for the manufacturing research so vital to advances in automation equipment or techniques [5] (see app. 1).

Automation Today

Taking a historical look at industry, manufacturing processes have developed through five basic stages over the years and all stages are still with us. Under pressure of growing output and economics the evolution rises to the level of automation (see exhibit 1).

To honestly evaluate the level of automation today is impractical. Only a vague idea can be gained. Dr. Joseph Harrington has mentioned in a recent paper that it would take 60 years just to bring manufacturing industry alone up to today's level of technology.[6] (See app. 2.) Why is industry in this state? Mainly because it requires considerable capital to automate and it requires considerable engineering talent and time. Only under pressure of process limitations or the competitive economics of survival does industry move into the complexities of automation.

A recent study covering 18,000 plants made by Automation magazine provides a fairly good idea as to the levels of automation techniques employed in industry and general plans now in process. Exhibit 2 shows some data developed from this study. It is evident here that only the simplest forms of automatic operations are widespread. In exhibit 3 an indication of basic operations of automatic nature is given. Here again it is obvious that there is yet a long way to go in automating operations on a broad scale.

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[5] Roger W. Bolz, "Manufacturing Research and Capital Costs," Automation, vol. 7, No. 6, June 1960, pp. 56–62.

[6] Dr. Joseph Harrington, "A Look Into Tomorrow," Automation, vol. 7, No. 5, May 1960, pp. 66–70.

EXHIBIT 1

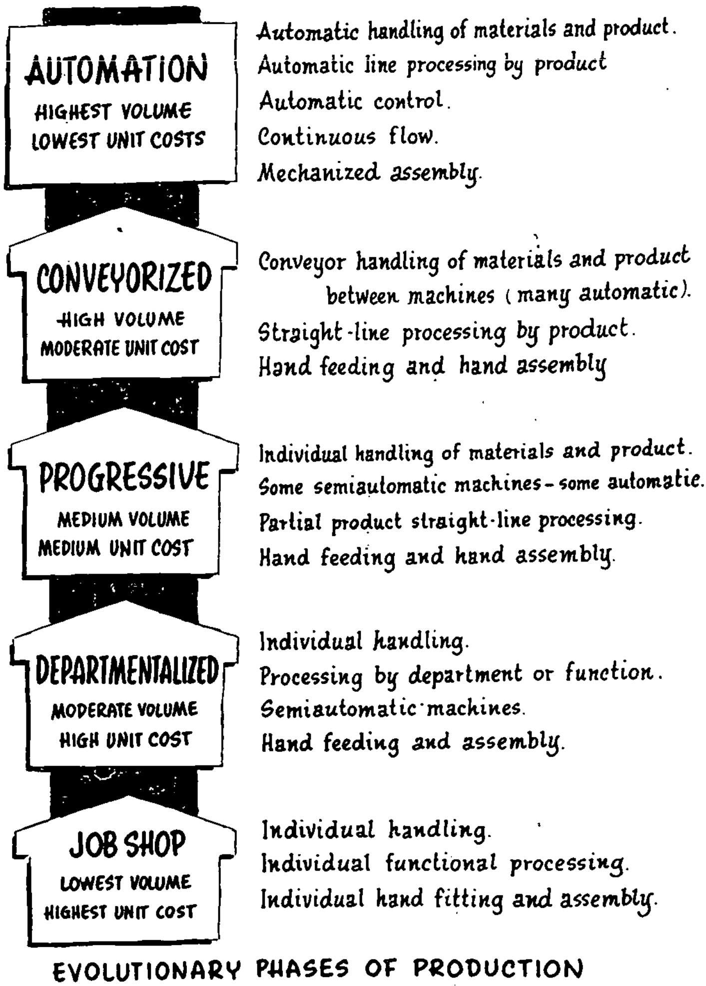

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EXHIBIT 2

TYPES OF AUTOMATIC EQUIPMENT AND CONTROLS

(2,693 Plants Reporting)

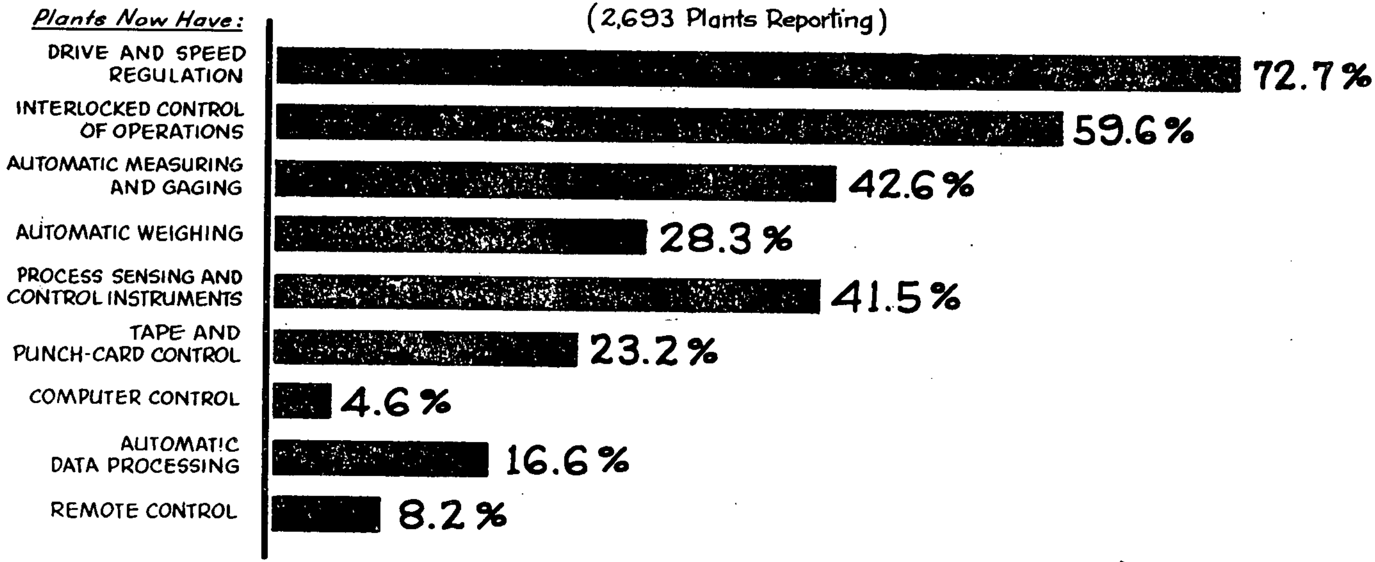


EXHIBIT 3

OPERATIONS THEY PLAN TO MAKE MORE AUTOMATIC IN 1959

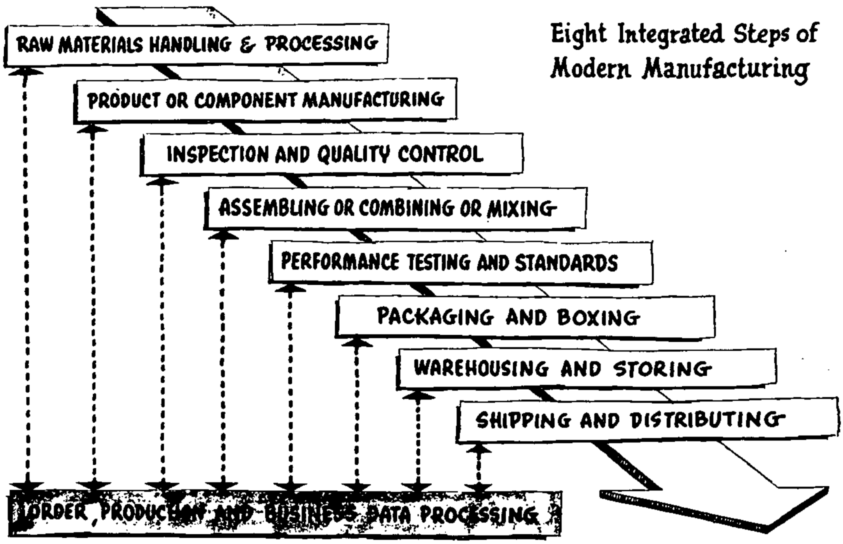
(1,675 Plants reporting)

% Now Used	Operation	% Planned for 1959
26.0	Assembly	17.9
6.9	Calendering, sheeting	2.5
6.3	Casting, forging, rolling	3.6
20.0	Cutting, shearing, forming	9.3
17.4	Data processing	8.8
23.6	Finishing, painting, coating, plating	10.4
48.0	Handling, conveying, transferring	26.2
31.8	Heating, baking, heat treating	10.9
15.5	Inspection	12.0
19.8	Machine tools	9.8
11.0	Machine tools, automatic load & unload	7.6
2.4	Machine tools, tape and card control	3.9
9.3	Molding, extruding	5.5
27.8	Packaging, bundling, filling	17.2
30.2	Processing	15.9
14.0	Stamping, drawing	8.1
6.8	Stock control, warehousing	5.7
10.7	Storage, feeding, sorting	7.3
16.6	Testing	10.3
18.9	Washing, cleaning, conditioning	9.2
5.4	Weaving, sewing, stitching	2.5
23.0	Weighing, mixing, blending	12.0
12.1	Welding, riveting, fastening	7.8
11.3	Winding, coiling	6.0
5.3	Other	2.9

Practical automation must be accomplished in reasonable stages. Normally, limited steps are taken in a sequence planned and calculated to maintain acceptable costs. The time consumed in completing each step adds up to a rather measured evolutionary process.

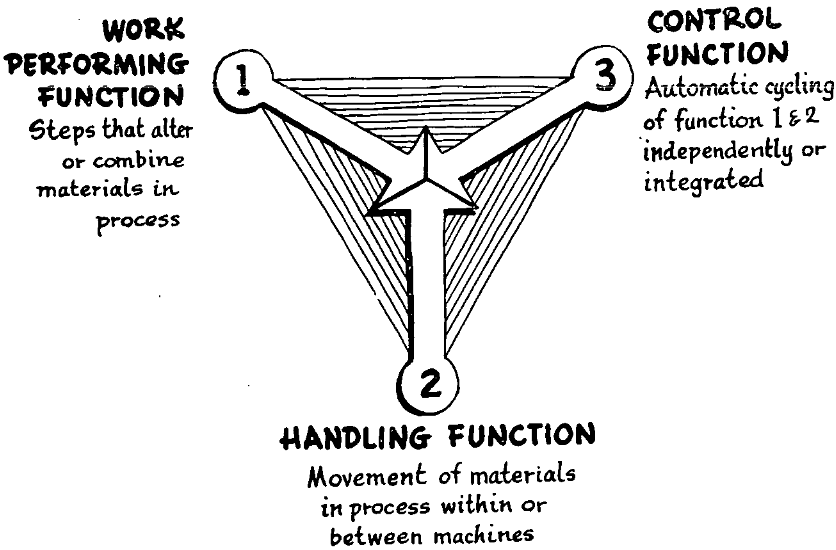
Exhibit 4 outlines the eight fundamental steps in the overall manufacturing process. Any one step can be automated or, depending on the industry and the economics, any group of steps. In a few instances all these steps can and are integrated into an automatic plant. Note that the final overall integrating operation of the automated plant is that of data processing. With this most sophisticated stage, information necessary for carrying on automatic operations is used directly in the system for management and control. This final achievement is yet in its infancy.

EXHIBIT 4



For the engineering and development of equipment to carry on the selected area of the eight-step process, there must be full cognizance of three key phases—the process, the handling techniques, and control. In implementing this overall system approach these three basic phases are integrated in a properly balanced fashion to insure a fully effective machine, manufacturing line, or process plant installation as in exhibit 5.

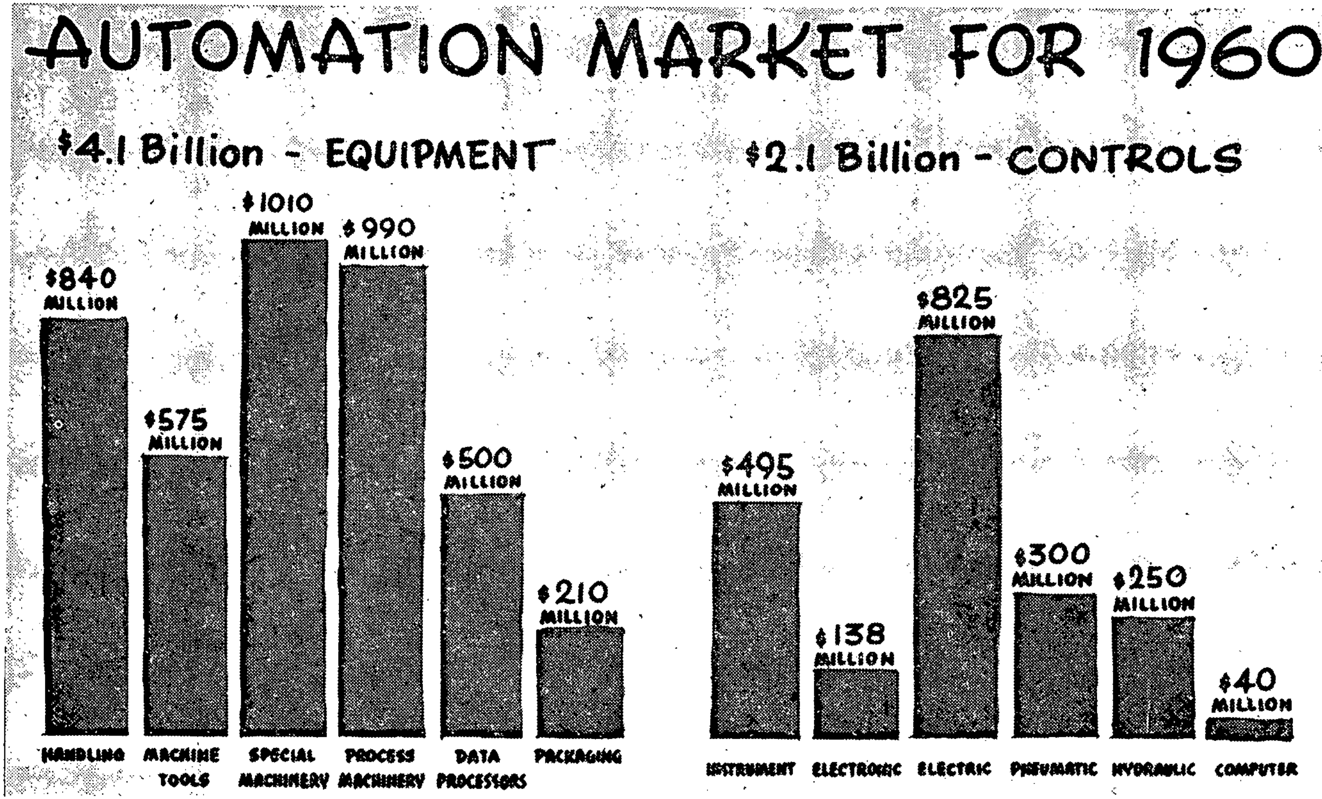
EXHIBIT 5



INVESTMENT FACTORS

In addition to the pertinent comment by Dr. Harrington concerning the investment picture [6] (see appendix 2), some idea of the automation movement can be gained from estimates of capital expenditures. Of the $8 billion expended in 1958 for production equipment, it is estimated that roughly one-half was allocated to automated facilities that year. Automation's estimate for 1959 was $5 billion and for 1960, $6.2 billion (see exhibit 6). These estimates include all expenditures made for improving present facilities, adding controls, computers, and complete new equipment. By 1970 this is conservatively expected to reach an annual rate of $15 billion.

EXHIBIT 6

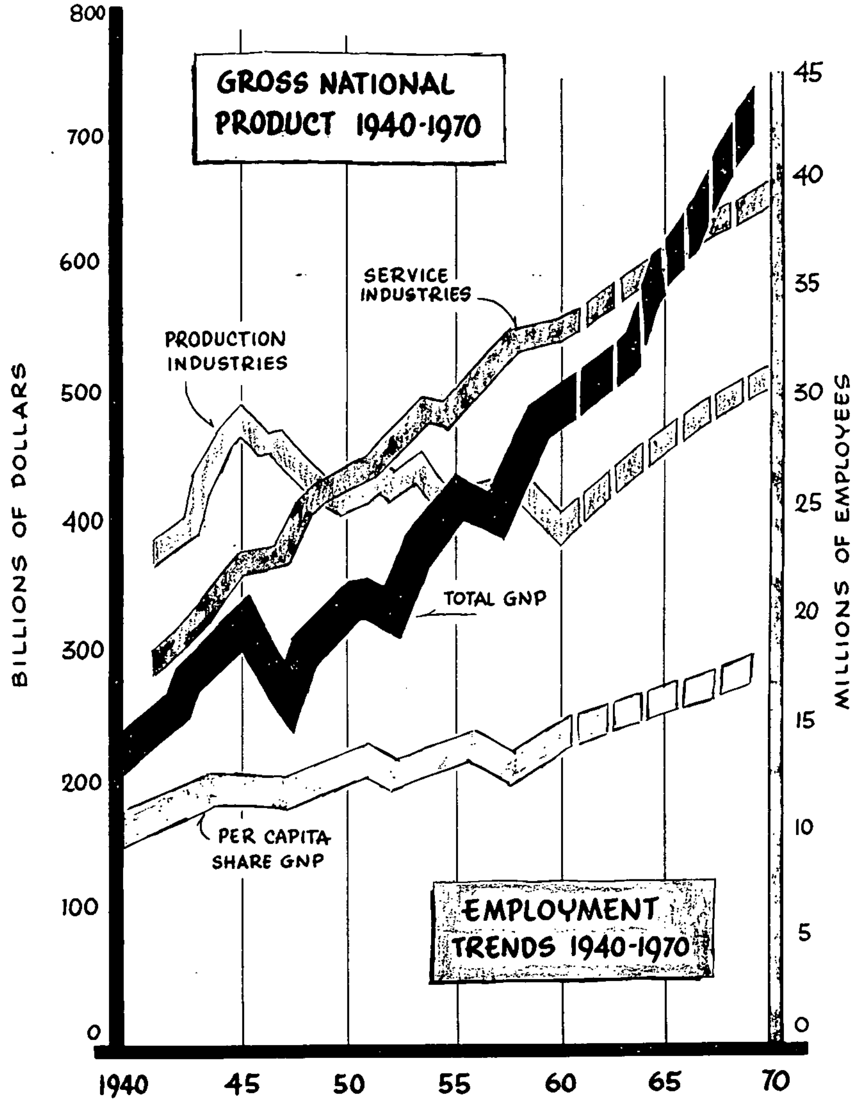

AUTOMATION MARKET FOR 1960
$4.1 Billion - EQUIPMENT
$2.1 Billion - CONTROLS
$840 MILLION
$575 MILLION
$1010 MILLION
$990 MILLION
$500 MILLION
$210 MILLION
$495 MILLION
$138 MILLION
$825 MILLION
$300 MILLION
$250 MILLION
$40 MILLION
HANDLING
MACHINE TOOLS
SPECIAL MACHINERY
PROCESS MACHINERY
DATA PROCESSORS
PACKAGING
INSTRUMENT
ELECTRONIC
ELECTRIC
PNEUMATIC
HYDRAULIC
COMPUTER

For a look at the coming decade, the National Industrial Conference Board Division of Business Analysis sees a picture that looks roughly like this: By 1970 the gross national product will probably reach the neighborhood of $800 billion (at present price levels). To accomplish a production job of these proportions will require a tremendous increase in capital. This means an annual total capital expenditure for new facilities substantially higher than the $35 to $38 billion now being invested annually. It is expected to average $58 billion annually, advancing gradually from today's level until the end of the decade when it should reach nearly $70 billion.

Whether we, in fact, actually reach this level of activity will in large part depend on stimulation of increasingly available capital at acceptable rates. Present stringent investment capital limitations in all but the largest companies places serious question on achieving this unprecedented goal. Consideration of these requirements must be carefully evaluated by Government and suitable measures taken to encourage availability of needed investment capital.

Spurring this investment in capital facilities will be a significant increase in research. By the end of the sixties investment in research is expected to more than double the present annual rate of roughly 2.5 percent of national output, which runs better than $12 billion. The major portion of today's research and development is devoted to products and materials. In the years ahead a significant increase in the portion devoted to manufacturing process research will be imperative if present GNP forecasts are to be realized (see exhibit 7).

EXHIBIT 7

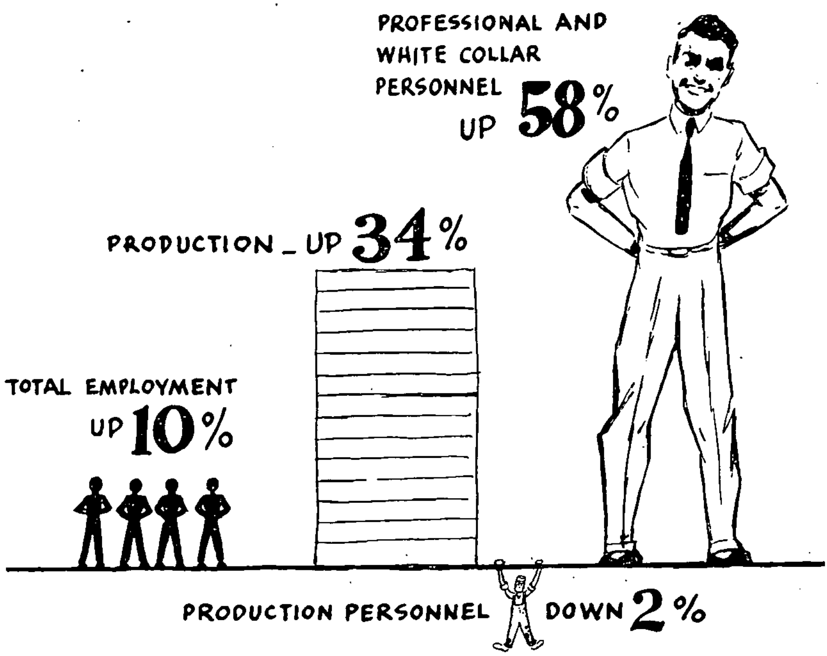


EMPLOYMENT

Since 1939 the population has increased 32 percent and the volume of goods and services has grown 382 percent. In this period the labor force has roughly followed population, increasing about 30 percent. In this same 20-year period the absolute number of unskilled persons in the work force has substantially dropped, but the number in professional, technical, clerical, and managerial employment has risen nearly 100 percent.

By 1970 the advances will be found almost exclusively in the ranks of the skilled workmen and the professional, technical, clerical, and managerial areas. Two factors are interesting to note in this regard. Those industries that have automated to the greatest degree have made the greatest capital investment per employee and created the highest contribution to our standard of living. Secondly, these industries have created employment opportunities that parallel the population growth while employee earnings parallel the increase in capital investments made. (See exhibit 9.)

EXHIBIT 8



TRENDS IN MANUFACTURING INDUSTRIES DUE TO AUTOMATION TECHNOLOGY 1947-1958*

Total employment .... Up 1.12 millions
Production personnel .... Down .25 million
Professional, white collar ...... Up 1.37 millions

* U.S. Dept. of Commerce data

The tenor of the times is set. There is no point in looking back. Opportunity will be everywhere and knowing the overall general trend of change in process behooves us to plan properly for the future. If both the individual and industry plan effectively there need be no unnecessary employee displacement. From past history the voluntary movement of labor has far overshadowed any job displacements taking place.[7] Research shows that the bulk of displacements arise from business failures or product failures, often with a direct influence from failure of the business to remain competitive. It appears obvious that individual worker security lies not in any particular job or company but rather in basic talents and broad skills, permitting ready shift to growing areas of newly developing industry.

From this overall view it appears imperative that two movements be encouraged by all possible means. One is the encouragement of increased self-education by the average employee. The other is encouragement of increased in-plant training and retraining of employees. The latter movement is fast gaining acceptance in industry but needs added incentive and encouragement at both management and employee levels.

A Major Misconception

Perhaps the greatest fallacy in most thinking concerning automation has been that of the disappearance of people and jobs from the scene. The concept of the disappearing personnel is one of static or shrinking markets, one that is unrealistic businesswise since automation under such conditions has little chance of long-range payoff financially.

Perhaps best illustrative of the trend is that of the development of missiles to supersede bombers. Although one missile specialist mans the several pushbuttons at firing, behind the scenes supporting personnel far outnumber those required to put a comparable bomber into the air. Technical competence and training of the missile crew must be far and away greater than that for the bombers.

The story is no different with the automated plant. Even though there are those who point out the broad advances made in machinery design toward reliability, there is still no perfect process. Wear and tear take their toll and there is seldom an alternate to having a highly trained maintenance crew if everyday production problems are to be economically handled. No plant will run itself completely unattended in any way. Somewhere along the line there must be skilled personnel for troubleshooting. It is a gross error to assume highly automatic equipment needs no attendance or superior skills. M. L. Jones, principal power engineer, E. I. du Pont, commented on this at the recent annual ASME meeting in Atlantic City:

> Serious complications arise when an operator is unable to interpret any malfunction of equipment and cannot take preventive steps to correct it. Failure to maintain the units correctly or to test them regularly also results in dangerous

[7] Recent Department of Labor statistics show that in 1 year over 8 million different workmen made 11.5 million job changes. Two-thirds of these changes were to a completely different industry and one-half to a completely different occupation group.

situations * * *. Today's instruments are electronic and electrical in operation and require more complex knowledge * * *.

The same is true throughout industry. Our needs are rapidly growing for more skilled personnel.

In the past dozen years total industry plant maintenance cost has risen 50 percent, proof enough that servicing of production machinery has not significantly changed in many areas, while some have increased.

Adding to this is the tremendous increase in demand for equipment. Design, production, and proving in of such equipment has created the need for many more skilled personnel and has greatly expanded the special machinery industry.

What Happens to Skills?

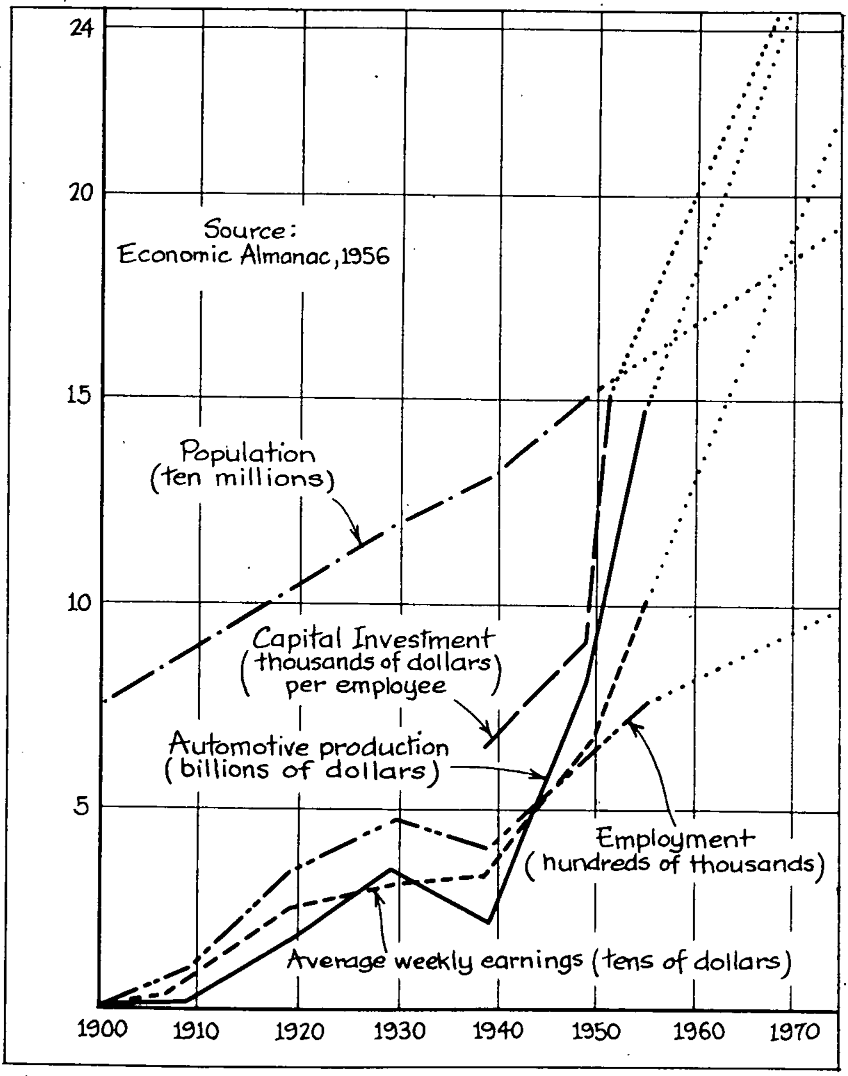
In studies of automation, much concern has been evidenced regarding the possibility of actual decline in skilled jobs. Concentration on production line jobs only has helped create this illusion. The facts are clear on this area—the need for skills really rises but not necessarily on the production line jobs.

It is a fact that major design effort in automating is directed toward making operations more automatic and self-policing. It follows as the day the night that the result is less need for a human operator to perform the machine tasks themselves. The graduation is toward machinery or process supervisors more highly and broadly skilled.

However, the big change and shift takes place into the supporting positions, the indirect labor increases in number and skill requirements overall. Studies of plants that have been automating during recent years show this trend plainly. The level of direct labor remains relatively static while indirect jobs grow.

Exhibit 8 shows this trend in the manufacturing field from 1947 to 1958 but the picture is similar for any significant period as automation has grown. Another part of this trend shows up in the growth of the skilled machinery building industry and the service industry. Part of the service industry growth has come from industry's need for highly skilled maintenance. Lack of skilled personnel has resulted in a significant rise in contract maintenance services. Here specialty groups service production plants on a regular and on-call basis. Electronics maintenance firms service all varieties of electronic controls and devices within a wide variety of industries. The need is still greater than the supply available and in some degree restricts the rapid advance into more sophisticated controls.

Exhibit 9



Automotive Employment, Population, Growth, and Earnings.

The move of the highly skilled into services and the service industry will continue. With the advance of automation into hitherto untapped areas such as lumbering, warehousing, merchandising, and small manufacturing plants, the necessity for specialty contract maintenance service will rise gradually. Even the need for such services to the homeowner is rising and as home equipment grows more sophisticated a spurt of growth in this area can be expected.

EDUCATION—THE MOST CRITICAL FACTOR

Innumerable conferences, meetings, seminars, and discussions have been held on the topic of automation during the past 5 years but all too little has been said about the most critical factor of all—education. Education is needed not only to help keep America in the scientific and engineering forefront but even more so to enable the entire population to take advantage of the rewarding opportunities that are present and that lay ahead.

There has been too little recognition of the fact that no full utilization of the opportunities in a technological age can be expected unless education of youth is complete. Understanding the rudiments of science and technology is imperative if one to adapt himself easily to the times. Appreciation of automation itself requires a broad technological outlook. Many whose high wages and livelihood depend upon automation have been prone to condemn the idea in other areas. Businessmen, although maintaining a profitable enterprise through automation, often fail to see the bigger picture in industry as a whole.

Even though we solve basic problems of adapting today to a gradually automating industry, the real problem will be in the tomorrows. Will our youth be ready to fit into a technological society and business world? When we look at the statistics on education—10 percent of youth are failing to complete grade school and a total of 30 percent high school—our concern should easily focus on this critical problem. With an inevitable decline in nonskilled jobs of all varieties, where will these future citizens fit into the picture? For one thing, effective industry training is dependent upon a good educational base. Indeed, personal stability and fulfillment in the years ahead will depend largely upon a broadening knowledge. Flexibility, adaptability, and facility in shifting from one area to another will become paramount.

Taking a long look ahead, our first concern should be a tremendously increased educational system with strong emphasis on better and more broadly trained educators in the public school systems.

The demand we are facing today is very different from any in the past. If we are to really make automation pay off nationally, all industry, labor, government, and community efforts will have to be combined to meet the demand for skills and abilities needed.

The primary emphasis will be on what has been termed "conceptual" skills rather than present "perceptual" kinds. As operations become more and more automated, personnel requirements move up the scale toward the management end. On-the-line production skills of machine-like varieties gradually disappear and higher levels take their place. While this trend is taking place, a good percentage of the jobs are translated to new areas developing.

To insure a continuing education advance, not only are programs of incentive needed at the high school level but also immediately and broadly at the industry level. It is imperative that broad-gage programs be instituted throughout industry to promote training and education. Supplementing apprentice training in skilled trades actively promoted by the U.S. Department of Labor, Bureau of Apprenticeship and Training, programs must be developed throughout industry to provide developmental opportunities at all levels. Such enlightened programs can include:

1. Orientation and on-the-job training.
2. Apprentice training to prepare employees for the skilled trades.
3. Graduate student courses which provide classroom training and work experience for recent college graduates.
4. Graduate study programs affiliated with universities and leading to master's and doctor's degrees.
5. Continued education in engineering and business administration on an undergraduate level, under company tuition plans.
6. Management training and development for potential supervisors, new supervisors, and experienced managers.

To advance these educational programs it is imperative that a joint industry-Government coordinating body be encouraged and activated. From this body suitable local community-education groups should be developed to create a unified approach. Flow of useful, reliable, and practical information and source data, readily available to all sectors of the country, would then be possible. Today's haphazard approach of laissez faire can hardly be expected to serve the needs in the years ahead.

A New Day

With the continuing growth of automation during the past decade, there has been evident a progressive change in the character of working conditions. Although there is great concern over possible ill effects, all too little is said about the advantages brought about by introduction of automation in manufacturing industries. Through expanding application, manufacturing concerns are fulfilling the highest requirements of industry—sufficient output to balance demands, competitive pricing, and adequate returns to labor and investor. "The task of industrial leadership," Henry Ford said in 1930, "is not to find jobs for as many men as possible but to find high-priced pobs for as many men as possible."

Most significant among the advantages apparent today is the rapid rise in professional, technician, and white collar jobs in these industries. Not to be overlooked, also, is the fact that automation is gradually invalidating the still-too-common practice of using labor as a commodity to match output with market demand.

Of concern to all of us is the direction in which industry is heading regarding labor. In all honesty, no really accurate and satisfactory answer can as yet be outlined in detail. Nevertheless, a general idea of expected changes can be gleaned as management gradually adjusts to evolutionary changes taking place. At the recent Southern Conference of the Controllers Institute of America, Dwayne Orton, educational consultant of IBM, presented one such interesting glimpse into the future with this statement:

> The older labor conditions of large supply and high rates of payroll to sales will change, and the problems of industrial relations will alter quantitative to qualitative. Labor expense will shift to labor investment. Labor will be capitalized rather than expensed. Volume of labor will be replaced by quality of labor. The concept of labor as the flex-

ible element to adjust to the business cycle will shift to the concept of labor as the element to be preserved. New forms of incentives for all levels of personnel will develop.

Change is inherent in the American scene. Along with technical changes wrought by automation will come a continuously improving working climate and a rising degree of industrial stewardship dedicated to the general welfare. Just how soon we will reach this new enlightened level of capitalized labor depends on vision and understanding leadership in both industry and labor circles.

Some Conclusions

A hard look at the whole economic and sociological picture today prompts some broad conclusions. First, we must study, develop, and use automation technology as much as possible to attain the maximum in benefits that are available. To do this we need practical, down-to-earth understanding and evaluation without group bias and without the "abstract, professional, and exclusive" cloud of obscurity that has surrounded the technology.

While it is considered unnecessary to go to the lengths of formulating a national policy on automation as Russia has done, yet it is desirable to recognize the state of our present development and realine general policy as needed to assert positive leadership and redirect the negative effects of some Government policies on business expansion.

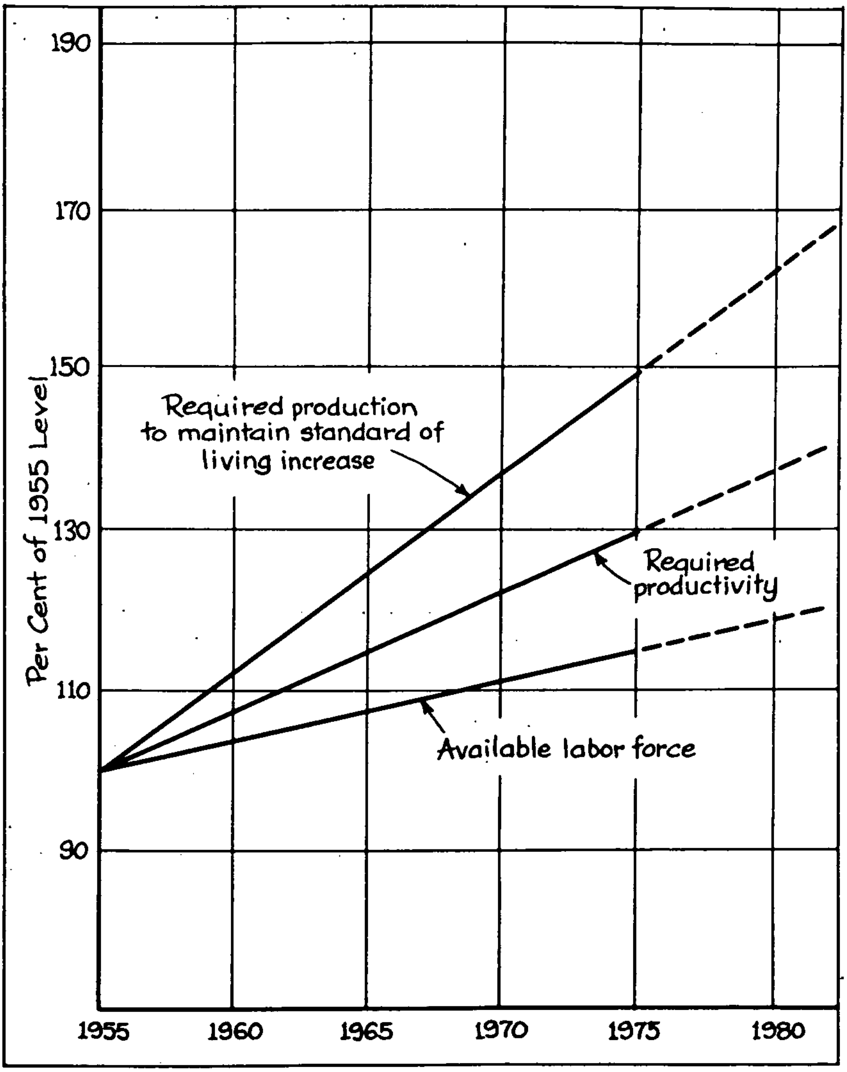
To foster a generally positive atmosphere in business encouraging improvements, to create a solid understanding among our citizens as to automation benefits and uses, to realine general policies to benefit the Nation as a whole, it is recommended that the following programs be sponsored and activated on a broad scale:

1. Enact legislation to provide capital moneys needed for automating small- and medium-size plant operations and to encourage availability of capital moneys on a broad base through suitable tax advantages to private investors and through increased depreciation return.
2. Provide positive stimulus to both individuals and to industrial firms in the small- and medium-size areas to promote inplant apprenticeships, on-the-job training courses, and special educational plans through direct tax advantages.
3. Provide direct aid to individuals who complete specified or accredited educational courses at all levels on a self-education basis through direct funds and/or through direct tax credit advantage to the individual.
4. Through present Government agencies stimulate development of new industries in distressed areas, especially diversified industries. Create a National Area Redevelopment Board to provide positive help and direct assistance in such redevelopment.
5. Encourage and aid individuals to relocate and readjust to severe displacement, if and when such is proved due to automation efforts or failure to automate. Provide some means to aid relocation or stimulate relocation of individuals through the incentive of tax advantage.
6. Create a National Automation Planning Board consisting of a select group of professional and experienced engineers with broad basic knowledge of practical automation, having consulting subgroups on detailed specific areas of automation technology, to serve as a cen-

tral clearinghouse of knowledge as well as a consulting panel for industry and Government guidance.

With some such organized and guiding precepts available it can be expected that free enterprise will seek and find its own most practical solutions to the problems ahead. Certainly stimulus through advantageous self-improvements holds the key to increasing advancement individually and industrially. Now is the time to plan aggressively for the dynamic sixties. We owe it to ourselves to be ready to take fullest advantage of all the opportunities that lie ahead.

EXHIBIT 10



LABOR FORCE AND STANDARD OF LIVING.

Appendix 1

Manufacturing Research and Capital Costs—Philosophical and Practical Considerations for Management

(By Roger W. Bolz, publisher-editor, Automation magazine)

Manufacturing industries have changed radically in general character over the past decade. Under the impact of automation few of the old parameters for decisionmaking remain valid today. Not the least of those requiring fresh approaches are capital equipment acquisition, equipment enginering, manufacturing research, industrial accounting procedures, and depreciation.

Perhaps most significant among the changes in the industrial picture is the dynamic rise in manufacturing engineering research. One lesson that has been learned through bitter experience in critical areas is that few industries can remain competitive without adequate investment in manufacturing research. No other factor is more potent in establishing the profit or loss position of any company.

Although most manufacturers pay for such research one way or another, proof of the fact that many already recognize the value of manufacturing research enough to invest consistently is plentiful. More than 25 percent of manufacturers today actually have regular staffs devoting time to this endeavor. Many more engage in such activity in less formal manner. The critical factor of note here is that in no other way will it be possible to combat inflation, rising wages, and competitive forces, both local and foreign.

The end result of manufacturing research is manufacturing equipment to carry out the newly developed or advanced methods of manufacture. Today this equipment is almost invariably of automated character, and here again the part played by research and engineering assumes a major role. Manufacturing engineering plays a dual role in development of improved lower cost production processes and in development of equipment to carry out these processes.

In the management of modern-day enterprises, the key part played by manufacturing engineering requires recognition from a technical standpoint first but, equally important, also from a capital acquisition standpoint. In the throes of the changes taking place it is all too easy for the engineering phase to become lost in clinging to past practices.

Not only is it desirable today to establish a formal group within the company or other means for development of new methods and machinery but it is also desirable to establish adequate means for handling such research and engineering costs. Adequate guideposts are already on hand and used widely enough to provide proof of advisability.

In evaluating your position for the coming decade it is desirable to raise a few questions: Is it safe businesswise to wait until competition forces the issue or is it better to be prepared with improved methods to maintain your profit ratio? Can you afford to take the attitude that someone else can pay for engineering your new automated equipment? Is it good business to bury equipment engineering costs in capital costs and hope for better depreciation allowances? Might not manufacturing enginering costs—largely research where automated equipment is concerned—provide a better financial picture if handled separately as they should be? A look at some of today's thinking on these subjects will offer some positive guideposts for action.

MANUFACTURING RESEARCH

Few other investments in manufacturing operations can equal the profits possible by means of new manufacturing techniques or innovations in production methods. Concentration of basic and applied research unfortunately has been primarily in terms of end products, not processes. In the scramble for new products the real values of new methods and equipment are easily overlooked.

This tendency to overlook the research and engineering phase of manufacturing has been emphasized by Eliot Janeway [1] with this comment:

> In recent years, the kind of engineering skills that set up production and make it tick have tended to get lost in the shuffle between the scientists at one extreme and labor at the other.

Fruitful research in manufacturing requires a thorough, continuing long-range program solidly backed by top management. Seldom can quick results be expected. In commenting on the value of superior research and development programs directed toward improved facilities and equipment, Mr. J. W. Keener, president and chief executive officer, B. F. Goodrich Co., says:

> * * * after a new capital facility is completed, it takes 6 months to 2 years for the plant to reach a profitable level of operation. Eleven new plants or expansions that have not yet made their contributions to B. F. Goodrich net income or to unconsolidated company equity growth should start producing income at conservative levels this year. Another 6 should become profitable in 1961 and 4 more in 1962 to 1964.

In altogether too many instances it appears that industry more or less expects production research to take place automatically when it comes time to replace equipment or tool up a new product. An common fallacy appears to be that all that is needed is a large number of quotations from equipment builders, without first researching and setting up rather complete specifications.[2]

As one works manager puts it:

> * * * if we are interested in some new equipment, for instance, we would contact all the manufacturers of this type of equipment. We would fully expect that these manufacturers in their quotations would include their engineering time to work out or develop systems or methods for our use. In such a case, the company that receives the order for this equipment is the one that is then reimbursed for the engineering time. The other manufacturers must charge this out as an ordinary company expense * * *.

[1] E. Janeway, "Tooling Up for the Aeronautic Age," Harvard Business Review, vol. 35, No. 6, November–December 1957, pp. 103–110.

[2] R. W. Bolz, "Engineering Automated Equipment—Who Pays?" Automation, vol. 6, No. 11, November 1959, pp. 58–64.

> In this age of automation to remain competitive we must be sure that we are buying the best equipment possible in order to be able to produce in the least time. Unless suppliers of equipment analyze tooling, methods, etc., thoroughly before quoting, we could never be sure that we were getting the best deal.

However, owing to the volume of such engineering work, equipment builders are finding it difficult to absorb such costs and either must decline to bid or shortcut the effort involved. D. E. Moat, vice president-marketing of Leeds & Northrup Co. indicates the problem this way:

> With the increasing complexity of the technical requirements today we have been forced to recognize that special engineering is a part of the production costs on special equipment. All manufacturers who are called upon to produce special equipment are moving in the direction of including these engineering costs as direct costs of sales rather than dealing with them through the applied overhead route. I believe that this is essential if we are to obtain accurate costs on special jobs, particularly when the amount of engineering will vary from job to job. At least this is the preferred procedure from the standpoint of the equipment manufacturer.

Another way of viewing the situation creates cause for real concern. Will a failure to recognize research and development costs in manufacturing processes result in a drying up of valuable sources? There is good reason and ample evidence to conclude it will. In commenting on the problem, G. E. Seavoy, vice president of Whiting Corp. has this pertinent comment:

> An example of this is an inquiry recently received for highly automated equipment in which pushbutton control was specified in a broad sense only as a requirement. Normally such equipment, nonautomated, would sell for $45,000 to $50,000. To do what the customer wanted would raise the selling price to $100,000 to $110,000. In order to make a safe estimate, over 3,000 hours of presale engineering would be required. At $6.00 per hour, this would represent gambling $18,000 in the preparation of a quotation with no assurance of getting the order.
>
> All this served, however, to formulate a policy with regard to situations like this, namely, that when the inquiry indicates that engineering will be relatively excessive, that the risks involved are accordingly abnormal, that it is border line in other aspects, either negotiate on a cost-plus-fixed-fee basis before making a quotation or else refuse to quote. Furthermore as equipment builders we would be uninterested in selling the engineering unless there were a commitment to buy the physical machinery.

In the same general vein, J. J. Jaeger, president of Pratt & Whitney Co. Inc., comments in this manner:

> * * * there is a correlated problem which many of the equipment manufacturers now recognize. It becomes increas-

> ingly difficult and expensive to study and arrange the proposals that are now being requested for many projects. It becomes a great question in my mind how much longer it will be possible to provide these quotations without some charge to the individual requesting these proposals. It appears in many cases that requests of this sort are being made for the basic information of the individual and in other cases merely to support another proposal that has already been basically accepted. I think this places an unfair burden on the manufacturer of equipment and it obviously must reflect in his average sales price of all equipments. I think you recognize that in like manner the direct engineering that is done on an order might well be considered a separate research expense; so too, might the proposal studies, which are required in many cases be viewable as a current expense rather than capitalized as a portion of the capitalized investment.

Regardless of whether activity, that of necessity today must be classified as engineering research, is carried out in-plant or obtained outside, it must be bought. There, of course, can be no "free" engineering realistically speaking. Good management demands recognition of both the urgent necessity for manufacturing research and the proper accounting procedures with which to handle it as a legitimate company expense.

CAPITALIZE OR EXPENSE

In recognizing all basic research, whether for a particular machine development or a complete line installation, it appears to be rather commonplace to expense such costs when development is carried on in-plant. In commenting on this phase, the general practice is pointed up by Edward N. Evans, president of Cambridge Wire Cloth Co.:

> We are most unfortunate in our type of manufacturing because there aren't standard spiraling machines obtainable to manufacture woven wire conveyor belts. Since these machines have to be made in our machine shop, we naturally find it necessary to do our own engineering and designing, which is handled as current manufacturing research expense.

Along these same lines is this statement from Kurt Hesdoerffer, administrator, automation and equipment development, Radio Corp. of America:

> It is the practice throughout RCA to budget engineering, development and "debugging" and run-in costs as overhead and to distribute these charges together with other overhead expenses throughout the division or department. Successful developments are capitalized on the basis of their reproductive cost.

That the research involved today in developing modern processing facilities is indeed recognized is evidenced by this comment from the president of another large concern:

> Today an extraordinary amount of research and engineering expense, both on the part of the purchaser in making preliminary studies of the need for such machinery and on the part of the supplier in designing and constructing special

purpose machinery, is incurred. In many cases the automation machinery supply people perform a segment of research and engineering development for the customer.

Studying engineering research costs from a general accounting standpoint provides a practical approach to the problem. The "Accountants' Handbook"[3] presents the basic considerations:

> Development costs may be incurred in large amounts in connection with some special department, project, or process, long after the business as a whole has been launched. Ideally such costs should be collected in an appropriately labeled account and treated as an asset until such time as it becomes proper to amortize the investment against the revenues realized, or, in the event that the result is unsatisfactory, to write off the item as a loss.
>
> The foregoing comments may be applied to costs of experimentation, testing and the like. Where such costs represent a regular activity of the business, necessary to maintain the position of the enterprise, they may well be treated as current charges; where such costs are incurred on a large scale in connection with some special project or undertaking, capitalization is not improper. In income tax administration, cases have arisen in which costs of developing patents and special processes have been excluded from current charges to income.

In following out such proposed procedure, the question often arises as to the practical aspects. Can such flexibility of handling costs be used? Is it acceptable? R. J. Van Dame, controller, Lincoln Electric Co., has this to say:

> As you are aware, section 174 of the Internal Revenue Code of 1954 permits a taxpayer to treat research expenditures, paid or incurred by him during a taxable year in connection with his business, as expenses which are not chargeable to his capital account. It has been our practice to deduct such charges from taxable income and, barring any change in the code, we would expect to continue this policy.
>
> On the other hand, if we were to place an order for some special machinery, involving a substantial amount of unusual engineering expense by the producer thereof, we would undoubtedly request an invoicing apart from the amount of machinery billing, because we feel that such engineering expense should be treated as a current manufacturing research expense rather than a capital investment.

In spite of many comments to the contrary, section 174 of the Internal Revenue Code of 1954 permits a selection of any of three basic methods for handling engineering and research costs in the manner most suitable.[4] These alternates are: (1) Charge the expenditures against income for the year in which it was paid or incurred; (2) defer the charges against future income starting amortization when benefits are first realized from the equipment and ranging up to 5 years; (3) charge the amounts expended to regular capital account.

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[3] Accountant's Handbook, 3d ed., Ronald Press Co., New York, 1955, p. 130.
[4] Internal Revenue Code of 1954, sec. 174: Final Income Tax Regulations, 1.174; "Federal Tax Guide Reports," Commerce Clearing House, Inc., Chicago, 1958.

Regulation section 1.174 points out that section 174 of the code applies only to specific areas of research and experimentation and pretty clearly outlines the application:

> * * * provisions of this section apply not only to costs paid or incurred by the taxpayer for research or experimentation undertaken directly by him but also to expenditures paid or incurred for research or experimentation carried on in his behalf by another person or organization (such as a research institute, foundation, engineering company, or similar contractor) * * *.

Some important considerations are involved in decisions concerning research expenditures, however, and must be seriously evaluated. Accurate determination of useful equipment life is a critical factor in selecting the proper method. Actual equipment construction costs such as labor, materials, etc., must be carefully segregated from the research, engineering, and experimentation costs not directly attributable to the machinery itself (see box). But, most important in the entire consideration is the risk involved. Where performance guarantees are exacted and, in fact, the taxpayer takes no risk, no portion of the expenditure can be deducted on a research or experimental basis.

Here, the buyer of equipment must be careful to understand the difference between engineering goals and performance guarantees in order to avoid limiting the assignment of such investments as deductible expenses:

> No deduction will be allowed if the taxpayer purchases another's product under a performance guarantee (whether express, implied, or imposed by local law) unless the guarantee is limited, to engineering specifications or otherwise, in such a way that economic utility is not taken into account * * *. Similarly, no deductible expense is incurred if a taxpayer enters into a contract for the construction of a new type of chemical processing plant under a turnkey contract guaranteeing a given annual production and a given consumption of raw material and fuel per unit. On the other hand, if the contract contained no guarantee of quality of production and of quantity of units in relation to consumption of raw material and fuel, and if real doubt existed as to the capabilities of the process, expenses for research or experimentation under the contract are at the taxpayer's risk and are deductible under section 174(a).

Discussion of this general problem with top management across industry indicates that practical use of these methods for handling such legitimate research costs is being made. Typical of such comment is that of Harris Zeitzew, director, manufacturing administrative department, Capitol Records, Inc.:

> We believe that developmental engineering costs should be treated as current expenses. Under present tax laws, we are authorized to take deduction for these expenses on a current basis, without being forced to capitalize any portion of such expenses. We feel that this policy should be continued, since we are securing an immediate tax advantage.

However, in the case of developmental engineering projects outof which some usable piece of equipment is finally developed for plant use, we believe that the equitable procedure would be to have the equipment appraised at the time of completion. The appraised value would include only those costs that would be incurred in the manufacture of a duplicate of the equipment. We would then be in a positon to charge our capital equipment account this amount, and could then credit our engineering development cost account. The excess cost above the actual amount capitalized would remain as a tax deduction.

Another strong case is made by B. F. Butts, vice president—production, Cinch Manufacturing Co.:

Specifically, we at Cinch Manufacturing Co. have invested heavily for years in automatic manufacturing equipment. These expenditures exceeding $100,000 per year have, for the most part, been designed for the assembly of electronic components, i.e.: Tube sockets, connectors. These products have, on the average, a short life due to technical obsolescence and are in most instances produced to specific customer design specifications. In view of these characteristics, the Bureau of Internal Revenue has allowed the full charge-off of all costs, including both design and construction, as an expense in the year of acquisition or on an as-completed basis.

This may well sound as if we have achieved a major concession. In some respects we may have received consideration, but all of these funds have been spent on products of a high degree of obsolescence and this appears to be a key point.

Another vice president of an automotive parts firm concurs:

This is sound thinking, and has been done for years by allocating such costs separately, rather than tying in with basic equipment costs.

Observing that individual practices will vary depending on the particular company fiscal and accounting policies, W. M. Moffatt, executive vice president, American Brass Co., has this to say:

In general it is our practice to charge all basic research, whether for a machine type or product line, to current expenses. Direct engineering costs for a successful machine are capitalized with the unit or units initially constructed. Engineering costs applicable to modifications due to faulty original design would be charged to current expense.

Depending upon interpretation of the code, there may be an area for some concern since the restrictions indicate if any research is expensed, all must be unless otherwise authorized by IRS. Here the overall company operations must be studied to evolve a suitable policy. This method of handling is evidenced in the comment of E. L. Goff, senior vice president, Associated Spring Corp.:

In this connection, special engineering is handled through Associated Spring research and development services, a large portion of the expense involved would come under the normal research budget. In special cases of prototype development on production equipment, the costs are charged back through expense and general burden distribution.

W. J. Delahanty, vice president, Burroughs Corp., comments pointedly:

> The obvious tax advantages, if these costs were to be written off as expense, have not been overlooked.

However, there is evidence that the advantages often are overlooked by other individuals. Witness such statements as:

> Whenever we purchase substantial machinery items, it is true that the vendors engineering is included, usually directly in the cost upon which their quotation is based. I doubt if the Treasury Department would permit the expensing of vendors engineering even if billed separately if it were in connection with an overall project.

There is need for careful segregation of expensable costs as indicated by M. J. Soberg, controller, Imperial Brass Manufacturing Co.:

> * * * costs of this nature are definitely expensable items. However, extreme care must be exercised in the handling of these charges. If an outside company were commissioned to build a special-purpose machine and no separation was made of engineering and research costs applicable to the special application, no grounds can be found for expensing a portion of the billed charges. If the charges are separated, they fall into the category of outside purchased services, these services being comparable to those rendered by our own machine design department.

In addition there is obvious value to having such detailed records, even though some executives feel that the work involved is an added expense. The value is basically underscored by this general superintendent's remark:

> It is my opinion that a standardized approach should be used which segregates the engineering and building costs and thus lends itself to complete analysis for the determination of quantity acquisition and replacements of outdated equipment or systems.

In the final analysis there appears to be a growing need for adequate recognition of research and experimental expenditures as a vital part of business operations. Today manufacturing engineering work of this nature must be accorded the same status as product development and research. There is real value to be gained not only in terms of solid accomplishment but also in terms of capital reserves, after-tax returns, and depreciation.

A LOOK AT DEPRECIATION

Acquisition of capital facilities invariably involves the problem of depreciation. There is no question that depreciation reform is highly desirable and necessary for meeting today's changed conditions. Use of unrealistic useful life spans for equipment creates considerable burden where relatively standard manufacturing equipment is involved. The story on automated equipment and plants, however, is considerably different and as discussed in this article involves a considerably different approach. Here research and experimental costs play an important role and need not be considered as an integral part of the cost to be capitalized.

The problem is highlighted in this remark by M. F. Hughes, controller, Faultless Caster Corp.:

> The next facet of the problem is the tax consideration involved. There has been a rather steady erosion of the purchasing power of the dollar during recent years. As a result depreciation reserves are no longer adequate to replace the capital equipment of industry. Under these circumstances, the financing of replacement equipment becomes increasingly difficult, and the improvement of capital facilities almost impossible.
>
> This situation is very graphically illustrated by the tremendous growth of leasing operations, wherein the prime factor in the decision to buy or lease is the immediately available income tax deduction of the rental payments under a lease agreement. It seems to me that tax considerations indicate there is much to recommend the charging of all engineering costs to current expense.

In commenting on the rate of return analyses for new equipment investments, Joel Dean[5] has stated:

> * * * the ranking of proposals will differ significantly from the before-tax ladder if taxes are correctly taken into account in computing rate of return. For example, accelerated amortization can convert a borderline project into a highly profitable investment opportunity.

In the same vein, Gordon Shillinglaw[6] observes:

> Expensable portions of the investment outlay and accelerated amortization influence the desirability of making some investments because, although they decrease the after-tax earnings in the initial year in the case of expensable items and in the early years with accelerated amortization, they do so by accelerating the Government's contribution (in the form of lower taxes). The net effect of these tax influences is, however, to reduce the amount of capital tied up in the facilities.

Unless there are some rather unusual conditions to consider, it is obviously most advantageous profitwise to write off costs as rapidly as possible. Authorities indicate this is especially true where income tax rates are high and there is no expectation for a significant increase in rate in the foreseeable future. Thus there is little advantage to burying manufacturing research costs in capital equipment.

Neither is there significant advantage in confining attention to selection between different methods of depreciation on machinery. Ad-

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[5] J. Dean, "Controls for Capital Expenditures," "Modern Management of Capital Expenditures," Financial Management Series No. 105, American Management Association, Inc., New York, 1953.

[6] G. Shillinglaw, "Measuring the Investment Worth of Capital Proposals," "Modern Management of Capital Expenditures," Financial Management Series No. 105, American Management Association, Inc., New York, 1953.

vantages in returns among the different methods are not nearly so large as the advantages found when applying fast writeoffs.

Actually, other factors being equal, the more rapid the writeoff for tax reasons, the faster the payback period. It has been shown by authorities that the more rapid the writeoff the greater the rate of return after income taxes. In addition are other advantages of importance:[7]

1. Generally speaking, if matters turn out badly, they will not turn out so badly with a rapid writeoff as they will with a slow writeoff.

2. In the common case where enterprise funds are limited, more cash is made available for productive use at an early date by a rapid writeoff than by a slow one.

Although there are many influencing factors that must be considered, the important point here that is also emphasized is proper recognition of current expenses that should be reflected in selling prices. Where current manufacturing engineering research and experimental expense is lumped in capitalized equipment, there is less chance for recovering all this investment through depreciation. Recovery is limited to that part used up through decrease in value of the machinery or plant system. Since this research effort must be of a continuing nature to remain competitive, depreciation return of capital for carrying on such work would be inadequate.

By using modern discounted cash flow techniques, bringing in the time effect on investment, it has been adequately proved that near-year returns far outweigh far-year returns. It is estimated that at a 10-percent discount factor a dollar of after-tax saving 20 years hence is only worth about 15 cents today. Realistic study of investment with this technique emphasizes immediate or short-term returns rather than long.

RECOGNIZE THE OPPORTUNITIES

As operations move more and more into automated systems, it appears desirable for management to carefully evaluate the methods for handling capital equipment additions. It is rather obvious that considerable variation exists in present procedures. There is much to be gained through a uniform approach. Not only can more accurate and detailed knowledge of real costs be assured but some larger business advantages are the prospect.

If it is wholly acceptable to expense costs as in-plant equipment development is carried out, is it any less desirable or unreasonable to similarly treat the same costs incurred in dealing with equipment builders? The problems are the same, the results little different, and the risks no less. In addition, the builder will be able to do a better job and, in many cases, remain actively in business.

With manufacturing research given its proper recognition and status there will be a far greater number of talented engineers attracted to this field of endeavor. Unlimited opportunities for increased production efficiency await those who organize the plan to meet the needs of the "automating 1960's." Manufacturing research and engineering will play a key role.

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[7] E. L. Grant and W. G. Ireson, "Principles of Engineering Economy," 4th ed., Ronald Press Co., New York, 1960, p. 317.

A PLAN FOR EQUIPMENT CONTRACTING

Because equipment can vary widely in character and complexity, the amount of special engineering and/or manufacturing research involved also varies. To properly handle various types of jobs, typical contracts are arranged to suit. As a guide, Glenn A. Barth, president, Barth Corp., submits this system for consideration:

1. *Firm price—design and build.*—Applies mainly to simple devices and simple special machines. If a firm price is required by the customer, sketches are made by design and priced by estimating.
2. *Firm price design—approximate price build.*—Applies to moderately simple equipment. Procedure same as for item 1 except firm price on build is reached after designs are completed and approved by customer.
3. *Firm price design—no price on build.*—Applies to relatively complex equipment. Firm price on build is reached after completion of design work.
4. *Approximate price design—approximate price build.*—This applies to complex equipment. Type of contract usually starts with customer authorization of initial design exenditures, usually a percentage of design price. Firm design price is reached during this design phase. Firm price on build is reached after completion of design work.
5. *Not to exceed initial price design.*—This contract is established on difficult and extremely complex equipment. It may include such phrases as "investigate the problem of" or "determine the feasibility of." Contract will terminate if project is not practical. If it is deemed practical, the stages that follow are: (*a*) Approximate design cost; (*b*) firm design cost; (*c*) firm build cost.
6. *Time and material—design and build.*—This is for subcontract work. Here complete details of the contract must be set up: (*a*) Total contract value; (*b*) design and build rates; (*c*) material and subcontract markup; (*d*) items classifying direct labor; (*e*) liaison engineering service charge; (*f*) terms.

APPENDIX 2

A LOOK INTO TOMORROW*

(By Joseph Harrington, Jr., Head, Mechanical Engineering Section, Engineering Division, Arthur D. Little, Inc., Cambridge, Mass.)

There is one thing which I think must be apparent to everyone. Automation is just one link in a long, long chain—the modern phrase of an infinite continuum called mechanization. It extends backward through many centuries to the dawn of civilization, and it will extend ahead through even more centuries. What has evolved in the past is history, but what will happen tomorrow is as yet unknown. It is, therefore, a safe area in which an after-dinner speaker can roam. It is also very intriguing, so let us take a look into tomorrow.

*This article is based on a paper presented at Fourth Conference on Manufacturing Automation cosponsored by Automation, Purdue University, and Manufacturing Engineering Council, April 1960.

I sense in the engineering world today an undercurrent of excitement which usually portends some great change. For hundreds of years we have been improving the productivity of our tools. Progress was slow in the days when handtools were driven by muscle power, but two centuries ago there was a sudden upward surge in the rate of progress when steam and then electric power were added to replace muscle power. Today we have a feeling we are on another point of inflection of this curve of productivity. We sense a forward surge not unlike that which we feel when the engines first drive a plane forward at takeoff.

I have asked myself what causes this feeling of change and turmoil. I think that is can be traced to two factors—one technological and one sociological. Both are relatively new, and both are very vital.

First is the recent advent of some powerful new techniques—systems engineering, servomechanisms, and reliable electronic equipment. All three were greatly perfected in the war years, and their impact on the industrial scene was clearly evident by the early 1950's. Self-controlled machines and preprogramed machines became practicable industrial realities.

Second is the artificially and unnecessarily induced fear in the minds of labor that the new class of machines would make the workman obsolete. They were told that pushbutton machines could and would do all the work, and to many a nonanalytical mind this concept held all the seeds of panic. The newly coined word, automation (whatever it meant), became anathema overnight, as if it were a Jack-and-the-beanstalk giant which had suddenly appeared and was uncontrollable. No wonder we feel that strange forces are astir.

ECONOMICS OF TECHNOLOGY

Actually, there is absolutely no mystery whatever in the technological future. The machines which will be offered to you for sale in 1965 are on the drawing boards now. The new materials and the new processes which will be announced in 1970 are already in the test tubes. All the engineers, research workers, economists, and workmen who will enter the area between 1960 and 1980 have already been born. If there is any mystery in the next decade, it is merely one of industrial secrecy or plain failure to communicate.

We know exactly where we are going, and who will be available to do the work. So let's stop worrying about miracles, at least for the next decade.

The real mysteries are now how we are going to automate—this conference is loaded with details about "how to do it"—but can we get it done, and can we then live with it. These really aren't engineering problems at all. (Probably that's why we are discussing them this evening, instead of during one of the technical sessions.) But we had better understand them, because we will be expected to solve them.

The public seems to reason, "Engineers invented the machines; let them solve the sociological problems they created." This is of course completely illogical, as you can see if we were to transfer the idea from the engineering profession to the medical profession, and require all married men to become obstetricians.

The two basic questions facing us are: (1) How can we form capital fast enough? (2) How can we educate people to live in an automated world? Any predictions for the world of tomorrow require an answer to these questions.

Let's explore the relationship of automation, productivity, wage rates, employment, and capital investment. So much has been written, and so many conflicting opinions have been flatly asserted about automation and our material welfare that it behooves us to understand as clearly as possible what these terms mean and how they are related. I am going to ask you to follow me, if you will, through an elementary exercise in economics, with subtitles in English. Economists use a so-called Clark diagram to illustrate the well-known relationship between wage rates and employment.

Assume for the moment that you are a manufacturer in a competitive market and that you have priced your product with as small a markup over the actual cost of labor and materials as is consistent with a reasonable profit on your investment. Now, if the wage rates are forced up without a corresponding increase in the productivity of the operators, you are faced with the unpleasant alternatives of either operating at an unprofitable level, going out of business, or raising your prices. An increase in price implies a decreased production in accordance with the well-known laws of supply and demand; and a smaller production means a smaller total employment in your plant.

If, for example, your original condition of equilibrium is represented by a point such as point A on this curve, figure 1, your new position will be represented by point B, which represents a somewhat higher wage rate and a decreased number of workers. Of course, the converse is true: If you enjoy a decreased labor rate, then you can employ more people.

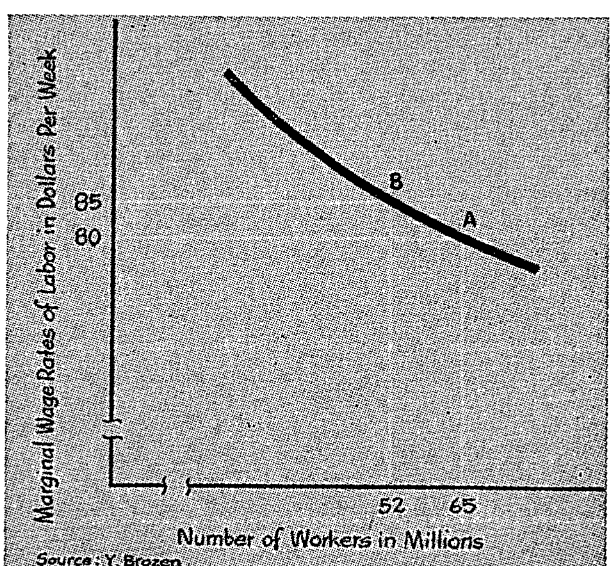


Fig. 1—Relationship of wage rates to employment is expressed graphically by the Clark Diagram.

Senator Douglas has studied the shape of this curve and has determined that the slope at the point at which the U.S. economy is operating is about -4. That is to say, an increase in wage rates, for example, from $80 to $85—which is about 6 percent—would cause more than a 20 percent decline in employment, all other things being equal.

In plain English, a man can't expect to get paid more if he doesn't produce more. If he insists, he puts his job in jeopardy.

Suppose you have been saddled with an increase in wage rates without a corresponding increase in productivity. How does this affect your thinking about automation? Do rising wage rates act as an incentive to greater automation? Obviously they do. The higher wage rates merely introduce a new factor in the old evaluation of the justification for mechanization.

When you are weighing the wisdom of installing a new line of machines, one of the contributory factors is the labor hours which will be saved by the new method or equipment. Now, if the price of labor per hour has increased, then the savings which will be accomplished by the proposed mechanization will similarly increase. Rising wage rates, therefore, do stimulate automation, all other factors being equal.

Now what does this do to our Clark diagram? Professor Brozen of the University of Chicago has demonstrated that with the availability of increasing mechanization, the new curve is in a higher position on the diagram, figure 2. The reasoning is that if the cost per unit for machinery goes down, then the cost per unit for labor can go up without increasing the total cost. You are still profitably and competitively in business.

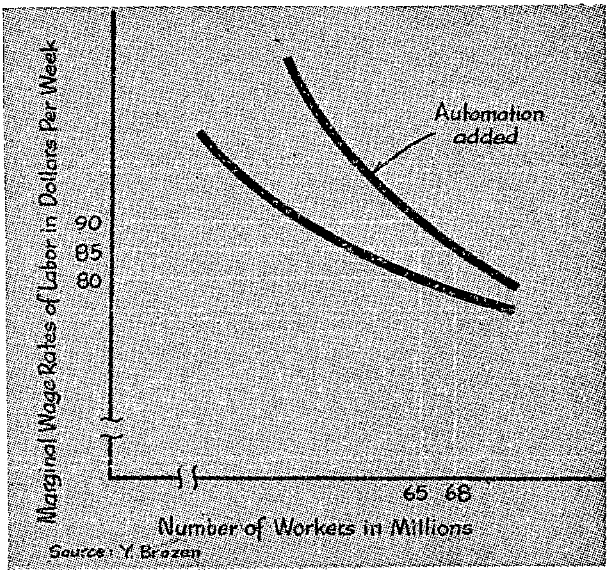


Fig. 2—Clark Diagram of *Fig.* 1 with additional curve portrays the effect of increased automation on the wage rates vs employment relationship.

This has been shown diagrammatically by the addition of another curve to our first diagram. As an example, it shows that where $80 wages corresponded to 65 million persons employed, $90 marginal wage rates can with automation be sustained with the same labor force.

What actually happens is that there is some increase in wages and some increase in the working force, and conditions will probably stabilize at some new point such as, in this example, an $85 marginal wage rate and a total labor force of 68 million. (These figures are illustrative, of course. They are not predictions of coming employment levels.) Thus, expansion of output and of employment both follow the increasing availability of more productive equipment.

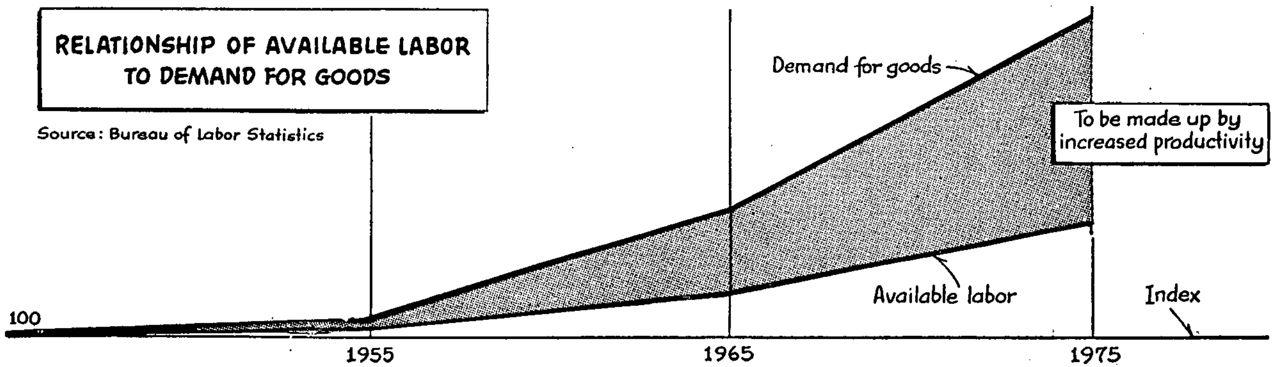
We have, therefore, demonstrated the interrelationship between automation, wage rates, and employment.

EMPLOYMENT OUTLOOK

A rise in machine productivity (automation) prevents unemployment; it does not cause it. To put it another way, if machine productivity had not increased over the past decade, unemployment would be greater now than it is. In plain English, a spiraling wage rate and a fixed output sucks in automation like a spiraling tornado sucks up shingles. We should not, therefore, fear automation, but accept it as a natural partner of the inevitably spiraling wage rates. Our real problem is to determine whether we can keep these two factors in balance.

In the past decade, both factors have been active: The employment-destroying effect of the tremendous increase in real wages and the employment-creating effect of automation. The former has been the dominant factor; and if it were not for the automation of the past decade, the Nation would be in really bad shape today.

In 1955, the Bureau of Labor Statistics made a long-range prediction that in the decade 1955–65 this country would experience a 50 percent increase in the demand for goods, with but a 15 percent increase in available man-hours to fill this demand. A similar increase in both demand and available man-hours was predicted for the following decade, 1965–75. These predictions reflect, on the one hand, a rapidly growing population and a steadily rising standard of living, and on the other hand a steady decrease in the number of hours per week devoted to productive labor by individuals and the steady decrease in the proportion of the population employed.


RELATIONSHIP OF AVAILABLE LABOR TO DEMAND FOR GOODS
Source: Bureau of Labor Statistics
Demand for goods
To be made up by increased productivity
Available labor
Index
100
1955
1965
1975

The discrepancy between the demand for goods and available man-hours to produce these goods can only be made up if there is a steady increase in productivity of the average worker. Mr. Ewan Clague, Commissioner of Labor Statistics of the U.S. Department of Labor, reports that a survey covering the years 1947–56 shows that the real product per man-hour increased at the rate of from 3.4 to 3.9 percent a year, depending on the particular concept used in measurement. It would seem that this rate, if continued, would just about permit us to keep up with the predicted demand.[1]

It seems anomalous that in an era of rapidly expanding population we have a decreasing number of productive man-hours per capita, but this is indeed a fact. If we are going to hold to our present increasing standard of living, we shall have to automate to the limit of our ability.

CAPITAL REQUIREMENT

Our capacity to automate is a direct function of our ability to form capital. This can't be done overnight. It costs a lot of money to automate and it takes a lot of time.

In 1950, Prof. Norbert Wiener, of MIT, wrote his famous prediction that factories would be fully automated in 10 years, or so the public—particularly the labor unions—understood him to say. It is now 1960: In all fairness we should note that the second edition of the book, "The Human Use of Human Beings," published in 1956, says:

> Short of * * * another great war, I should give a rough estimate that it will take the new tools 10 to 20 years *to come into their own.*[2]

[1] Clague points out that the impact of automation on productivity cannot be isolated quantitatively; there are too many factors affecting it.
[2] Italics added.

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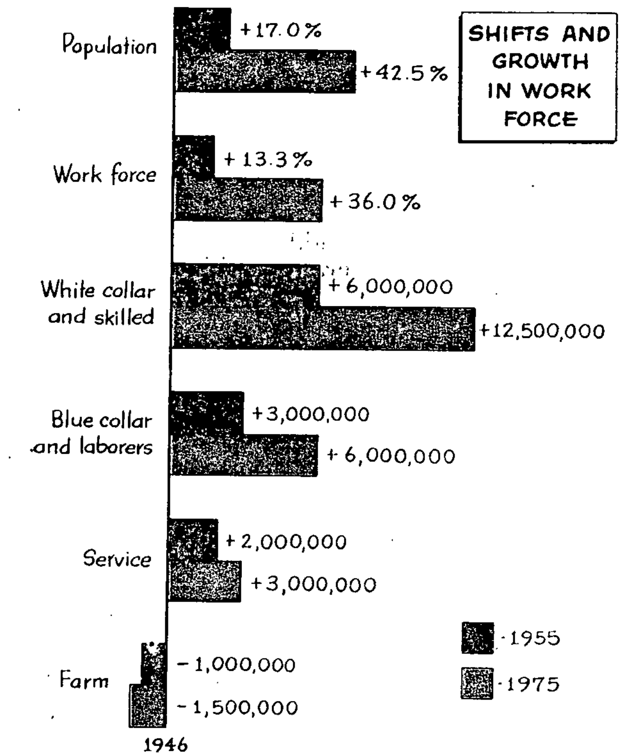

AUTOMATION—May 1960

Professor Brozen has estimated that the investment necessary to automate the manufacturing industry alone would run on the order of one-half a trillion dollars. Remember that $8 billion was spent in 1958 for capital formation over and above that necessary for replacement and keeping up with the population growth. Dividing one-half trillion dollars by $8 billion per year, we find that over 60 years would be required to raise all the manufacturing industry just up to the level of today's technology. By that time, technology would have moved far beyond where it is today. Also, bear in mind that today's technology is far from the 100 percent pushbutton stage.

This calculation pretty effectively answers Professor Wiener's fears. It also gives us one of the answers to our question of the possible place of, and limitation on, automation in the manufacturing industries. It seems safe to say that there will be a tremendous demand in the foreseeable future for capital investment in more productive equipment. We have more know-how than we can put to work. There just isn't enough money to go around, and it does take capital to put know-how to work.

There are a number of things which limit automation—lack of engineers, lack of energy or materials, lack of understanding on the part of management (which means lack of confidence), but above all lack of capital. We can't save enough money in this country to carry out all the things we know how to do. In fact, it looks as if we would have barely enough capital to keep our expanding population on an improving standard of living.

Our dilemma is that we want to have our cake and eat it too. We want full employment, but we want higher wages. We want our standard of living to increase, but we don't want to work for it; we want more leisure time and to spend our money on entertainment instead of putting it into savings, i.e., capital formation. Now if you really feel the need to worry about something, worry about that dilemma. It's worthy of your mettle.

What to do about it is a little out of my line. I'm sure if there were any obvious or easy answers, they would have been prescribed long ago. I suspect that unorthodox and possibly heroic measures will have to be taken to achieve a breakthrough but achieve it we must. That is our first major task for tomorrow.

EDUCATION NECESSARY

Now for our second basic question. How can we educate people to live in an automated world? We have been talking heretofore about wage rates, capital investments, and employment from the point of view of industry as a whole. Let's swing around now and talk about them from the individual's point of view. When automation comes, what happens to the workman's paycheck? What are his chances of losing his job? What will the new equipment require of him?

It can be shown that for every $1,000 invested in capital equipment here in the United States, $350 is added to the national income. No one person, of course, gets all of this. Twenty dollars of it goes for local real estate taxes, $50 of it goes to the Federal Government in corporate income taxes, $60 of it is interest or dividends and goes to those who saved up and invested the original $1,000 of capital, and the remainder, $220, goes to labor as increased wages. Clearly, it is to the benefit of labor as a whole to foster capital formation and investment in more productive machinery.

The truth of this can be demonstrated if you will stop to think of those industries which have made the greatest progress in automation in the last quarter of a century. Think of them, if you will—steel, automobiles, chemicals—and you will realize that each of them is outstanding for a high wage level.

Over and over again, we hear of cases in which a mechanization program has so stimulated the activities of a company that employment by the company has actually increased rather than decreased. There are, of course, some changes in job assignments in any such evolution, but these are resisted chiefly by those people too lazy to rise to the challenge of anything new even in progress in their own financial and organizational status.

There is a great deal of scare propaganda going around about technological unemployment. Actually, there is no such thing as technological unemployment. There may be technological displacement, but seldom do we pay much attention to the absorption of workers which occurs because of technological change. If there were technological unemployment, we would expect to see the greatest drop in employment in those arreas having had the greatest investment of capital in more productive equipment. Similarly, we would expect areas which have enjoyed scant mechanization to show the greatest stability of employment, but quite the contrary is true. For instance, the steel, automobile, telephone, and chemical industries have invested tremendous amounts of money in automation, and in every one of them we find that employment is vigorously increasing.

Just for the record, note too that more automatic machinery requires less physical effort, stamina, and endurance to operate. It calls for more judgment, experience, and stability. Thus, the older worker has a better chance of retaining his economic usefulness than he does without the advent of automation.

What about the absorption of workers which occurs because of technological change? There is a strange and alarming equation apparent in the development of automatic machinery. If you can justify the introduction of a new machine, you expect that the savings in labor, material, and other production costs will be equated to the costs of developing and building the new machine. While the expected savings come only partly from labor at the machine operator level, the development and construction of the automatic machinery is largely labor and draws upon highly skilled machinists, electronic technicians, and engineers. On a dollar-for-dollar basis over the 2- to 5-year payback period, we are absorbing scarce and expensive man-hours of skilled labor when we displace an equivalent value of semi-skilled labor. The scarcity of this skilled labor is one of the limiting factors on the pace of automation to which I referred a little while ago.

The record of the last decade shows clearly this transfer in the manufacturing industries from production workers to nonproduction workers, particularly scientists, engineers, and highly trained people of all sorts. At the turn of the century, 7 percent of the total work force was in the nonproduction category; today, the percentage is 24 percent. There will be a high premium in the future on educating, retraining, and upgrading workers. A trend has already set in but it must continue and even accelerate. I anticipate a lively demand in the next decade for skilled machinists, machine erectors, electronic maintenance men, instrument technicians, and computer operators, as well as for engineers, designers, and inventors.

In the long term, then, automation is going to put a tremendous burden on the educational talents of the country, for engineers, economists, technologists, technicians, and maintenance men are going to have to be trained to conceive, design, build, and service automatic machines. This burden must be carried by both the public schools, the colleges, and the universities on the one hand, and by industry itself on the other. Even organized labor is taking a part in upgrading and retraining its members. Where essential, industry and labor can retrain those members of today's work force, but the thing to worry about is how to give the right training to the next generation as it is growing up.

Apparently a key problem is the creation of interest in scientific and engineering training amongst the high-school students of today. In spite of the current efforts to interest young people in scientific or technical careers, we are not getting a corresponding upsurge of entering students. In the post-sputnik clamor for engineering training in our schools, the leading educators in this country spoke up firmly against the abandonment of fundamental training in the liberal arts. And they were quite correct in doing so. What it comes down to is that we need to get both the liberal arts and the engineering training if we are to remain abreast of progress. And this means more and harder work for the young people.

Previous generations of young people in this country, and young people in other parts of the world today, have thrived on a far heavier workload than our youth seem inclined to carry. If I may be permitted, I would point my finger at this as one of the key problems of the day.

We must exert every effort to train young men and women in science, engineering, and technology to meet the technical demands of a mechanized civilization; and we must also exert every effort to train them in liberal arts to meet the problems of personal and civil life in this increasingly complex world.

And that is our second major task for tomorrow.

STATEMENT OF WALTER BUCKINGHAM, DIRECTOR, SCHOOL OF INDUSTRIAL MANAGEMENT, GEORGIA INSTITUTE OF TECHNOLOGY*

Effect on Employment

The long-run record of technological growth has been one of increasing job opportunities. Case after case can be cited to show that total employment in firms and entire industries has increased following the introduction of mechanization or automation. The telephone industry offers a typical, though perhaps spectacular, example. Automatic dial equipment began to be introduced about 1920. Today 89 percent of telephone callers in the United States get their connections automatically. Since 1920, employment in the Bell System has increased from 200,000 to about 600,000. The oil industry also began to use continuous flow refining methods about 1920 and in this industry employment has since doubled. However, these particular industries have had a great overall economic expansion so the increase in employment cannot be attributed entirely to automation.

These cases, therefore, represent only one side of the picture. There are equally dramatic statistics to show declining employment in other industries. A million railroad jobs have disappeared in the last 20 years and the persistence of over 50 depressed areas where unemployment persists at 6 to 14 percent, even while inflation threatens, keeps the specter of hard times alive. Obviously automation is not the sole cause of this unemployment any more than it is responsible for the great expansion of jobs in other industries.

Stable full employment, even a labor shortage, could conceivably occur after 1980 but only if the most authoritative population forecasts turn out to be wrong. Remember there is about a 20-year time lag between birth and entrance into the labor force. Children already born practically insure no labor shortage for nearly two decades and current trends would have to reverse completely to remove the specter of unemployment. According to the latest prediction of the U.S. Department of Labor, the increase in workers entering the labor force in the 1960's will be by far the largest of any decade in history.[1] This is a 50 percent greater increase than the 1950's. The total labor force will grow by 20 percent, up 13.5 million to 87 million by 1970. Beyond that, U.S. population is excepted to grow by a record 28 million to 208 million by 1970. If this occurs the workforce beyond 1980 will be glutted with entrants seeking jobs. Most spectacular is the U.S. Labor Department revelation that in the year 1965, the number of young people reaching the age of 18 (when they normally enter the labor force) will make a sudden and drastic 50 percent jump from its

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*The material in this statement is drawn from a book, "Automation: Its Economic and Social Impact," to be published soon by Harper & Bros., New York.

[1] "Manpower: Challenge of the 1960's," U.S. Government Printing Office, 1960.

usual annual growth of about 2.6 million to 3.8 million. Since this prediction is based on children already growing up, a serious depression could result in 1965 from this cause alone if there is not proper economic planning to prevent it. Furthermore, the U.S. Department of Labor now predicts the number of women workers will increase at twice the rate for men in the 1960's. By 1970, there will be 30 million women seeking jobs in the United States.

Decline in Production Workers

Output has risen enormously in several industries which have been automating, yet the number of direct production workers has not increased. In the rapidly automating oil refining industry production workers fell by 10,000 during the decade ending 1957 although total operating capacity rose from 5.3 to 8.4 million barrels daily. In the chemical industry production rose 19 percent from 1956 to 1958 while production workers shrank by 36,000. Fifty percent more automobiles are produced today with no more employees than in 1947 and 12 men today produce a ton of steel an hour as against 20 in 1941.

In the last decade, which was characterized by the most rapid scientific development in history, output of all goods and services in the United States rose about 50 percent (in terms of constant 1954 prices), total employment increased 15 percent but employment of direct production workers remained about constant although population rose over 12 percent. The Bureau of Labor Statistics reports that in the last 10 years "nonproduction" workers in manufacturing have increased at about 15 times as fast as production workers. The American Machinist magazine recently reported about 40 percent of firms surveyed required more skilled maintenance men and 21 percent hired more engineers after automation. Managers, clerks, and professional, technical, and service workers are all growing rapidly as a percentage of the workforce; craftsmen and foremen are remaining about the same; and semiskilled and unskilled workers are falling slightly and farmers are declining drastically.

In another survey of 1,574 metalworking companies, the magazine American Machinist, reported that about a fifth said that they had recently installed automatic loading, transfer, or assembly equipment. Only 26 percent of these reported an increase in employment, the average increase being 21 percent. Fifty-one percent of the firms reported no change in employment while 23 percent reported decreases averaging 16 percent.

Silent Firing

In apparent contradiction to these overall industry statistics, the BLS automation studies revealed that few if any regular employees were laid off as a direct result of automation. In the television manufacturer case, for example, assembly workers were reduced but the employees in the riveting, packing, and shipping departments were barely affected. In the bakery study, the plant was automated in 1952 and in 1953 the workforce was down by 4.4 percent due partly to layoffs and partly to normal attrition. The next year, however, sales increased, output expanded and employment rose 3.6 percent. By 1955, total employment had reached its highest peak since 1951—about 6 percent above the 1951 level.

There are two explanations for these discrepancies. First, in all of the BLS case studies automation was introduced during prosperity when there was expanding employment. Permanent reductions in the workforce due to technological changes are apparently sometimes postponed until a general downturn permits layoffs to be blamed on national or international conditions. Then, when recovery occurs, fewer are recalled than were laid off.[2] Since businessmen are sensitive about public relations effects of layoffs, some university research investigators have voiced the suspicion that they have had easier access to data in those firms where the introduction of automation coincided with increased employment.

This is why unemployment remained so high after the 1957–58 recession. There are about 160,000 unemployed in Detroit who will probably never go back to making automobiles, partly because the industry is past its peak of growth and partly because automation has taken their jobs. Steelworkers returning after the 1958 recession found the same work being done by 20 percent less men. Possibly half of the Nation's 400,000 soft coal miners may have to leave the industry for good.

Some large employers have admitted that they timed layoffs to coincide with periods of recession when general business conditions could be blamed even though increased efficiency from automation was the underlying cause of employee reductions. When the economic recovery came in late 1958 and early 1959 they anticipated further investment in automation and were hence cautious about rehiring. One of the Nation's top executives was quoted by New York Financial Columnist Sylvia Porter (Mar. 10, 1959) as saying:

> I'd rather have our employees work a longer week and pay overtime than add one more man than necessary to the payroll. * * * It's cheaper to pay the extra expense of overtime than to pay the extra expense of a public relations drive to explain a layoff.

Second, automation has apparently proceeded slowly enough so far to allow normal turnover to disguise some of its effects. For example, the manufacturer of TV sets studied by the BLS showed no employees laid off as a result of automation. In fact, new job classifications and new machine-tending jobs were created. But it took advantage of a high turnover of women workers and simply cut back its hiring when automation began.

A changeover to office automation usually takes longer than in the factory. The continuity of office operations cannot be interrupted and the data of the old arrangement usually cannot be transferred directly to the new system. There is no way of stockpiling materials or products in advance and little opportunity to make trial runs. Typically, the transaction must therefore involve several distinct stages during which time at least three separate work forces are needed—one to continue the old system, one to convert records and procedures to the new system and one to initiate and operate the new system. This is analogous to a relay race in which the new runner must already be running at full speed before the torch can be handed to him and the

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[2] Charles Killingworth, "Automation in Manufacturing," I.R.R.A., Dec. 28, 1958. See, also, Fortune, November 1958, pp. 241–242, for supporting statistics.

old runner can retire from the race. A changeover to an electronic data processing system embodies a compounding of technological and organizational changes in a continuing operation and typically takes from 6 months to 4 years. For example, in the TV manufacturing plant studied by the BLS, automation was introduced in two stages in a period of about 3 years. Printed circuits were substituted for hand wiring. Then 2 years later, a mechanical device to insert the components was introduced to replace hand soldering.

Therefore, the problem becomes not the worker who is fired but the worker who is not hired. The unions call this "silent firing." The major problem is a transfer one, displacement, not general unemployment. What do you do with a surplus of some kinds of labor and a shortage of other kinds at the same time, or a surplus in one location and a shortage in another? Jobs not upgraded in the short run may be in the long run. Whether people can be upgraded to fill them is a matter best considered as a problem of the absorption of displaced workers.

Unemployment Versus Displacement

The often expressed fear that automation leads to unemployment is somewhat exaggerated for three reasons. First, even partial automation will probably be limited to industries which employ at the most, a little less than half of the U.S. labor force. This is the manufacturing sector (which comprises 25 percent of all workers) and office clerks in large firms which account for another 15 percent. Yet manufacturing is the most highly union-organized sector. Second, automatic controls do not replace the labor force entirely, although in terms of labor hours there is a considerable saving. As routine clerical and operative jobs are abolished, new maintenance and technical jobs are created which go far toward offsetting the loss of former jobs. Third, extensive training and educational programs will be required as the labor force is upgraded and these will to some extent counteract unemployment by delaying entry into the labor market.

The impact of automation on the individuals affected should not be underestimated, however. Don Mitchell, chairman of the board and former Sylvania Electric Products Corp. president, said:

> It doesn't do much good to try to convince an individual worker that over a 25-year span there is no such thing as technological unemployment. He doesn't care whether there is or not. All he is worried about is that he lost a job.

Those who disparage fears of technological unemployment often assume the existence of a self-adjusting labor market. There is a real danger that imperfections in the labor market will seriously delay absorption of the displaced workers.

Neither automation nor technological growth in general have so far caused any lasting unemployment but there has been considerable labor displacement. Displacement is not the same as unemployment, of course, since displacement is an individual matter while unemployment is an aggregate. A displaced worker is counted as unemployed only when he cannot find another job within a reasonable time. In the past as machinery has replaced men in production, energy has been released which was partly absorbed by expansion of employment in travel, entertainment, and personal services. Automation should accelerate this process. There are plenty of facts to show that the less mechanized service industries have already experienced a consistent growth of employment at the expense of the more mechanized goods producing industries. In recent years service employment doubled while goods producing employment was increasing by only 4 percent.

The BLS case studies of displacement from automation indicate the highly particular and individual nature of the problem. In the automated bakery it was found that only 5 percent of workers were displaced by automation although it had been expected that 25 percent would be. Furthermore, it was expected that expansion of the business would permit rehiring of these same people into new and more highly skilled jobs. The workers most affected in the bakery were materials handlers, break mixer helpers and hand wrappers. Strong efforts were made by management to reassign these workers to new jobs. Because of a determination to keep the new building as clean as possible, new sanitation jobs were established and some of the displaced bread wrappers and helpers were transferred to them.

In the BLS oil refinery study only 1 of the 164 workers directly affected by automation was actually laid off although 81 workers were displaced. Of these, 67 were reabsorbed into other jobs with the firm and all classifications equal to or higher than the ones they lost except for a few individuals who took lower classifications by choice. There were thus only a few cases of downgrading. Of the 14 workers who were no longer with the company after automation was installed, all either retired on pensions or quit voluntarily. In another department of the same firm 62 workers were displaced, 47 of whom were offered jobs comparable to their old ones in the same plant.

Another case pinpoints the problem more specifically. A carefully conducted study of the Murray Body Co. showed that when 5,000 workers were released in the highly prosperous year 1954, 29 percent had still not found new jobs a year later. Many of the younger workers found new employment easily, and apparently some benefited by being forced out of dead end jobs and into better opportunities. But for three other classes of workers there was only tragedy. "Older" workers (over 45) were out of work an average of 6 months (compared to 3 months for all workers together) and 82 percent used up all of their unemployment compensation before finding another job and had to retire into dependency on others or social security. All of the women exhausted their unemployment compensation benefits and only half ever found other jobs. Many of these were at lower skills and wages. Negroes also fared badly. While the average wage cut of all those workers who found new jobs was 9 cents an hour, Negroes on the average had a wage cut 60 percent greater than this.

Problems like this are not likely to ease as the percentages of older people and Negroes rise and the number of women seeking employment increases. The U.S. Department of Labor expects a 70-percent increase in people over the age of 70 by 1975 as against 17 percent increase in those of the 25–44 or "prime of life" group. Negro birth rates exceed whites and the percentage of women seeking employment is also rising. Already this problem is being felt. For example, the percentage of Negroes out of work to total unemployment in major industrial centers in mid-1959 was roughly double their percentage in the total population. It may be that "today's laborer is tomorrow's electronic engineer" but, as George Schultz says, "It is stretching language and compressing reality to say that semiskilled operators can easily become high skilled technicians." It is equally doubtful that the tremendous reduction in clerical jobs, held mostly by women, that office automation has caused will lead to expanding opportunities for women elsewhere. Nor will the displacement of unskilled Negroes necessarily ease the upward mobility of Negroes into skilled or professional jobs. Automation does not upgrade people, only their jobs. This vital distinction highlights the crucial transitional problem.

Types of Displacement

Displacement of labor takes several forms. First, a worker may be permanently laid off with loss of seniority and other job rights. This kind of displacement from automation seems to be relatively rare. A second but also direct form of displacement involves transfer of the displaced worker to another department of the same firm. Several BLS case studies have found this to be a common occurrence. The decline in employment in production in the automobile industry has included both of these types. Third, indirect displacement may result through vertical integration due to automation. An example is the case of the Murray Body Co. that formerly supplied a third of the Ford Motor Co.'s body parts. When Ford automated its stamping plants, no Ford employees were displaced, but 5,000 Murray employees lost their jobs.

Fourth, indirect displacement may arise when automation causes horizontal integration by increasing optimum plant size to the extent that smaller firms are forced out of the market by competition. Walter Reuther aptly remarked that "automation in Detroit causes unemployment in South Bend," referring to the fact that the Studebaker plant in South Bend could not compete with the more highly automated General Motors and Ford plants in Detroit. Another example from the automobile industry illustrates this. Packard and Hudson have been forced out of the automobile business in part because they could not afford to enlarge their plants and markets sufficiently to match their larger automated competitors. Toward the end Packard produced all its own engines and those for the large Hudson on one automated engine line but even this volume was too small to utilize the automated equipment fully.[3]

A fifth form of displacement is in the so-called hidden unemployment of downgrading. It is true that automation creates a demand for new skills of a higher order and no doubt there will be a long run upgrading of the labor force. However, because automation renders many skills obsolete and dilutes other skills by further division of labor, and since the new skills require extensive training and education, workers may not be able to move easily into the new jobs. When they cannot they are often downgraded in work even though their pay may not be reduced. This underemployment is often overlooked in the total employment statistics.

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[3] James Stern, "Fact, Fiction, and Folklore of Automation." A paper presented to the Industrial Relations Research Association, Chicago, Dec. 28, 1958.

Absorption of the Displaced

What can be done for the worker who is displaced by automation? If he is young and energetic enough he can be trained for promotion to one of the new, high-skilled jobs created by advancing technology. If he is only moderately adaptable he may be trained or developed to keep pace with changing job requirements as his trade evolves. If he no longer has the zest, ability, or youth to learn higher or newer responsibilities he may be transferred laterally to another job with similar requirements to the one just abolished. In time this new position may disappear but time heals many wounds and in time this employee may not be replaced when he retires.

The barriers to labor mobility have always been great, but even in the face of increasing concentration of capital it is likely that labor is more mobile and flexible today than ever before. Cheap transportation, improved communication, and the disintegration of family and community ties, which specialization and industrialization have encouraged, all tend to make for labor flexibility among firms in the same industry or firms offering similar jobs. However, movement among occupations, particularly to more highly skilled jobs, entails great costs which individual workers cannot normally bear and this is exactly the kind of mobility which automation will require.

Rationality, self-interest, mobility, and flexibility, while highly desirable means of making industry more efficient and resource allocation more rational, are not ends in themselves. Too much of these make pirates of businessmen, gypsies out of workers and, in general, irresponsible citizens who do not own real property, vote, or assume civic responsibilities. On the other hand, too little of these qualities makes for narrow provincialism, ignorance, waste and a great loss of potential accomplishments.

It is not necessary that all workers be equally sensitive to changes in the demand for labor or differences in opportunities. A highly mobile minority in each occupational group will usually preserve the necessary flexibility of supply except where there are structural changes taking place such as automation may produce. The individual rewards for mobility, and penalties for immobility, seem likely to increase. This will favor young, aggressive workers with few family responsibilities and discriminate against older, more settled workers. It also may encourage the opportunists and the irresponsible as against the more stable elements in the work force.

There is no reason why labor should be more mobile, flexible, and willing to assume the enormous risks of economic dislocation than the other components of production—capital, management, and natural resources—which are to varying degrees organized, concentrated, and immobilized. The possible loss of an unrealized profit or, at most, the loss of a business investment may be a greater disadvantage to the growth of the economy but it is usually not as severe a personal hardship as the loss of a job is to a worker.

Displacement does not always cause hardships, of course. Young workers may be benefited by being squeezed out of dead-end jobs they drifted into by accident or out of archaic business that they inherited. The best favor that some people can receive is to be forced into more productive opportunities. The displacement problem is partly relieved because most of the really spectacular growth of automation so far has been in clerical work and in some particular industries, such as telecommunications, where there has been a great economic expansion anyway. In these areas automation performs new tasks more than replacing old ones and it has been women workers who have been most affected. Women tend to change jobs more frequently than men and are often working merely to supplement the incomes of their husbands or parents. Hence, they are not always totally dependent on their jobs for a livelihood. This fact has helped automation to be introduced without causing many obvious hardships or much noticeable unemployment. Layoffs have remained constant and even fallen in some industries, but the hiring rates have fallen even more. The displacement problem has been disguised by normal labor turnover, the more than proportional impact on women who are often not the sole support of a family, and the general economic expansion.

This situation also characterized the earlier mechanization process. Glassblowers and woodcarvers practically vanished before the demand for their skills had completely disappeared. A shortage of blacksmiths and a demand for horseshoeing lingered well into the 20th century after the advent of the automobile. The general effect has been a reduction of hiring of workers with unneeded skills although periodic layoffs are not unknown and are frequently severe. The displaced worker is thus usually not fired. He is just not hired in the first place.

The threat of displacement from automation, in the foreseeable future, faces only part of the workers in industries employing about 40 percent of the total labor force. This includes clerks in business as well as manufacturing workers for which the necessary education and training will delay the entry of young people into the labor force. Unfortunately most of the displacement is concentrated in a few industrial centers. In the long run the service industries will probably take up most of the slack. But since there is no automatic regulator in the economic system that guarantees full employment these conclusions must assume a continued economic expansion. As automation advances in our basic industries, the American economy becomes like a rocket which must continue to accelerate or else fall from the sky. Whether this overall expansion will continue is an important question.

In the past, undue unemployment has been prevented by general economic expansion, except for relatively short recessions like 1958, special problem areas like Detroit and parts of West Virginia, and of course, the great depression of the 1930's. Those workers no longer needed in manufacturing have been eventually absorbed in new industries, or in the service areas. How long this absorption takes is in large part up to the Government. Full employment and expanding markets are vital prerequisites to a rate of absorption of displaced workers that will avoid acute personal hardships and general injustice to workers. Full, stable employment is not only politically expedient and socially desirable. Automation makes it economically necessary for two reasons. First, the increased capital investment makes nearly continuous use of plant and equipment imperative. Idle capacity is too expensive to have for long. Second, the labor force, in general, is becoming more highly skilled. This means longer and more expensive training programs are needed and therefore labor turnover becomes less tolerable.

Displacement of labor is inevitable from automation as indeed it is from all technological change. The tractor displaced millions of horses; but workers can never again be treated like horses and displacement cannot be allowed to accumulate into pools of unemployment. Leaders of management and labor must jointly assume responsibility for relieving the hardships caused by automation. Relieving, of course, does not mean holding back technological progress. Workers will still have to move from place to place, change occupations and adopt new attitudes, but business firms and governments will need to pay a larger share of the cost.

In times or places where there is unemployment or underemployment of labor (or other resources) there is no economic cost of producing anything that utilizes them since nothing is given up or lost by their activities. Much in fact may be gained. If normal turnover of workers can be supplemented with retraining programs and enlarged and liberalized employee benefit programs, such as severance pay, unemployment compensation, and moving expenses, then labor displacement from automation can be comfortably absorbed and need not lead to excessive downgrading or unemployment. Large unions have already negotiated transfer rights for displaced workers to other plants of the corporation without loss of seniority. They have also secured increases in age maximums for entrance to apprenticeable trades in some cases and are asking for higher age limits for eligibility to company-sponsored retraining programs. All these measures should increase labor mobility either geographically or occupationally.

In view of the rapid growth of automation there may be an increased likelihood of abandonment of plants and the creation of depressed areas. There are several such areas already in Pennsylvania, Michigan, and West Virginia. If one large firm adopts automatic operations, other firms in the industry may have to scrap or sell undepreciated machinery and adopt similar techniques or be squeezed out of the industry by the lower costs of their automatized rivals. Entire communities could become ghost towns if this happens. Under these circumstances, older workers with accumulated seniority and higher skills are most affected. Although there should be no long-run attempt to freeze existing industrial patterns, nevertheless, some kind of direct assistance may become necessary to mitigate the most acute hardships in these distressed areas.

Some considerable aid could result from requiring the firms that are seeking lower cost locations to bear a larger share of the social costs of their operations. For example, the costs of moving workers and their families, earlier retirement under pension plans, increased unemployment pay and retraining programs should be borne largely by the firm. Industries composed of large and expanding firms could guarantee some minimum annual wage. Other costs would have to be borne by the Government. For example, a greatly expanded free employment service would facilitate mobility and reduce frictional unemployment. Public works projects in distressed locations would provide jobs which would generate the purchasing power necessary to sustain business.

Those who say that there is no such thing as technological unemployment are right if they mean that, in the past, depressions and mass unemployment cannot directly be traced to technological progress. But this is not to say that there is no such thing as technological displacement. Displacement of labor and other productive elements are essential elements of automation as well as the older mechanization. Personal hardships caused by this displacement must be insured against but it is important to remember that the displacement itself must not be prevented. Free movement of workers, capital, and natural resources among alternative occupations and geographical areas are necessary for obtaining the benefits of technological progress. Without flexibility and mobility of productive resources of all kinds, our economy would stagnate and the rich harvest from economic progress would be lost.

Displacement can lead to unemployment but it need not. There must be certain conditions prevailing in a country if individual worker displacement is not to snowball into severe unemployment. Since automation creates new jobs as it destroys old ones, the rate of automation emerges as a critical factor. To control this rate and ease the transition hardships, management and labor must first join in assuming the responsibility for preventing those individual hardships and tragedies that are inevitable from automation. Second, it is the responsibility of the Government to guarantee full, steady employment and conditions conducive to economic expansion. Ralph Cordiner, chairman of the board of General Electric, put it this way:

> If, in spite of the best planning we can do, some people are temporarily unemployed because of technological change, both industry and Government have a recognized responsibility to help families through any such periods of transition.

If automation is to benefit labor it will have to be largely through its effect on the national economy and not through its impact on the plant. Physical working conditions are undoubtedly improved but there is no other definitely established benefit to workers. Job opportunities in factory production have been substantially reduced. But these reductions have been offset by expansion of the service industries. However, the continuation of these opportunities is due more to forces determining national economic growth than to developments within the firm, such as automation. For the most part, overall economic growth will probably have to provide the economic environment in which new entrants to the work force and the victims of "silent firing," such as forced job transfers, will be able to find opportunities for employment.

Safety—Physical and Emotional

Automation improves working conditions in several ways. First, in nearly every case there is greater safety. This is due to mechanized materials handling, elimination of the most hazardous jobs, and the reduction of the number of people in direct production areas due to remote controls such as monitoring dangerous operations with electric eye or television equipment. Hernia, eye troubles, and foot accidents have virtually disappeared in the Ford Motor Co.'s automated Cleveland engine plant. In one major automotive stamping plant scrap steel formerly was collected at individual scrap collection areas where it was baled and moved on open conveyors to the central collection area. Workmen were exposed to physical dangers and there were frequent injuries. Automatic equipment now loads the scrap into balers and closed conveyors move it to the collection area where it is automatically loaded. The whole process is monitored by television.

In the pottery industry, silica dust has long been a hazard. Closed silos and automatic conveyors now handle all of dust-producing materials. In the chemical and petroleum refining industries potential toxic exposures were always a great risk. Automation has reduced this risk but has added a less likely but more dangerous risk. This is that of a rupture in the lines which could lead to a single, catastrophic exposure. In one plant studied by Professor Bright, of Harvard, several operations were combined in one location by automation and a serious fire occurred 2 weeks after the changeover. While automation may practically eliminate many types of accidents and industrial diseases, the risk of isolated, but disastrous, accidents still exists and in a few rare instances, the dangers are actually increased.

The decline of physical risks could be partially offset by greater emotional hazards. The highest incidence of gastric ulcers in the hourly paid group is now among skilled machinists who exert less physical effort than most workers. Ulcers, although physical in result, are caused primarily by mental or emotional stress. It has also been reliably estimated that 20 percent of all employees in peacetime are borderline emotional cases. A recent medical study of heart diseases revealed that unskilled laborers are among the least likely to have heart attacks of all occupational groups while among those most susceptible are people working with computing machines.

Automation may increase workers' feelings of security because the continuous nature of automatic processes permits greater regularity of employment and hence more job security. On the other hand, this advantage could be partially offset if regularity of employment means regularity of nightwork, or if automation causes increased boredom or leads to a more rigorous industrial discipline from machines. Automation may reduce the interaction among workers both by reducing their numbers and increasing the distances among their workplaces. A study of workers' attitudes toward automation by Prof. W. A. Faunce, of Michigan State University, showed that the main complaints of 125 workers were increased noise, need for closer attention to work, and most important, loneliness from being isolated from other workers. At least one British union has already asked for—"lonesome pay." Solitary confinement is one of the most dreaded forms of punishment. Many people become highly erratic unless they are kept in constant contact with others. (A typist erroneously translated my scribbled word "erratic" as "erotic." This may be true also!)

Related to lonesomeness is boredom. This is not peculiar to automation, of course. It is perhaps more typical of old-style conventional mechanization than of automation but some operative jobs under automation may still be highly routine and boring. These jobs are usually the most likely to be mechanized or automated, however, since they are based on simple, repetitive tasks. In Coca-Cola bottling plants the old method of inspection was to put four bottles of finished product in front of a strong light and have an inspector watch for any foreign matter in the drink. Then someone initiated a conveyor system in which the bottles ran continuously. This was a much faster process, but the job was so boring that every now and then a Seven Up had to be run through to see if the inspector was alert.

People also become hostile if their personality is ignored. A good way to make an enemy is to ignore someone. Prof. William Faunce, of Michigan State, quotes a typical worker as commenting, "They (the supervisors) never say hello—they treat you like a machine. They used to be friendly. Now they seem under a strain." In general, however, automation reduces the number of workers under a foreman's jurisdiction and hence increases the opportunity for interaction between workers and supervisors. Likewise the greater integration of operations increases the foreman's contacts with other foremen and with his superiors. Man-machine relationships are also changed. A worker quoted by Faunce reflected this in saying, "On my old job I controlled the machine. On my present job the machine controls me." Still another worker expressed increased nervous tension saying, "I pushed the wrong button and stuff flew all over. I was lucky (not getting hurt) but it cost the company $13,000 to fix the machine."

Automation may stimulate the mental activity of workers with desirable or undesirable effects depending on the presence of constructive outlets and opportunities to utilize them. Prof. Charles Walker, director the Yale technology project, quotes a worker as saying:

> On my old job my muscles got tired. I went home and rested a bit and my muscles were no longer tired. On this new automatic mill your muscles don't get tired but you keep on thinking even when you go home.[4]

Professor Faunce also found workers' nervous tensions to be higher after automation but, significantly, 72 percent preferred their new jobs in automated departments over their previous factory work.

Automation clearly improves working conditions in general by permitting better "housekeeping" in the plant. Automated plants are cleaner, neater, and more pleasant to work in. There are automated grain mills that have eliminated all dust. There are foundry workers who never touch the molding sand except from curiosity and oil refinery workers who could wear dinner jackets and white gloves on the job and never get them soiled. Automation is not without its esthetic advantages.

Upgrading or Downgrading?

Automation has improved working conditions but, contrary to popular belief, it does not seem to have upgraded workers. According to testimony at the congressional hearings on automation, 23 new activities have been created by automation but only 4 have required engineers to get special training. A recent survey of a cross section of metalworking firms that had recently automated revealed that 43 percent believed the new machinery required less skill than the old equip-

[4] Harvard Business Review, February 1958, p. 112.

ment, 30 percent reported no change in skill requirements and only 27 percent felt that higher skills were required.[5]

Professors Mann and Williams, of the University of Michigan, studied a plant that, prior to automation, had 450 employees performing 140 different tasks in its central accounting areas. They estimated that 50 percent of the tasks were eliminated by automation and 30 percent more substantially changed. Ninety percent of the workers were directly affected. But with all this dislocation there was no significant upgrading in skills required. Before automation the classification range of jobs had been 3 to 13 with an average job grade of 8.0. After automation the average rose almost imperceptibly to between 8.1 and 8.2. Even some of the highest grade and supervisory tasks were programed for the computer.[6]

Professor Bright found that skill requirements actually fell in 8 of the 13 automated plants he investigated. In one other plant no change in skills was evident. In only 4 of the 13 cases were workers shifted to higher skilled jobs elsewhere. In none of the plants was there any significant change in the composition of the work force Proportions of hourly production workers and maintenance workers remained about constant. There was a slight increase in indirect hourly workers and a great increase in the "process development" workers but numerically this latter group was small (less than one-half of 1 percent) so that the total composition did not change much.[7] Earlier, Bright had reported that his studies showed that—

> the motive for automation was in fact to create jobs so simple and easy that unskilled labor could man them. * * * In the particular plants I studied * * * automation seemed to lower training requirements for the majority of workers.[8]

In the Bureau of Labor Statistics case studies of an oil refinery, a major airline, a large mechanized bakery, a television manufacturing firm and an insurance company the general effect on skill requirements was a transfer of employees from one relatively low-skilled job to another of similar grade. In some cases there was definite downgrading. For example, in the insurance company study only 5 out of 20 employees transferred to computer operations were upgraded. None of the 56 who were retained in other jobs were upgraded, although several new employees with higher skills were hired from the outside. In most cases, the new jobs created by automation in both factory and office were filled by existing personnel after some on-the-job training. For example, in the oil refinery case nearly half of the factory workers affected ended up in maintenance work. Kenneth Van Auken of the Bureau of Labor Statistics, who supervised this and other automation studies said:

> There was very little upgrading among those employees directly affected by the computer. It is equally clear that the indirect effects of the computer installation have opened avenues of upgrading * * * for a select group of people.[9]

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[5] American Machinist, Oct. 21, 1957.

[6] "Organizational Impact of White Collar Automation," a paper presented to the Industrial Relations Research Association, Chicago, Dec. 28, 1958.

[7] J. R. Bright, "Automation and Management," Harvard University Press, 1958, pp. 193–194.

[8] Harvard Business Review, November–December 1955.

[9] "Man and Automation," Yale University Press, 1956, p. 31.

Some studies indicate that automation does not even increase the maintenance force significantly except during the "debugging" period and except for electrical maintenance. Newly automated plants frequently hire inexperienced workers and give them only limited training. Some case studies show that former machine operators tend after automation, to become only machine "monitors." They rarely have to actually do anything, but who must be constantly alert. Other evidence points to "job enlargement" but this is often in the form of a requirement that the operator be responsible for more complicated machinery or for a greater variety of machinery.

Even operating a variety of machines need not require greater skill. A study of a large utility company in the United States revealed some job enlargement from automation and so do some other single plant studies but a mere requirement of familiarity with more different kinds of equipment is not the same as upgrading. It is the demand for a more intensive knowledge that counts. There is no convincing evidence that automation upgrades workers generally in this sense. Nor do more complicated machines necessarily require more complicated skills to tend them.

A large aircraft manufacturer made a theoretical job analysis to determine the abilities required of operators of its electronic computing equipment. The study indicated a paradoxical combination of high technical competence and low mental capacity—the employee should have a B.S. degree in engineering and an IQ of 81. As Professor Killingsworth points out:

> Merely pushing buttons and watching for warning lights is unlikely to hold intrinsic interest and challenge for very long.

We cannot afford to continue using intelligent workers in low mentality jobs. Of course, many people are engaged in dignified professional, commercial, and craft employment, but in our economy it is industrial productivity that sets the pace for the rest. A Chinese coolie working in a rice paddy from before dawn until late at night without the aid of tools or technology produces far less economic value in a day than an American industrial worker, but the coolie may actually be making better use of his particular abilities than many of our factory workers. At least he is working at nearer his capacity. He is not dependent on machines and, according to some psychologists, the coolie may be better adjusted emotionally to his environment.

Many of the most highly specialized workers never use more than a tiny fraction of their abilities. Although they earn high wags because of their high productivity when working with machinery, their jobs could be performed by well-trained monkeys. A completely inexperienced worker can be trained in 30 minutes for more standard factory jobs. Thus, there is often not much more productivity to be gotten out of bigger factories or units of machinery.

Effective effort toward a goal often needs to be continuous. Beyond some point to subdivide it further requires either costly changeovers or great loss of accumulated knowledge and skills, momentum and workers' interest and morale. Under automation maximum productivity may lead to an integration of formerly separate functions, reversing the trend of mechanization to further trivialization of labor.

The same person may be required to follow a job through several successive stages. Thus much more complete and efficient use could be made of that most complex machine of all—the human being.

The effects of automation may be simultaneously to enlarge and upgrade some jobs and further specialize, trivialize and downgrade others even in the same plant. In the highly automated Ford engine plant in Cleveland, Ohio, for example, there is a wide gap between the job requirements of different workers. Some workers command automatic machines that perform an incredible number of tasks at once. Others do the most trivial, routine tasks without any mechanical assistance such as those workers who fit sparkplugs into threaded holes for other workers to tighten. This is a temporary situation, however, based on a mixture of mechanization and automation.

The general manager of a large, automated bakery in France recently said:

> The only difficulty we experienced in the automatization of our cookie factory was when we had to transform our "pastry cooks" into "chemist's assistants"; when we had to indicate to them that a cooking temperature is not taken by opening the oven door and putting one's head inside but by reading the indications shown on the dial of an oven thermometer; and when we had to teach them to carry out precise and constant measurements.

Another French manager is quoted as saying:

> The very rapid evolution during the past 30 years of the glass and mirror industry, the present very technical aspect of manufacture and means of scientific control, have transformed the trade of the glassmaker, who has nothing in common with his former self. The men at Chantereine today are controllers, estimators, electronics experts, mechanics, oven supervisors, operators of tractors or traveling cranes * * * yet the glassmaker's trade has preserved its particular spirit, built upon devotion to the trade and to the sense of teamwork, and has kept its traditions.[10]

In the past mechanization (which is a part of automation) has led to the obsolescence of many skills and to the dilution of others by a further division of labor. Mechanization has increased wealth and reduced drudgery in the long run but in the short run it has often caused hardships to workers whose skills were rendered obsolete, diluted by a further specialization or whose jobs were abolished altogether.

Automation is more than mechanization, of course, and its effects on skills are not the same. Prof. William A. Faunce, of Michigan State University, made an intensive study of a highly automated autombile plant and found four appreciable changes in job content. There was a reduction in the amount of materials handling, a decreasing control of the work pace, an increase in attention required by the job and a change in skills required. In the old plant, workers usually handled the parts themselves and fed materials into machines that they them-

[10] Robert Caussin, "The Transfer of Functions From Man to Machine," Diogenes, winter, 1959, pp. 117–118.

selves controlled. They could vary the speed somewhat and thus could work ahead of schedule and then take an unscheduled "break." After automation the work pace was set by automatic transfer machinery, there was no way to work ahead and take a break and close attention to pushing buttons or watching lights was required.[11]

Other effects found by Faunce were an increased amount of supervision required, a lower scrap rate, improved quality and quantity of output, easier and cheaper maintenance and storage, an increase in indirect labor costs, such as for shipping clerks, and a greater need for preventive maintenance and storage. But there was no appreciable effect on wage structure.

Resistance to Technological Change

A sign on a backwoods Georgia road reads, "Choose your rut carefully. You'll be in it for a long time." Many people seem to get great satisfaction from burying themselves in routine activities. They strongly resist any threat of change because it strikes at their basic emotional security. Industrial workers are no exception. Often they believe that they are dependent for their livelihood on a unique combination of machines, plant organization and their own highly specialized skills. Sometimes they are right but, right or wrong, where this belief exists workers can be expected to resist automation in a thousand subtle ways. In some cases they are able to effectively sabotage automation even despite official acceptance by their union leadership. Serious obstacles to automation loom where management fails to foresee this attitude and forestall its consequences. Many employee attitudes will have to change, or be changed, through better planning, communication, consultation, and education.

People do not resist technological change as much as they do the social change that accompanies it. Humans have an amazing capacity to adapt themselves to new technology. Sixty years ago no one believed women would ever be able to operate even the simple, slow speed automobiles of the time. Today 18-year-old farm boys fly jet planes faster than sound while their grandparents drive 300-horsepower cars at high speed on crowded, multilane expressways. People can also adjust to rapid social changes under the proper conditions. The foreign minister of a newly formed African country, who has a Ph. D., has written several books and speaks fluent English and French, delights and shocks his audiences by saying, "Now, my father was a cannibal."

Tapping Labor Skills

Studies at Harvard and MIT show that when employers treat a worker as a person possessing valuable skills and knowledge, and demonstrates it by asking his advice on how best to apply new technology, the results are usually full cooperation and many useful suggestions. Workers accept new technological and social conditions easily when consulted in advance and allowed to plan and participate in the changeover. But when merely told what is to happen, or what is happening or has already happened, workers often demon-

[11] "The Automobile Industry: A Case Study in Automation," ch. 4 in Jacobson and Roucek (eds.), Automation and Society, Philosophical Library, 1959.

strate their resentment to the changes in many overt ways ranging from lower productivity to sabotage. They may also exhibit a variety of unconsciously developed symptoms such as mistakes of all kinds, frequent accidents, and even severe and chronic illnesses bordering on occupational diseases.

When Frederick Taylor led his crusade for scientific management in 1895, he proclaimed the primacy of piecework, asserting that the business enterprise and everything in it (including human minds and behavior) could be broken down into tiny bits and pieces and analyzed like chemists analyze an unknown substance. Following Adam Smith's theory of specialization and the division of labor, Taylor extended his scientific analysis from production to every other aspect of business. He sought to reduce work to its simplest elements to rationalize them and thereby increase workers' output. For example, he made a careful time and motion study of every movement involved in the job of handling pig iron. By theoretical analysis, Taylor devised a more efficient method. He taught this method to a workman named Schmidt, who was soon able to handle 47 tons of pig iron a day, as opposed to 12.5 tons previously. Furthermore, says Taylor, Schmidt was "glad to do it."

Implicit in Taylor's theory, however, was the assumption that men could be studied and treated like machines. Taylor realized that this mechanical regime would have some kind of impact on workers. Consequently, he suggested that the worker most likely to succeed would need to be "stupid, phlegmatic, and resemble an ox."

Fortunately, workers refused to submit completely to the machines and let the logic of efficiency take away all their judgment. Unfortunately, workers all too often had to express their revolt against machinery and rationalization by using their individuality and ingenuity to outwit the industrial engineer rather than by cooperating with management to their mutual advantage.

Modern industrial relations begin with the assumption that workers are essentially cooperative human beings, possessing a vast store of knowledge and ideas about their particular jobs and the firm's operations. It is also assumed that they will take individual and collective action to advance what they believe to be their self-interest. This reservoir of ideas, knowledge, and energy can be successfully tapped if a method can be devised that will maximize both the self-interest of the workers and that of the firm at the same time. Productivity can be greaty increased, even in plants of above-average efficiency, if workers can be convinced that their own interests will be served by greater output. It is not enough to make speeches or distribute pamphlets to them pointing out their vital stake in the firm's welfare. Nor are workers likely to be easily impressed by the logic of mathematics of the marginal productivity theory of wages. They may react emotionally rather than logically. Or they may remember instances of speedups and rate cuts in the past rather than the times they received fair, even generous, treatment. In all too many cases they have good reasons to be suspicious so they must be convinced by actual demonstration that they will be allowed to share in the benefits accruing to the firm not only from any increased effort on their part but also from improved technology.

Since workers sometimes feel that their best interests are served by resisting technological changes it follows that management must plan carefully to overcome this resistance and, better still, enlist the active support and enthusiasm of the employees to work toward the best interests of all concerned. Following from the assumptions of individual dignity and worth of workers this planning must be with, not just for, the workers. Proper planning for technological changes requires consultation with the workers or their representatives.

Of course, consultation does not require relinquishing any management prerogatives to unions or workers. The decision to make changes, and when and how, must rest finally with management. In any business organization, management must retain its authority to manage in order to fulfill its proper responsibilities. So the management must always retain the right to veto any suggestion of the workers and bear the sole responsibility for all decisions. But the mere process of fully informing the workers of all anticipated changes and eliciting their suggestions builds confidence and loyalty and will also produce valuable suggestions and ideas. Of course, management must consult workers sincerely as equals and not paternalistically. It must be willing to listen to criticism without prejudice and accept reasonable suggestions regardless of who makes them. Management must recognize that workers have a right to know what is going to happen to them and a right to have some say over the conditions of employment that are closest to them. Management will frequently find that workers or unions have no desires whatsoever to even participate in company policies or decisions but they want to be treated fairly and be informed. They will recognize it if there is an attempt to fool them with a "sense of participation" rather than genuine consultation.

Sources of Increased Production

Increased production from consultation can come from two general sources. First, increased personal effort is nearly always possible without endangering health or safety. It is natural for most people, whether they are company presidents, lawyers, or machinists, to engage, at times, in "featherbedding" practices to protect, spread out or increase the apparent importance of their jobs. Every trade and profession has its featherbedding techniques and some of them have been passed down from fathers to sons for generations. These practices, which waste time and restrict output, can be eliminated only by convincing people engaged in them that more genuine effort toward getting the job done will benefit them personally. This is not an easy task because many people consider the right to work and make a living in their chosen occupation (and location sometimes) as a natural and inalienable one. If they have lived through a depression they will vigorously guard their "tricks of the trade" since these are tools which they believe will protect their livelihood. Continued full employment is the best way to combat this attitude.

Actually the elimination, or reduction, of featherbedding may not mean harder work at all because the creation and maintenance of an appearance of industriousness and job importance can be most difficult. However, it does not mean the concentration of effort toward the single goal of increased output of the plant. Furthermore, effort directed toward a positive, constructive goal is more rewarding emotionally, and less fatiguing physically, than featherbedding since physical fatigue is closely associated with frustration and lack of constructive purpose. To achieve this goal, workers must be consulted frequently and openly.

The second source of increased production comes from technological improvements such as better methods, plant layout and scheduling, or new inventions. It is reasonable to expect that men who devote their lives to a single aspect of a specialized operation will have good ideas for technological improvements regardless of their IQ's or formal education. This has long been recognized by the use of suggestion systems but all too often these fail to produce any tangible results because workers are not consulted about their application or assured that when successfully applied, the innovator will be adequately rewarded. Workers do not usually object that rewards are insufficient but merely want a voice in making them. Workers' representatives on consultative committees are usually less generous than management in suggesting rewards. They are concerned, however, that rewards be proportional to the merits of the suggestion, even though wide variations in rewards result. They feel that this is an indication that management is really interested in their ideas. Furthermore, they want to know exactly how the suggestion is to be exploited and what the ultimate effect is likely to be. Inventions and improved techniques have been known to have been suppressed for generations because of fear that their use would lead to unemployment or lower wages in the long run. Thus, frank and open consultation is necessary or technological improvement is retarded.

Personnel Planning for Automation

Effective supervisors must have three classes of skills according to Professors Mann and Williams of the University of Michigan. These skills are technical, administrative, and human relations. Different combinations are required at different times and at different organizational levels. Human relations skills, they say, are most necessary at the highest and lowest levels of supervision, with technical and administrative skills most important at intermediate levels. Automation is usually an outgrowth of an already high level of mechanization so human relations skills are of greatest importance in automated factories. The University of Michigan studies also indicate that during the early stages of changeover to automation technical and administrative skills are most important to upper level supervisors who must plan for broad organizational changes.[12] Human relations skills at this stage are most important for lower level supervisors who must communicate the impending changes to the workers. Toward the end of the changeover when the basic technical and organizational problems have been solved there remain mostly human relations problems. Then skill in this area becomes of paramount importance to all levels of supervision.

The success with which a transition to automation can be effected depends on management's ability to enlist the support of the workers involved. This, in turn, depends on management's conception of the problems encompassed by the changeover. Two concepts have been observed. First, the "hardware approach" in which management is

[12] Floyd Mann and Lawrence Williams, "Organizational Impact of White Collar Automation," paper presented to Industrial Relations Research Association meeting, Chicago, Dec. 28, 1958.

mainly concerned with the selection of proper machines and their substitution for existing operations. Many human problems arise from the failure to analyze the changes in the division of labor and in the organizational structure brought about by automation. Management is often more anxious to buy machines than to think about how to use them. As John Diebold says of the typical management, "There is an almost incredible preoccupation with equipment." Firms which are preoccupied with the machinery and neglect the human problems have had troubles. These firms had planned for the changes, of course. But the planning was in the tradition of being concerned with the financial and technical aspects. There was little concern for people except where the people affected directly the financial and technical features. For example, management would be concerned with the number of employees which would be transferred or laid off but not with the people themselves.

Second is the system approach that considers the introduction of new equipment as an opportunity to reevaluate organizational objectives, administrative, human, and technical problems. Here a major objective is that of enlisting active employee support.

The BLS case studies of automation reveal several ways in which communications to employees can be handled in preparation for automation. In the bakery and oil refinery cases notification of changes took place automatically as a part of union-management advance planning. In the study of the TV manufacturer, foremen and union officials were informed of automation changes 2 weeks in advance. Workers learned only by the "grapevine." In the insurance company study the personnel manager met regularly for a year in advance with a representative of the section in which the computer was to be installed. He told the employees that some would be displaced but no one would lose his job or suffer a pay cut. The company's newspaper described impending transition to automation with no attempt to gloss over the expected effects. The result was a smooth, painless transition to automatic data processing. However, the method of handling the transition in another case was to inform the supervisors only and tell employees only those things that they specifically asked to know about.

Kenneth Van Auken, Assistant Chief of the Division of Productivity and Technological Developments, U.S. Department of Labor, reports in two case studies of automation, a bakery and an oil refinery, that management and union representatives worked out personnel plans, including compensation changes, in consultation prior to automation. In these cases the BLS noted that unemployment and employee discontent were both minimized. Advance planning and consultation also created more willingness by workers to accept change and eased the transition to automation with a minimum of displacement problems.[13] But Van Auken notes that advance consultation is rare and exists largely where there is a mature relationship and a mutual respect between the parties as, for example, in the ladies' garment industry.

In most of the successful transitions to automation, consultation of workers has played a major role. In one case a labor union has taken

[13] "Personnel Adjustment to Technological Change," in Automation and Society, Jacobson and Roucek (editors), pp. 346–347.

the initiative. The Amalgamated Lithographers of America appointed a "director of technology" to work with management to promote automation and has proposed a $2 million union-management fund to help carry out this objective. In the case of the bakery studied by the BLS, labor and management were found to have worked together successfully to solve employment problems raised by automation. Workers were fully consulted, not just told what was to happen. Frequent conferences were held. The result was that displaced workers were reclassified so as to retain the same pay scale even if moved to lower skilled jobs. Unions call this "horizontal downgrading." After the transition to automation was completed, it was found that no worker had been cut in pay, some workers had been upgraded and only 5 percent had been laid off in contrast with 25 percent that had been predicted. In this case, however, the entire transition to automation took 5 years.

In the BLS study of the TV manufacturer, full and careful consultation prevented labor resistance. However, automation was introduced at a time of model changeover. Pay rates on the automation jobs were set at 5 to 15 percent above straight time for unskilled assemblymen. The company asserted that with increased productivity it would be able to improve its position in the industry through a more diversified production. In the insurance company study the company had been plagued for years by high labor turnover. The average clerk stayed less than 5 years. Installation of a large electronic computer cut costs in half: 21 punchcard machines and 85 employees did the work of 125 older machines and 198 employees. Labor turnover permitted the transition without any layoffs and average salaries rose from $3,700 to $4,200 after automation. In this case three things contributed to a successful adjustment. Labor turnover was high enough to avoid direct layoffs; there were similar jobs in other divisions of the company to transfer to; and the company was growing rapidly during the transition. This combination of favorable circumstances cannot always be expected to exist.

The Detroit Edison Co., with 11,000 employees, recently automated its customer accounting and collecting. About 400 people who were most closely associated with the new system were kept fully informed of changes through a long-established plan of "participative management." The changeover was a complete success. However, the company felt it not necessary to consult or orient the employees in customer relations since they were not directly affected. These employees did not understand the reasons for many procedural and policy changes and a resentment was built up that led to challenging of procedures, magnification of errors, accusations, and other frictions. Outside consultants found that the basic trouble was—

> insufficient communications and training * * * and inadequate opportunities to participate in the change and to know what was going on.[14]

The kinds of jobs affected most by automation are frequently those that are the most routine. Semiskilled machine operators, fabricators, and particularly clerical workers are the most vulnerable. The latter represents the most clearly definable group since banks, insurance

[14] J. D. Elliot, "EDP—Its Impact on Jobs, Procedures, and People," Journal of Industrial Engineering, September-October 1958, pp. 407-410.

companies, and other firms with large accounting functions have employed mostly younger women and here the installation of new data-processing equipment is proceeding at a rapid pace. Here the number of jobs is most likely to shrink since electronic computers sharply decrease the need for clerks. There will probably continue to be attractive openings for secretaries in law, real estate, insurance, and business in general but there will be increased skills required for these jobs and a more intense competition for them.

Union-Management Cooperation

Union cooperation will be needed to gain acceptance for necessary job changes and transfers. No major union has opposed automation and most say they welcome it. In only 1 of the 13 plants studied by Bright was there even any concealed resentment to automation by workers or union leaders. The United Automobile Workers is a union whose membership has declined enormously, in part from automation, yet the leaders have still not opposed automation.

The meatpacking industry provides a good example of a constructive approach to automation. In late 1959, the unions at Armour & Co. accepted a new plan whereby the company contributes 1 percent per hundredweight of meat shipped, up to a total of $500,000, to a fund to help workers displaced by automation to move to new jobs. A committee of four management and four labor representatives, with a neutral chairman, administers the fund that helps train employees in new skills and assists in moving to new locations.

The International Longshoreman's Union and waterfront managements have set up a three-man arbitration board to determine royalties to be paid to workers displaced by "containerization"—the use of large, reusable metal boxes loaded at the point of origin and which eliminate manual cargo handling.

Good results can be obtained where unions are thoroughly consulted when automation is being considered. Workers are usually willing to go along with even the most drastic changes if they understand why they are necessary and what is going to happen. They can even be counted on as a valuable source of suggestions and ideas. Adequate incentives and job security could lead to valuable improvements from workers who otherwise would withhold ideas for cost-saving improvements for fear of downgrading, wage rate reduction or layoff.

In summary, the overall outlook for labor is good if the lines of two-way communication can be kept open and improved. The likelihood of successful consultation for automation and other technological changes also appears good. These depend, however, on proper fiscal and monetary policies of the Government to maintain stability and economic growth.

The Hope for Small Business in an Automated Economy

The effect of automation on the size of plants and firms depends on a variety of factors and is complicated by statistical and definitional problems. The size of plants and firms are two entirely different things. An enormous firm may consist of countless small establishments while a much smaller firm may own nothing but one relatively large plant. Size can also be measured in a number of ways. Automation may reduce a firm's labor force while increasing its capital investment and sales volume. Thus, some measures of size, such as number of employees, managerial capacity, and length of communication channels would decrease, while other measures, such as value of assets and volume of business, would rise. Furthermore, size of a plant or firm is relative to its market. While technology in general, and automation in particular, tend to increase the optimum absolute size of plants, if not firms, increased knowledge, new products or services and reduction of artificial trade restrictions may simultaneously expand their markets; thus, the net effect would be to reduce the relative size of both plants and firms.

Although a sizable concentration of capital is normally necessary before a firm can achieve the economies of automatized operations, there is reason to believe that automatic control devices may lead to decentralization of plants. The growth of electric power transmission technology and the introduction of lightweight fabricating materials have already permitted plants to be located at great distance from power and supply sources. Since automatic equipment requires little direct labor, there should no longer be any compelling need to locate automatic production plants near large population centers. The generally reduced labor requirements due to automation have resulted in a trend toward the construction of relatively smaller plants, more widely decentralized, by many of the largest firms including General Motors, General Electric, Philco, United States Steel, and Alcoa.

Decentralization of production is often accompanied by further concentration of ownership, however, because established firms frequently take the lead in developing new products or expanding into more remote areas. Decentralization of plants does not necessarily result in less concentration of market power and may even result in greater concentration. Still, office automation seems to provide some economic justification for centralized management of an entire industry. Technology, in general, has required that factories and other production units be built on an ever larger scale, but previous technology alone has never been able to provide economic justification for the holding company or chain control of a large number of similar units widely separated geographically. Now, however, automation may permit real economies of centralized financial and accounting control.

For example, many large corporations control hundreds, or even thousands, of separate establishments which have varying degrees of operational autonomy and can achieve all of the economies of large-scale production within their own plants. These firms have now installed electronic computers for processing payrolls and other accounting records for their entire nationwide operations. This may make for greater overall efficiency, but through tighter centralized control and at the possible loss of competition. Thus, while automation is likely to increase the most efficient size of plants, which would tend to reduce competition unless markets expanded correspondingly, it may also increase the efficiency of administrative control of large corporations over their farflung branches and subsidiaries.

There is one way that automation could lead to more competition. Classical economics assumed that businessmen, as well as all other economic decisionmakers, had a high degree of knowledge upon which to base their decisions. The lack of such information has been a major deterrent to rational economic action and one reason why competition has never functioned in reality in the way it was pictured in theory. Automation, as much as anything, is a revolution in the theory and practice of handling information. Electronic computers and other automation devices greatly increase the speed and accuracy of information transmitted to management, and frequently available to workers and consumers as well. Economic decisionmakers in many cases can now have information in time to make intelligent decisions on it. So automation may contribute more to the resurrection of the economic man than to his deeper interment.

Yet the logic of automation has seemed to be so clearly against the small productive unit, many businessmen have felt it necessary to proclaim repeatedly that small business is sure to survive and grow. It has been frequently reported, for example, that about 80 percent of United States and European production is in units of 25 or less, so small business will always have the lion's share of the market; but automation is applicable to much of this area of short production runs since the differences in products are often superficial enough for automation machines to handle. Most of this production of 25 units or less is already done by very large firms.

The high birth rate of new firms is also frequently cited as evidence of the continuing vitality of small business, although little is said about the high death rate or the average 5-year life expectancy. There has been much publicity of the fact that giant firms stimulate small enterprises through purchasing, subcontracting the distribution arrangements, but there has been little discussion of just how independent a dealer, for example, really is from his manufacturer.

There are five reasons, however, why small firms in certain industries may be able to survive and even grow in the age of automation. First, although electronic control equipment is usually thought to be expensive, the cost is not too great for certain kinds of small businesses. Electronic computers can be rented part time and need not be purchased if a firm's volume does not warrant it. The Rich Electronic Computer Center at Georgia Tech provides this kind of service. Other automation machinery is within the reach of smaller firms. Cleo Brunetti, General Mills' director of engineering research and development, testified at the congressional hearings on automation that his firm was developing two new kinds of partly automatic machines in the $3,000 to $15,000 range for small manufacturers. Recently, this company announced plans to sell $40 to $45 million worth of electronic components to "small" firms, $30 million to "medium-sized" firms, and only $30 million to "large" firms.

There is a lot of automation in the relatively small plants of very large firms proving that small scale automation is at least technically possible. One of the most highly automated firms in the world, for example, is the French Government-owned Renault firm; however, its small automated tractor plant normally produces only about 25 units a day. In spite of its relatively small output this firm is ahead of General Motors in many technological developments. In Belgium and Switzerland, small firms have developed automation for the manufacture of parts such as valves and transistors that they sell in other countries.

Of 13 automated plants studied by Prof. J. R. Bright of Harvard, the two most highly automated were small, independent firms.[15] One of these, an oil company, adopted automation for the specific purpose of reducing its investment and installing a cheaper plant. In industries processing liquids like oil or homogenous solid products such as grain, gravel, or fertilizers, there is already a high degree of automatic technology and relatively small firms can automate with standard equipment. It is true that some smaller automobile producers went out of business because they would not afford automation; but, they could not afford mass production equipment either. Thus it was mechanization rather than automation that excluded them.

Second, it is not necessarily true that competition from large automated firms will always squeeze out small nonautomated operators. Lack of capital or insufficient markets certainly do put small firms at a disadvantage and in may industries automation favors the large, established enterprises. There are, however, some industries in which automation technology is relatively simple and standardized, and where development time is short. For example, Professor Bright tells about the Fisher-Price Co., of East Aurora, N.Y. This is a firm with a total engineering staff of three people, including the draftsman; yet it has developed some highly ingenious automatic assembly equipment for making toys. The machines are not only constructed of standard hardware and the simplest, homemade devices but are astonishingly flexibile. Production can be converted easily from a locomotive to a duck; the equipment can be modified so as to shift from mounting a dog's ear to inserting a butterfly's antenna.[16]

American Telephone & Telegraph, the largest private corporation in the world, is buying many small parts made by Swiss automation because of the advantages of Swiss quality, craftsmanship, technology and small enterprise in the electronics field. Dr. Brunetti said:

> In the electronics industry where there are about 55,000 varieties of components, one company cannot become efficient in the production of all of them, have the capital to set up these lines, or have the management capability to handle all this in one big business.

As proof of this assertion Ralph Cordiner, president of General Electric, told the congressional Committee on Automation:

> We have about 40,000 suppliers, most of them small businesses, and many of them aggressively mechanizing and automating their operations.

On the other hand, since automation normally reduces flexibility, small firms can sometimes provide a variety of products that would be prohibitive to a large automated firm. Bright found one oil company that rejected automation for fear of losing its best customers because they frequently required specially prepared products on short notice. He also quotes an automated motor producer who said:

> We put all the investment into design of a new product—and they (a small job order producer) can copy it overnight.

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[15] Bright, op. cit.
[16] Bright, op. cit., p. 220.

We've got the overhead. They're making * * * the profits. No, automation isn't going to put them out of business.[17]

Third, in some industries where the giant firms are automated, it is possible for the small firm to survive without automating. Where high transportation costs limit the economic size of the market, small nonautomated firms can compete successfully with large automated rivals in local or regional areas. If personal services, such as installation, adjustment or repair, are a necessary part of the product, the small firm may have added advantages. In Atlanta, Ga., where there are no iron, coal, or limestone deposits, the Atlantic Steel Co. makes steel and steel products (largely from scrap) and uses the best known technology to compete successfully with other steelmakers many times its size.

Fourth, the informal, personal relationships, and direct communication channels of small firms permit imagination and determination to pay large rewards. When new products, new materials, new markets, or new ideas appear, an alert and aggressive small operator can be profiting from them before a large automated firm can draw up changeover plans or perhaps even before the news percolates up to the policymaking level. When Ford wished to introduce automation, it turned to small specialist firms in the machine tool industry, to what it called the "small, uninhibited firms with no preconceived notions."

The most daring and imaginative example of automation found by Bright was a coal mining company of 35 employees including a technical staff consisting of one 34-year-old manager-engineer. Their system included a continuous mining machine, a self-propelled conveyor and a remote sensing device that could determine the difference between rock and coal and transmit the information to the suface 1,000 feet away. Although the experiment did not succeed, the reason was a failure of supply, not of technology. The first commercially successful use of office automation was developed by Lyons Tea Shops in England with a small staff, a minimum budget and a homemade computer described in 1947 by observers as "held together with baling wire and tape."

Fifth, some economic trends favor small enterprise in spite of automation. The growth of the professions and the expansion of the trades indicates increasing opportunities in areas traditionally served by small businesses. Furthermore, increased income permits people to buy unique, nonstandardized products that more effectively express their individuality; to utilize more personal services for their convenience; to desire more leisure time. All of these tend to generate economic activity organized in small units.

On the other hand, it seems clear that in perhaps the majority of industries the cards are definitely stacked against the smallest firms and many of the medium firms as well. James P. Mitchell, U.S. Secretary of Labor told the congressional committee investigating automation:

> So far our studies show that only large companies producing standardized goods for an expanding market have been able to use the more advanced types of industrial machinery.

[17] Ibid., p. 221.

In some situations small firms can persist by producing a variety of unique items to special order on short notice or providing personal services but the opportunities for expansion are strictly limited beyond a point. Growth in these cases is not a matter of incremental increases but of an enormous jump to an entirely different kind of technology, organization, and market. This chasm between the small nonautomated shop and the giant automated, integrated enterprise cannot be crossed in a series of short jumps. Furthermore, in the industries that supply mass markets with standardized, mass-produced goods the small nonautomated firm cannot hope to survive. Most economic studies show that the largest firms in most manufacturing industries are not the most efficient; but neither are the smallest. However, the largest firms can survive and grow either through sheer monopoly power or through the enormous momentum of their accumulated technology and experience, established brands or financial and political connections. The smallest firms are squeezed by mechanization and continuous process technology, by vertical and horizontal integration and monopoly power of their large rivals perhaps more than by automation. Yet in many industries automation adds its weight to other economic forces destructive of small enterprise.

The best hope for small business lies in the possibility that people may demand genuine variety, high quality and personal services as their living standards rise. Whether they will or not remains to be seen. The general tendency toward conformity and standardization has continued in the United States although real incomes have pushed upward. The small firm could help to reverse this trend by providing genuine craftsmanship and dependable service and calling consumers' attention to the economic advantages of high quality products and the psychological benefits of personality expression in truly unique products and services.

It is important to make sure that the national economy grows fast enough to maintain plenty of new job and business opportunities for workers and small businessmen displaced by automation. Unemployment and displacement breed social unrest. At a minimum, it is worth something to have tranquility. But much more important, the obvious and highly publicized advantages of automation should not be allowed to overshadow the plight of the little man searching for a place in a growing economy.

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STATEMENT BY VANNEVAR BUSH, HONORARY CHAIRMAN OF THE BOARD, MASSACHUSETTS INSTITUTE OF TECHNOLOGY CORP.

No American now doubts that we must be strong in the future, strong in a military sense, and strong also technically and economically. To maintain this strength we need to do many things.

No nation can be strong unless it has wise leaders. In particular, we will need, in coming years, great scientists and able engineers. To this end we need to ensure that every youngster in the country, of outstanding ability and ambition, is given the opportunity for all the education he can usefully absorb, clear to the doctorate if he can go that far, with no obstacle due to lack of funds, and no favoritism of any form.

If we interrupt his schooling for military experience, we should ensure that, in that interval his training is fully commensurate with his ability, and that the interruption in no way slows down his progress toward outstanding mental accomplishment. We need to provide, for these youngsters on whom we will later depend for our progress, an atmosphere in which they will grow in health, in scholarly attainment, in understanding of their fellow men, and in the enjoyment of true accomplishment. We need to do far better than we have done in the past on all these things.

The need will be for leaders in every field, for men in all professions, but especially for scientists and engineers in the type of world we must live in, capable at their professions, and broadly trained to understand the complex society in which they will operate. There is some misunderstanding on this subject among young men. Scientists are men, who seek to grasp nature, and man himself, who knows physics, chemistry, biology, other sciences, so deeply that they can create new understanding, and develop new relationships. Engineers are men who join with a less deep grasp of science a knowledge of economics and business, so that they can apply science for useful ends. But both need to be men of the world with the ability to work effectively with other men, and to be useful citizens in every sense.

These youngsters will live in a very interesting and challenging world. Long ago man learned to supplement the power of his muscles by the use of mechanical power. He learned to cause machines to make more machines that would carry out a series of complex operations automatically. This latter is called automation. It is a new word and an old idea. The natural aptitude of Americans for mechanical things, combined with our natural resources and broad markets, together with the wide individual freedom and opportunity which is our country's watchword, have rendered this the most prosperous Nation in the world. Today the pace is accelerating, and other nations are learning to mechanize extensively, to create mass production, to automate.

We need to stretch ourselves to hold our lead. To this end we need to do better some things we have relatively neglected. For many years we depended heavily on others for the advancement of basic science, while we devoted ourselves principally to its application. Now we need to lead the way in every field of fundamental science, for there cannot be greatest advance unless we ourselves create the new knowledge which is to be applied. We need to devote more of our thought to the future, rather than merely to current needs; we need to have more vision.

An example or two may render this last point more clear. There is a great furore today on space exploration and rocketry. Well and good. But there is no corresponding widespread interest in the new advance being made in the field of biology. Yet the latter, as it becomes extended and applied, may be far more important in shaping our national health and vigor, modeling new industries and new processes, improving our understanding of ourselves, than any scientific advance that has so far altered our lives.

To take another field; man advanced rapidly when he learned to relegate to the machine those manual operations which are definable in concrete terms and repetitive. He still has far to go in this regard. Today he is beginning to learn to turn over to the machine those aspects of his mental processes which are definable and repetitive. The great digital computing machines are just a beginning. This is an exciting field, and a challenging one. Its full development will require keen, versatile, courageous scientists and engineers. It is a far more interesting field, to me, than fields that are more readily presented in popular form.

The Subcommittee on Automation and Engery Resources has all these subjects, and many others, before it for consideration. On the wisdom with which they are treated will depend much of our future prosperity and security.

STATEMENT OF JOHN DIEBOLD, PRESIDENT, THE DIEBOLD GROUP OF MANAGEMENT CONSULTING COMPANIES

Mr. Chairman and Members of the Subcommittee, it is most appropriate at this time to consider the role of automation and technological change in our economy. The Committee is to be commended for once more turning its attention to this subject—a subject which has assumed increasing importance as a domestic issue and powerful force in the entire world.

The original hearings of this Committee marked the first national recognition of the important role of automation and technological change in our society. The proceedings of those hearings have been widely read and liberally quoted from. Those hearings provided one of the first comprehensive publications containing the views of many persons representing different sectors of the economy, all concerned with automation.

The present compilation of testimony is perhaps of even greater import in view of the present economic and world political situation. I welcome this opportunity to bring my original testimony up to date.

INTRODUCTION

Many of the promises, and certainly some of the problems of automation, have become realities in American life. The uses of automation that we predicted in 1955 have, for the most part, come to pass. No longer must we speak of the "Advent of the Automatic Factory." Automation has "arrived." During these few years, since the hearings in 1955, "Automation" itself has become an industry. The increases in manufacture of automatic equipment for machine and process control in the factory have been complemented by the phenomenal growth of the electronic data processing equipment industries servicing both factory and office. The whole new field of computer technology has passed from its infancy stages to one of high complexity and sophistication. It was only several years ago, when I first testified before this committee, that the first computers became available for office use. Yet, today, electronic data processing equipment is a common tool of industry.

Both office and factory automation have been most instrumental in increasing our productivity and national output. In fact, their importance in the economy has made it necessary to transcend our present thinking of these techniques as simply "tools" of production. Automation, and the concepts that it embodies, has become a *national resource*—a source of strength to the nation and a stimulus for technological change.

It is questionable whether we have used this resource as effectively as we should or could, although our achievements seem spectacular. The uses to which we put our energies and the results derived can no longer be compared only with our own historical performance. The world has changed too fast for that. We have seen very graphically in the last few years the results of efforts in the technological area. We have watched our chief competitor, the Soviet Union, make remarkable gains both militarily and economically. If we do not make the fullest use of the techniques we have developed, you may be sure that the Soviets will do just that.

Neither technical nor economic reasons have prevented us from making optimal use of automation. Perhaps, the most important single fact surrounding automation has been that fear it has engendered—*fear* of the human consequences of automation. Much of it has been irrational; some of it reasonable. The fact remains that we must improve the environment for achieving technological changes. But we must also recognize that in order to reap the benefits of technological innovation, we must be prepared for innovation in the social environment. We must be willing to consider new solutions to human problems we cannot solve with old methods.

We are in a critical economic war. The United States Government should do all it can to stimulate private enterprise to produce cheaply and efficiently, and increase business' re-investment rate. This calls for a positive national policy toward productivity and technological change.

At the same time, government, business and the community must work together to minimize—and hopefully eliminate—the human hardships that may appear locally due to rapidly changing economic conditions.

The fact remains that we still do not know enough about the effects of automation, or indeed technological change, to intelligently deal with it. This lack of facts stimulates the fear. In the five years that have elapsed since the initial hearings on automation and technological change, no concerted effort has been made on a national basis to overcome our ignorance. Certainly the efforts of this Committee will do much to help meet this need.

REFLECTIONS ON MY ORIGINAL TESTIMONY

Chairman Patman in his recent letter inviting me to submit testimony before this Subcommittee asked for my views on:

The progress which automation has made since the earlier hearings in 1955.

The growth of the automation industry.

The extent and type of employee displacement.

And the problems of retraining and reallocation of workers.

Representative Patman specifically asked where I felt that events had reinforced my earlier views and where my views had changed in light of current trends. I will address myself initially to these questions. I believe it would then be helpful to discuss in more detail various aspects of automation of interest to this Subcommittee—to attempt to "bring automation up-to-date." My discussion will include the following sections: Automation Today, more on the concept of automation; Applications and Uses for Automation; The Automation Industry; and Economic and Social Aspects of Automation. The statement will conclude with my views on the need for a national policy to deal with automation and technological change.

Changes in Views

In 1955, I stated before this Subcommittee that I did not feel that "automation requires any special legislation." I still think the legislation should not be directed specifically at automation, so much as it is necessary for government recognition of the total problem of coping with technological change.

The hearings, which this Subcommittee inaugurated in 1955, stressed the potential impact of automation and technological change on the United States. During the intervening years, this "potential" has partially been realized. The introduction of automation technology has resulted in changes within industry and government. It is not difficult to determine the importance that industry places in automation; the growing amount of industrial capital expenditures for automatic equipment speaks for itself. Unions have recognized automation and have made an issue of it at the collective bargaining tables. The Federal Government, in its various agencies, is continually installing substantial amounts of electronic data processing equipment to obtain greater efficiencies (and, indeed, recent Congressional committee hearings were devoted to measuring the effects of electronic data processing in government). Individual state governments have held conferences to consider the economic and social consequences of automation for their states—the Governors of both Massachusetts and New York convened such conferences recently. Automation has become a national issue.

In these last few years other issues have become crystallized in the public's eye; our rate of national economic growth, the political and economic competition with the Soviet Union, the growth of the free world as a source of competition and as a market and the problems of bringing underdeveloped countries into the twentieth century economically, technologically, and socially. All these issues seem to me to be interdependent with each other and with the issue of automation and technological change. We cannot sustain a high national growth rate, we cannot compete effectively in the world markets, we cannot adequately aid foreign countries, unless we make the fullest use of our productive capabilities. We have not accomplished this in recent years. I believe we will have continued difficulties in overcoming our domestic and international problems unless we tackle this issue; how to employ automation and technological change most effectively.

To my mind, there is a clear need for *national policy* aimed at making the most effective use of technological change. It is not a question of dealing with automation alone. Automation is part of a complex pattern of continuing technological sophistication within our economy. In fact, it is most difficult to isolate the effects of the uses of automation techniques from other change. The Bureau of Labor Statistics, for example, correctly recognized this difficulty when they recently announced the sizeable productivity increases in 1959 over 1958. They pointed out that this increase could not be attributed to one factor alone but to "the combined effect of a number of interrelated influences, such as skills of workers, managerial skill, changes in technology, capital investment per worker, utilization of capacity, layout and flow of material, and labor-management relations."

The problem, it would seem, is much broader than simply attempting to "control" automation through special legislation. We cannot "legislate" automation into existence, just as we cannot legislate its disappearance. Automation is a philosophy of technology—a set of concepts. In itself, it only makes available to us the knowledge of how to better satisfy our material and intellectual desires. Automation does not "cause" anything. To attribute any inherent evils to automation or technological change is like aiming at the shadow instead of the object.

For years we have allowed the turn of phrases, such as "Automation causes * * *," to erroneously direct our approach to the subject. These phrases are really shortcut ways of saying "When we *apply* a set of automation techniques, these sets of results occur." Our own actions or inactions actually *cause* the results.

It has been frequently said that "technological change causes unemployment"; but if a person literally believes what he has said, it is like saying "atomic energy causes war." Atomic energy does not cause war and technological change does not cause unemployment.

We know, for example, that the economy is going through a period when the unemployment rate is much higher than the national average for the unskilled, uneducated worker. This state is expected to continue for a long time to come. Is automation or technological change keeping the unskilled unemployed? Or rather is there a more basic problem of the failure to eliminate substandard education and training?

My personal belief is that the prevailing fear of automation and technological change is totally misdirected. If there must be concern over change, it should be directed towards our own actions in coping with change. We have not even devoted sufficient efforts to examining the "change" phenomenon—and this is necessary before we can act properly.

Ironically enough, the nation presently finds itself in a state in which it is not making the fullest uses of the available labor manpower and productive capacity; this at a time when there is an international economic necessity to do the opposite. The national productivity and output has increased only rather sluggishly in recent years. My original views on the rate of speed at which automation would be introduced were that it would "take a long time to effect." I believe that the problems of application are even greater than were anticipated at the time of the initial hearings. Much of the difficulty has not been technological as much as it has been the human problems encountered: introducing new concepts within business organizations not readily adaptable to change, consciousness on the part of management and labor to minimize decreasing employment opportunities within the company and such. These kinds of problems have not been solved to a sufficient degree to substantially increase the rate at which automation will be introduced into industry.

In connection with the above problem is the one of education and reeducation. This problem seems more impressive to me now than during the original hearings. The question of what are the changing skill requirements of industry still goes unanswered. On a national scale, we still have not given this question sufficient study, though it has already become a problem among large localized groups of unskilled workers.

Greater understanding of the extent of the problem is needed. A recent study by the State of New York dissected the problem of its future manpower needs and showed what the educational requirements would most likely be in the near future. The Bureau of Labor Statistics through its fine case studies has shed further light on this problem area. I would think that more research is needed on a national scale to determine our needs in this area.

Because of some of the difficulties that have developed in the introduction of automation, some of the benefits that I anticipated earlier may not come to pass so readily. I do not expect that excessive leisure will be of concern to us in the near future. The problem of increasing our national output would seem to me to take precedence over this. In the same view, I would not expect any drastic reduction in the average workweek figures. In some industries, I would expect that my earlier estimate of decreases in the workweek to the low thirties may come to pass. (Some industries have already achieved this level.) However, the greater reductions in workweek will probably continue to occur in those industries with high workweek levels, agriculture and services.

Views That Have Been Reinforced

I began my original testimony by emphasizing the need "to derive some factual information about automation and its impact upon the economy." This need is more urgent than it was before. While I don't feel that automation has been introduced at as high a rate as has been technically possible, its introduction and its impact have far outstripped what little we have learned about it. My original recommendations included "an outline of a factual study of automation." I have submitted a more complete "Guide" to such a study, once again, in the following section in this statement. Studies are still vitally necessary. Academic groups and governmental agencies have effected fine studies in this area, but they have been limited by serious lack of funds to carry this work further. This would seem to be a proper area for supportable research by all levels of government; Federal, State and local. Private Foundations could also do more to support study in this field. A solid, comprehensive body of facts on the economic and social effects of automation is still nonexistent!

Though we are far from making the best uses of automation, I am most encouraged by the greater recognition that it has received as a new set of concepts rather than as an extension of mechanization. I previously referred to automation as "a basic change in production philosophy * * * a means of organizing or controlling production processes to achieve optimum use of all production resources—mechanical, material and human."

While industry is far from being organized along these lines, more people are beginning to understand the concepts behind it. We learn of more imaginative uses for automation technology every day.

Many of the feasible applications for automatic controls that I talked about in 1955 are already operational facts. Especially in the process industries, optimal control is now closely approachable. "It makes it possible to do things that you could not do before, in addition to doing the things we have been doing more efficiently." This still seems to me to be the greatest contribution automation can make to our economy.

The new levels of achievement and doing present tasks more efficiently have not been limited to large business organizations. "Small business" can make extensive use of automation techniques both in the factory and the office. Manufacturers have given attention to the design of electronic data processing systems specifically for the use of small business. We have also experienced in recent years the widespread application of the service bureau concept. These bureaus have been designed to care for the needs of smaller organizations without their own computers (I have discussed the service bureaus in more detail in the section on "Applications," also, data on the extent of usage of small electronic data processing systems is found in the section on "The Automation Industry"). In the factory, the availability of flexible machine tools with numerical control may serve to increase the competitive power of smaller business. My initial opinion that numerical controls would be slow in coming seems to have been borne out. Only recently this technique has started to catch hold in industry, but its rate of acceptance will increase rapidly for years to come (I have included growth estimates of the numerical tool controls industry in the section on the "Industry").

The total automation industry has grown to major proportions within the economy. As I recall, the growth potential of the automation industry seemed doubtful to some witnesses on account of what was considered the high investment needed to obtain automation equipment. However, versatile systems, special designs, lower cost per operation and the service bureaus have succeeded in making automation available to practically all sectors of the business community. According to my firm's estimates there were more than ten thousand computer systems installed by July 1960; this includes 6,717 card calculators (see Exhibit I). When the initial hearings were held, the electronic computer systems in operation could be numbered in the dozens. Of this July 1960 total, about twenty-eight hundred were small computer systems. We have estimated that more than forty-five hundred systems are on order. My firm's long run projections for this industry put electronic data processing equipment annual sales well into the billion dollar category.

Other sectors of the automation equipment industry, machine and process controls, are expected to grow at comparable rates.

As the installation of these equipments is accomplished, I think we will begin to notice "where automation is introducing changes in our concepts, our ways of thinking about management. The organizational structure of business (will) start to shift." This opinion, that I stated in 1955, I still hold today. My feelings now are that the restructuring trend will continue in business organizations. "This makes for many changes in the requirements of what people are doing in firms. It again calls attention to education, and to areas where it is necessary to understand precisely what is happening."

The issue of education has taken on major proportions with respect to business needs: greater need for the professional college-trained scientist, engineer and technician; less need for the unskilled. New applied sciences have developed in the last few years which have centered about the concepts of automation; these sciences have synthesized the worlds of mathematics, electronics and business. As business grows more sophisticated in its applications of automation, the demand for management personnel trained in these sciences will grow. Now is the time when these people should be trained. I feel quite strongly that this task—of training management personnel who can make the fullest use of automation concepts and techniques—is not being carried out. With all the profusion of data processing courses and surveys of automation attached to business school curriculums, we have few examples of institutions of higher learning in business which fully integrate the concepts of automation into the entire course of study. One of the bottlenecks, then, in making the fullest use of automation may very well be the lack of adequately trained management manpower.

No doubt, the most prominent aspect of automation is how industry's use of this technology affects employment levels. I pointed out earlier that automation is part of the continuing process of technological change. As part of this change, it has contributed to the "dynamic movements from one industry to another" within the civilian labor force. The long trend of a decreasing percentage of the labor force engaged in manufacturing will most certainly continue. In the last decade, the manufacturing sector has not only shown percentage decreases, but has decreased in terms of absolute number of employees. Following both the recessions of 1954 and 1958, the manufacturing employment highs have failed to reach prerecession levels. The heavy capital equipment expenditures to further automate and mechanize facilities certainly contributed in some part of this trend.

Most of the manufacturing employment decreases were taken in the production work force. This was accompanied by higher employment levels for non-productive workers, those in the managerial and clerical work force.

Recent estimates for this latter sector show it to be perennially behind production workers in raising its productivity and in its absolute productivity as well. In the years to come, I would expect productivity in this sector to rise at a faster rate than it has previously; this should result, to a great extent, from the increased (and more skillful) use of automatic data processing equipment.

The major employment opportunities can be expected in the services and non-manufacturing, non-agricultural industries. I would expect that in some sectors of the latter category—transportation, public utilities, finance and insurance—further increases in productivity may affect employment opportunities somewhat.

I would like to re-emphasize here my earlier comment that if we are to adequately cope with any human problems arising out of dislocation of industry, minimized employment levels in certain industries, new skills and education requirements, we must direct attention to the basic reasons why these problems exist. If industries relocate to new areas, there is a basic problem of stimulating economic growth in the vacated area. If certain industries recede their employment roles, facilities and manpower must be made available to help the displaced develop new skills and obtain different employment. Technological change cannot be encouraged, any temporary problems that may develop in its path cannot be solved, by dealing symptomatically with the change itself.

BRINGING AUTOMATION UP TO DATE

Automation Today
Applications and Uses for Automation
Growth of the Automation Industry
Economic and Social Aspects of Automation
A Guide to a Study of Automation in the U.S. Economy

AUTOMATION TODAY

Throughout the testimony submitted before this Subcommittee, you will come across definitions of automation. Though views will differ, depending on the background of the witness, I think that the concept of automation as a *new* way of analyzing and organizing work will be more heavily stressed than at the original hearings.

As I pointed out earlier, I still feel that the concept of the system is most crucial in describing automation. It is the main contribution that automation will make to business organization. If automation means anything at all, it means something more than a mere extension of mechanization. I believe that it marks a break with past trends, a qualitative departure from the more conventional advance of technology that began with jagged pieces of flint and progressed up to the steam engine. It implies a basic change in our attitude toward the manner of performing work. Perhaps because we see things more easily than ideas, this meaning of automation as a way of thinking has been obscured by a fascination with the machines of automation. As a result, when we hear the word "automation" we tend to think of electronic computers, massive transfer machines, numerical tool controls, or perhaps the instrument panel of an oil refinery—machines that new concepts have made possible. Automation, however, is much more than machines, and it is important to understand this if the full social and economic implications are to be understood.

Unquestionably, industrial progress began hundreds of years ago. Great strides were made in the industrial revolution of the eighteenth century. This was the period of mechanization. Mechanization provided power-driven tools, eliminating many manual tasks and freeing labor from much of the physical work required in production. But no matter how small a portion of brute strength was involved in running a machine, a human worker was always needed to operate and control it. Production processes, therefore, were necessarily designed around the human worker as operator. His reaction time, his powers of perception and concentration and discrimination, his height, his power to withstand heat and cold, his two arms and ten fingers and his ability to coordinate them dictated what could and what could not be done.

Now, through systematic application of the principle called feedback, machines can be built which control their own operations, so that production processes do not have to be designed to take into account the human limitations of a human worker. To me, this is one of the distinctive facts about automation. It is no longer necessary to think in terms of individual machines, or even in terms of groups of machines; instead, for the first time, it is practical to look at an entire production or information-handling process as an integrated system and not as a series of individual steps. It is through the new technology of automation that we are now beginning to possess the ability and the tools to build such systems.

In the past our limited knowledge of the nature of feedback and control made their application dependent upon the ingenuity of individual inventors who used these principles for the sporadic construction of individual machines or segments of overall systems. Even if we had been inspired by the idea of integrated systems, as some men have certainly been at different times in history, we did not in the past possess the technical knowledge to turn this idea into reality. Today, because of advances in the theory and technology of control, communication, and information, we do possess that knowledge and, equally important, we are beginning to apply it in many fields of endeavor.

Automation is more than a series of new machines and more basic than any particular hardware. It is a way of thinking as much as it is a way of doing. It is a new way of organizing and analyzing production, a concern with the production processes as a system, and a consideration of each element as part of the system. It is something of a conceptual breakthrough, as revolutionary in its way as Henry Ford's concept of the assembly line. Indeed, it may in the end have an even more widespread effect on business and industry, since its technology rests on a firm theoretical foundation rather than on a specific method of organization or particular kind of machine. Automation is, therefore, adaptable to many different kinds of operations—office work as well as factory work—in small concerns as well as large.

I think that a good part of the confusion which has resulted in attempts to describe automation has come about from defining the word in terms of the nature of its applications. Many of the definitions offered in the past have not conflicted with one another as much as they have neglected one another. That is, they have defined only one segment of what can properly be considered automation (this is the difficulty one encounters when a definition is attempted in terms of "hardware," or machinery, instead of concept).

Chart A, produced by the International Labour Office, shows very graphically the evolution of automation. Very properly, I think, automation is shown phased into the continuous development of work processes.

Although we are in a position to draw some valid conclusions from an adequate study of today's manifestation of automation, we must remember that automation has not really got off the ground. The concept of automation is what is important. Future machines and hardware will undoubtedly be different from anything that we can presently envisage, but I feel that for a long time to come they will simply be extensions and realizations of the concept of automation.

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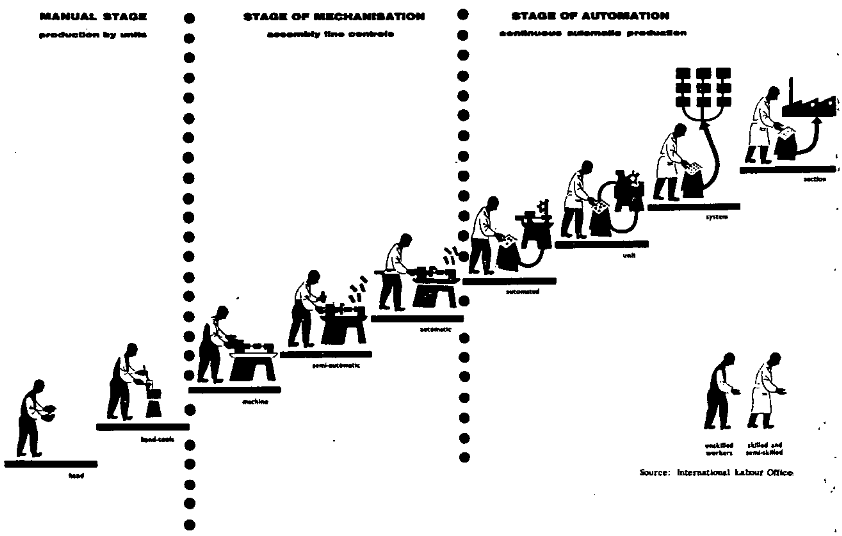

Source: International Labour Office.

CHART A

APPLICATIONS AND USES OF AUTOMATION

As it has developed in the United States, automation takes many forms and can be classified in several ways.

One such classification is as follows:

Computers.—Automatic handling of information by use of electronic systems.

"*Detroit Automation.*"—Integration of machines; linking together, by means of automatic transfer devices of the machines of production.

Process Control Systems.—Computer and integrated control systems for operation of process (oil, chemical, atomic) plants.

Numerical Control.—The use of tape and other automatic control devices to direct operation of machines and machine systems.

The mechanization of what we already do today is the part of automation that has received the most attention. The automated engine lines in automobile plants, and massive transfer machines are familiar examples of automation. These machines and the jobs they do are important, for they contribute to increases in productivity. But they represent the least significant way in which automation increases productivity.

Eight or ten years ago, I was inclined toward this definition of automation, but with more practical first-hand experience, I soon changed my mind. The more I have been engaged in the actual application of automation to industry and government, the more convinced I am that the fundamental importance of automation is not so much the connecting of machines as it is the ability to create automatic information and control systems. The machines change from year to year, but automation is important as a combination of theoretical understanding, information handling, and of the practical application of this theory to build self-correcting systems.

The truly great gains from automation come when it extends the range of man's capability by permitting him to undertake new tasks and reach hitherto unattainable objectives. It is in this area that man's productivity is multiplied, not a few times, but by many orders of magnitude. And it is here that the greatest difficulties are encountered in determining automation's economic consequences.

For example, the principles of long-range weather forecasting are well understood, but digesting the mass of data necessary to produce accurate long-range forecasts has until now been beyond the reach of man or machine. Just recently, a computer was designed capable of doing more than 100 billion arithmetical computations a day. A giant like this will soon be able to provide accurate long-range forecasts, with repercussions for agriculture, construction, transportation and other industries that are breathtaking to contemplate.

Our experience has shown that the motivations for automating have been very diverse. Apart from the fact that many considered it a band wagon on which they should climb, the overriding factors dictating a decision to automate usually were, and still are, (1) to cut production costs, (2) to reduce labor requirements, (3) to do existing things faster, (4) to do things not possible before, (5) to increase productivity, and (6) to aid in decision-making by providing fuller and faster information.

Probably the most common, and the worst reason for embarking on an automation program is to save labor costs. Office management in particular has been bedeviled for years by rising clerical costs and the difficulty of hiring enough clerks to get the work done. Mindful of claims to the effect that one man can be taken off the payroll for each $5,000 invested in automatic equipment, management has looked on automation as the answer to a nightmare.

At first glance, this looks like a good enough reason. Ordinarily, an automatic machine does reduce labor costs, though seldom as much as management had hoped. Here is a simplified example of the economics of the situation which shows why.

Computer Economics

A computer system with tape, tape printer, and peripheral equipment may rent for about $20,000 a month. In addition, the cost of going from the old to the new system can easily reach $275,000. It may cost more if the old system is particularly antiquated. The new system, therefore, has to relieve enough clerks to pay for the equipment and to yield a return on the investment. For a three year payout on the investment, annual savings above machine costs must be $92,000. To produce this savings from personnel alone, these costs would have to be reduced $332,000 a year. At $5,000 a year per clerk, this means a net reduction of 66 clerks for the investment to be barely justifiable. And this net reduction has to absorb the extra personnel costs for programmers and machine operators.

The main trouble with this approach is not that savings usually fail to match expectations.

When labor saving is the main goal, it automatically demotes to second place what should be the primary aim of any company installing automation equipment; to exploit fully the potentialities of these machines for doing things that cannot be done well, or cannot be done at all, without them. But even so, automation can cut costs in other less obvious directions.

A Department of Labor study of an insurance company, which installed a computer in the classification sections of one of its divisions, reveals where some of these savings lie. The computer reduced personnel in this particular area from 198 to 85 workers and freed more than 15,000 square feet of floor space for other uses. It reduced the number of punched card machines from 125 to 21, and the yearly rental for these machines from $235,000 to $19,000. Monthly punch card requirements have been cut by nearly 2.5 million. Altogether, the computer is expected to cut the classification section's budgets in half.

Indeed, management has often introduced automation largely to reduce labor costs and then finds that it has done the right thing for the wrong reason. One chemical company figured that for every dollar saved by reducing the man-hour content for each unit of product, it saved at least three dollars because it could produce a better product more efficiently and with less waste.

"Detroit" Automation in Practice

Among the first examples of the Detroit type of automation are the two Brooks Park engine plants of the Ford Motor Company, near Cleveland, which since 1951 have been turning out six-cylinder engine blocks from rough castings. The castings which are first produced in an automated foundry, are fed into a broaching machine, which then "just goes 'whoosh' and it is done," as one startled observer described the process. Altogether, 42 automatic machines, linked together by transfer devices that automatically move the blocks through the complete process, perform 530 precision cutting operations and borings. A rough casting goes through the line and emerges as a finished engine block in just 14.6 minutes, as against nine hours in a conventional plant.

From the start to finish along the 1,545 foot line, no operator touches a part. "I don't do nothing but press these two buttons," the operator of the broaching machine on an automated Ford Line at Dearborn remarked. "Sometimes I use my thumbs (to push the buttons), sometimes I use my wrists and sometimes I lay my whole arm across. The only time I sweat on the job any more is when the sun is 100 and something outside."

All too often today the economies expected of automation do not bear fruit in actual practice. The expected savings from high cost installations may turn into unrealized hopes.

The following, by now famous, case story clearly illustrates that automation can be a two-way street, if the moves are not properly planned.

Late in 1952, a well-known Midwestern automotive supplier began planning a new and highly automated plant that was to prove almost disastrous.

This new facility was an industrial automation scheme designed for the production of body frames for the 1955 model of a popular low-price automobile. The heart of the plant was a 39-station riveting and welding transfer line for assembling the frames. Anticipated rate of production was 200 frames an hour, which represented 40 per cent of the customer's total requirements.

A new plant in northern Illinois, specially designed to house the machinery, was scheduled to go into production in the Summer of 1954—allowing a leadtime of eighteen months between preliminary design and full operation. Although the machinery was installed on time, a continuing series of mechanical defects prevented the line from working properly. For example, the lack of complete drawings and proper references from the equipment vendor resulted in misalignment by one-fourth of an inch of a 30-foot station, which, in turn, prevented transfer through the station. Similarly, a number of transfer clamps had to be redesigned because original plans proved inadequate.

Mechanical problems continued to hold up production throughout the Summer of 1954. By Autumn, the body frame manufacturer was forced to install manual machines in order to meet delivery commitments for the beginning of the 1955 model year. This meant hiring 2,500 workers, rather than the originally planned 1,000. Because of local labor shortages, unskilled workers were hired. Although the plant was located in an area which had a history of labor trouble, little weight had been given to this fact when an automated facility had been planned. As things turned out, the company was faced with severe jurisdictional disputes and slowdowns.

The company succeeded in meeting production schedules with the manual equipment while debugging progressed on the automatic line. The line ran at reduced speed during the Spring and Summer of 1955, but in the Fall, the machinery began to have frequent breakdowns. Pressure for production prevented, for a time, the shutdown needed for correcting the engineering defects, but the line was finally shut down and rebuilt, with redesigned parts substituted for the ones which were faulty. This work took more than a year to complete. In the Spring of 1957, the line was finally started up again. It ran almost perfectly for four months, turning out superior frames at better than the originally planned rate of production.

The 1957 production year then ended. The 1958 model of the automobile was redesigned on a new frame, which was all welded. The original investment in the automatic line was about $4 million.

The estimated cost of retooling for the 1958 frame was about $2 million. In the meantime, because of the frame manufacturer's poor delivery performance, the automobile manufacturer cut his order by about 40 per cent. The economic justification for the automatic line was destroyed. As a result, the 1958 frames were produced on a semi-automatic line in one of the supplier's original plants. The estimated loss on operation of the automated plant was almost $10 million.

Why should all this have happened? The series of difficulties this manufacturer experienced—unanticipated mechanical trouble, labor trouble, insufficient time for debugging the new equipment, severe pressure for production—might at first glance be put down to nothing more than a run of plain bad luck.

But it was not bad luck. Every one of the difficulties that made automation a fiasco for this company can be traced to inadequate planning and insufficient lead time. In short, the company grossly underestimated the magnitude of the change it was undertaking.

Process Control

When the material being processed is not a rigid, solid object but something that flows by its very nature—a liquid, a gas, electric energy, a solid in crushed or powdered form—continuous flow is a good deal easier to achieve. Thus, it is not surprising that automation began earlier and has gone much further in the processing industries than in manufacturing, although these industries are still a long way from full automation.

In chemical manufacture and oil refining—the industries that have gone the furthest in automating—entire systems of control instruments regulate the production processes, making it virtually automatic from raw material to finished product, and sometimes to finished by-product as well. A modern oil refinery, oil men estimate, is 80 to 90 per cent automatic. In Esso's refinery at Fawley, England, six men on any one shift operate distillation units processing 5.5 million gallons of crude oil a day. In another plant in Iran, one operator in a central control room regulates 50,000 barrels a day, the total output of four wells singlehanded. "A man may work for months on a pipeline, or in a refinery, or even in the production fields and never see or touch oil," an official of the Oil Workers Union has said.

Here are a few more examples that further illustrate the advantages of more automated process control:

> The chief instrument engineer of a chemical company stated: "Our most significant improvements in purity, increases in

throughput for existing equipment, and increases in product uniformity have been brought about by the addition of either analytical instruments or by rearranging the existing instruments into tighter control loops, or by the combination of both. When we have studied the economics after installation, it has not been unusual for us to find savings to the company of anywhere from $50,000 to $150,000 per year by adding instrumentation that costs from $10,000 to $15,000."

Installation of automatic product gauge controls in a plastic film extrusion operation yields savings on materials of $33,000 per year. The cost of the controls was $24,500.

The installation of computer to control a catalytic polymerization unit in a refinery, in conjunction with chromatograph stream analyzers, other new sensing elements, and pneumatic to electric and electric to pneumatic transducers yielded an increase in yield from 86% of theoretical maximum to 93% plus an annual savings in cost of catalytic material of $75,000. Total annual savings are approximately $350,000. The total cost of the control installation was $300,000.

The installation of new instrumentation system in a pulp plant resulted in increasing the yield of one cord of wood from .57 tons to .8 tons of pulp.

Numerical Control

Numerical control automation, which has just recently begun to be applied on a widespread basis, is especially applicable to small shops with short runs of greatly varying products—typical job shops. There are roughly 750 of these tape fed machines in existence today. As I mentioned in earlier testimony, the bulk of U.S. hard-goods production is in lots of less than 25 identical units. But today's plant automation is largely of the "Detroit type"—large transfer machinery, suitable for only a small portion of our national production. The solution of this problem is on hand in the numerically controlled machine tool. The development of smaller versions of this equipment will be of principal importance to the factory in the future. Such machines will be capable of producing a short run of one product and then, with a change of tape, producing a few more units of an entirely different product, all from the same tool.

Individual companies adopt automatic control because they expect to benefit from its use by doing existing things better through cutting labor costs, increasing the yield from a facility, reducing in-process inventory, facilitating change in product characteristics or for other reasons. However, the greatest gains in productivity from automation will come from being able to do altogether new tasks and achieve previously unattainable goals. Manufacturers have stated that: using a new numerical controlled machine tool, the total cycle times in the fabrication of an assortment of different parts are reduced from one-half to slightly more than one-tenth the cycle time using under numerical control than comparable tools under manual or tracer control.

Just recently a large manufacturer announced that it already had put into operation seventy-five "program-controlled machines" in the last few years. The company was specifically interested in applying automation to its job shop operations.

The next decade will see the spread of this kind of system in the plant, as the last decade has seen the spread of the computer in the office.

For several years now, my firm has conducted comprehensive surveys of users of automative data processing equipment to find out what have been their experience. We have generally found that proper uses of the "hardware" through careful planning has opened possibilities of greater control and analysis than ever existed before.

Chart B shows part of the result of a survey we took 3 years ago of two hundred and eighty users of computer systems. The areas of greatest satisfaction occurred where the inherent speed of the equipment led to satisfaction. There seemed to be less feeling of success applying the computer where more complex management problems arose (improvement in employee morale, for example) and where there was greater need for management science (long-range decisions) techniques. These problems rather than the equipment have been the major stumbling blocks to successful automation—these, rather than any technical problems that may have developed. Technical developments, new machines, and all the results of competition and new ranges of equipment are all of no avail unless they are properly applied. For a long time, it has been this area of application that cast a shadow over the data processing field. The lag between technical achievement and actual application was, say two years ago, so significant as to be almost dangerous. The lag still exists, but at least there have been worthwhile developments in the application of computers. Information instead of paper work is becoming the raison d'etre of more and more machine systems, and the imaginative developments in 1959 have been quite interesting.

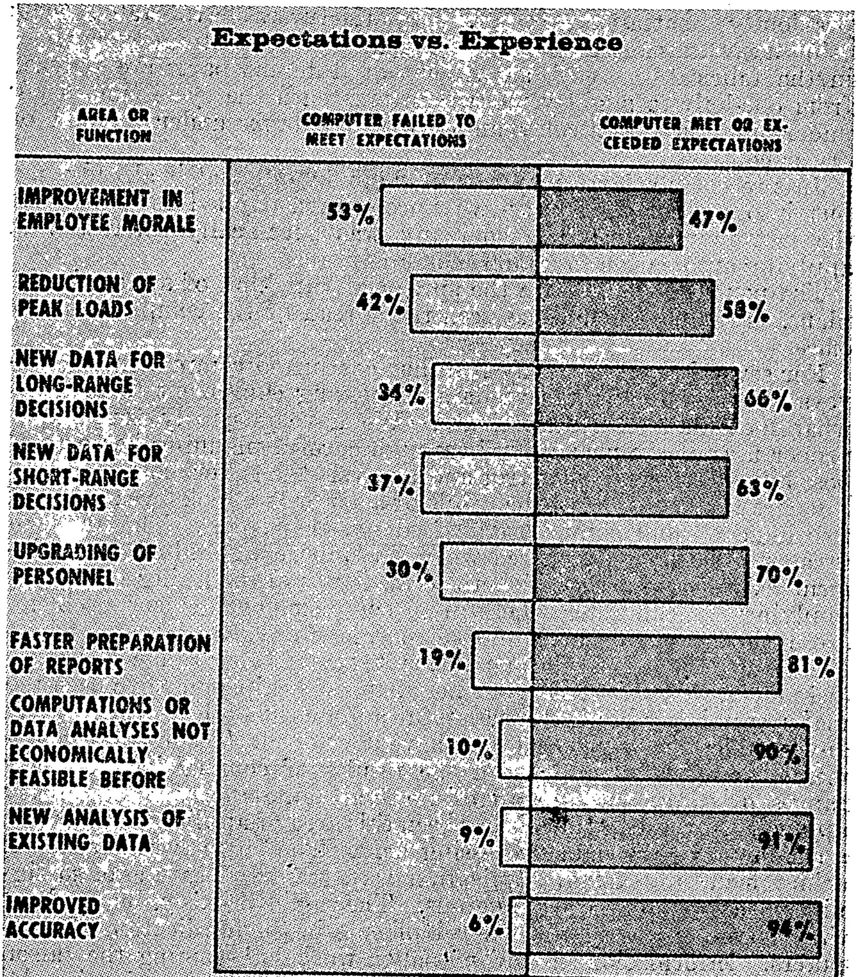

CHART B

Source: John Diebold & Associates, Inc.

A textile manufacturer in New York uses a computer almost entirely for information on inventory, sales analysis, and material available for sale. Not only has this been found to be profitable, but the company is developing new applications and further information requirements that will require a larger system in the next two years. A major oil manufacturer is developing a complete program for marketing accounting that will not only reduce costs, but will provide marketing managers with up-to-date information on sales and sales tendencies all over the country. A drug and consumer goods manufacturer is using a computer to keep constant track of area sales in relation to a national index of purchasing power for a given area. As soon as discrepancies are detected between actual sales and sales that should be expected, corrective action is taken and the results can be measured on a week by week basis.

Another producer of consumer goods has been able to use a computer system to determine the effect of money spent for advertising and promotion, and to test the probable effect of expenditures on different types of advertising. The result has been a significant change in his advertising and promotion policy.

A chemical company is developing a program for patent searches and classification that will save large amounts of the time of skilled research workers, while the computer is also being used to provide the company's customers with optimum mixes of fertilizer for specific conditions. A utility company will use one of the new generation of computers to overcome the problem of providing customers with up to date, accurate answers to inquiries, in addition to performing the basic data processing work. The Boeing plant in Wichita, Kansas, is using direct connections from the factory floor to the data processing center in order to gather production data as part of an integrated system of production control.

There are many other examples, but it is enough to say that, although they remain the exception rather than the rule, many companies have made significant progress toward utilizing some of the real potential that computers offer.

The present uses for electronic data processing can be summarized under three headings: (1) Business Data Processing, (2) Analysis for Management, and (3) Scientific and Engineering Applications. This is similar to the breakdown we use for our computer surveys.

Survey Categories for Electronic Data Processing Equipment Users

-Business Data Processing-	Analysis for Management-
1 Payroll	1. Expense Distribution
2. Accounts Receivable & Billing	2. Budgeting and Estimation
3. Accounts Payable	3. Sales Analysis
4. Cost Accounting	4. Linear Programming
5 General Accounting	5. Simulation
6 Production Control	6 Market Research
7 Production Scheduling	7. Statistical Surveys
8 Inventory Control	8. Prediction & Forecasting

Scientific and Engineering Applications

-CHART C-

Source: John Diebold & Associates

In Chart C, I have reproduced the categories under which we collect data for our surveys. It gives a good picture of present kinds of uses for computers in industry. Generally, payroll and accounting functions are most often cited as EDP applications. Production and inventory control is becoming widely accepted for computer utilization as well as are operations research techniques (used in simulation, distribution and routing problems and production and inventory controls—to name just a few).

One of the areas of discussion prominently raised at the previous hearings was the application of electronic data processing techniques to small business. Though most small businesses are far from knowing the fruits of automation, many have already tasted it—and many more will do so in the near future. This has come about due to two developments. One, the addition to computer manufacturers' product lines of small scale computer systems specifically designed for the capacity needs and pocket books of smaller businesses; second, the expansion in number of service bureaus and data processing centers. The latter only rents its customers time on computer systems. The service bureaus mostly offer complete services in addition to renting machine time to customers; these services include programming, systems design and consultation.

The service bureau has significantly opened up automatic data processing to small firms. Though they could not justify equipment of their own, use of the service bureaus has been proven economical for such continuing applications as payroll, sales analysis, inventory control, and particularly beneficial for special problems in the operations research category involving linear programming methods.

One of the largest computer center networks, the Service Bureau Corporation, a subsidiary of IBM, has reported that the backbone of its business is from small firms, most of whose gross sales are under five million dollars annually. Their customers include insurance agencies, schools, hospitals, union locals, small manufacturers, medical clinics, dairies, banks, mortgage companies, independent telephone companies and other smaller utilities.

The impact of the service bureau concept on business should be even greater within the next few years. All the leading computer manufacturers have opened large numbers of such centers, and are continually opening more of them. These companies include IBM, Remington Rand, RCA, Minneapolis-Honeywell, General Electric, and Burroughs.

In addition to manufacturer-run service bureaus, independent service organizations are cropping up all over the country. The independent service bureaus do not have the built-in contacts and customers that manufacturers' service bureau have. They must offer results at rates reasonable to the customer, and at the same time, must operate a profitable business.

Entirely independent service bureaus are in most cases offering punched card tabulating services. They will usually have punched card calculators or small computers for jobs which require more complicated analyses. In order to provide a low-cost service, these companies will specialize in one application, design a standard program which can handle simple variations of that application and will sell this to small firms at an economic rate. The large volume obtained through many customers makes this possible.

An example of this type of operation is located in New York City. This company has standard punched card equipment and a small punched card calculator. They have designed a payroll application on this equipment which can be used for several of the companies which they service. One of these companies has a 1,000-man payroll, a fairly large operation. It is a construction firm which found it very difficult to prepare accurate payroll records under their working conditions. This service relieved their accounting office of a big problem and also prepares the payroll checks and records at a lower cost.

This company has recently installed a computer which will increase its capacity considerably. The company expects to be processing payrolls for companies employing as few as 25 and as many as 1,000 employees. The significant factor in the economics of such an operation is that a standard payroll is designed and the equipment is set up to process a series of payrolls in one run. Only the imprinter changes so that the check and journal headings will show the proper company name. This provides the means for very small companies to take advantage of savings available through large volume processing.

It seems that the small independent service bureaus will be specializing in particular areas, such as payrolls, or insurance calculations, for assisting large companies during peak periods, or survey results analysis, or general accounting functions. Through standardized systems, they will be able to provide low-cost service to the small companies and not only increase their own business but also provide benefits to their customers. The customers, in so many cases, cannot afford their own equipment and even cannot afford specialized treatment, including systems design and programming on a large computer, at a service bureau.

The service bureau concept has gone beyond specific applications to small business. Large service bureaus operate high speed computers for use of the larger corporations to solve highly complex problems. Cooperative service bureaus have also been formed. While many companies are solving their data processing problems through the use of outside service bureaus, a number of companies have found it more feasible to buy a computer on a cooperative basis with other companies. In most cases, the companies who have banded together have done so because their competitors were able to buy computers of their own. In order to compete, the smaller companies had to have the use of computers and had to have them close enough geographically to perform their daily requirement.

One of the earliest groups of this type is SPAN, a group of fire and casualty insurance companies in Hartford, Connecticut. These companies installed a computer system in early 1958 for processing their paper work.

A similar arrangement was accomplished and is operating in the midwest, except that the companies involved are seven engineering firms.

A third group which has seen the need for electronic equipment is a group of banks in Texas. This group of banks will buy equipment and establish a joint computer center.

The important economic fact to recognize is that each cooperative group is applying the computer for the same type of application—banking, insurance and engineering. The hardware of the system can, therefore, be designed for the application. The computer operation also has a steady flow of customers. These factors make for a more economical operation than service bureaus who are soliciting different kinds of business.

All these factors—the service bureau, the data center, the cooperative bureau, the new small-scale computer systems—would seem to indicate that what can be called "small business" will have an economic opportunity to make use of automative techniques. It may be further concluded that it will be an economic necessity for them to do so.

Who Uses Automation

Despite the burgeoning use of automative techniques, both in the factory and the office, woefully little quantitative data are available as to usage by industrial and commercial sectors of the economy. The extent of penetration of automation equipment within any industry group is still not clearly ascertained.

As a firm, we assemble this kind of data. We are presently in the process of updating past computer surveys. From a qualitative standpoint, the bulk of computer installations can be accounted for among the following industries: aircraft manufacturers, transportation, insurance companies, computer component manufacturers, financial firms, public utilities, other manufacturing, military and research, science and engineering.

More data is available for the controls and instrumentation industry. I will show in the following section, The Growth of the Automation Industry, that this industry can be expected to grow at a fast rate.

During the next decade, the developments in automation should have a growing impact on American industry. Research now being conducted by electronic equipment manufacturers should yield these results. I think it is only fitting to conclude this section on "Applications" with a short discussion of the kind of developments we can expect in these next ten years.

The most immediate progress will be made in the area of communication equipment. Large corporations, which took the lead in initiating the use of large-scale computing equipment for data processing, will give more management attention to integrating accounting, purchasing, inventory control, and shop scheduling through centralized processsing.

Until now, automatic data processing has been largely confined to batch processing. This means collecting data during the day, usually in the form of punched cards. These cards are then sorted and processed against a sequential file in a daily processing run. However, several improvements in the punched card system soon to be introduced should speed up the operation and reduce the input preparation costs.

Faster Fact Gathering

As is indicated in Chart E, equipment will be available this year for card-to-card transmission of data over regular long-distance telephone wires. Relatively inexpensive sending machines installed, for example, in a company's branch plants and sales offices will be used to send information at the rate of 40 cards a minute (and for the price of a phone call) over the telephone lines to headquarters where a receiving machine will produce the data on another card.

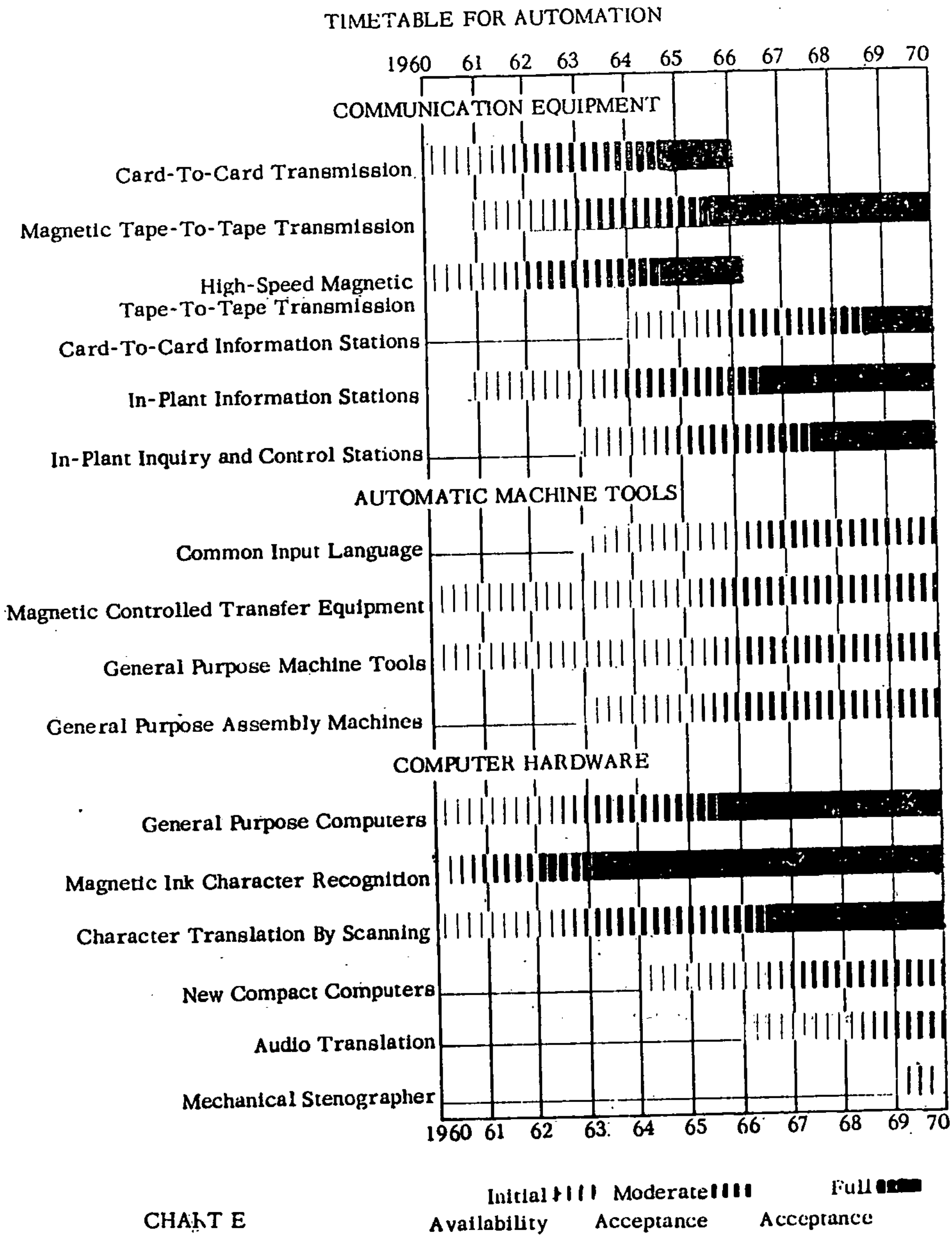

CHART E

Source: John Diebold & Associates, Inc.

An extension of this system, the card-to-card information station, also will be available. It would work like this:

A production worker drops his time card into a "remote station" computer located on the production floor and, using a keyboard, inserts such variable data as employee number and quantity produced. This information is then transmitted over cables to a central information station which punches a transaction card. The transaction cards transmitted from this and all other remote stations are accumulated and subsequently converted to magetic tape and fed into the computer.

Improvements in magnetic tape transmission, however, will eventually do away with the extra operation of converting punched cards to tape. By 1961, tape-to-tape transmission utilizing long distance telephone lines will be available. Even higher-speed tape-to-tape transmission will be possible with the use of coaxial cable. This advance is expected about 1964.

Before the decade is out, it will be possible to feed information from remote stations in plants and offices directly into a central computer, which will maintain an up-to-the-minute file and will immediately feed back answers to requests for any data contained in the file.

In-plant information stations, which will be introduced in 1961, will permit direct, continuous transmission of punched-card data from the remote station into the central computer. The computer will be able to maintain an up-to-the-minute file. It will also produce daily summary reports of operations.

By 1963, continued advances will make possible the in-plant inquiry and control station, which could automate the whole scheduling process. A medium-size computer will do the basic file maintenance of incoming data, but it will be attached to a bigger computer which will draw its information from the file, coordinate such complex processes as scheduling, and relay any changes back to the remote stations.

Service industries, such as banks, will use inquiry stations, for example, to check customer accounts and to record transactions. Airlines will be able to make and confirm reservations quickly, and at the same time, record billing information. Department stores will check credit, and account balances automatically.

Automating the Plant

The truly automatic factory is still far from a reality today, but during the next decade, improvements on existing equipment and systems will bring it closer to realization.

With existing tape-controlled machine tools, extensive calculations are required to prepare the instructions for the coded magnetic tapes. Today, these calculations are performed on a computer using specially prepared programs for each specific part. By 1963, a common input language for computers will simplify this job.

A few companies, both here and abroad, are already using tape-controlled transfer equipment to link together several of these automatic machine tools into an assembly line. Further development of this equipment can be expected in the next ten years.

To be efficient, automatic tools today can perform only one specific function. But automatically controlled tools which can perform a number of different jobs, such as cutting and stamping, will be in use by 1962. The next step after the development of these general purpose machine tools will be the development of general purpose assembly machines.

Versatile New "Brains"

Behind all of these advances are a number of major improvements in the computer itself.

General-purpose computers, installed this year, will be able to handle equally well such business functions as inventory and scheduling, and such engineering functions as the design and development of new equipment.

New compact computers, which will be available by 1964, will be smaller, faster, and more flexible. They will be able to do more jobs simultaneously and will make a bigger file of information easily accessible.

Wider usage of magnetic ink character recognition systems will take place during the decade. Many banks are already using magnetic ink account numbers, which can be "read" electronically, on their checks. Character translation by scanning is another development in this area. In this process, a photo-electric eye scans the numerals and records them.

By 1966, it will be possible to instruct a computer verbally by means of audio translation. In another four years, a mechanical stenographer attached to the computer will give back the recorded data on a sheet of paper. To get the most out of its investment in this revolutionary equipment, management will give more attention to finding broader uses for these new tools of industry.

Growth in the Automation Industry

In the last five years, the growth in the use of automation techniques has certainly been great. But it is my guess that this billion dollar automation equipment industry of today is still in its infancy. I don't think this statement is optimistic. On the contrary, it is quite realistic. In the late 1940's I remember hearing of a statement that "fewer than a dozen electronic computers will be able to satisfy the entire computational requirements of this country." There is no need belaboring this prediction.

I said earlier that I felt that there were real problems in application, that automation would be slow in coming. But "slow" is a relative word. Automation will be "slow" in being applied as compared with its *potential* applicability. In absolute terms of dollar value of equipment delivered, diversity of machines introduced and number of units installed, the growth rate of the automation industry will generally outstrip that of the entire economy for a while to come.

Several factors can account for this growth: continuous interest on the part of business men in methods which may lead to cost reductions and better management control, technological development within the automation field, and more competition in the industry itself.

One department in my organization is specifically concerned with analyzing the automation equipment market. We are always in the process of updating our estimates and projections. It is significant that projections of the future market usually must be revised upwards as we receive more data on present market conditions!

This section will mainly include some of my firm's data on the industry's historical growth and some projections for future growth.

Process Controls and Instruments

This industry should grow threefold by 1970. Chart F illustrates my firm's estimates of the potential market for automatic controls and instrumentation. We may expect that expenditures for this type of equipment can approach and even exceed three billion dollars a year by 1970.

The process industries, such as chemicals and food processing, have been the major users of controls and instrumentation. Companies dealing with products manufactured in continuous flow systems have been quickest to adopt the use of this equipment. We can expect spectacular growth in process industries during this next decade. Chemical production is estimated to rise more than 125% by 1970,

ACTUAL & PROJECTED EXPENDITURES FOR CONTROLS & INSTRUMENTATION

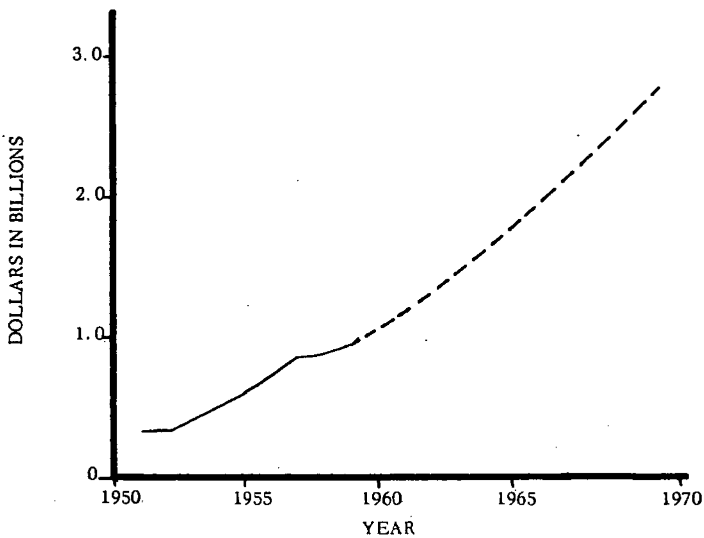

CHART F

Source: John Diebold & Associates, Inc.

for example. Not only will process control equipment production grow due to growth in its market, new technological developments yielding new uses will expand this market to an even greater extent. Of the total expenditures in 1970 for controls and instrumentation, that equipment going to the process industries may account for about two thirds of this total, or about two billion dollars. Chart G is a graphic comparison between the rise expected in Gross National Product and a projection of process control and instrumentation expenditures. The growth rate in these industries' expenditures will be greater than ten per cent per year during these next ten years. Most certainly, it will outstrip our national growth rate rather dramatically.

Numerical Control Equipment

Numerical controls have shown the greatest growth rate of any sector of the automation equipment field largely because it is the newest of commercially acceptable automation techniques—and there are relatively few actual units installed. Numerical control is only six years in existence, but its acceptance by industry seems complete.

In the last few years, annual sales of this equipment have been doubling the previous year's sales record. We can expect this high rate of growth to continue for years to come. In the next three years, my firm's estimates show this industry growing by five hundred per cent to within the one hundred million dollar range. Chart H shows our projection, again with a comparison to a gross national product estimate.

Already, more than forty companies have developed numerical control equipment and are promoting its sale. The technique has demonstrated distinct advantages over conventional machine tools that outweigh its initial high cost: large potential reductions in production costs, greater accuracy and more speed—to name just a few.

Undoubtedly, the large capital outlays needed to install numerical controlled machines will keep many small businesses from employing them at this time. Many may simply be reluctant to lay out money for new tools when it would seem that the ones they have are perfectly good. Eventually, competition may drive the smaller businesses to use of this technique. Making these automated tools economically feasible for them will require that the machines have great flexibility—which they are technically capable of—and good service on the part of the manufacturers. I think the latter will certainly occur. The analogy may be made here to the role of the manufacturers of computers who have done a great deal in bringing the technical know-how to the equipment users.

RATES OF GROWTH: GNP & PROCESS CONTROL EQUIPMENT

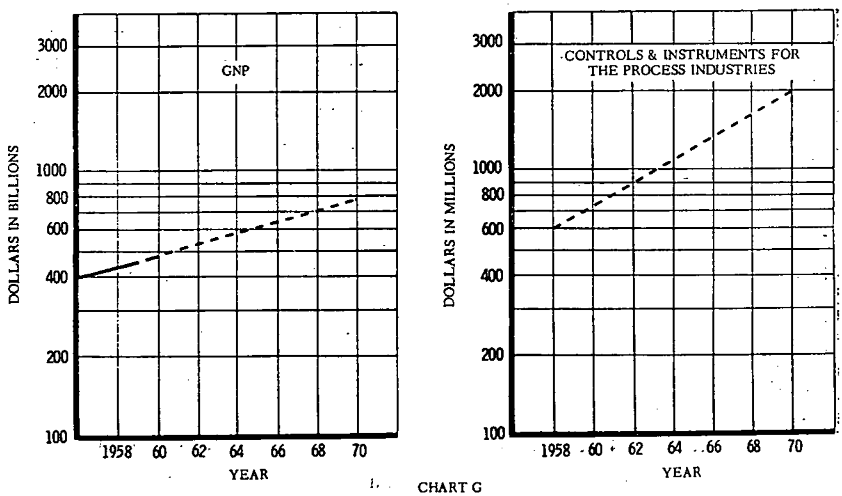

CHART G

RATES OF GROWTH: GNP & NUMERICAL CONTROL EQUIPMENT

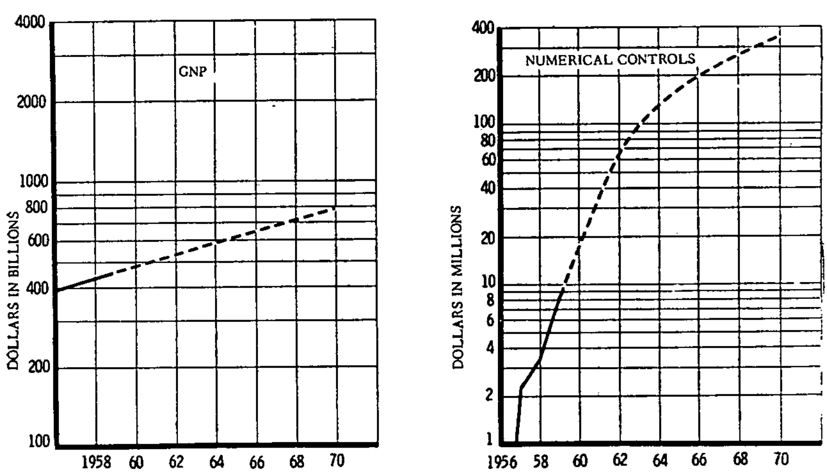

CHART H

Source: John Diebold & Associates, Inc

The impact of numerical controls on the economy has yet to be strongly felt. This aspect of automation has not received the wide public attention given to computers and transfer equipment; but this phase of the industry alone may well have a most significant impact within certain manufacturing industries. When you consider that about 70 to 80% of the metal-working industry deals with production runs of twenty five units or less and that these operations have been the last to yield to cost reduction efforts, numerical controls are bound to have a major effect on this manufacturing industry. One prognosticator says that "within five years, fifty per cent of the new machine tool facilities will be represented by numerically controlled tools." No doubt this subcommittee will hear other estimates of future numerical control usage from witnesses identified with that industry. Suffice to say, that growth in the application of numerical controls even to twenty five per cent of new machine tool facilities will have national economic consequences.

Electronic Data Processing

I think that it can be safely said of electronic data processing that it is the most extensively used technique developed within the concept of automation; there seems to be little doubt that the influence in our economy will grow even greater. The intelligent use of electronic computing machinery and its peripheral equipment hold out promises of productivity which we do not, at present, even know how to measure—the "productivity" found in accomplishing things we never thought of doing or simply could not do before. There is still a long way to go, however, in extending the use of this equipment within industries to accomplish day-to-day business functions—payroll processing, inventory control, production control and other such applications.

The number of companies that have computer systems is still a minute fraction of total American industry. Chart I is a summary table of our latest estimates of the number of computer installations.

Total installations, as of July 1960, were almost eleven thousand. This is more than a 34% increase over last year's total. These figures only denote computer systems delivered; hundreds more are on order.

I think I can summarize the basis for this recent progress by considering four factors that have had far-reaching influence in automatic data processing: first, development and introduction of new machines and new technical developments; second, significant developments in automatic data processing for the small and medium size company; third, the growth of competition in the computer field; and fourth, the improvement of the use made of computers through better planning and better applications.

ESTIMATES OF COMPUTER INSTALLATIONS*

	-Delivered- (As of July 1960)	-Delivered- (As of July 1959)	% Increase over 1959
Large-Scale General Purpose Digital Computer Systems	607	383	58%
Medium-Scale General Purpose Digital Computer Systems	840	444	89%
Small-Scale General Purpose Digital Computer Systems	2810	1691	66%
Miscellaneous Digital Computers	6717	5636	19%

CHART I

*NOTES: The figures here are on a systems classification, based on the computer and its associated peripheral equipment as defined below. There is no implied evaluation of machine capabilities in terms of large, medium and small. Minimum requirements for each class follow·

Large-scale: The system uses magnetic tapes and the computer operates at microsecond arithmetic speeds. Price in general is in the order of magnitude of one million dollars or more.

Medium-scale: The system uses magnetic tapes and the computer operates at millisecond arithmetic speeds. In general, the price range is from $500,000 to $1,000,000.

Small-scale: The system does not use magnetic tapes, but the computer is internally programmed. Miscellaneous computers are card calculators and other machines which do not fall into one of the above systems classifications

Source: Automatic Data Processing Service
John Diebold & Associates, Inc.

Technological improvements in electronic computers have been made in such areas as data storage and retrieval, computing speeds and a host of developments leading to special capabilities of "hardware" to cope with specific problems. The most recent important development has been the transistorized computer. We are now faced with a new generation of computers with new capabilities. Generally, the new computing machines have the following attributes:

(*a*) Greater Reliability. Machines will make even fewer mistakes (if this is conceivable) and they will be in operating condition in a greater proportion of the time.

(*b*) Costs of installation will be lower, partly because the machine systems are smaller and partly because of the fewer environment requirements for the installation.

(*c*) Lower Cost Per Unit of Performance. This has several additional implications. The greater speed of processing will permit applications that were impossible before for economic reasons.

(*d*) Greater Flexibility. One machine is now able to serve many more functions than before. For instance, it is, at least from a technical viewpoint, much more reasonable to combine scientific and business applications than it was before.

The development of smaller machines has opened up new areas of business to the computer manufacturers. As can be seen in Chart I, in terms of absolute increases in number of installations and percentage increases in number of installations and percentage increase, small scale computer systems have shown the most impressive growth. Many of these systems have gone to the smaller and medium-sized companies. The growth in the use of service bureaus, discussed in the previous section, has also expanded EDP usage considerably.

The third major development has been a healthy increase in competition among the computer manufacturers. This has resulted in a direct increase in number and kinds of systems available. There is also considerable pressure for the computer companies to provide even better service to customers.

Competition in computers has gone through three stages. Several companies have entered and then withdrawn from the field to leave three or four dominant firms manufacturing business data processing equipment. The third stage began in 1958–59 when a whole new group of powerful firms entered the computer field. Chart J shows the initial announcement dates by major manufacturers of commercially available computer systems.

The industry presently is still dominated by a few companies. IBM, which has maintained its position as the largest in the industry in terms of sales volume, may find it difficult to hold its share of the market in the face of stiffer competition from the rest of the industry. Estimates of IBM's share of the computer market have declined from approximately 80% levels more recently to about 75%. Other computer manufacturers are predicting that this percentage will fall even further. In terms of dollar volume of the market, this should increase for the next few years. Chart K contains our estimates of the annual incremental value of installations since 1955. From an installed value of about seventy-five million dollars' worth of equipment in 1955, 1960's installation value should be about six hundred fifty million dollars. The industry is capable of doubling this 1960 figure within five years. However, projections vary considerably, but even the conservative projections for annual installation values are higher than those presently. Personally, I expect the computer market to achieve its high growth potential.

INITIAL ANNOUNCEMENT DATES OF COMMERCIALLY AVAILABLE

COMPUTER SYSTEMS

Manufacturer	Announcement Dates										
	1950	1	2	3	4	5	6	7	8	9	1960
Remington Rand	X										
Teleregister		X									
IBM			X								
National Cash Register			X								
Bendix Corporation				X							
Burroughs				X							
Monroe					X						
RCA						X					
Minneapolis-Honeywell						X					
Royal Precision							X				
North American Aviation (Autonetics)							X				
Philco								X			
General Electric									X		
Thompson-Ramo-Wooldridge									X		
Control Data Corporation									X		
Packard Bell											X

CHART J

Source: John Diebold & Associates, Inc.

Approximate Value of Installations
Yearly Increments
Commercial Business and Scientific Data
Processing Electronic Computer Systems*

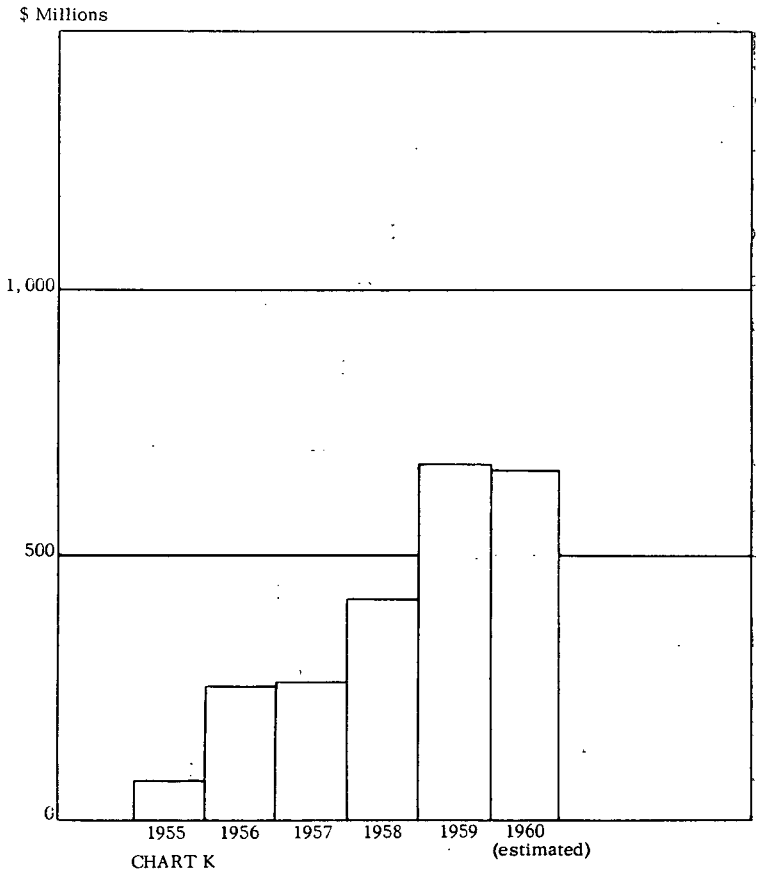

CHART K

*does not include punched card calculators or punched card system unless associated with a computer as peripheral equipment.

Source: John Diebold & Associates, Inc.

Economic and Social Aspects of Automation

I do not believe that we are presently experiencing the full economic and social influence of automation—that is, of fully utilized automation concepts and techniques. The acceptance of automation techniques by industry has been more gradual than it might have been. Technical or economic feasibility did not hold back the introduction of automation; lack of understanding the new technology, fear, improper planning and other human mistakes are more likely reasons. I think it would not be too great an exaggeration to say that the economic and social environment had a greater limiting impact on automation than the impact of automation on the environment.

An inspection of the aggregate productivity figures would not reveal any abnormally high productive influence in the post-war economy. Even if the recovery year 1959 is included in productivity calculations, total U.S. private industry still only had an annual rate of increase in output per man-hour of about 3 percent for the entire post-war period 1947–59. The non-agricultural sector of the economy had an annual average of about 2½ percent for the same period. More recent average productivity growth is even lower. The annual average increase in productivity from 1953–59 in non-agricultural industries is slightly less than 2.3 percent. In terms of impact on the total economy, it would be difficult to discover where any revolutionary element had been introduced into the works. Of course, substantial productivity gains have been made in a number of individual industries as a result of the introduction of mechanization and automation equipment; in some cases, human hardships have developed; in others this has not been so. But in the aggregate sense, automation has not so greatly affected the economy that it can be isolated from advances in technology that we continuously experience.

I do not want to give the impression that I intend to minimize the economic effects of automation. The Subcommittee will, no doubt, be provided with many statistics documenting the dislocations of workers and job eliminations attributed to technological change. However, I want to avoid incorrectly attributing these results to automation. I made the statement earlier that automation is a set of concepts and techniques; it is a body of knowledge making available to the nation more efficient means for producing goods. This technology does not cause anything; how we use it yields the results. In other words, how the economy is operating has an influence on what the results will be.

If normal technological change takes place in a rapidly expanding economy, usually the benefits of change are only noticeable: increased productivity, higher wages, new products, etc.

When these same changes take place in a slow moving economy, disruption may occur. The basic problem in this case is not attacking the problem of "change." Clearly, the problem here is the slow growth of the economy.

This may seem like a most academic point, but I believe that it is very important to realize when dealing with the difficult problem of integrating technology in our highly complex economy. There have been times in the history of man when technological developments were so potent and their introduction so rapid that normal economic growth could not accommodate the changes without much human suffering. But I would suggest that in our case we may not be suffering from too rapid an introduction of technology as much as we are experiencing a slow rate of economic growth—the recent war average of about 2.5%.

Economic Aspects of Automation

Automation has continued to be most strongly utilized in the manufacturing sector of the economy. The transportation, communications, utilities, finance and insurance industries are also making use of these concepts to a growing degree.

In terms of the effects on total industry employment, automation has probably most affected the manufacturing sector; I say, "probably" because whether the use of automation or mechanization has been more responsible for the decreases in employment needs is still a moot question. The Federal Government has also made extensive use of automation techniques; the effects on government employment were investigated recently by the Committee on Post Office and Civil Service of the House of Representatives.

The economic effect on individuals in an industrial situation experiencing the introduction of automation has varied greatly from industry to industry. A lot has depended on what kind of automation technique was being employed, whether it was electronic data processing, "Detroit" automation, process control or machine tool control. Labor-management relations have also played an important role in affecting the outcome. The versatility of the work force, age levels, education levels, all influence what will happen after automation has been installed.

I have generally found, from my firm's experience, that the installation of automation equipment does not lead to mass layoffs of company personnel. Through the means of retraining, natural attrition, transfers and retirements, dislocation of personnel is minimized. In all cases of successful introduction of automation, management planning for the installation was carefully executed.

Not in all cases could layoffs be avoided. In certain instances, employees were not capable of learning new skills that would be required of them. When transfer possibilities were not available, termination of employment eventually proved necessary. Even here, I found, in several instances, where management maintained the employment level of an operation significantly above what was necessary after the automation equipment was installed. Though it is difficult to generalize that this is standard practice, I have heard others in the field relate this same experience.

Within the last year or two, automation seems to have become a national issue on two counts. First, on the domestic side, it has caused a good deal of fear. To be more precise, I should say that automation has been used to create fear, specifically, fear of unemployment. Secondly, on the international front, we recognize that we need the production efficiencies that automation allows us if we are to compete effectively in the free world markets; we also need increased productively if we are to maintain our defense position and yet increase our standard of living. These two positions would seem to contradict each other, but they simultaneously exist.

In some of those industries where it is recognized that displacement of labor has and will continue to occur, some action has been taken. The Armour "automation fund," set up last year, attempts to study the "automation problem," tries to find opportunities for employment for workers displaced by automation and inaugurates retraining programs. This company-financed program is paid for by a levy of one cent per hundred weight of meat shipped, up to a maximum of $500,000 in the fund. The Armour fund has been referred to as having "set a pattern" for other industries. Several other companies are actually setting up study committees in the Armour fashion. Judging by the publicity received by a company when it embarks on such a program, there seem to be relatively few companies attempting this. However, a start has been made.

It is also encouraging that other institutions have begun to take steps to train both those who are already in the working force and those who will one day join it for the new jobs that automation creates. Several universities, for example, are now offering courses in computer programming, and a number of computer manufacturers are training clerical personnel on the job. A technical high school in Buffalo offers a course in which students build a digital computer and then learn to solve problems with it. At least one union, Local 1 of the International Brotherhood of Electrical Workers in St. Louis, in cooperation with the Federal Office of Apprentice Training and a local vocational school, has set up what it calls a "postgraduate school" for training in new electrical techniques.

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Within a short time, 400 members had signed up for a three-year course and were attending 38 different classes four nights a week.

Two state governments, as I previously mentioned, held conferences to discuss the economic and social implications of automation. Both in New York and Massachusetts, the problems of coping with the effects of technological change and automation were aired. At these conferences, at others and in private discussions, I have usually found recurring arguments in both the "optimistic" and "pessimistic" camps of automation.

I noted these arguments in my study of automation written under the sponsorship of the National Planning Association.

> Here is a summary of some of the arguments most generally used by those who consider automation a blessing rather than a menace.
>
> Automation is nothing new, so there is no reason for concern. Technological changes have occurred throughout history without dire results, and automation is just another technological change. There is no more need to legislate against automation than there was need to slow down the introduction of the assembly line. Technological change is progress and should be welcomed.
>
> Everything will work out in the long run. The natural forces in the economy will make whatever adjustments may be necessary to the introduction of automation. This can be brought about through the movement of displaced workers to other industries, through the expansion of output of industries that automate, or through the introduction of new industries into the economy. If the industries that apply automation expand their output, there may be the need for the same number of workers, but they will be producing a great deal more than before. The introduction of new industries, through invention and research, will take up whatever slack may develop in the economy.
>
> Automation is the key to a shorter work week. There is an unmistakable trend towards less work and more leisure. To realize this goal without sacrificing our real standard of living, we must increase productivity. And automation is the means to increase it. The result of automation will not be forced idleness or unemployment but the enjoyment of more leisure.
>
> Unlimited demand for goods and services will prevent unemployment from automation. Since human wants are unlimited, increased productivity and production through automation will find a market in satisfying these wants. Through greater productivity, earnings will increase to such an extent that there will be a tremendous rise in our standard of living. These increased earnings can come about through higher wages or through lower prices or through a combination of the two.
>
> Automation will create a bigger pie, so that everybody's slice will be larger. This is far better than trying to limit the size of the overall pie and then fighting about how the smaller pie is to be distributed.

Automation will come slowly and in limited quantity. It is neither big enough nor fast enough to warrant concern. Its speed is limited by the long-range planning it requires, the shortage of trained personnel, and the huge investment required. At best, it will affect only a small segment of the total economy, and even those who are so affected will have plenty of time to adjust.

Automation is the only means of maintaining our standard of living in the face of a significant labor shortage. The future problem will be unavailability of labor, not unavailability of jobs.

Employment has been increasing. While everybody is shouting about the harmful effects of automation on employment, there has been a steady increase in employment in the past few years during which the impact of automation should have been at its highest. What unemployment there has been can be attributed to cyclical swings similar to those which occurred before the advent of automation.

Automation brings about lower prices.

A more responsible management will not permit automation to have harmful effects on employment.

Development and growth may occasionally mean hardship, but it is a small price to pay for progress. (This is a rare argument, but as an attitude it may be prevalent.)

The growth of the automation industry itself will provide employment for a good number of those put out of work by the products of the automation industry.

Automation is the key to national survival. The only way that the United States will be able to stay ahead of, or keep pace with, Russia is through a strenuous increase in productivity. At the same time, more leisure, more comfort, and more consumption goods are the goals of American economic policy.

Automation will bring economic stability. In an automated plant, labor costs will be so low and capital costs so high that it will pay to continue production and lower prices rather than to to cut production and lay people off. And even if production is cut, the cut in employment will not be proportionate, because most of the work will be indirect labor that does not vary with volume of production. Furthermore, automation programs must be long-term in nature, and their completion will not depend on short-term changes in sales.

This means that investment expenditures will be more stable. In these ways, cyclical fluctuations will be reduced.

Some of these arguments or points of view are sound. Some are false. Others are a mixture of fact and fancy. The dilemma is increased because there are contradictions and disputes even among those who agree that automation is a blessing and should not worry anyone. The most significant characteristic of all these approaches is that they are weak arguments for the point of view they espouse. The strongest arguments are those that are founded on world politics, rather than on economics.

The reason for the weakness of these arguments as they now stand is that there are no facts to back them up. There are no facts on which to base an evaluation of their worth, and there are no structures of theory within which the facts can be developed, sorted, and evaluated. The only strength that these viewpoints have is the fact that the counter arguments are also weak and unfounded.

The more common arguments for concern over automation are indicated below. The wide diversity of appeals that they have and the difficulty of evaluating them without greater knowledge—of facts and theory—can be seen even from this limited presentation.

The boom has helped up to now. The advent of automation—which is still in its infancy—has been accompanied by the greatest period of boom that America has ever experienced. A backlog of wartime demand and huge government expenditures have created the boom. This cyclical upswing has masked the effects of automation on unemployment because the temporary factors of a boom have enabled the economy to absorb those technologically displaced.

Automation is an accelerating phenomenon. As yet we have not seen its real effects. There have only been instances of complete automation, and some factories that can be considered partly automated. But the real impact will come in the future, when the gestation period is over, and the technical difficulties have been overcome. At that time, there will be a sudden surge forward, at an accelerating rate, and the resulting unemployment will wreak havoc with the economy.

There will be no purchasing power. As automation replaces workers and permits the manufacture of products without labor, these workers will be unemployed. As a result, they will not be receiving the wages that permit them to buy the products of American industry. The result will be the piling up of stocks in warehouses and the biggest depression that we have ever had.

And like every depression, it will spread to those areas of the economy that are not directly affected—the non-automated areas.

The growth of job opportunities cannot grow as fast as necessary.

Markets will become saturated. There is really no sense in pretending that automation will permit the same number of workers to turn out more products, because there will be no desire for these additional products. After everybody in America has two cars, he will not want a third. The truth is that there will be fewer workers turning out the same amount of products, because there is a certain point beyond which additional units will not be absorbed. In addition to the sufferings of those workers who are actually displaced, the drying up of their purchasing power will create a national depression that will eventually have repercussions on those who were not displaced by technology.

In comparing the pessimistic point of view with the optimistic, two things become clear—and without any need to pass judgments on the validity of either point of view. In the first place, the pessimistic side—or those favoring control and mitigation—is much the more powerful. It is on the offensive, it has much more active advocates, and it can appeal to the emotions much more effectively. Secondly, the pessimistic side has a definite program which it can champion. The higher minimum wage, the guaranteed annual wage, the four-day week, the granting of specific guarantees, and eventually the control of investments in automation—these are all specific points that can be put forth as a constructive program to avoid the dire consequences that are predicted. The opponents of these viewpoints have nothing concrete to offer, and they are constantly on the defensive.

The issues are most closely drawn by organized labor, as they have a direct stake in employment movements. Chart L is a summary of some of these key issues, and how labor wants these issues resolved.

Social Aspects of Automation

Automation's social consequences are broader than its economic effects. Results in the social sphere also depend on the speed and degree of automation. Although automation can influence nearly every phase of our life—from what we do, to how we are governed—there is as great a lack of factual information as there is for the economic questions. Even the immediate effects of automation at the work place are hard to ascertain. There are only a few thorough studies of this subject. The few that exist are not sufficient to come to any generalized conclusions.

CHART L. AUTOMATION: HOW LABOR SEES THE ISSUES AND THE ACTION TO BE TAKEN

MAJOR ISSUES	ACTION TO BE TAKEN
Industrial Decreasing job opportunities in manufacturing, mining and transportation industries. Workers are being "dislocated," they need more job security. Change in wage structure and job evaluation systems. Labor not sharing in the gains of productivity from automation. Industry's labor needs are changing fast, workers must be retrained.	*by Industry* Through collective bargaining establish provisions for: Shorter work week. Stronger seniority rights. Severance payments and other supplementary benefits. New systems of compensation, eliminating incentive-type wage payment plans. Higher wages. Earlier retirement. Retraining Programs. Special Funds to cope with Automation problems. Advance notice of employment changes.
National The slow rate of Economic Growth: The GNP should be growing at a 5% annual rate as opposed to the recent 2½% growth trend. Rate of increase in real earnings per worker is too low, not as high as early post-war growth rate. Increased Number of Economically distressed communities. High sustaining unemployment levels, the possibility of automation leading to a "wholesale unemployment and depression."	*by Government* Stimulate Economic Growth through increased Federal spending, foster "job creating, job-inducing programs." Promote a Federal Training and Retraining Program. Government legislation inducing lower work week levels. Greater aid to Economically distressed communities. State Governments should incresae unemployment benefit. Change Social Security regulations to provide retirement benefits at earlier age.

The individual studies come to different conclusions, depending on the kind of automation that was introduced (factory automation or electronic data processing), where it was introduced and the conditions under which the change to automation took place—to name a few. There have been cases reported, for example, where the introduction of automation in a process plant led to higher morale among the workers, a more highly developed social unit in the plant and an upgrading in skills. But these reactions have not been true in all cases studied—or even in a majority of the ones that I have seen. A study of an automated assembly line operation reported "increased feelings of tension" among the workers; nor is this an isolated case. Recent studies of automatic data processing installations report a high level of routine work—as high or higher than before the introduction of the automatic equipment. In other establishments, routine work decreased in a comparable situation.

From my own experience, I find that one generalization holds true for the entrance of electronic data processing into an operating unit: there is an increase in the percentage of skilled personnel for the given operation unit after EDP is installed. At the very least, we can see the newer skills are needs—programmers, systems analysts, systems engineers. Certain valid generalizations can be made about the needs for retaining programs and, especially for education.

On all levels of working and living we will need more education. Beyond retraining those who already have jobs to prepare them for more highly skilled work, we must face the larger problem of how we are to increase our resources of engineers, scientists, and trained technicians. At present, a good part of our most talented raw material goes to waste every year. About half of the high school students in the upper 25 per cent of their classes do not attend college at all, and another 13 per cent drop out before the finish. All told, almost two thirds of those best fitted to exercise scientific and technical leadership are not being trained to their highest capacity.

This problem will grow more acute in the years ahead, and not only because the need for trained men will grow. We are still drawing heavily on the knowledge and the trained personnel developed under the pressure of military needs. But we cannot go on living off our hump indefinitely. We will have to develop ways of making higher training available to those best suited to make good use of it.

On the high school level, where technicians are trained and where the decision for or against science as a career is often made, the situation is equally acute. High school programs must be reassessed and so must the supply and quality of high school teachers.

As Dr. Allen V. Astin, Director of the National Bureau of Standards, has pointed out, "with the great shortage we now have of scientists and engineers, it is difficult to get anyone with any competence to do the teaching in the high schools at the present time."

But the question of education goes far beyond better training for work in specialized fields. Many of the new jobs that automation will create (supervising the intricate workings of delicate machines, for instance) will require an increasing ability to think and to judge, increased understanding of mathematical and logical methods, in short increased education in the largest sense of the term. Management will need these abilities on a higher level. And all of us, if our increased leisure is to mean something more than just another day when we can sleep late, will need to develop some of these qualities. In view of these needs, one of the great mistakes we could make would be to concentrate all our attention on the specialized problems of educating scientists and technicians.

More than that, the fact that the new machines are capable of providing us with more information than we have ever had raises questions of the highest importance. Just as they can provide answers to scientific questions that could never be answered before, so machines can provide answers to questions outside the field of science that could never be answered before because no one person or group of people could comprehend all the facts. Man could become a cog in the machine, accepting, in Norbert Wiener's words, "the superior dexterity of the machine-made decisions without too much inquiry as to the motives and principles behind them." It is here that our ability to think, to judge, and to understand will stand us in best stead. For machines are only machines. It is up to men to decide how to use them.

Foreign Aspects of Automation

In the practical application of automation concepts and techniques to industry, the United States leads the world, at the present time. In terms of growth rate in application and absolute number of automated installations we are ahead of any country in the free world. I have not included the communist-block nations because there is no substantial data to estimate their progress accurately.

Qualitatively, we know that they are moving ahead at a fast rate. To the extent that they are employing automation, it is interesting to consider Premier Khrushchev's report to the 21st Congress of the Communist Party of the Soviet Union. He gave some indication of the widespread applications intended for mechanization and automation under the Soviet Seven-Year Plan for Economic Development (1959–1965).

Mr. Khrushchev reported that, "Integrated mechanization and the *automation* of production processes constitute the chief and decisive means for ensuring further technical progress in the economy and, on this basis, a new rise in labour productivity, the lowering of cost prices, and the improvement of the quality of products." This theme is further amplified in Mr. Khrushchev's statement of the "target figures" with regard to level of *automation* to be obtained. Of particular note was the indication of plans for the "establishment of more than 50 experimental model enterprises where the latest patterns of integrated automation will be put into effect."

In a final section, in a discussion of specific provision of the "plan" as it pertains to educational development, it was stated that "the greatest increase in the number of engineers graduated (during the years of the 'plan') will be in the specialties of chemical technology, *automation*, computing engineering, radio-electronics and other branches of new technique." Stress will also be placed upon scientific development and, "in particular the successes of computing mathematics [which] are directly connected with the development of *automation*."

I would suggest that it would be sheer folly to take these words lightly, in view of the Soviet Union's accomplishments in the field of engineering education, and the science of mathematics. Recent reports point to a gap between "theory" and "application" in the field of automation in the Soviet Union. I would not expect this state to last very long (if, indeed, it is an accurate picture of present achievement levels).

It would also be a mistake to take a complacent attitude toward European business. Though we "out-automate" Europe by sheer volume alone, the level of sophistication in automatic techniques is high, especially in factory automation.

My company continually surveys the Western European electronic data processing market. We have found the European attitude to be more cautious of EDP hardware than is true in the United States. The cost factor of automatic equipment is given heavier emphasis. However, we have found that the average European computer user can be expected to make better use of the hardware's capabilities than his American counterpart once it is installed. He has been predisposed by his educational background to more easily accept the theoretical capabilities of the electronic hardware.

Western Europe has a total of over 2,000 computer installations, or about 20% of total United States installations. However, over 90% of this total are small computer system installations. What is most significant is that France and Germany, between themselves, have almost 70% of total European installations. Orders for computer systems number in the hundreds for all Western Europe.

Between the Russians on one hand and Western Europe on the other, we literally "have our hands full." It seems to me that we are in a most tragic plight as a nation when we must worry about the ill-effects of introducing automation—even at a slow rate!

Guide to a Study of Automation in the U.S. Economy

In my final recommendation before this subcommittee in my initial testimony, I suggested that a study of automation be undertaken on a comprehensive basis. This study is still needed. Other witnesses will no doubt make this same suggestion to this subcommittee; I have seen testimony of people who have made this recommendation at other Congressional hearings.

Some excellent studies concerned with automation have been accomplished. Certainly, the Bureau of Labor Statistics of the U.S. Department of Labor is to be congratulated on its Studies of Automatic Technology series. The Bureau's recent studies on the introduction of office automation were most welcome. People in the academic world have also produced some significant work in this field. Quite frankly, I still feel that the problem of gathering adequate data has not been surmounted.

The following discussion and "Guide" is taken from a planning pamphlet that I prepared last year for the National Planning Association:

> Automation is only one of the many complex interlocking factors that shape the economy. While it may not be practicable or possible to study all of the factors that make up the economy, we can make an industry-by-industry study of what automation has meant so far, and thus foresee with some certainty what it is likely to mean in the future. We do know that the potential impact of automation is such that we cannot disregard planning for it. We need complete enough information to plan for the kind of action automation will require from industry, labor and government. It is for the purpose of obtaining this type of information that I here propose an initial study of the economic consequences of automation.
>
> In making a study of automation, we must also give emphatic attention to the education problem in all its aspects—a problem that is corollary to the economic one. I feel very strongly that the educational problem is the most challenging one we shall have to face as the age of automation advances. We must first determine what the economic direction is likely to be, and then meet it with reasonable human foresight. We must ascertain in some detail the nature of the industrial, managerial, labor and social problems experienced by the industries that have already begun to automate, if we are to determine just how we are to train people to meet them.

It seems to me that, at this point, the most useful way of collecting, organizing, and analyzing the information necessary to such a study as this is a detailed case-by-case approach to a number of specific industries that are representative of the several types of applications of automation practiced today. It would be valuable also to study a few typical industries where there is some especially interesting aspect to the way automation has been applied or has affected them. The following list should provide a good starting point:

THE AUTOMOTIVE INDUSTRY

This industry has solved some immense problems in automating some of its processes and illustrates well the kind of automation that has come to be called "Detroit automation." A study of the industry should develop useful information on how workers and working conditions are affected in factories which have learned how to handle long runs with specially designed automatic machinery.

PAPER MANUFACTURING

This is a processing industry which is just beginning to use feedback control systems. The effects of automation on labor here are likely to be slight, since there will probably not be much reduction in working force, but there are other interesting aspects to be studied. A change in the productivity of the capital equipment is one of these. In addition, the technical problems in this industry give a good deal of insight into the fundamental technical problems that must be overcome before automation can become complete in the processing industries. For example, present methods of measuring or testing paper consistency involve actually tearing the paper and letting water seep through it. If this area of the industry is to be effectively automated, this method, which is now an art, must be turned into a science.

FOOD PROCESSING

This is one of the traditional automatic machinery areas and would be an interesting study from the standpoint of determining whether there are really any differences between the social and economic effects of introducing the older style of automatic machinery and the newer developments.

AIRFRAME MANUFACTURE

Since production runs are very short and engineering changes are frequent, the airframe industry has many of the problems of job shop manufacturers, even though it is dominated by a few large companies. In a sense, it could be said that the airframe industry is pioneering in job shop automation. Appropriate case studies, therefore, could shed considerable light on the potential forms and the pace of job shop automation.

The airframe manufacturing industry is again worth studying because it relies heavily on computers for scientific calculation. From my own experience, I suspect that there has been an enormous increase in employment as a result of these techniques and it would be important to see whether the situation in this area is applicable to the wider problem of employment opportunities. In addition, the aircraft industry is starting to use computers on a wide scale for office use. But perhaps an even more valuable study could be made in this field on insurance companies, since this industry is already using computers and is certain to be one of the heaviest users of them in the future.

OIL AND CHEMICAL PROCESSING

These industries are highly instrumented and have introduced a certain amount of centralized control. They would provide a valuable study of the relationship between manufacturing areas and the office in an industry where there is almost no labor directly involved in the manufacturing process. As more is learned about the use of computers, considerable change is bound to occur in this industry through automation, and it is an area which should be explored. It is also an industry where we can measure the effects of automation over a considerable period of time. A case study could record what happened in the original shift from batch to continuous processing twenty-odd years ago.

ELECTRONIC ASSEMBLY

This industry is interesting because the problem of considerable and continuous variation of the product is involved. The methods that are being used to attack this problem, and their effects on an industry that even today relies on an enormous amount of womanpower for production, would illuminate the problem of other industries faced with this kind of situation.

OFFICE AUTOMATION

In this area, several kinds of studies might profitably be made. For example, it would be worthwhile to compare the approaches used by Sylvania, which has a large number of branches and a single computer centre for all of them, and by Allstate Insurance or Prudential, which also have a large number of branches and are introducing computers into each of them.

It is also important to find out what will happen when medium-sized business introduces computers into the office. There are a few cases where this has already been done, and I think one or two case studies of such businesses would be very worthwhile.

NONBUSINESS USES OF COMPUTERS

One of the most far-reaching influences of automation may well be the use of computers for cultural and purely scientific applications. Their use in such tasks as tracing satellites and codifying the Bible has received much publicity. Their possible capacities for extending the frontiers of present knowledge may have a significant influence on education and on the direction of future research.

It would also be of value to make similar case studies of industries that have not yet automated to any significant degree. These studies could be less thorough, but their objective would be to determine the factors that limit automation. Clearer definition of these barriers would enable us to determine whether automation in these areas is merely a question of time or whether the present obstacles are permanent ones. Some industries that would be appropriate for study in this area are construction, transportation, small job shops and companies producing custom goods.

STUDY PROCEDURE

As for the procedure to be followed in conducting these case studies, I would suggest the following steps for each industry:

1. A general introductory survey of the particular industry should be made so that the study team can get a general idea of the kind of developments that have been taking place.

2. On the basis of this introductory survey, one or two specific companies should be selected for more intensive study. These companies should be typical of the industry in the sense that they are doing things which other companies could and probably will do—that is, they should not be uniquely large, in a particularly dominating position or financially capable of doing things other companies in the industry could not afford. However, they should also be companies that either have done or are doing a good deal in the automation field, and in this respect, they may not be typical of their industry.

3. Before a detailed approach is made on the case study of the company, the study team should obtain general and background information on the history and development of the company.

4. The study team should conduct a pilot study which would include: interviews with key people; discussion with both the personnel department and the union about actual personnel shifts; discussion with manufacturing and planning departments about existing and planned changes; meeting with the controller's department about changes in data processing; and estimate of the relationship of this company to the industry at large.

5. From study and analysis of the pilot study results, it should be possible to develop a plan for a more detailed study, including check lists and a carefully devised plan of action.

6. Based on the data that have been obtained, further observation and interviews should be undertaken. During this time, the study team should primarily observe what is happening. Individual workers, as well as members of management, should be interviewed and their observations studied in detail. All related files and inter-office memos should be examined and, during the course of the study, all pertinent inter-office data should be available to the study team. The team should plan to spend a substantial amount of time on the company's premises, since the more revealing findings may come from a study of a process in the course of development, even though a good deal may have been done toward automation. The team should attend meetings and talk freely with people, but it is important that they remain noncommittal and make clear that they do not represent a particular bias, or endorse a particular doctrine.

The preceding paragraphs suggest some of the major aspects that must be considered in a study of automation but, of necessity, other problematic aspects will emerge in the course of the study. The questions that follow are intended to suggest a more specific outline, although by no means an exhaustive one, of questions that must be asked and answered in a study before we can determine the implications of the present and future developments of automation. For purposes of simplification, I have divided these questions into impact areas. Obviously, any such division is arbitrary—for whatever affects industry affects labor, and in turn, the entire community.

AUTOMATION AND INDUSTRY

Extent and Rate of Automation

What industries not highly automated could be so if present technological advances were applied? What has prevented the introduction of automation in these industries?

In automated industries, what degree of the total production capacity of the industry can be described as automated? What percentage of the individual plants that have introduced automation can be described as large, medium or small?

Within an individual company, what percentage of operations are automated? Which operations have been automated? Which have not? Why are the non-automated operations not automated? Because of cost? Because they are not suitable for automation?

When did the company first begin deliberately to automate? When was the automation equipment installed? Was it installed all at once, or over a period of time? How much did the equipment cost? How did its cost compare with the replacement cost of machines it replaced? What percentage of the automation equipment replaced machines that were obsolete? What percentage of the total spent on equipment in each of the last five years was spent on automation equipment? What is the estimated total cost of automating to date?

Did the product or process have to be redesigned before automation could be introduced? What did this involve? How long did it take? Did the new machines have to be specially designed and built? Were there any special problems in getting them designed and built?

Is the company planning further automation? What current technological or economic development might affect the rate and/or degree of automation? What percentage of operations, and which operations, are expected to be automated within the next five years? Within the next ten years? How much equipment will be replaced because of obsolescence in the next five years? Will it be replaced with automatic or conventional machines?

Has automation permitted the production of new goods or services?

If automation has not been introduced, what are the reasons? Is it because of high costs?

The difficulty of integrating automatic machines with conventional machines? The financial risk involved in automating? Because there seems to be no need for it? Because of worker or union hostility?

Effects of Automation

On Production: Has total production risen for the entire industry and in given companies within the industry since the introduction of automation equipment? If so, how much of this increase can be directly attributed to automation?

On Productivity: To what extent has the introduction of automation increased the productivity of labor? Of capital? To what extent does it force us to re-examine the productivity concept itself? How useful is a measure of output per man-hour when machinery is so large a determining factor in output? Can we still talk meaningfully of direct and indirect labor?

On Costs: How have production costs beeen affected? If they are lower, where have the principal savings been effected? Have capital requirements been reduced? What part of the direct labor and capital saving has been offset by the cost of design, production, and maintenance of automatic equipment? Has the cost of automation waranted its use?

On Purchasing Power: If automation has lowered cost, how have the savings been apportioned? Are profits higher? Have wages been raised? Have dividends or reserve funds been increased? Are prices lower? If so, how have markets responded?

The Automation Equipment Industry

What is the nature and size of the firms producing automation equipment? What proportion are new firms? How great a part of the total production effort is performed by old firms? Does this represent a major diversification? How rapidly have firms expanded in this field? What is the incidence and nature of mergers?

What portion of the total output is absorbed by military or defense needs? What is the extent and what are the types of Government participation in research and product development? What is the effect of patents?

How is Industry Structure Being Affected?

Automation and Competition.—What happens to competition as a result of high capital requirements? As a result of optimizing productivity? As a result of patents? Does automation in one firm or group of firms curtail output and employment in other firms?

What is the prevalence of mergers in automated industries as compared with nonautomated industries?

How is small business faring? What is the percentage of new firms in the industry? What is the percentage of business failures? How many of these are small businesses? Have small companies been able to automate? Have they been able to automate to a comparable degree with larger firms?

Automation and Centralization.—Is there a tendency toward greater geographic centralization or decentralization? Have new plants in the industry been built in the same location as the old ones? If not, are the reasons for moving attributable in whole or in part to automation, or are they attributable to other causes? What are the future plans of companies in this connection?

Automation and Company Organization.—Is there a tendency toward greater administrative centralization or decentralization? How have management responsibilities changed? What new kinds of problems has management had to meet? In recruiting new members of management, have men with new kinds of skills been needed?

Automation and Labor.—Because the effects of automation vary not only from industry to industry, but also from firm to firm, labor implications must be distilled from case studies analyzing specific instances.

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Automation and Employment

For both whole industries and individual companies within an industry, how have total labor requirements been affected since the introduction of automation? How have the proportions of production, maintenance, supervisory, and clerical workers changed since the introduction of automation?

What change has there been in total employment in the automated segment of a company? What changes has automation made in the proportions of direct and indirect labor in this segment?

How many workers have been displaced by automatic machines? Were other jobs found for them within the company? If so, how many were downgraded, how many were upgraded, and how many moved into jobs similar to the ones they left? If they had to leave the company, how many found jobs in the same locality? In the same industry?

Automation and Retraining

What is the proportion of skilled and unskilled labor employed before and after the introduction of automation? What new job skills have been needed? What job skills have been made obsolete?

How many workers needed some retraining to handle a new job? How was this retraining accomplished and how long did it take? Who paid for it? Was it done on company time? Did it take place within the plant, or was it necessary to perform it outside? If so, what institution handled the retraining? Was it adequate?

What special problems did older workers present? How were these handled?

Did automation create jobs that could not be filled from within the company? If so, how many were there, and how were they filled?

What are the estimated future demands for skilled, semi-skilled, and unskilled labor?

Automation and Industrial Relations

How has automation affected the general level and structure of wages? How has it affected the particular wages of displaced employees who were transferred to another job within the company? The wages of employees working in the automated segment?

How does automation affect job equity?

What are the worker attitudes toward automation? How has it affected working conditions in terms of safety, machine pacing, increased responsibility, and improved work area?

How are industrial relations policies and hiring policies changed? What provisions have been made for displaced employees in the form of severance pay, early retirement, or other benefits? How has automation affected collective bargaining? How have union jurisdictions been changed; how has internal union organization changed?

EDUCATION AND AUTOMATION

How has the present supply and quality of engineers and technical personnel affected the degree and rate of automation? Has a shortage of trained personnel discouraged any firms from introducing automation? How has the availability and quality of needed personnel affected the development and production of automation equipment?

Are existing institutions adequate for giving vocational training to adults? Are there enough of them widely enough distributed? Are their programs adequate? Are secondary school programs adequate? Or, are the high schools teaching skills that will be outmoded before they can be used?

What role can subprofessional training play in providing those workers who do not have engineering backgrounds with sufficient facility in automation skills to fill needed positions? How, and by whom, can such training best be provided? To what extent does such training depend on the redefinition of job titles and descriptions?

Will engineering and technical skills be the key to the important jobs in an age of automation? Must we train engineers to be managers, or managers to be engineers? Are the skills required of the successful manager in a world of ever more complex technology the same as those required in a world where business success depended upon the artful use of insufficient information? If not, what does this imply for management education?

What kind of training can be provided for individuals who have already completed their formal education? How successful have union programs been? Management or company sponsored courses? University extension programs? Home study courses?

CONCLUSIONS

The United States Government should formulate a national policy that will effectively stimulate automation and other technological change.

I find it totally unreasonable—and dangerous—that as a nation we permit the waste of a potent national resource, automation. We are faced with a continuous, economic and political challenge on the international front that demands sizeable outlays for military security, aid to foreign nations, and other international programs. At the same time, we continuously try to raise our material standard of living.

To keep increasing our standard of living and, simultaneously, maintain our economic and political position in the world, we must sustain a high economic growth rate. Real increases in our national output will continue to be heavily influenced by our productivity increases—and productivity increase is a basic result of technological change.

I think we must face up to the fact that we have not made any concerted effort to deal with the problems that retard economic growth. The nation cannot long sustain a high rate of technological advance without coping with these problems; we simply cannot wait for evolutionary forces to solve our internal problems.

The national policy that will foster automation and technological change should be aimed mainly at bettering the environment for change. (For purposes of formulating national policy, automation should be considered as part of general technological change. It is difficult to separate automation out of the mainstream of change and somewhat useless to do so.) This policy should be geared to set in motion two programs simultaneously.

A program for identifying the effects of automation and technological change within our society should be initiated. We must learn how to stimulate automation to best advantage and, at the same time, minimize any harmful effects that may accompany it.

Secondly, mechanisms that can encourage economic and technical growth where such growth has stagnated must be designed. I do not feel that this can be accomplished through the efforts of private enterprise acting alone; the resources of local communities and, of the state governments, are sometimes not sufficient to overcome stagnancy. Individual action by the Federal Government is also insufficient.

A cooperative effort employing the resources of all these sectors of the economy must be brought to bear on these problems if they are to be solved. The government can do much to encourage business through enlightened tax policy and technical aid; communities and states can do more to provide worker training and retraining facilities and assisting in area redevelopment; business can initiate programs to assist employees in adapting to change situations.

A program of continuing study will provide more knowledge on how best to cope with change. It will supply the data needed to influence the social and economic results of the introduction of automation and other technology.

However, no study will be of value if it is an expedient way to avoid taking action on national issues. The extensive knowledge gathered can, perhaps, be best employed in helping to recognize—in advance—where action should be taken to stimulate technological and economic growth.

I also think it is very important that through national policy we encourage the widespread application of basic science to industry. Most of the significant innovations of the post-war period have come about through military research programs. Private industry has been unable to make the fullest use of these advances. The Government can do much to encourage the dissemination of this kind of information to business. Private enterprise can be further stimulated to employ new techniques and equipment through fiscal policy.

The encouragement of innovation in industry must be supported by labor, if we are to achieve its full benefits. Featherbedding in industry has become a valid issue; it is wasteful not only to the individual company in which it occurs but to the entire economy as well. In many instances, labor has shown that it can facilitate change by sponsoring its own retraining programs and by intelligent collective bargaining. The responsibilities of labor in this area will be much greater in the years to come. It remains to be seen whether present labor-management relations, which mainly revolve about periodic collective bargaining sessions, are sufficient to cope with future problems.

These recommendations are far from new. It is vital, however, that they be carried out. I recommend the study of automation at the first congressional hearing, as others have since. Concerted action of government, community and business to make the fullest use of this most important national resource—automation—has been suggested previously, although in vain.

I think it is worth remembering that a national resource, as well as a natural resource, can be lost forever if it is not conserved with intelligence and farsighted planning.

STATEMENT OF RALPH E. FLANDERS, U.S. SENATOR (RETIRED) FROM THE STATE OF VERMONT

On November 14 and 15, 1957, the Joint Economic Committee held hearings on the subject of "Automation and Recent Trends." In a statement before that committee I testified to the nature of the distribution of the increased profits arising from automation which would best assure increased incomes and consumption and avoid inflation. While the testimony was directed specifically toward efficiency and cost savings arising from automation, it is applicable to all increases in efficiency arising from whatever source.

In that testimony I asserted that the increased profits from improved production should be distributed three ways. Of these, one is increased wages, the second is lowered prices, and the third is increased profits. While I suggested that one-third be assigned to each of the three elements, that was a suggestion only. Some part of the increased profits must go to labor, some part to the consumer, and some part to the producer if the profits are to become socially useful and not self-terminating and self-defeating. (An alternative to increased earnings would be shorter hours without increased take-home pay. The wage earner may decide to take his portion in leisure instead of money.)

On the face of it, the wage earner would benefit from increased wages. However, this benefit would be canceled out if his purchases had to be made at increased prices. To raise wages and subject the purchaser to inflation is a poor bargain for the wage earner, who is a consumer as well as a wage earner.

It is not so obvious but just as true that the wage earner in his take-home pay and likewise in his capacity as consumer will benefit from increased profits to the producer. A little thought make this clear. Improvements in efficiency and lowered costs of production in the modern world do not derive from harder work on the part of the wage earner nor from his improved personal efficiency in other respects. The lowered costs come from better business organization and particularly from the expenditure of large sums in modern methods and equipment. It is essential for the higher wages and lower prices that this process of investment continue. It is the function of profits to make certain that this process does continue. In the proposed subdivision of the increased profits, the allotment to the producer is an essential element which must be maintained.

Unless this three-way distribution is regulated and effectively carried out, the whole program of economic progress as it affects the individual is arrested and comes to a halt. There are evidences at the present time that the channeling of the increased profits predominantly to wages is bringing about a stagnation of economic improvement which must be overcome.

A most unfavorable element in our present situation has been the complacency with which businessmen have accepted wage increases which were passed on to the consumer. Wage increases so compensated for constitute the mechanism of our present-day inflation. Thereby the wage increases are nullified, our price level is increased so that we lose foreign markets, further investment in cost-reducing equipment is slowed up, and stubborn areas of unemployment develop in equipment industries. That is the situation in which we find ourselves today.

A difficulty in this situation lies in the fact that it cannot be cured by legislation. The problem is a moral one, not one of law and law enforcement. The remedy therefore lies in a widespread understanding of the requirements for economic advance, in a widespread public demand for business and labor statesmanship, and in a realization by both labor and business that their selfish interests are advanced by this statesmanship and destroyed by its absence.

Yet it must by all means be noted that while the positive contribution by government to a continued economic expansion is thus limited, the negative implications are of the utmost importance. Legislation which does not take account of the true basis for improvement may well be destructive. The same is true of administrative practices which seek to manipulate our economy by means which handicap the constructive distribution of profits. An understanding of these fundamentals erects a no-go, red light sign which cannot be disregarded without disaster—perhaps not without a crash.

STATEMENT OF IRVING LEFKOWITZ, ASSOCIATE PROFESSOR OF MECHANICAL ENGINEERING, CASE INSTITUTE OF TECHNOLOGY

Case Institute of Technology has been actively engaged over the past 7 years in a research program concerned with the application of computing machines to the automatic control of industrial processes. The primary objective of the research is the development of principles and techniques of computer control for optimizing process performance, including methods of analysis upon which engineering design and evaluation may be based. In particular, design for specific commercial applications have been avoided in favor of analysis and general theory.

The "Process Automation" project is under the joint sponsorship of the following companies:

General Electric Co.
International Business Machines Corp.
Republic Steel Corp.
Thompson-Ramo Wooldridge Corp.
Westinghouse Corp.

I have been closely associated with the project since its inception and have been its director for the past 2 years.

The term "automation" has been widely employed in recent years to describe the general class of machine applications to human tasks and functions. These applications fall into three categories:

1. Mechanization.
2. Data processing.
3. Automatic control.

Mechanization refers to the use of machines to replace routine mechanical operations performed by labor. Examples include transfer machines, automatic machine tools and the host of laborsaving components of the modern assembly line. The operations performed by the machine normally follow a fixed program or set of instructions built into the machine.

Data processing refers to the general field of application of business machines and computers to payroll transfers, inventory control, classification, computation, etc. It involves, generally speaking, the replacement of "white collar" functions by machine. Again, the operations are performed according to a fixed program set into the machine.

Automatic control is distinguished from the preceding categories in that the operation or mode of action is not predetermined but rather is based on measurements of the plant or process under control. In conventional control applications, for example, the control device acts on the process according to the deviation of the controlled variable from its desired value and in a manner such as to minimize this deviation.

Modern developments in automatic control have extended much beyond the simple feedback loop described above. The control of multivariable systems subject to complex interrelationships among the variables has become increasingly important to the process industries (and particularly so to the military). Effective control of such systems has only recently become feasible with the advent of the modern high speed, on-line computer. This has led quite naturally to considerations of computer control for optimizing system performance; e.g., control of a process such that product of the desired quality or specifications is produced at minimum cost.

The work of the "Process Automation" project at Case Institute has been wholly concerned with the development of computer control for optimizing system performance. The emphasis is on improving performance of the plant rather than replacing man by machines. Indeed, it is expected that most optimizing control applications would result in an increase in labor costs: although the operating labor might decrease, the increased research, engineering, and maintenance requirements would more than offset the difference. There is potentially much more to be gained by developing control techniques which will increase yields and efficiencies, improve product quality and perhaps, more important, make feasible those processes whose complexity or critical specifications preclude conventional control techniques—than is to be gained by fulfilling the publicized concept of the automatic factory.

There is no question that mechanization and other aspects of automation result in labor displacements, changing skills and changing job opportunities. This creates a very real and pressing problem. The answer to the problem is not, however, to inhibit technological advance. The competition for world markets as well as the maintenance of a strong military position would make extremely dangerous our country's taking any unilateral action of this kind. It seems that a more positive approach is the generation of a broad program, representing the joint interests of labor, management and government, and providing adequately for the training, adaptation to new skills, and the relocation of the displaced labor.

A related problem that might be mentioned is that of meeting the demand for personnel with the advanced training required for the newly automated systems. An important limitation to the general application of advanced control systems in industry is the supply of engineers and technicians possessing the necessary background and skills to design, operate, and maintain such systems. It is necesscary for our educational institutions to anticipate these needs and to provide the educational and training facilities for meeting them.

STATEMENT OF EDWIN G. NOURSE, VICE CHAIRMAN, JOINT COUNCIL ON ECONOMIC EDUCATION; FORMER CHAIRMAN, COUNCIL ECONOMIC ADVISERS

I am pleased to note the continuing interest of the Joint Economic Committee in the subject of automation, on which you held hearings in October 1955. I have received numerous indications that those hearings elicited considerable interest both here and abroad.

As to your suggestion that I might wish now to make a supplementary statement touching on subsequent developments, I am afraid I have little to add. I have not found opportunity for following closely the technical developments in this field, though it is an important peripheral interest in connection with my continuing study of problems emerging under the Employment Act. I will therefore make only two brief observations:

One is that I am continually impressed with the need for an increasing number of technicians in the labor force we train for an automated industrial future. Great stress has been placed on the importance of training scientists, but the technician here and in other fields such as medicine and the related sciences is a different category. It is my belief that increased attention should be given to considering job specifications for a variety of skills in this area below that of the scientist as such and above those of the mechanic or other skilled worker.

The other point which I think could properly be kept active in the thinking of the committee relates to the rate at which automatic systems can profitably or should, in terms of economic policy, be introduced into our industrial life. This is a point which I discussed with Vannevar Bush, and found that he as an engineer was in agreement with my thinking as an economist, that the craze for automation might prove a pitfall to some managements. Impressed by the pressure of rising wage rates, they may adopt automation as a way of saving labor and raising unit efficiency, not fully mindful of the burden of overhead cost under conditions of less than full-scale operation.

While I think this point is extremely important, it may be that it lies rather more in the field of technical industrial management than within the purview of the large policy questions which concern the Joint Economic Committee.

STATEMENT OF B. D. THOMAS, PRESIDENT, BATTELLE MEMORIAL INSTITUTE

In preparing this statement for your committee, I took occasion to review the proceedings of November 1957, and December 1956. It is interesting to observe that at that time the problems of paramount importance before the committee appeared to be three: (1) The education of scientists and engineers and the unfavorable comparisons between our educational system and that of the Russians; (2) problems of technological unemployment and the fear of technological unemployment resulting from actual and threatened automation; and (3) problems of older workers. It is my opinion that real progress has been made on all of these problems.

I have evidence based on my personal experience with the public school system in Ohio, at least, that a valiant effort has been made to improve the quality of instruction, particularly in our secondary schools. It is significant, I think, that the greatest progress has been made simply by increasing the challenge to the student. We have gotten around to establishing special courses—"accelerated courses" they are called, which recognize the gifted student, and at the same time callenge all the students to an increased effort.

The results have been astonishing. This year of 1960 has seen an unprecedented number of high school graduates applying for college admission, with so many of them qualified, that many colleges reluctantly have had to reject hundreds, or thousands, of applicants that a few years ago would have been considered very promising material for college entrance. The situation has been viewed as a new sort of crisis with a great deal of soul searching going on among admission committees relative to the methods of selecting students. As an answer to the problem of finding an adequate number of better-qualified candidates for college training, the result has been somewhat overwhelming. Some concern still exists as to the relative numbers that go into science and engineering. In our economy, the numbers and the economic status of scientists and engineers are set ultimately by supply and demand. In Russia, these are established by political fiat. It is useless to discuss the relative merits of the two methods, since the second is not open to us, but in my opinion our method is preferable.

There is also still some concern about the adequacy of the training of our scientists and engineers relative to Russia. On this we can do something. In my opinion, the need, as it was 3 years ago, is to improve the economic status of teachers, so that as a profession teaching will be able to hold the many capable persons who for economic reasons today go into industry or other professions.

On the second problem, so far as I am aware, the extension of automation and technical improvements into industry has been so gradual over the past 3 years that no major problem of technological unemployment has been created. I am of the opinion that the conclusions reached as a result of the studies by your committee—that the answer to the problem lies in reeducation—is still sound, and I believe that your work in gaining public recognition of the problem and its solution has been one of the major contributions of your committee.

I am sure that it must be apparent to everyone that the high standard of living that we in this country enjoy, and the position of economic leadership that the United States has, depend upon our workers' operating the most elaborate, sophisticated, and effective industrial mechanism the world has ever seen. We have only to make comparisons, which have frequently been made before this committee. Our per capita use of electric power, for example, shows that we put into the hands of our workers far more efficient means to produce the wealth that enriches our economy than is given to workers anywhere else in the world.

This elementary economic fact—that the average standard of living is determined by the productivity of the workers increased by technical means—makes it apparent that technological advance is a good thing for the economy and for the average citizen, provided it is utilized to increase production. Consequently, it has seemed to me that one of the principal concerns of this committee, in its study of the economic consequences of technological change, and particularly automation, should be to suggest and possibly to implement methods for removing or overcoming obstacles to the full utilization of our technological know-how. The importance of this is increased by the position in which we find ourselves relative to foreign competition. Against foreign cheap labor, our principal weapons are highly skilled labor and our technical sophistication. They are the only really effective means we have to maintain the way of life we have learned to cherish as our American heritage.

The obstacles to a full utilization of our technological potential are not hard to find. Except for ignorance and indifference, exemplified by the farmer who told the county agent that he was farming only half as well as he knew how, the principal cause of failure to utilize our technical knowledge to the fullest extent is the economic dislocation that may arise out of a change. Industry may be reluctant to scrap obsolete plants because of plant investment. Or labor may resist an otherwise desirable technological change because of a temporary adverse effect on a particular group of workers.

In our competitive society, fortunately, there is a strong motivation for an industry to keep up to date in its operations. The pressure of competition acts effectively to force businesses to maintain their technical operations at as high efficiency as possible. If they do not, they suffer in comparison with other parts of the industry. They cannot afford to retain nonprofitable obsolescent plants.

The effects of technological change on labor are not so simple. Nor are the problems associated with change so easy to solve. It is not so obvious that improvements in our economy benefiting many outweigh adverse effects on a few. The economic dislocations involve human adjustments that cannot be ignored. Technological unemployment becomes a haunting fear in the minds of people who may be involved in a change in the operating routine of an industry.

It is easy to say that technological unemployment is not a real problem when one is not affected by it. Even so objective an observer as Philip Murray, former president of the CIO, was quoted in a former report of this committee as having said in 1951:

> I do not know of a single solitary instance where a great technological gain has taken place in the United States of America that it has actually thrown people out of work. I do not know of it, I am not aware of it, because the industrial revolution that has taken place in the United States the past 25 years has brought into the employment field an additional 20 million people.

I am sure that this will be recognized as an overstatement. Certainly there are instances in our industrial economy where men have been replaced by machines. It is significant, however, that such dislocations are uncommon enough, and the relocations of such persons into new employment are so rapid, that we do not recognize a very serious problem. The 20 million new jobs mentioned by Mr. Murray, created by technology, completely conceal the relatively few that are lost by technical change.

Fear of technological unemployment is perhaps a greater obstacle to technical progress than unemployment itself. Fortunately for the United States, in relation to the rest of the world, we enjoy a greater measure of labor mobility and adaptability than other countries. This circumstance will stand us in good stead in our competitive relations with other economies. The receptiveness of our workers to the learning of new skills is a critical element in adapting ourselves to technical change.

The third of the three problems that were mentioned in previous reports of the committee—problems of the older worker—is one that seems likely to increase in our economy. The outstanding developments in medical and pharmaceutical science which have been brought about by modern research have had the effect of extending the lives of people. The percentage of our total population in the higher age brackets has increased and will continue to increase.

Technology offers the only way to solve this problem of caring for older workers. Technical improvements in industry have had the effect of extending the useful lives of our workers. The reduction in physical effort alone has made it possible for men to continue in productive capacities long after they would have been forced into retirement by the physical demands of older methods of production. Furthermore, an efficient, highly technical, highly mechanized industrial economy is needed to support any large segment of the population in the secure leisure we contemplate for our older retired workers.

Another economic problem, related to technological advance, that seems to be causing more and more concern, is the problem of increasing foreign competition. This is an exceedingly complex matter, and certainly cannot be dismissed with any easy generalizations. It is commonly said that such foreign competition as we are subjected to, comes about because of extremely cheap foreign labor. This may be true, but if we put ourselves, for the moment, in the place of foreign industrial enterprise, the complaint would be otherwise. They would say they find it difficult to sell in our markets because of competition with the low-cost output of our highly mechanized, automated, and efficient industrial machine.

It seems to me that neither of these generalizations tells the whole story. What seems important is that the real income of workers of all countries is determined by the output of the tools that they have to work with. This is a very impelling reason for us to improve the level of our technical skills in every field. Our principal fear of foreign competition is that it will somehow reduce the real income of our own people. If this comes about, the reason is more likely to be in our failure to maintain our technical competence than from any further degradation of the working standards of foreign labor.

We have some studies in progress at Battelle that seem to indicate that some imbalance exists in our economy, owing to the failure of the service industries to keep pace with the vast and very effective program of research and development that characterizes our modern product industries. Some of the economic value of product research is lost to the public because the service industries are unable to exploit the full potentialities of the new or improved product. I would suggest to your committee that it extend its investigation into this field to develop a better understanding of these relationships.

I am very glad to have an opportunity to submit a statement on economic stabilization to the subcommittee. The committee performs a valuable service by its studies on the effects of technology on the economy. The subject is complex, but it is very important that it be understood, not only by the Members of the Congress, but by the public generally. Our survival as a nation may depend on the depth of our understanding.

VIEWS OF INDIVIDUALS FROM GOVERNMENT

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STATEMENT OF A. V. ASTIN, DIRECTOR, NATIONAL BUREAU OF STANDARDS

I am pleased once again to discuss the experience of the National Bureau of Standards with computing machines and with the general activity related to automation. In order to concentrate on our most recent activity, I should note that my testimony before the Subcommittee on Economic Stabilization of October 27, 1955, described the Bureau's specialized technical service role to other Government agencies, its experience to that date, and some of my personal views on the nature and importance of automation to our economy.

The present statement will emphasize primarily changes since my 1955 statement. The Bureau's central service role in the data-processing field was strengthened through the provision of funds by the Congress for the design and construction of a pilot data processing machine. This machine, called the PILOT, will be described. A number of the more important technical assistance projects of other Government agencies will be briefly outlined. My own views on the nature and importance of automation to our economy are substantially unchanged from those I presented in 1955, but I should like to expand on the critical relationship between physical measurement and mechanization or automation.

1. The Pilot Data Processor (PILOT)

The original proposal for design and construction of a PILOT data-processing device to be used as an exploratory research tool in support of the National Bureau of Standards' advisory services to other Government agencies was prepared in May 1954 and was presented to the Congress in 1956. The facility was to provide a versatile tool for realistic simulation of the capabilities of many different kinds of data-processing systems as well as investigation of the novel performance characteristics required for a wide variety of data-processing problems in Government.

The initial request was predicated on the design of a minimum initial facility based on an extension of the DYSEAC configuration, a transportable computing installation just completed (1954) for the Department of Defense. It was to be a general-purpose high-speed data-processing installation with sufficient flexibility, especially in its input-output capabilities, for investigation and trial runs of problems characterized by large volumes of data and/or logical complexity of processing. Although Congress approved the proposal and authorized work in 1956, the initial budget required several years for design and acquisition of components. During the interim, however, advantage was taken of the progress of the state of the art and the evidence of new and more complex potential applications.

The present design, for which approximately $1 million was finally authorized by the Congress in 1959, is now in its final phase of construction. The features of the PILOT have been carefully selected and place higher emphasis on flexibility with respect to the range of applications than on simply higher speed and increased storage capacity. The criteria of selection have been a combination of (1) high speed of internal logical operations, minimized housekeeping operations and potentially large internal storage; (2) flexibility and expandability of external storage devices; and (3) provision for concurrent or overlapping operation of major segments of the system to effectively exploit both high-speed internal capabilities and slower but very large external storage.

Basically, the internal installation is a network of 3 computers, each carrying out a different function; the primary computer to carry out the arithmetic and logical processing operations, the secondary computer to carry out the redtape manipulations internal control of operations, and the third computer to control the flow of data to and from the peripherial external units. The nucleus system has a small very high speed internal memory, a modest number of magnetic tape units for external store, and a minimum array of input and output devices.

With a target date of September 1960 for completion of construction, it is anticipated that initial productive operation can be planned for immediately following a shakedown period of several months. The intended workload for which it has been designed includes a wide gamut of potential problems of the following types:

1. Data-processing tasks having considerable logical complexity, in addition to handling the management type problems with large volumes of data.

2. Where required, simulation of the operations of available and/or proposed data processors for the purpose of evaluative intercomparisons.

3. The preparation, updating, searching, selection, and retrieval of information in mechanized files. A prosaic example is the personality files of the form used either for personnel activities or for security functions. A more sophisticated example is the files of abstracts of scientific information or the surrogate files of the actual patent documents.

4. Simulation of dynamic situations including both those that are internally self-contained within the data processor, such as war games or the simulation of vehicular traffic, and those that require coordination with or control over external analog and/or digital devices, such as air traffic control or sequencing of an elaborate physical science experiment.

5. Processing of structured information that may appear either in the syntactical form of open-text natural language or in the graphical form of ranging from draftsmen's drawings to photographs, in which the emphasis is on sophisticated logical manipulation.

2. Assistance Projects to Other Agencies

Among the more important mechanization and data-processing projects recently undertaken by NBS are the following:

1. Post office mechanization project

This continuing project initiated in 1956 had as its objective the operations analysis of mail handling in order to recommend and/or develop automatic equipment and techniques for improving the mail-sorting operation. Because the amount of mail per person has increased over the years at a rate that would eventually make manual processing impossible, it was hoped to improve the speed and volume of handling of the mail without significantly increasing post office facilities and/or personnel, while reducing the unit cost of handling the mail. This program has involved the development of prototype mail-sorting systems, the investigation of combinations of keyboards, codes, and operators, the development and analysis of encoding methods, and the obtaining and analysis of statistical data on mail distribution and letter characteristics.

2. Patent Office operations

To cope with patent search workloads, a joint project with the U.S. Patent Office has attempted to utilize electronic data-processing techniques for the search problem. Since 1956 several experimental search routines have been developed and tested, particularly in the chemical arts, and research investigations have been undertaken in a long-range program of exploring the interaction between classification, coding, and machine requirements. These efforts have included analysis of the feasibility of searching English language texts by machine, the study of artificial dialects for use in retrieval experiments, experiments in picture processing and analysis, investigation of the applicability of lattice theory to models of information selection and retrieval systems, and a continuing survey of related work in mathematics, linguistics, and machine processing of graphic information.

3. Development of information selector

To use voluminous office record files, such as the correspondence and plans files of the Bureau of Ships, a means of automatic searching has been under development. This includes a device based on the Rapid Selector, originally conceived by Vannevar Bush. The device uses optical and electronic computing methods for high-speed search and selection of documents which have been previously microfilmed and placed on large storage reels. In conjunction with experimental operation of the device, assistance has also been given in document analysis and encoding for multiword selection. One of the major problems with this development is to increase the speed of film handling from the present 5-feet per second to a desired 20-feet per second and to design an optical system which will accommodate the wide variations in film quality.

4. Pictorial data processing

In 1956 a survey of devices capable of scanning printed or typed information and producing coded outputs suitable for digital processing was undertaken for the Rome Air Development Center. At the same time, an automatic scanning and display device was designed and constructed for the simulation of character recognition operations on a high-speed data processor. Under sponsorship of the Bureau of Ordnance, research and experimentation were initiated in automatically processing pictorial information for economical storage: Sample photographic maps were selected and subjected to computer processing. The U.S. Naval Training Device Center requested development of a technique to scan digitally aerial stereophotographic information and translate such information into elevation profiles. This involved reading into a high-speed computer stereo pairs of photographs by means of a scanning device and deriving the required information. The objective is to evaluate the practicability of a scanner-computer system for photogrammetric analysis.

5. Management of data processing for Bureau of Supplies and Accounts

At the request of the U.S. Navy's Bureau of Supplies and Accounts, advice and assistance was provided on the application of automatic data processing techniques to management problems of the Navy. The Bureau of Supplies and Accounts is primarily responsible for the logistics and accounting systems of the Navy. The speed and accuracy with which information is made available for command decisions is of utmost importance. This study involved an analysis of the flow of information and the development of standardized methods for representing data handling operations so that effective automatic data processing equipment might be introduced into the process.

6. Public Housing Administration

The Public House Administration examines reports of eligibility for continued occupancy of low rent housing. Preliminary studies were made, at the request of the Public House Administration, of the feasibility of automatically editing the data on these reports for internal consistency and for compliance with the regulations governing such occupancy. Flow charting, programing, and machine analysis of the problems of data editing, statistical compilation, and automatic generation of form letters were undertaken, completed, and demonstrated on a high-speed computer.

7. General Services Administration

The Federal Supply Service of the General Services Administration is responsible for furnishing centralized supply support to all Federal agencies through a network of depots in various parts of the country. In order to control this network, prompt and responsible data reporting and processing are required on inventories, management conditions, and accounts. The National Bureau of Standards was asked to review specifications for an automatic data processing system for this operation, to evaluate technical proposals submitted by various manufacturers, and to recommend a specific equipment system. In addition, NBS has planned and conducted training and orientation programs for GSA personnel.

8. Federal Communications Commission

The Federal Communications Commission requested NBS to advise and assist in a study to determine the feasibility of applying automatic data processing to problems of licensing and control of civilian broadcasting and to the coordination of information and licensing with the International Telegraphic Union. To meet the demand for service and licenses, up-to-date information must be provided as fast and as accurately as possible to the FCC Commissioners and examiners. After a preliminary study to identify the areas susceptible to automatic data processing techniques, a detailed investigation was made by a task force of NBS and FCC personnel to determine the data flow patterns. Concurrently, engineering computations and daytime AM broadcasts were analyzed and programed in a pilot analysis of currently authorized broadcast activities. Based on the findings, specifications are being established for data processing equipment which will best serve FCC's responsibilities.

9. Maritime Commission

The Maritime Commission has undertaken a feasibility study to determine the advisability of utilizing electronic data processing equipment. The Maritime Commission has a special responsibility for computing the subsidy rates for cargo- and passenger-type ships and for the ship mortgage insurance program. With the assistance of NBS personnel, a comprehensive analysis of the present management system has been initiated to determine the requirements for automatic data processing systems to meet the increasing demands for more timely and complex data. This study is still in the preliminary stage.

10. Fort Detrick

In 1955 the U.S. Army Biological Laboratories at Fort Detrick requested the Bureau's assistance in determining possible automatic data processing applications to experiments and to data analysis. An evaluation of performance characteristics of available data processors to meet these requirements was undertaken. The task was complicated by a number of special interlocking considerations. One complicating factor was the existence of a collection of punched cards representing a considerable prior investment. Following a survey and study of computational requirements, a system was chosen and the equipment is now installed and operating.

11. Veterans' Administration

An investigation of the feasibility of applying automatic data processing techniques to the handling of electrocardiographic data was undertaken at the request of the Veterans' Administration. Design and development of special equipment for collecting the data for input to an automatic data processor were also a part of the task. It is hoped that this task will result in the development of techniques to assist in diagnosing heart malfunctions. Prototype equipment has been designed and constructed and an experimental computer program to test the complete data handling procedure is being tried.

12. Weather Bureau

The U.S. Weather Bureau has requested assistance in implementing its planned use of unattended automatic weather stations. These stations are necessary to meet the demand for more weather data. The Bureau is now assisting in a study and development program for the determination of the kind and quantity of data to be taken and the prototype development of special electronic instrumentation for automatic weather observation and data transmission. Progress in this program has been made.

These projects are indicative of the wide variety of problems to which computer technology and data processing techniques have been applied. It is clearly evident that many Government operations involving the handling of large quantities of data and records can benefit from the introduction of these new techniques. In another area closely related to the Bureau's basic concern with the techniques of physical measurement, the implications of automation are also of great importance.

3. Automation of Measurement Processes

The National Bureau of Standards, through its responsibility for the national standards for physical measurement, is very much involved with development and utilization of devices and methods for accurate and uniform physical measurement. Automatic techniques have begun to make a significant impact on both the means for making measurements and the methods of utilizing the results of measurement. A few examples of how the Bureau is using or planning to use automatic techniques in some of its activities will indicate the nature of this important trend.

For more than 50 years the Bureau's standard sample program has aided the attainment of reliable measurement techniques throughout the chemical and metallurgical industries. A standard sample is a small sample of a material, the chemical and/or physical characteristics of which have been accurately determined. When the properties of the standard sample have been reliably identified, it can be used to calibrate measuring instruments in other laboratories or on production lines. With one class of standard samples, the spectrographic standard samples used to calibrate spectrometric anlaysis equipment, the Bureau has recently mechanized its methods of characterizing the individual samples. The method involves automatic analysis of the sample, computation of percentage composition of selected components, printing out of the computed results on a punched card together with a visual display of the results on appropriate instruments. Such mechanization has enabled the Bureau better to keep pace with the rapidly expanding industrial requirements for measuring service in this area.

In a quite different area of metrology—namely, that involving the measure of length—the Bureau has under development or study several important automatic methods. End standards or gage blocks provide the primary means of controlling the accuracy of length measurements throughout industrial production facilities. The Bureau calibrates annually many thousands of master gage blocks which industrial firms use in turn to calibrate their own working and production line standards. The Bureau has partially automated this process in that data from manually performed mechanical measurements is automatically processed by punched card techniques. Under study is a plan to mechanize the entire operation by replacing the manually performed mechanical measurement by automatic optical measurement.

Another type of length standard is the line standard such as the standard meter bar by which the meter is defined as the distance between two engraved lines on a bar of platinum-iridium alloy at a designated temperature. Calibrating line standards is a tedious and exacting task requiring a high degree of manual skill. Research is underway to mechanize this process. An electronic technique has been developed to detect an engraved line defining a position on a scale and to sense and record the number of light fringes observed during the motion of an interferometer, an optical instrument for length measurement, between two engraved lines. The latter development is of great importance in connection with the proposed redefinition of the meter in terms of an optical wavelength on which international accord is expected to be reached in October 1960. In excess of a million fringes must be counted in an interferometer to pass from a wavelength standard to a meter bar or yard standard. It is only practicable to do this with automatic counting techniques.

Another development now well underway is an automatic electrical balancing bridge for the acquisition of thermodynamic data. Modern industrial, military, and scientific requirements for data on the thermophysical properties of materials are so pressing that means must be found to acquire such data more rapidly. The automatic bridge which is under construction by a private instrument company will facilitate this process substantially. Closely related to this is the extension of thermodynamic data by automatic computational processes into temperature regions not yet adaptable to controlled laboratory measurement but important for design purposes. Through the development of suitable programing techniques for large-scale digital computers the Bureau has been able to provide defense agencies and industrial organizations with large quantities of critically needed data on the properties of materials at high temperatures.

The preceding examples, which are by no means all-inclusive, serve to illustrate the trend in measurement and data analysis processes. The Bureau is actively exploring its entire measurement program with the objective of improving its operations through automation wherever possible. In general it is felt that automatic processes offer the following potential advantages:

(1) Provision of more extensive and more rapid calibration services to industry without important staff increases, and at lower cost for equivalent service;

(2) Opportunity to perform extremely difficult measurements without detailed dependence on high skilled and very scarce metrologists;

(3) Opportunity to increase accuracy through elimination of bias of human operators and ability to make many observations quickly and reliably;

(4) Opportunity to increase accuracy through direct coupling to automatic computational devices for cross-checking and for printing out results;

(5) Opportunity to optimize experiments through the coupling of automatic data-taking equipment to automatic computing devices and to adjust the plan of experiments rapidly according to the results of prior data.

In summary, it is believed that the only way the National Bureau of Standards can effectively fulfill its statutory responsibilities to our rapidly expanding technological economy in the physical measurement field is through extensive mechanization of measurement activities.

4. Dependence of Automation on Progress in Measurement

In a still broader context the National Bureau of Standards and its management are very much alert to developments in automatic measurement and computation in our advancing technological economy. It is through measurement that the properties of materials and devices are made to conform to preestablished requirements. It is through uniform measurement related to a consistent system of national measurement standards that full interchangability of materials, components, and devices throughout the country is possible. It is through accurate measurement and control, intelligently applied, that a high degree of quality and reliability in technological products becomes possible. It is through automatic measurement and control that we find some of the greatest opportunities to exploit the advantages of accurate and uniform measurement in improving efficiency, quality, and reliability. And, finally, it is through automatic measurement coupled to automatic control through automatic data processing that we find the greatest unexploited opportunities for optimizing production processes. Until all such automatic processes are integrated into a complete system there will be only partial utilization of the advantages of automation.

Thus the relation of measurement to automatic control is critical. Also the more accurate the measurement the better the control. In a high-speed automatic system, especially one dealing with a complex processing operation, the dependence upon accurate measurement cannot be overestimated. Modern computational devices now provide highly efficient tools for processing vast amounts of data which can provide for fairly elaborate production controls, but these devices are limited by the quality of the raw input data supplied to them. If the measurement techniques are inadequate to the requirement, then the use of computational devices becomes, in a sense, inadequate or wasteful. I believe that there is a direct relationship between progress in automation and progress in the science of measurement. To support the effort leading to automation, it will be necessary to support, in addition to systems studies such as those previously given, significant research and development in the field of measurement and instrumentation.

Both the field of measurement and the related field of instrumentation show significant promise, particularly in the area of electronics. Technological advances in this area have been vital not only to progress in automatic measurement techniques but to automatic control and data processing as well.

There is little doubt that the future of the measurement sciences will find better standards, new standards, valuable new measurement techniques, all leading to higher precision and better production control. Such progress cannot but lead to the realization of what today is the promise of automation.

I would only add this note of caution that much research and development is still required. This requirement must be met with urgency because of current international consideratons. In my earlier statement I noted an analysis which indicated a 3-percent annual increase in the productivity of the labor force of the United States. Recent accounts of the rise in productivity in the U.S.S.R. indicate strong competition from behind the Iron Curtain. If this is true, it is probably attributable to the emphasis being placed on measurement, mechanization, and automation in that country. Within the U.S.S.R. plans and activities for increased industrial productivity are closely correlated with a strong emphasis on automation, measurement, and measurement standards.

It seems clear that the competition which exists between our two ideologies will be conducted as much in the economic arena as in any other area. The challenge for minds and markets must be met by maintaining America's productive superiority. Automation, supported by advanced measurement, is a key to that economic challenge.

STATEMENT OF ROBERT W. BURGESS, DIRECTOR, BUREAU OF THE CENSUS

This statement is in response to a request which Mr. Patman, Chairman of the Subcommittee on Automation and Energy Resources of the Joint Economic Committee addressed to me on April 19, 1960. Mr. Patman referred to the testimony I gave the committee on October 15, 1955, in a statement on automation in data processing and the office. He indicated that the committee would appreciate a "thoroughgoing reconsideration of the problem" and an updating of the information supplied 5 years ago.

My formal testimony of October 15, 1955, concluded with the following paragraph:

> I think we can say that "automation" is a new word for a now familiar process of expanding the types of work in which machinery is used to do tasks faster, or better, or in greater quantity. For a century or so we have been adjusting to more and more mechanization. We have thrived and grown great partly because of this, certainly not in spite of it.

Neither the additional experience using electronic data processing equipment our Bureau has acquired during the past 5 years nor the updated statistics on employment by industry and occupation and the updated statistics on production of goods and services lead me to modify that conclusion in any way.

CENSUS ELECTRONIC DATA PROCESSING FACILITIES AND RECENT EXPERIENCE

Following the general organization of my earlier statement I will first report on activity in the development, acquisition, and use of electronic data processing equipment at the Bureau of the Census during the past 5 years and on the impact this equipment has had on our employment rolls.

At the time of my earlier report to this committee we were engaged in processing, in addition to our regular recurring work, the returns from the 1954 Censuses of Business and Manufactures. I reported on this activity and presented a few simplified illustrations of how we were using the two Univac I's, which at that time constituted our electronic data processing installation, to accomplish work which prior to the advent of this kind of equipment was performed by large groups of clerks doing either manual or punched card operations.

Not long after I appeared before the committee in October 1955, we addressed our attention to an evaluation of our data processing requirements over the next several years. Of course, the 18th Decennial Census of Population and its companion census of housing loomed large in this evaluation. But in addition to the 1960 censuses there were the 1958 Censuses of Manufactures and Business and the

1959 Census of Agriculture to be considered. As a result of the estimates of workloads which resulted from this evaluation we took steps to expand our electronic data processing facilities significantly.

In addition to the two Univac I's the Government had acquired for our Bureau by October 1955, it has since acquired two Univac 1105's which are now in operation at our Washington headquarters. Also we concluded arrangements with the University of North Carolina and the Armour Research Foundation under which, in return for Government assistance in defraying part of the purchase price of Univac 1105's compatible with the Census Bureau machines, each of these organizations has agreed to make available to the Bureau of the Census, during the period 1959 to 1961 when our requirements are at their peak, approximately two-thirds of the time available on an 1105 owned by the institution.

Thus, at present we operate six large-scale electronic data processing systems, four at our central headquarters and two others at locations away from home. Government engineers maintain our two 1105's while the manufacturer is maintaining our two Univac I's and will continue to do so until such time as we can expand our maintenance staff to take over these responsibilities. At each of the two locations away from home maintenance services are supplied by the educational institution. We reimburse them for our share of maintenance costs.

Another significant addition to our installation of electronic data processing equipment is FOSDIC—Film Optical Sensing Device for Input to Computers. One paragraph of my 1955 statement was:

> By the time of our next decennial census we expect that, again, automatic equipment will influence greatly not only how fast we do things, but how we do them. We foresee equipment which can greatly reduce our requirements for a large staff of temporary employees to convert the information on schedules to holes in cards. In past decennial censuses we have employed several hundreds of such key punch operators. We are hopeful that in the future, there will be available equipment capable of reading marks placed on census schedules by our respondents or enumerators. Such equipment would eliminate the need for the large staff of key punch operators for a short term job.

Our expectations of 1955 have been realized. Engineers at the National Bureau of Standards developed the basic principle involved in Fosdic. By controlling a beam in a cathode ray tube they were able precisely to scan microfilm images of census documents and detect whether or not marks appeared in specified locations on the image. With the assistance of Census engineers appropriate control circuits and magnetic tape recording circuits were designed and reduced to a prototype machine by the NBS personnel. Subsequently four production models of this equipment were built by our laboratories. These machines are now in full-time operation—24 hours a day, 6 or 7 days a week—scanning microfilm copies of questionnaires filled out by the 1960 census enumerators and transcribing the information to magnetic tape.

Before attempting to provide some indication of the impact on employment at our Bureau of these electronic devices, I should call attention to two important ways in which the nature of our data processing workload in connection with the decennial censuses differs from what it was in 1950.

The first of these is that whereas in 1950 the census of agriculture was taken at the same time as the censuses of population and housing the current census of agriculture was taken separately beginning in October 1959. The enumeration date for the 1960 Censuses of Population and Housing was April 1, 1960. Furthermore, the main part of the processing of the 1959 Census of Agriculture is being accomplished at an installation of punched card equipment in Parsons, Kans. The processing of the 1960 Censuses of Population and Housing is divided among, (*a*) offices at Jeffersonville, Ind., where the bulk of our clerical force for this work is employed and where we have the cameras which microphotograph the schedules, (*b*) our central headquarters where all of the Fosdic equipment and most of the electronic computers are located, and (*c*) each of the two educational institutions previously mentioned.

Another important difference between 1950 and 1960 relates to sample information. The 1950 Census of Population included a basic list of questions asked of 100 percent of the population plus some additional questions asked of every fifth person. The 1960 census asks a shorter list of questions for 100 percent of the population, and most of the questions are asked of only every fourth household. In other words some questions that were 100 percent questions in 1950 are sample questions in 1960 and the sample was changed from 20 percent of the persons to 25 percent of the households. The net effect of these changes has been to reduce considerably the total amount of manual coding required for the 1960 census as compared with the 1950 census despite the increase in population from about 150 million to about 180 million. Coding is the conversion to a number code of descriptive information reported by an enumerator. For example, a person who is reported as an "ignition expert" in an auto repair shop must be assigned the code 472808 before we can classify him appropriately in the tabulations showing occupation and industry.

Obviously our decisions relative to the timing of the census of agriculture and the allocations of questions between 100 percent and sample for the 1960 Censuses of Population and Housing were influenced by many considerations. With respect to the allocation of 1960 Census questions between 100 percent and sample, however, the nature of our electronic data processing facilities was an important factor in the decision. With Fosdic's ability rapidly to convert intelligence recorded by a census enumerator to magnetic tape, plus the electronic computer's ability rapidly to tabulate, it became apparent that the tabulation and publication of basic population and housing characteristics could be expedited significantly if the 100 percent questions were limited to those which did not require manual coding. Where no coding is necessary the census schedules can be microfilmed immediately they are received at our processing office in Jeffersonville. This we are, in fact, now doing and we confidently expect that for the first time in our Nation's history the final official counts of the population of each State on the basis of which the seats in the House of Representatives will be apportioned will be the product of automated tabulations. Always in the previous 17 decennial censuses of our Nation these counts were obtained by hand because no mechanical method was fast enough to provide them to the time schedule specified in existing law. Furthermore, for the first time in our history the tabulations classifying the population by such basic characteristics as sex, age, race, and marital status will be available at the same time as the total counts.

The impact of electronic data processing equipment on employment in our Bureau can be measured roughly by comparing full time staff at the time we were processing the 1950 censuses with our estimated full time staff at the time we will be processing the 1960 censuses. Of course, the change in timing of the agriculture census and the other differences between 1950 and 1960 must be borne in mind in interpreting these comparisons. Another obviously important factor is the approximately 20 percent larger population in 1960 than in 1950.

Almost 10 years ago during the October to December quarter of 1950 our full time staff working on the Seventeenth Decennial Census reached a peak of approximately 9,500 employees. This decade we expect our full time staff to reach its peak of approximately 4,000 employees during the July to September quarter of 1960. Thus, with a maximum staff only about 45 percent as large as it was 10 years ago, we plan to process the census data for a population 20 percent larger than it was in 1950 and to publish the results much sooner than ever before.

Even more striking is a comparison between the two decades of the numbers of employees assigned to the tabulation operation. At the time of the 1950 censuses the staff of our Machine Tabulation Division which included the key punch operators who converted information recorded on our schedules to holes in punched cards rose from about 400 employees in the July to September quarter of 1949 to a peak of about 4,750 employees in the January to March quarter of 1951. This decade a roughly comparable staff is composed of our Machine Tabulation Division and our Electronic Systems Division plus the employees who operate the cameras which microphotograph the census schedules. This staff will increase from about 600 in the July to September quarter of 1959 to a peak of only about 750 in the July to September quarter of 1960. Whereas 10 years ago, in those parts of our Bureau directly concerned with what can be termed the mechanical tabulation of census results, the necessary recruitment and training and other problems attendant to a temporary increase in staff was measured in terms of over 4,000 employees, this time the comparable activities call for an increase only on the order of 150 employees. It is important to recognize that these comparisons do not mean that census employees have lost their jobs because of electronic data processing equipment. They simply indicate that we are able to discharge our responsibilities at decennial census time by adding smaller numbers of temporary employees.

General Remarks on Effects of Mechanization and Automation

The second section of my statement 5 years ago presented some historical statistics relative to our national economy which I deemed relevant to the interests of this committee. Many of the comments I made about these data at that time are as true today as they were 5 years ago. However, my remarks and the statistical material which accompanied them can now be elaborated to include data which have become available in the intervening 5 years.

Although I recognize that some of the following will be repetitious, I believe that a rewrite of the second section of my earlier report with updated data and comments will best serve the interests of the committee.

The growth in our economy requires ever-increasing productivity from each worker. That this demand has been met is due in large part to the ingenuity of those who have developed and successfully introduced mechanical devices ranging in complexity from automatic dishwashers through mechanical harvesters to electronically controlled steel rolling mills and oil refineries. Recent advances have been heavily dependent on advances in electronics computers and other control equipment. Our factories, farms, and homes now operate more efficiently in the sense that those who work there can spend a larger share of their effort on activities involving judgment and intelligence rather than mere brawn and muscular coordination.

One has only to compare the farm or industrial labor pattern of 1850 with that of 1960 to see that this relegation of many repetitive routine tasks to machines rather than to human beings has had a tremendous effect on our way of life. But even though there have been problems and conflict in acomplishing the readjustments that necessarily accompany the developments leading to increased productivity, the effect has actually been more of an evolution than a revolution. And with the growing capabilities of electronic and mechanical equipment, man has continued to make the machine his servant rather than his competitor.

Until very recently the development of machines to lighten the white collar workers' load has been overshadowed by the development of devices to relieve man's back, rather than his mind, of drudgery. Nevertheless, the typewriter, adding machine, punched card equipment, and other office devices, which are now in common use, were just as important developments for office work as the tractor was for the farm.

Machines which can handle the drudgery of the office as efficiently as machines which can handle the drudgery of factory, farm, and home are now arriving on the economic scene. Does this mean that routine office workers will vanish from the streets of our cities the way that pitchfork-wielding farmhands have vanished from the Mississippi Valley? Possibly yes, but not in a few short years and perhaps not in our lifetime. We can confidently expect that advances in automation in this field will make it possible to supply types of information which have long been needed but which could not be economically provided. The transistor, the magnetic core, and the vacuum tube undoubtedly will greatly reduce the human effort required in many large-scale clerical operations. Experience here may be similar to that when punched card equipment was introduced. In the early 1900's the demands for information could not be met by hand methods. This inability to meet need led to the development and introduction of punched card tabulation and accounting methods. The Census Bureau played an important and leading role in this development. But the development has not displaced people; instead the lower costs and increased possibilities for timely information have made it possible to meet more of the demand for increased facts to guide decisions by American businessmen and governments. The result of this along with other factors has been an increase in the proportion of the labor force in clerical occupations from about 3 percent in 1900 to 12 percent in 1950 and 15 percent in 1960. Thus there is every reason to believe that the development of cheap and versatile electronic data processing machines will not be accompanied by a major reduction, if any, in the number of office jobs.

Employment statistics support the view that, while advances in science and technology may cause declines in some areas of employment, over the long term they create increases in others. Between 1940 and 1950—a period of unusually rapid scientific development—employment (including the self-employed) increased from 47 million to 60 million (26 percent); between 1940 and 1960, it increased from 47 million to 66 million (40 percent). The facts that new entrants into the labor force are encountering longer periods of unemployment and intermittent jobs before they become experienced enough to secure long-term jobs and that persons above 55 or 60 years of age appear to drop out of the labor force, presumably because they do not obtain attractive job offers, are evidence that the character of jobs is changing rapidly.

The employment figures show that in spite of the installation of improved machinery, more workers were required to produce the amount of goods and services wanted. It is interesting to compare the increases in population and in output of goods and services with the 40-percent increase in employment. Population increased only 35 percent in the 20-year period, while the Nation's output of goods and services, measured in constant dollars, increased more than 100 percent.

The gain in employment is interesting because in 1940 many people were concerned about machines displacing men. And it is especially interesting that some of the industries that introduced new machines employed substantially more workers after the introduction than before. The telephone industry, for example, which put in the dial telephone and displaced many operators, nearly doubled its employment between 1940 and 1950, and it added over 10 percent more in the next decade.

Between 1940 and 1960 workers shifted from one industry to another and from one occupation to another. Some of these shifts, no doubt, resulted from the introduction of machines. For example, there was a marked drop in employment on farms. Much of the farmwork formerly done manually is now done more efficiently by machinery either in shops or on the farm.

Where did the farmworkers go? If they did not drop out of the labor force, they probably went into the industries where employment was expanding. Between 1940 and 1960 manufacturing payrolls showed an increase of 5,600,000 workers (52 percent), wholesale and retail trade an increase of 4,600,000 (67 percent), services—excluding services in private households and also educational, medical, and other services rendered by Government agencies, but including finance, insurance, and real estate—an increase of 4,200,000 (86 percent), and contract construction an increase of 1,300,000 (102 percent). Increases in some industries appear to be directly related to increases in many parts of the economy in the use of automatic equipment. For example, some increases in services and manufacturing can fairly be ascribed at least partially, to an increase in the demand for persons to design, manufacture, and repair automatic equipment for applications in many different types of activities.

Shifts in the occupational distribution are particularly interesting. Farmers and farm laborers, who constituted 18 percent of the employed group in 1940, were only 8 percent in 1960. Nonfarm laborers and private household workers also became relatively less numerous. On the other hand, increases in proportion were recorded for office workers; professional and technical workers; nonfarm managers, officials, and proprietors; service workers outside private households; and skilled craftsmen and foremen. The occupational classifications that increased in importance are generally higher paying than those that declined, so it appears that opportunities for more desirable jobs have been created.

A long-range view of the growth of employment in the machinery industries is given by the census of manufacturers. Manufacturing has taken tremendous strides since the turn of the century, and the machinery industries have progressed faster than the average. In 1899 some 4½ million production workers were employed in manufacturing industries. By 1958, the number had increased to 11,700,000—a gain of 160 percent—although the increase in population was only 128 percent. The machinery industries showed even greater gains. In 1899 some 400,000 production workers were employed in these industries; in 1958, 1,800,000 were so employed—more than 4 times the 1899 figure. In 1899 production workers in the machinery industries were about 9 percent of the production workers in all manufacturing industries; in 1958, they had climbed to 16 percent. The manufacture of machinery and equipment has thus grown in importance within the whole structure of American industrial production.

While the comparison of production workers in 1899 and 1958 provides a good picture of the growth of the machinery industries within manufacturing, the figures for production workers and the use of 1958 are not satisfactory to show the growth of total employment in manufacturing. As I mentioned above, the occupational distribution is shifting, and production workers are declining in relative importance. The decline over a long period is striking. In 1899 production workers were 93 percent of all employees in manufacturing, but in 1956 they were only 76 percent, and in 1958 only 73 percent. In the machinery industries (where data for a long period are not available), production workers were 80 percent of all employees in 1947 and only 71 percent in 1958. The use of 1958 understates the growth in employment because of the mild recession in that year. This recession is evident in the figures for machine tools and metalworking machinery, which I attach to show the effect of the business cycle.

To see the growth of total employment in manufacturing, we should compare the 5 million employees in 1899 with the 17 million in 1956. Data on total employment (including nonproduction workers) in the machinery industries in 1899 are not available.

Largely because of the record of past changes and the accompanying circumstances as I have observed them, I do not expect the further development of machines to reduce the number of jobs over the long term. Furthermore, in my judgment, the new jobs will be less arduous, more satisfying to the individual, and better paying. Not only have new types of machines resulted in increased production, but they have enabled us to make more goods in fewer hours of work so workers have had more opportunity to engage in recreational and cultural activities. These in turn have created further demand for goods and services. The characteristic effects of new machinery on production and employment in the past seem to me very similar in the main to what we are currently seeing for electronic computers and can reasonably expect in the future.

Summary

In summary, I believe that automation applied to data processing may well be accompanied by a net increase in the overall demand for workers as well as an improvement in the opportunity for each worker to make fuller use of his talents. There seems to be no reason to expect a change in the historical pattern of growth of demand for work output more than offsetting the reduction in man-hour requirements to accomplish the work originally required. Our country appears to be in an era of rapid growth. The development of new industries, the increasing productivity, the growth of the population, the average citizen's desire for new products and more old products, the widespread business confidence, the recognition of responsibility by the Government to promote sound economic growth under the Employment Act of 1946, all promise a continuous expansion of our economy.

Automation may lead to some serious shortrun dislocations in particular industries, in particular parts of our country, and in particular age groups. In the long run, however, it seems to me that the dislocated groups will adjust to the new situation and that automation will facilitate and promote the general expansion of the economy.

As has happened in the past, personnel requirements while keeping pace with the increase in the total size of the labor force may undergo changes in types of assignments. Labor force projections for the next decade indicate that not only will our Nation's labor force increase by almost 20 percent to some 87 million workers by 1970 but most of the increase will come at the two extremes of the span of working ages. Whereas it is estimated that the number of workers aged 25 to 44 will increase by only 1.6 million between 1960 and 1970, the number of workers under 25 years of age is expected to increase by 6.4 million and the number 45 years old and older by 5.5 million.

Relative to the older workers changes in the character of assignments can create real problems which call for skillful handling and understanding of human relations as well as economic problems in making the adjustment between the different types of workers required on the new and the old bases. It is obvious that the organization that tried to adopt a hard-boiled attitude toward its original workers would lose in worker resentment and public disapproval as well as in loss of related knowledge and skills that can be converted for valuable application in the new areas.

With almost half of the estimated increase in our labor force during the next 10 years being young people, more and more premium will be placed on education, training, and adaptability. Greatest difficulty in finding their first job will continue to be experienced by the new workers with the least education. The competition for the better jobs among new workers will become keener. Employers will find their stake in a sound educational system becoming larger and larger. They will have to employ a larger proportion of young and inexperienced persons and consequently they will have to provide more and better training on the job and become more skillful in recognizing diamonds partly concealed beneath an unpolished exterior.

The whole picture, however, continues to impress me as the continuation of an evolutionary process rather than the beginning of a revolutionary one. To compete successfully in the 1960 labor market, people need better and more broadly based education and training than they did in the 1860 labor market. Our democratic society developed the educational and training facilities to meet these needs at the same time it was shortening the workweek and otherwise improving our standard of living. I foresee that, with the appropriate exercise of the necessary intelligence and zeal, we shall make the necessary adjustments and apply these newer and better tools to provide ourselves with more and better goods and services. Intelligent application of mechanization and automation leads to increased productivity and efficiency, the material foundation for more satisfactory living.

Production workers in machinery industries and in all manufacturing industries, 1899–1958

[In thousands]

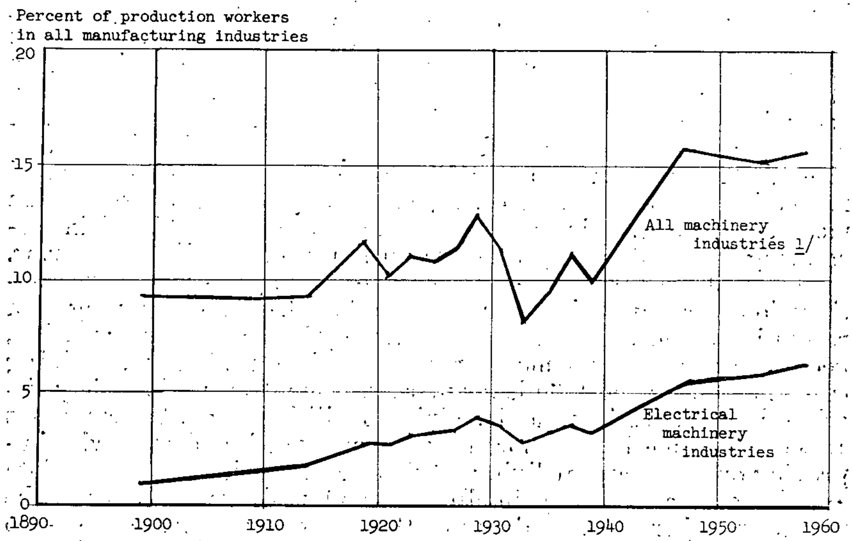
Year	Total manufacturing	Machinery industries					
		Total		Electrical machinery		Other machinery [1]	
		Number of production workers [2]	Percent of total manufacturing	Number of production workers [2]	Percent of total manufacturing	Number of production workers [2]	Percent of total manufacturing
1958	11,721	1,824	15.6	721	6.2	1,103	9.4
1954	12,373	1,893	15.3	722	5.8	1,171	9.5
1947	11,916	1,883	15.8	639	5.4	1,244	10.4
1939	7,808	784	10.0	248	3.2	536	6.8
1929	8,370	1,091	13.0	343	4.1	748	8.9
1919	8,465	998	11.8	241	2.9	757	8.9
1909	6,262	568	9.1	92	1.5	476	7.6
1899	4,502	414	9.2	43	1.0	371	8.2

[1] Includes engines and turbines, tractors and farm machinery, machine tools, textile machinery, pumps and compressors, office and store machines, sewing machines, etc.

[2] Figures for 1899–1929 are not entirely comparable with those for 1939–58, largely because the earlier figures include boiler shop products and foundry products. These industries were not classified in machinery industries after 1931.

Source: U.S. Bureau of the Census, Census of Manufactures, 1899, 1909, 1919, 1929, 1939, 1947, 1954, 1958. Figures for total machinery industries for 1899–1929 compiled by Harry Jerome from the Census of Manufactures and published in "Mechanization in Industry" (National Bureau of Economic Research, 1934), p. 232.

PRODUCTION WORKERS IN MACHINERY INDUSTRIES AS PERCENT OF PRODUCTION WORKERS IN ALL MANUFACTURING INDUSTRIES, 1899-1958



1/ Figures for 1899-1931 are not entirely comparable with those for 1933-1958, largely because the earlier figures include boiler-shop products and foundry products. These industries were not classified in machinery industries after 1931.

Sources: U. S. Bureau of the Census, Census of Manufactures, 1899, 1904, 1909, 1914, 1919, 1921, 1923, 1925, 1927, 1929, 1931, 1933, 1935, 1937, 1939, 1947, 1954, 1958. Figures for all machinery industries for 1899-1929 compiled by Harry Jerome from the Census of Manufactures and published in Mechanization in Industry (National Bureau of Economic Research, 1934), p. 232.

Average number of production workers in metalworking machinery (industry group No. 354), 1927–58, and in machine tools (industry No. 3541), 1919–58

Year	Metalworking machinery (industry group No. 354)		Machine tools (industry No. 3541)	
	Number of workers (in thousands)	Index of workers (1947=100)	Number of workers (in thousands)	Index of workers (1947=100)
1958	161.0	93	37.0	67
1957	223.7	129	59.6	109
1956	229.0	132	65.2	119
1955	204.9	118	58.6	107
1954	206.3	119	62.1	113
1953	234.0	135	76.8	140
1952	225.7	130	79.5	145
1951	199.3	115	64.0	117
1950	149.0	86	41.6	76
1949	139.5	81	38.6	70
1947	173.0	100	54.9	100
1939	81.0	47	37.0	67
1937	[1] 80.2	52	[1] 37.5	68
1937	[1] 90.2	46	[1] 47.3	86
1935	51.3	30	28.3	51
1933	25.5	15	12.7	23
1931	38.8	22	21.3	39
1929	74.1	43	47.4	86
1927	49.3	28	[2] 32.4	59
1927			[2] 35.3	64
1925			30.8	56
1923			33.4	61
1921			21.3	39
1919			53.1	97

[1] The smaller figure excludes data for establishments engaged primarily in manufacturing rod and ware forming and fabricating, rolling mill, sheetmetal-working, and wire drawing machinery and is comparable with figures for later years. The larger figure includes data for these establishments and is comparable with figures for earlier years.

[2] The smaller figure excludes data for establishments primarily engaged in manufacturing machine tool accessories and is comparable with figures for later years. The larger figure includes data for these establishments and is comparable with figures for earlier years.

Source: U.S. Bureau of the Census, Annual Survey of Manufactures, 1949–53 and 1955–57, Census of Manufactures, 1947, 1954, 1958. Data for years prior to 1939 compiled by Solomon Fabricant from the Census of Manufactures and published in "Employment in Manufacturing, 1899–1939" (National Bureau of Economic Research).

STATEMENT OF LEO A. HOEGH, DIRECTOR, OFFICE OF CIVIL AND DEFENSE MOBILIZATION

Review of the information presented to your committee in December 1956 by Dr. Bevis indicates that he basically outlined the program of the President's Committee on Scientists and Engineers, which at that time had been in existence for only a few months. Upon termination of the President's Committee on December 31, 1958, a final report of its activities was submitted to the President.

Incident to the termination of the Committee, certain of its functions were discontinued; other functions were transferred to other agencies or organizations; and a few instances, the activities of other agencies or organizations were broadened to include those formerly the concern of the Committee. Federal agencies currently carrying on tasks which were part of the President's Committee program, as described in the final report, include the U.S. Office of Education, the National Science Foundation, the Department of Labor and OCDM.

Basic data on the current and prospective supply and demand of scientists and engineers, a subject discussed with your committee by Dr. Bevis in 1956, are prepared by the U.S. Office of Education (annual statistics on college graduates), the National Science Foundation (periodic manpower studies) and the Department of Labor (current and future employment trends). The utilization and local action (talent development) programs of the President's Committee, also mentioned by Dr. Bevis in 1956, were transferred to OCDM on January 1, 1959, where they are being continued and expanded.

The enclosure entitled "Activity of the Manpower Area of OCDM" sets forth our current manpower activities including the utilization and local action (talent development) programs.

THE MANPOWER AREA OF THE OFFICE OF CIVIL AND DEFENSE MOBILIZATION

Among the problems facing the Nation in achieving and maintaining both economic development and military preparedness is the judicious management of our manpower resources. Fulfillment of OCDM's responsibility in this respect requires (1) a manpower organization in place, capable and ready to function, (2) an adequate knowledge of present and foreseeable manpower supply and requirements, and (3) actions to reduce or eliminate present and foreseeable manpower shortages. Specific activity is undertaken by the manpower area of OCDM to meet each of these requirements.

An annex, the national manpower plan, to the national plan for civil defense and defense mobilization has been prepared which sets forth the basic principles and administrative organization at National, regional, State, and the local levels for coping with situations ranging from "cold" war up to and including general war. Under the provisions of the annex, the State, regional, and Federal Employment Security System (primarily the U.S. Employment Service) serves as the heart of the civilian manpower agency, responsible in the preattack period for operational planning for civilian manpower mobilization, and for emergency manpower operations under conditions of either limited war or general war.

Conferences have recently been held in each OCDM region to bring together officials from the agencies and organizations having manpower mobilization roles and functions and to discuss their interrelationships. This group includes representatives from OCDM, the Selective Service System, and the Office of Manpower Administration (U.S. Department of Labor), together with State civil defense directors, the State employment security agency directors and the State selective service directors for the region concerned. The purpose of these meetings has been to insure a mutual understanding of the national manpower plan, and an understanding of the administrative organization and interagency cooperation necessary at the various levels for insuring maximum effectiveness in manpower resource management. It is planned that similar meetings will be held in each State so that throughout the United States, down to each local community, there will be an integrated manpower program that can go into effect on a self-triggering basis. Such implementation is already underway in a number of regions.

In meeting the requirement for having an adequate knowledge of both present and foreseeable manpower supply and needs, a cooperative program is being conducted with the Department of Labor in improving the Nation's capability for estimating the postattack supply of manpower, and for evaluating the manpower requirements of various agencies having mobilization responsibilities. This study will result in a better understanding about, and help achieve maximum realism in, determining manpower reqirements.

With respect to the actions for reducing or eliminating significant manpower shortages, two programs are being emphasized:

(1) The utilization program—designed to achieve, throughout our industrial complex, the most effective use of skills in being. It consists of a series of conferences, held under local sponsorship but under the auspices of OCDM. Participants are primarily industrial managers, Government officials from agencies employing scientific and engineering personnel, officials of professional societies and college deans. Conference objectives are (*a*) to set forth policies and procedures for improving the utilization of professional, scientific, engineering and technical skills, and (*b*) to motivate conferees to take subsequent action in their companies or agencies to improve the management of their own manpower programs and procedures. The average attendance at each conference is approximately 100 persons, the majority of whom are from middle or top management.

(2) The talent development program—designed to insure that manpower requirements for the future, civilian as well as military, are met through the continuing availability of the right kind and quality of skills to keep pace with an economy which is becoming increasingly complex and increasingly dependent on technological progress. This program is implemented through the creation of community groups, composed of representatives from industry, labor, Government, pro-

fessional societies, and civil organizations, all working in collaboration with elementary and secondary schools, colleges, and other educational institutions (*a*) to identify youth with talents for manpower specialties which are or will be in short supply; (*b*) to encourage and assist such youth to enter into and complete their education in those fields in which they have aptitudes, interests, and abilities; (*c*) to improve school curriculums across the board with emphasis on science and mathematics; and (*d*) to provide for and encourage an orderly progressive transition from the secondary schools to institutions of higher learning.

Two other activities of the manpower area implement its mission:

(1) The management and policy supervision of the national defense executive reserve. This program, established under the Defense Production Act and Executive Order No. 10660, provides for the establishment and training within each agency of Government of a nucleus executive reserve drawn from all geographic areas and from all segments of the economy—industry, agriculture, labor, the professions, professional societies, public and private institutions—for employment in executive positions in Government during periods of an emergency. During the past year, the reserve has grown to approximately 2,500 in 15 agencies. The second national training conference of the reserve group was held on May 23–24 in Washington. Through the reserve program, OCDM seeks to avoid a shortage of manpower with leadership skills ready to help the Federal Government to manage the mobilization program in an emergency.

(2) Developing programs for meeting the postattack manpower requirements for civil defense operations through the preattack identification of community manpower resources which most closely relate to postattack manpower needs, and the preattack, voluntary commitment or assignment of these resources to specific, postattack civil defense functions. Such a plan would appreciably expedite the postattack problem of apportioning remaining manpower resources among the various civil defense services. One community survey has already been made to test the feasibility and practicability of this plan; others are being planned.

Among the OCDM committees which are concerned with manpower, the manpower area receives assistance on specialized manpower problems from the Committee on Specialized Personnel, an advisory group, composed of individuals from industry, labor, and Government. The Committee is a focal point for the exchange of information on specialized personnel, the recruitment, training, allocation, and utilization of persons possessing specialized competence or aptitudes for acquiring it, to the end that the Nation may make the most efficient use, consistent with our society, of the relatively small number of such persons in our Nation. The activities of this Committee contribute to the development of manpower mobilization policies and programs.

STATEMENT OF JAMES P. MITCHELL, SECRETARY, U.S. DEPARTMENT OF LABOR[1]

The hearings before the Subcommittee on Economic Stabilization in 1955 furnished a useful source of information on developments in technological advance up to that time. As we enter a new decade, it is appropriate to consider anew the progress and prospects of technological change, some of the social changes it implies, and the challenges it poses for public and private policies.

The last 5 years have witnessed a growing awareness of the importance of greater productivity as a means of achieving national economic goals. The underdeveloped nations, where the bulk of the world's population lives, are striving to improve their primitive production methods and thus to raise their standard of living. In the industrialized societies, greater productivity affords a means of advancing the enjoyment of leisure as well as the purchasing of goods and services by public and private sectors.

In retrospect, the United States may also be viewed as an initially underdeveloped nation which has made unparalleled industrial advances to achieve high economic and social goals. We have organized our industries for greater productivity while we have maintained freedom and democracy.

American workers and their families have shared in many ways in the progress of technology. One can obtain a vivid picture of the improvements in living conditions and the extension of social security during the first half of this century in the Department of Labor's 1959 publication, "How American Buying Habits Change." Since 1950, there has been further growth in the well-being of the American people. Today, average real personal income per family, after taxes, is about one-fifth higher than it was a decade ago. We have seen a wider distribution of homeownership, higher education, and medical care. More people travel within our country and go abroad than ever before. These gains in personal well-being have been made while the United States has been supporting unprecedented peacetime defense outlays and has been giving considerable assistance to other nations.

Looking forward, a high rate of economic growth will be essential in meeting an ever-expanding demand for goods and services. By 1970, population will be over 208 million, up 28 million over the decade. An accelerated expansion of our economy would also give us continued means to assist the less-advantaged free nations to achieve a higher level of economic development.

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[1] Prepared by Bureau of Labor Statistics.

I. Technological Progress and Prospects

In the light of these responsibilities, the growth of organized research and the wider application of scientific knowledge by American industry are welcome developments, opening up new possibilities for maintaining if not surpassing previous rates of economic growth. Through research and development, we have made advances in the use of synthetic materials, light metals, and gases; in the invention and use of electronic devices such as transitors; and in atomic and space technology.

Industrial automation is one of the strands in this varied pattern of technological change. American industry is making impressive progress in using automated machine tools for metalworking, longer and faster conveyors for materials handling, electronic computers for business tasks and scientific research, and automatic controls for various processes.

Technological innovations that raise output per man-hour take many other forms, and every industry has its own story to tell. Our farm economy, for example, has been revolutionized not only by greater use of tractors and farm machinery but also by wider application of chemical fertilizers, insecticides, and electric power, and new knowledge about genetics. Coal mining has seen substantial progress in the use of automatic loaders, continuous mining machines, and strip mining. Railroads have achieved cost savings through the use of specially designed mechanical maintenance-of-way equipment as well as through electronically controlled freight yards and central traffic control. Electric utilities are installing larger and more efficient turbine generators. Huge earthmoving machines have been used in the building of roads and on vast construction projects. The air transport industry is adopting high-speed jet aircraft.

While automation is a continuation of the process of mechanization that began over 200 years ago, it is nevertheless a higher stage of technology, penetrating such industrial operations as controlling, inspecting, and data processing. Engineers now aim at building entirely automatic production lines requiring virtually no direct labor. This goal contrasts with the preautomation approach, where every effort was made to routinize and specialize the worker's performance on the job, making him an adjunct to a machine. The spread of this new viewpoint about the organization of work is bound to have wide ramifications for the utilization of labor in industry and business.

The statistical record of changes in productivity or output per man-hour—a useful, though partial, indicator of the overall rate of technological change—shows impressive gains in the postwar period and also points out areas for improvement. A recent report of the Bureau of Labor Statistics, "Trends in Output Per Man-Hour in the Private Economy, 1909–58," together with a 1959 supplement, provides considerable information on this important subject.

The annual rate of change in output per man-hour for the private economy for the period 1947–59 averaged more than 3 percent (actually, 3.1 percent for the measure based on man-hours derived from payroll data, and 3.4 percent based on man-hours derived from household interview data). This was higher than the rate for the 50 years, 1909–58, which was slightly less than 2½ percent. The difference was due largely to the high postwar rate of increase—6.1 percent—

in the farm sector, although the nonfarm sector showed an average postwar increase of 2.4 or 2.8 percent (depending on the man-hour measure used), somewhat higher than the approximate 2 percent average gain for the period 1909–58.

Output per man-hour in manufacturing, based on man-hour estimates for all employees, increased at an annual rate of 2.9 percent over the 1947–57 period. For production workers only, the rate was 3.9 percent, compared with 3.3 percent in the 1909–39 period and 5.3 percent for 1919–29, when mass production and the electrification of industries were advancing. Mining and railroads also showed postwar gains considerably above the national average but many service industries have tended to lag.

There are some grounds for expecting a continued upward trend in output per man-hour. We must keep in mind, however, that the application of technological inventions depends as much on economic and social factors, including the behavior and attitudes of businessmen and workers, as on technical progress. Our knowledge of automation is already far ahead of its use in industry.

Reports about business investment plans suggest that greater stress may be put on automation in the future than in the recent past. Over the next few years, businessmen plan to give more attention to modernization and the cost-saving potentialities of automatic equipment. In carrying out these investment plans, businessmen will undoubtedly consider whether market demand is growing sufficiently to absorb the greater output. Today, as in the past, mass purchasing power is an important condition of mass production.

In the long run, the advance of automation will also depend, to a great extent, on increases in a special type of capital investment—the education and skill of the work force. Managers and workers need a higher level of knowledge to design, maintain, repair, and manage complex automatic equipment. The progress of our technology, as well as population growth, therefore, will require larger public and private outlays to improve our school, apprenticeship, and industrial training programs.

The human element must also be considered in assessing the outlook. American workers and their organizations, on the whole, accept the view that a firm must try to improve its competitive position in order to maintain its markets and assure employment. Foreign visitors to our factories have often commented, with some envy, on the readiness of American workers to accept sweeping changes to improve productivity. Some resistance to the introduction of labor-saving machinery, however, cannot be overlooked. An understandable fear of unemployment or downgrading often underlies efforts by both workers and supervisors to preserve jobs that are no longer needed. Allaying these fears, therefore, will be helpful in quickening the pace of change.

II. Implications for Unemployment and Employment

Finding an answer to the key question, "What is the impact of automation on the levels of unemployment and employment?" involves a number of complex issues. Because the effects of technological changes cannot be readily disentangled from those of competition, changing patterns of consumer demand, and related factors, it is difficult to identify and count the particular individuals affected.

Case studies of plants or offices where automation was installed, made by the Bureau of Labor Statistics and others, have disclosed that some establishments have successfully averted layoffs partly because the change affected only one phase of each plant's activities at a time and the workers displaced from one operation were transferred to other activities. Moreover, having a relatively favorable market position, these plants were often able to expand their output and thereby maintain employment.

The impact of automation on such a plant's employment, however, may not be felt until long after its installation. Employees laid off because of the contraction of sales during a recession, for example, may not be rehired because of improvements made earlier. The cost-cutting potentialities of automated equipment which are sometimes not fully realized in a period of prosperity, often are achieved in a period of recession.

Automation has a different kind of impact when a whole plant is involved in the change. Since the full benefits of automation may require extensive changes in plant layout, some companies prefer to take advantage of their modernization programs to build entirely new plants in other localities. In some cases, the old plants are shut down and the workers are left stranded. In others, the workers may retain their jobs, but the relocation of their families may create a heavy social burden.

Plants and industries where demand is contracting or where markets cannot be expanded sufficiently are often unable to avoid displacement. The introduction of labor-saving machinery in the railroad industry, for example, resulted in reductions in force as rail traffic continued to decline or failed to expand as much as productivity. Employment in agriculture and coal mining has undergone similar contraction. In such cases, we do not know whether the overall reductions in jobs would have been more severe if efficiency had not improved.

Direct displacement at the plant introducing new machinery is only part of automation's impact. If less mechanized producers in the same industry can no longer compete with the plant that modernizes, they will curtail employment and workers located far distant from the site of the original change will be affected. According to some reports, this appears to be the situation in the automobile parts industry, for example, where some producers and subcontractors have gone out of business because of the competition of automated producers.

Automation's indirect effects on the markets of other industries are also significant. Some technological changes result in savings not only of labor but also of fuel, materials, and capital requirements per unit of output. For example, the switch from coal to oil with railroad dieselization reduced the market for coal and, therefore, was a factor in the decline in the number of jobs for miners.

The use of new materials and products as substitutes for established ones may also have a significant impact. The growth of plastics and synthetics production, for example, has ramifications for many established industries and markets for steel are affected by the expansion of the aluminum industry.

Technological changes in American industry thus may imply simultaneous displacement of workers and expansion of job opportunities, In assessing the overall impact, therefore, we must turn to the record of changes in unemployment and employment in the economy as a whole.

The record gives us some confidence that automation and productivity can advance without an increase in the overall rate of unemployment. Despite far-reaching changes in technology that have transformed American industries since 1900 the overall unemployment rate, although based on fragmentary data for the years prior to 1940, has shown no clear-cut tendency to increase.

In the postwar period, the rate of unemployment has varied more with business conditions than with the rate of technological advance. Unemployment averaged about 4 percent of the labor force in the prosperity year 1956, about 6.8 percent in the recession year 1958, and about 5.5 percent in the recovery year 1959.

While recent changes have not brought mass unemployment, it is clear that some groups of workers, once displaced, have serious difficulty in finding other jobs. Unemployment rates are particularly high for operatives, farm laborers, and unskilled workers. Mining, agriculture, and nondurable manufacturing industries as a group have relatively high rates.

A large proportion of those unemployed are out of work because of short-term or seasonal maladjustments in the demand and supply of workers. Changes in technology, use of resources, location of industry, or consumer demand are responsible for most long-term unemployment. The number of persons unemployed 15 weeks or more in July 1960 totaled about 834,000 and comprised 20.7 percent of the unemployed. Those unemployed for 27 weeks or longer numbered over 400,000.

Turning to the employment record, we find a significant shift in the industrial makeup of our economy rather than a decline in total employment. With the growth of productivity, proportionately fewer workers are needed in the industries producing goods—construction, manufacturing, agriculture, and mining. The service sector (trade, government, transportation, public utilities, finance, insurance, real estate, and other services) on the other hand, has expanded its employment. Today, about 25.5 million persons are employed in goods-producing industries and 32.5 million are in service industries (excluding domestic service workers and the nonfarm self-employed). Forty years ago, about 24.1 million were working in the goods industries with only about 15 million in the service industries.

The service industries, as a group, will probably continue to increase employment at a higher rate than the goods-producing industries, as a group. Between 1960 and 1970, our manpower experts estimate that total employment will rise by about 20 percent. This forecast assumes a continuation of the relatively high level of employment of the past 15 years, a continued flow of scientific and technological advances, and the absence of war. Our experts take account not only of the impact of labor-saving techniques but also such expansive factors as the growth of urban population, the spread of research, education, and medical services, and the greater complexity of business.

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Industries will vary widely, however, in their rate of employment growth. Construction, finance, insurance, real estate, trade, and government are expected to increase faster than total employment. Manufacturing may grow as much as the total economy, but the growth of transportation, public utilities, and mining is expected to be much slower. Agriculture will actually decline in employment.

There will also be significant changes in the occupational structure of the labor force. During the past decade, the number of professional, office, and sales workers exceeded for the first time the number of persons employed in manual occupations. Over the next 10 years, the white-collar groups are expected to increase more than the average: engineers, scientists, and other professional and technical workers, by over 40 percent; clerical and sales workers, by nearly 25 percent. Office work will undoubtedly be affected by the introduction of electronic computers and other automatic office appliances, but an expanding volume of recordkeeping should continue to increase the need for clerical workers among all types of enterprises. However, routine clerical workers will be less in demand; new types of jobs in the programing and operation of computers are already appearing.

Employment of skilled workers will expand at a somewhat slower pace than these groups, but relatively faster than employment as a whole. In the past, mechanization displaced the glassblower and other handicraftsmen and enlarged the class of skilled workers, such as electricians and tool and die makers, who were less closely identified with a single product or process. Automation will probably entail the training of more workers as electronic technicians, instrument-makers, and machine repairmen.

Semiskilled workers—routine assemblers, machine watchers, and operatives—will find relatively fewer opportunities, as will unskilled laborers. Where jobs consist of simple, repetitive, routine elements, it is becoming more and more feasible to adapt them to some mechanical or electrical method of operation.

Important changes in the content of jobs are taking place. The substitution of power-driven machinery for arduous physical labor is one of the major accomplishments of modern technology: the decline of "bull work" in foundries, the heavy labor of the "gandy dancers" on the railroad, and the exhausting lifting and loading by materials handlers in metalworking operations. Industrial television and remote controls of various sorts permit the worker to handle dangerous materials without direct contact. The workers in some plants now supervise highly automatic equipment, sometimes an entire battery of machines or an elaborate instrument control panel. Such work does not require active physical manipulation of machinery but rather a certain type of patience, an alertness to malfunctioning, and a sense of responsibility about highly expensive equipment.

III. Challenge of the 1960's

To assure economic growth in the 1960's at a pace sufficiently rapid to absorb workers displaced by technological change and those entering the labor market, without an increase in the unemployment rate, constitutes a vital challenge. The task will be greater than in the past because a much larger increase is expected in the labor force during the 1960's than during the 1950's.

The creation of new job opportunities is by no means an automatic process; it depends on the monetary, fiscal, wage, price, investment, and other policies of all groups. The Employment Act of 1946 recognizes that both the legislative and executive branches of the Federal Government have some responsibilities in encouraging all groups to adopt policies that maintain a high level of employment. Americans no doubt will continue to disagree over the specific economic policies to be followed, but we are confident that no responsible group will urge restriction of technological advances as the means of maintaining full employment.

History suggests that the progress of science and technology will stimulate long-term growth of investment and create new job opportunities. Invention opens up new areas of expansion by bringing into the reach of economic possibility activities that were not hitherto known or feasible. The first Commissioner of Labor, who had felt during the depression of the mid-1880's that invention had lost some of its dynamic effects, revised his pessimistic forecast a decade later to take account of the expansive forces released by the growth of railroads, the rise of the steel industry, improvements in machine tools, the inventions of rubber, sewing machines, and telegraphy. Within our own lifetime we have seen the creation and growth of the automobile, aircraft, air conditioning, and television industries, among others. And currently the availability of computers and automatic controls is contributing to the emergence of industries based on nuclear energy and space technology.

Indeed, industrial and scientific research and development are themselves a dynamic factor in our economy. Such activities—on which about $12 billion were spent in 1959—constitute a major industry employing over a half million persons. While a considerable portion of these funds is devoted to military projects, the benefits for the civilian economy have been and will remain impressive. Research on weather modification, solar energy, and solid state physics may provide important opportunities for new industrial growth.

While a high level of employment is certainly essential to an orderly adjustment to technological change, our educational, training, and employment practices and institutions must also be adapted to cope with the problems of the individuals affected. We have tried to clarify the manpower problems of the future in the Department's widely distributed pamphlet, "Manpower—Challenge of the 1960's." The development of human resources will require social inventiveness of a high order. In our democratic society, all of us—local communities, labor organizations, management, government, and the public—are responsible.

DEPARTMENT OF LABOR ACTIVITIES

The Department of Labor has a deep and continuing interest in the manpower problems created by changes in technology, with no disposition to minimize the difficulties of achieving an orderly transition. The growth of automation has provided a new framework for many of our activities. Three groups—unemployed displaced workers, young workers, and older workers—are receiving special attention.

Finding jobs for workers whose jobs have been eliminated and who are unemployed constitutes a major concern of the Department of Labor. Our studies indicate that this problem calls for a variety of programs. We have endeavored to improve the adequacy of unemployment insurance benefits and to extend coverage to excluded groups. More attention needs to be given to providing income maintenance for jobless persons undergoing retraining. A few States now permit displaced workers whose skills and jobs have been made obsolete by technological change to draw unemployment insurance benefits while undergoing retraining.

The U.S. Employment Service and affiliated State employment security agencies are trying to improve their counseling, testing, and placement services, to help displaced workers make adjustments or take retraining needed to obtain new jobs. The development of better testing and placement methods for all workers should prove particularly useful to those whose skills are obsolete. Too often employers tend to reject applicants whose previous occupations, such as miner or railroad worker, are thought to have no relation to the job to be filled. Yet more careful consideration of aptitudes and other traits often reveals that such workers have abilities that are readily transferable to other industries and occupations.

Unemployed workers in chronic labor surplus areas face particularly difficult problems. Many require retraining and assistance in relocating. The experience of communities that have succeeded in attracting new industries indicates that the cooperation of local business, labor, and community groups is necessary to redevelop local resources.

Devising appropriate measures for assisting the unemployed displaced worker requires comprehensive and timely information about the Nation's manpower needs and resources. We are therefore trying to develop additional employment and unemployment statistics and to broaden our knowledge of the characteristics of the unemployed. By pinpointing anticipated changes in the demand for various occupations, local skill surveys conducted by State agencies in cooperation with the Department of Labor are proving useful in directing the efforts of training and guidance groups. We are now planning manpower studies to gain a better understanding of the extent of displacement caused by technological changes and the experience of workers in adjusting to these changes.

Technological changes present particularly challenging problems of occupational preparation for young people who will increase in number sharply during the 1960's. By the late 1960's, about 3.8 million new young workers will enter the labor force each year compared with 2.6 million a year now starting their work careers. Altogether, 26 million new young workers will enter the labor force during the 1960's—almost 40 percent more than in the 1950's.

Every effort should be made to educate young people to prepare them for the opportunities that are developing. They will face keener competition for the better jobs, and those who leave high school before graduation will be at a definite disadvantage in the labor market.

Sound counseling and vocational guidance are essential in this changing world to avoid the waste of human effort and training resources in preparing for jobs that technology is making obsolete.

The Department of Labor has painstakingly developed comprehensive information for the guidance of young people in choosing occupations. The "Occupational Outlook Handbook," the basic source of information, is being kept up to date to take account of technological changes, and we are endeavoring to achieve the widest possible distribution.

The plight of the older worker whose skill has been outmoded by technological change is often tragic. While older workers generally have greater job security than younger workers because of seniority and other special protection, once they are displaced, they face a longer period of unemployment.

To raise the productivity of the work force, it is essential to utilize the talent and skill of all workers, appraising them on the basis of individual merit rather than preconceived notions about their ability. As part of the Labor Department's efforts over the past few years to overcome the prejudice of employers who discriminate in hiring on the basis of age, the Bureau of Labor Statistics and the Bureau of Employment Security have undertaken pioneering studies of the hiring policy and practices of employers, the relationship between age and work performance, and the labor market experience of older workers. While inferior productivity is often cited as a major reason for not employing older workers, our studies show that the performance of workers over 45 compares very favorably with that of younger workers on the same jobs and that some older workers are more productive than some younger workers.

We have tried, in a recent brochure, "Employing Older Workers" to highlight successful policies and practices in employing older workers, drawn from actual experience. As automation advances, counseling of older workers becomes particularly important in assisting them to choose a suitable field of work, in presenting their qualifications effectively to employers, and in overcoming their lack of confidence and other deterrents to successful job seeking and retraining.

LABOR-MANAGEMENT PROBLEMS

Technological change in the 1960's will present challenging issues for labor and management. In planning for and negotiating new contracts, they will deal with the problems and benefits of productivity advances not as isolated issues but as matters that pervade virtually the entire field of collective bargaining. The introduction of labor-saving machinery, moreover, creates critical human problems in the day-to-day adjustments that take place within plants. Workers naturally fear the loss of income that elimination of jobs usually implies. The acquisition of seniority rights and vacation, pension, and health benefits deepens the sense of ownership in jobs and a threat to job security understandably arouses the most profound concern among workers and their organizations.

The dramatic recent cases of conflict over these issues must not be permitted to overshadow the many instances of peaceful introduction of technological change. Here, collective bargaining has provided successful procedures for orderly change, for maintaining and setting new wage rates, for reassigning and laying off workers, and for handling grievances. Wages have been increased and severance pay plans established through these channels.

In the past year, some impressive steps have been taken to supplement collective bargaining with a new and highly constructive approach to the issues of technological change. In the meatpacking industry, Armour & Co., and other concerns have agreed with the United Packinghouse Workers and with the Amalgamated Meat Cutters and Butcher Workmen to establish a joint committee and fund to study the problems of training, retraining, relocation, and other adjustments. In the west coast longshore industry, management and labor have set up a fund to give affected workers a share in the savings from greater mechanization.

Three features of these arrangements stand out. First, they recognize management's need for cost saving for economic health or even survival. Second, they contemplate that changes affecting people be gradual. Third, they set up machinery outside of the deadlines and pressures of normal collective bargaining procedures to deal with the issues.

As automation and other technological changes affect industry, we will need to consider such innovations in the social machinery to deal with the human problems that arise. When labor and management cooperate, taking account of the stake of the public in their agreements, we obtain the maximum benefits from technological change.

IV. Some Basic Guidelines

While the problems of adjusting to the impact of automation are often difficult, they can be handled in an orderly fashion with good will. To help all concerned adopt an intelligent approach to these problems, we are assembling objective information on industry's experience. The most recent report, "Adjustments to the Introduction of Office Automation," covers the experience of 20 companies that have introduced large-scale computers. Study of the policies that successfully mitigated hardship reveals some basic guidelines. The 10 essential points, summarized below, should prove useful to labor and management. Additional knowledge will no doubt lead to revising or supplementing these guides.

1. *Planning for changes.*—Making preparations in advance for the people affected by automation is as important as the planning of the technical and financial side.

2. *Informing employees in advance.*—Giving workers some prior notice about new developments is an important step in allaying anxiety about changes.

3. *Utilizing present workers for new automation jobs.*—Most of the workers qualified to do the new tasks under automation can probably be found among those already employed.

4. *Providing training for new jobs.*—Giving timely attention to training both in the classroom and on the job, is a critical step in introducing automation.

5. *Reassigning workers to other jobs.*—Transferring employees to other jobs, instead of laying them off when their jobs are eliminated, is a constructive practice followed by progressive companies.

6. *Retraining workers for other jobs.*—Workers whose jobs are eliminated by automation can often be assigned to do other tasks with only brief periods of retraining.

7. *Making use of the maturity of older employees.*—Arbitrary opinions about their lack of adaptability to retraining are not backed up by the findings of research workers or by experience.

8. *Taking advantage of turnover.*—Turnover can be useful in eliminating jobs without having to lay off employees. By not filling positions left vacant by people quitting, retiring, or dying, management can assure places for those whose jobs are eliminated by automation.

9. *Providing orderly procedures for layoffs.*—If these preventive efforts are not completely effective, it may be necessary to lay off some workers. In this event, an orderly procedure is highly important. A key step is to inform employees in advance and to arrange with the local office of the State employment service to search for new jobs.

10. *Maintaining good employee-management relations.*—Success in dealing with problems of automation depends to a great extent on the quality of the labor-management relationship already established and on the skill of both parties in human affairs.

While we must improve our administration of such changes, we must recognize that some of the problems created by automation may be beyond the powers of individual firms and unions to handle. Broader public policies may be needed. Accordingly, we will need to observe closely the course of change and study the implications. Wisely used, automation, one of the remarkable achievements of modern science and technology, offers new opportunities for advancing the well-being of our Nation and the rest of the free world.

Department of Labor Publications Relating to the Labor Implications of Automation

"Adjustments to the Introduction of Office Automation" (BLS Bull. 1276, 1960), 86 pp., 50 cents.

A study of some implications of the installation of electronic data processing in 20 offices in private industry, with special reference to older workers.

"Automatic Technology and Its Implications: A Selected Annotated Bibliography" (BLS Bull. 1198, 1956), 78 pp., 45 cents.

More than 350 references on the operations of automated equipment in business and industry and the implications for labor, management, government, and the economy.

"Automation and Employment Opportunities for Officeworkers" (Occupational Outlook Series, BLS Bull. 1241, 1958), 14 pp., 15 cents.

Vocational implications of electronic data processing for clerical personnel. Discusses the training required, earnings, and employment outlook for the newly created occupation of programer.

"Case Studies of Automation" (free.)

Series of case studies of plants introducing automation. Describes changes and implications for productivity, employment, occupational requirements, and industrial relations. Published BLS reports include:

"A Case Study of a Company Manufacturing Electronic Equipment."

"The Introduction of an Electronic Computer in a Large Insurance Company."

"A Case Study of a Large Mechanized Bakery" (BLS Rept. 109).

"A Case Study of a Modernized Petroleum Refinery" (BLS Rept. 120).

"A Case Study of an Automatic Airline Reservation System" (BLS Rept. 137).

"Chronic Labor Surplus Areas: Experience and Outlook" (BES Rept. No. R–182, 1959), 90 pp., free.

An analysis of labor market developments and employment outlook in chronically depressed areas and other areas with relatively heavy unemployment.

"Comparative Job Performance by Age: Office Workers" (BLS Bull. 1273, 1960), 36 pp., 30 cents.

Compares the job performance of 6 age groups, including output per man-hour, accuracy, and consistency of performance. Covers 6,000 employees in industry and Government. Similar study of factory workers in BLS Bulletin 1223, 1957.

"Employing Older Workers. A Record of Employers' Experience" (BES Rept. No. R–179, 1959), 56 pp., free.

A book of illustrations, drawn from actual experience of sound and successful employer policies and practices in the employment of older workers.

"From School to Work" (BLS rept., 1960), 13 pp., free.

Highlights from a study on the early employment experience of youth in 7 communities, 1952–57.

"Job Guides for Younger Workers" (BES rept., 1959), 66 pp., 40 cents.

Listing and description of duties, qualifications, and characteristics of over 100 occupations designed primarily for young persons who do not go beyond high school.

"Manpower—Challenge of the 1960's," 24 pp., free.

Pamphlet showing the changes in population and labor force and shifts in occupational and industrial structure which are expected to take place between 1960 and 1970.

"Monthly Report on the Labor Force," issued monthly; free.

Current data on employment, unemployment, hours and earnings from employer reports, household surveys, and unemployment insurance records.

"Occupational Outlook Handbook" (1959 ed.). (BLS Bull. 1215, 1959, 785 pp., $4.25.

Comprehensive reference book for counselors and students presenting up-to-date occupational information covering 600 occupations and 30 major industries.

"Occupations in Electronic Data-Processing Systems" (BES rept., 1959), 44 pp., 25 cents.

Job descriptions of key occupations, covering process flow and worker traits.

"Older Worker Adjustment to Labor Market Practices" (BES Rept. No. R–151, 1956), 269 pp., $1.25.
An analysis of experience of older workers in seven major labor markets.
"Productivity: A Bibliography" (BLS Bull. 1226, 1957), 182 pp., $1.
Covers nearly 900 references in productivity measurement, factors affecting productivity and significance of productivity change.
"Trends in Output Per Man-Hour in the Private Economy, 1909–58" (BLS Bull. 1249, 1959), 92 pp., 50 cents.
Indexes of output per man-hour, output and employment in major sectors. Analysis of trends and factors affecting changes. Notes on data.

VIEWS OF INDIVIDUALS FROM INDUSTRY

STATEMENT OF RUDOLPH F. BANNOW, PRESIDENT, BRIDGEPORT MACHINES, INC., AND PRESIDENT, NATIONAL ASSOCIATION OF MANUFACTURERS

I. Current Automation Developments

Those of us who are actively engaged in manufacturing and devoting our energies to the common problems of business through the National Association of Manufacturers appreciate this opportunity to present views to the Subcommittee on Automation and Energy Resources of the Joint Economic Committee of Congress. Our statement deals with automation and its impact on employment and economic activity.

On October 25, 1955, Mr. Marshall G. Munce, vice president, York Corp., York, Pa., and chairman of the National Association of Manufacturers' Committee on Industrial Problems, testified on the subject of automation before the Subcommittee on Automation of the Joint Economic Committee. The views then set forth are still valid and events of the past 5 years bear out this conclusion. Problems will certainly confront us in the years ahead as we prepare to take advantage of advances in technology. Consideration of these before the subcommittee, we trust, will contribute to a better understanding of the effects of automation and will be of assistance in spreading automation's benefits to all our people.

The fine reception of Mr. Munce's statement by the committee and by a number of persons interested in automation who have quoted Mr. Munce's statement since 1955 prompts me, in behalf of the association, to preface this current statement with a brief review of the highlights of that testimony. While we wish to avoid repetition at this time, still we feel that the record of the last 5 years supports the soundness of the principles put forth in the original statement presented by Mr. Munce and the validity of the predictions made at that time.

With this brief review as a background we will then proceed to examine the record over the past 5 years to see what general policies can be followed in the light of this new information to utilize the benefits which will accrue to the American economy from automation.

MUNCE TESTIMONY

Three principal subjects were dealt with in 1955. They were:

(1) The nature of automation, what it means and also some of the misconceptions associated with the word "automation."

(2) The impact of automation on our economy and what it will mean to the American people.

(3) Industry's views as to what policies Congress and the Government should follow to secure for the Nation and its people the maximum benefits from technological development and progress.

1. Nature of automation

Automation is not essentially different from the improvement in methods of production which has been going on from the dawn of history. Since the establishment of this Nation, this process has occurred at an increased rate because of the economic climate in which our economy has operated. The protection guaranteed by the patent laws and the incentive of rewards under our competitive free market system have acted as a spur to the inventive genius and to the accumulation of capital of the American people.

At the time of the 1955 statement, automation was characterized by ingenious control mechanisms such as electric eyes, mechanical brains, and other intricate electronic equipment which could control and direct the operation of complicated machines used in the productive process. An examination of a few of the more advanced automated processes of that period showed that these innovations and machines were not something that appeared on the scene overnight but had been developed over a preiod of years—30 years for the continuous flow process in petroleum refining and 33 years in the case of dial telephones. In fact, automation has been with us for some time and in retrospect we are all familiar with its nature. Indeed, it is only the word "automation" which is new to us and not the process.

2. Impact of automation

The 1955 statement pointed out the effect that increased efficiency in agriculture has had on our population. Since early 1800, when 75 percent of our working population was engaged in producing food and fibers, mechanization and other aspects of scientific agriculture have reduced this proportion to about 10 percent. The net result of this transition has been a better life for the entire population. The farmer is able to enjoy more industrial products because he can feed more industrial workers. The industrial workers enjoy more and better agricultural products in addition to industrial products because they are relieved of having to work in agriculture to provide their own food. Such social and economic changes resulting from technological improvements are not only inevitable but desirable.

Technological changes have brought a change in the makeup of the labor force. The transition from the farm to industry and changes within industry itself have altered the nature and the number of jobs. A 13-fold increase in the use of motor fuels and a 4-fold increase in the number of telephones has not only increased the employment in these industries (174 percent in oil refining and 130 percent in telephone companies) but has also altered the type of work done by the employees in these industries. Now, jobs not only pay more but they utilize the abilities of our work force to a greater extent than previously.

Automation will and should bring a reallocation of job opportunities. The transition to jobs which produce wanted and needed goods and services represents the utilization of our valuable manpower resources in areas which benefit both the employees and the consumer. To thwart this natural evolution of improving jobs and products would be throwing a roadblock in the path of our economic and social progress.

In his analysis of job reallocation, Mr. Munce especially noted industry's concern with any discomfort or actual hardship that an individual worker may encounter in this reallocation of his job. While these unfavorable conditions may exist in certain cases, employment statistics bear out the fact that such cases are comparatively isolated because the flexibility and mobility of our labor force present a favorable picture of the general overall adaptability to employment opportunities. As far as flexibility is concerned, the decrease in manufacturing employment has been offset by a similar increase in the trade and service fields.

Available data on mobility attest to even greater movement within and between the various categories of our labor force. Census Bureau statistics indicate that an average of over 6 million people make the transition, one way or the other, into or out of the labor force, from one month to the next. In addition, millions more make a change within the labor force each month. In all, more than 8 million changes occur each month. Any assumption that people wish to perform the same task on a job for the rest of their working days and are satisfied with their present consumption of goods and services is an underestimation of the ability and ambition of our labor force and its desires for a higher living standard. The history of our economic advancement refutes such an assumption.

Looking at the future impact of automation, Mr. Munce predicted that life can be made richer, better, more rewarding—with greater opportunities for the young, increased satisfaction for adults, and more comfort for the aged. The attainment of these goals will be dependent upon the availability of capital, new skills, and the flexibility and mobility of our labor force.

3. Policies for automation

After emphasizing the benefits that can flow from automation, Mr. Munce urged that business, labor, and Government work toward a better understanding of automation and at the same time do everything possible to thwart the persistent effort of certain groups to scare the public into fearing this step forward. Since the ultimate objective of automation is to create a vast abundance of products and services, it follows that consumers must have the ability to purchase this added production. The best way to insure these purchases is to reduce the price of the products which can be achieved by the reduction in production costs which automation can produce so that the buying power of all consumers is increased. Mr. Munce warned that cost reductions can be negated by the exercise of labor monopoly powers to extort wage and fringe benefit increases which will wipe out the benefits of productive efficiency which automation makes possible.

(In interpreting this possibility, we must recall that in a free enterprise economy cost reduction is the chief incentive which leads to the installation of new equipment and new methods. To the extent that such cost saving is reduced by practices which are intended to preserve jobs, the incentive is impaired and industrial progress is slowed down. We should be wary of social measures which impede technological progress.)

To foster automation, tax-rate reform is mandatory. A gradual reduction in corporate and individual progressive tax rates over a 5-year period could easily be financed out of the growing productivity of the economy. Such a tax program would enhance the position of the individual taxpayer both as a worker and a consumer. Equally important, it would help to provide the necessary capital to business for the introduction and expansion of automated processes.

Mr. Munce concluded his testimony on an optimistic note, stating that as long as we adhere to the principles of freedom, individualism, and competitive enterprise we can achieve an orderly transition into the more productive economy which automation can provide in the future.

II. Integration of Automation Into Our Economy

No one can deny the desire of our population for the products and services which automation can produce. The production of more, better, and cheaper consumer items will raise American living standards to undreamed of levels. Automation is capable of achieving such goals. Aside from producing such desirable effects, automation is sorely needed by the U.S. economy if we are to maintain our competitive position. Both our allies and the Russian bloc have had considerable success in automating their present industrial structure and they are continuously working toward the introduction of more automated processes. In the case of the Russian bloc we must automate for security reasons and in the case of our allies, we must automate to maintain a competitive position. If the United States does not provide the proper economic climate for the development and innovation of automated processes, other nations will.

Urging government, labor, and business to accept and promote the principles of automation, is not suggesting policies which are contrary to the political or economic philosophy of the United States. Since the inception of this country as a nation our political philosophy has generally been to foster an economic climate that will promote the free market economy. In such a climate we have been able to allocate freely our material and manpower resources to the most efficient production of goods and services which our population has been both willing and able to purchase. Automation offers to us a tool with which we can speed up and expand this process of satisfying human wants.

Although it has already been stated that some form of automation has been going on continuously since the dawn of history, automation as currently envisioned by experts in the field is only in an infancy stage. The complex problems that individual firms face in introducing automation eliminates an overnight arrival of automated processes on the industrial scene. The nature of the product or service to be automated will determine the timetable for the introduction of automation in specific instances. First, a product must be in large demand which necessitates a continuous production schedule. Next, the product cannot be subject to frequent fundamental design changes which would make the present automated machine obsolete in a short time. To automate a productive process is a costly venture and there must be sufficient useful life to the machine to pay off the original cost. For example, the preparation, canning, labeling and carton packing of food products is highly automated already. By the very nature of this operation it is a natural for automation. Within the food-processing industry a great variety of products such as soup, vegetables, meats, etc., are the products of highly automated plants. More and more supply plants for the automobile industry are introducing automated machinery. The production of engine blocks is currently referred to as an example of automated plant. At the same time no one is likely to plan an automating the production of hulls for large racing yachts.

There have been various estimates as to just how much of American industry is suited for automation. Diebold [1] estimates, on the basis that 80 percent of American industry produces in lots of 25 or fewer individual pieces, that only 20 percent of manufacturing industry is now well suited for automation. In addition, completely new industries producing completely new products will be highly automated in their initial construction. However, at present the most serious concern does not arise from this type of situation, but from the transition of existing productive facilities to automated production. The transition will not occur overnight to disrupt the employment picture. The changeover will be an evolution, rather than a revolution—a glacier, rather than a flood. In May 1960 the New York Telephone Co. announced that it had completed the changeover from operator service phones to automatic dial service in the city of New York. The introduction of dial telephones on a large scale began in 1922. The brand new Tidewater Petroleum Refinery in Delaware is today regarded as the ultimate in automation with its "continuous flow" process. But the essential elements of the "continuous flow" process have been in operation in the refinery industry for 30 years.

No automated process simply arrives on the scene. Various steps, machines and groups of machines are constantly improved over the years. These steps alone are often slow and usually costly. Once the separate steps of the productive process are developed to a stage where automation of the entire production line is a possibility, then the real job of integrating these separate steps can begin. It is a time-consuming, costly and not always a successful process. The overall integration of the automated individual steps in the productive process often requires a complete rebuilding of the individual machines which independently were considered to be fully automated. Much as we anticipate the advantages which will flow from automation, its development and installation will require time. We are fortunate that we have the time to prepare for the adjustments which must accompany the arrival of automation.

III. Impact of Automation

Statements made by labor, management, and Government representatives before the Subcommittee on Economic Stabilization in 1955 indicate that all elements of the American economy accept and welcome the progress, change, and increased productivity which will accompany automation. While some groups were more optimistic over

[1] Diebold, John, "Automation: Its Impact on Business and Labor," National Planning Association, 1959.

our automated future than others, there was unanimous agreement that automation will prove essentially beneficial to our economy. When the particular results of automation were analyzed, deep concern, especially on the part of labor, was expressed over the displacement of workers as machines took over jobs now performed by manpower.

Often the displacement of workers by machines is referred to as "technological unemployment." This is a misnomer for it connotes the general idea that technological improvements are accompanied by increases in unemployment. The economic history of the United States disproves that theory. The long-term transition of our economy from one of agriculture to one of industry, the shift of employment from goods-producing industries to service industries, and the shift in the occupational makeup of the labor force between blue collar and white collar workers are examples of the displacement of workers due to technological changes. Yet, as these fundamental transformations were occurring, employment expanded and the only serious unemployment problems encountered were associated with general economic recessions. Therefore, the term technological displacement is more descriptive of the particular situations where machines have displaced manpower on specific jobs. The impact of technology is on the allocation of our labor force to specific occupations and industries, and not on the level of employment generally.

The concern over the technological displacement which will accompany automation ranges from a dire prediction of mass idleness to a more rational attitude that recognizes the possibility of some displacement, a part of which will be taken care of by normal attrition and the remainder of which can be ably handled through rehabilitation and retraining of those affected.

At present, studies are available which show how this problem of displacement has been handled in plants where automation has been introduced. Admittedly, the results of these studies are not necessarily indicative of any body of hard and set rules as to what will happen to that portion of the labor force which may be subject to displacement as a result of automation. Nevertheless, these are actual case histories and the facts uncovered present a sounder basis for judgment than any speculative predictions.

These case histories were prepared by the Division of Productivity and Technological Developments, Bureau of Labor Statistics, U.S. Department of Labor. The plants studied included an insurance company using a computer, an airline using an automatic airlines reservation system, a mechanized bakery, a modern petroleum refinery, and a group of offices using mechanized equipment.

INSURANCE COMPANY [2]

This particular insurance company decided to install electronic computers in its classification section, which employed 800 people. Of this number, 198 worked in areas directly affected by the intro-

[2] "The Introduction of an Electronic Computer in a Large Insurance Company," Studies in Automation Technology No. 2, U.S. Department of Labor.

duction of the electronic computer. Installation required 2 years and during this period the personnel department interviewed and screened the 198 people whose jobs would be affected by the installation. Aptitude and screening tests showed that nine employees from this group had the ability to operate the new equipment. They were retrained and assigned to operate the computers. There were 133 employees in the section transferred to jobs within the same division or in other divisions. The remaining 56 employees were retained in the classification section of the same division performing noncomputer duties.

To staff the automated classification section, 20 additional employees were brought in to complement the 65 employees who remained in the classification section. The end result of this innovation was that 85 employees (at an average salary of $4,200) operate 21 machines and manage work which under the old system required 198 employees (at an average salary of $3,700) to operate 125 older machines.

In the entire transition not one employee was laid off and no employee was required to accept a salary cut. On the contrary, many were promoted to positions requiring more skill and received appropriate pay increases.

AIRLINE AUTOMATIC RESERVATION INSTALLATION [3]

By the year 1959 automatic reservation systems had been installed in all but 3 of the 12 domestic scheduled airlines. In the case study made by the Bureau of Labor Statistics, the installation was made in the year 1952. Since the end of World War II, airline traffic had increased at such a rate that the development of some type of electronic reservation system became essential. Reservation personnel operating under the old manually processed reservation system simply could not cope with the rising volume of traffic.

Prior to the installation of the electronic system, all company personnel were briefed on the new electronic reservation system. To dispel fears of displacement, all employees were notified that no one would be laid off or downgraded as a result of the installation of the new system. All reservation employees were trained on company time to operate the new equipment. In addition those personnel assigned to engineering jobs on the new equipment were given special training by the manufacturer.

By 1956, 4 years after the installation of the automatic reservations system, employment in the reservations section of the airline studied had increased from 259 to 529 employees, a 79-percent increase. This was due to the large increase in the volume of business done by the company. Naturally there was no employment displacement. More important, there was a complete upgrading of the jobs performed by reservation personnel. The number of low-grade monotonous tasks were eliminated and the number of higher paying jobs were increased.

The following table illustrates the occupational change that occurred in this particular airline reservation department.

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[3] "A Case Study of an Automatic Airline Reservation System." Bureau of Labor Statistics Report No. 137, U.S. Department of Labor, July 1958.

Reservation personnel employed by airline

Occupational group	1952	1956	Percent change
Total	295	529	+79
Supervisory personnel	40	51	+28
Nonsupervisory personnel	255	478	+87
Reservation agents	248	461	+86
Clerks	34	3	−91
Sales and service agents	214	458	+114
Specialists	0	2	
Statistical, personnel and other	7	15	+114

MECHANIZED BAKERY [4]

Unlike the insurance company computer and the airline reservation system, both of which dealt with the programing and processing of informational data, the case history of the automated bakery involves an industry that produces a material product. In addition, the bakery workers affected by the introduction of automated machinery were members of a trade union and worked under conditions set in a contract. Finally, this particular baking plant was not in the dynamic business expansion category that prevailed in the insurance and airline industry. As a result, the employees displaced by innovations were not immediately placed in positions created by expanded business activity.

This history of the Z Co. bakery showed that it had a good size business but it was not able to fulfill the demand for its output. Most of its machinery was a pre-World War II vintage and its unit costs were high. After a 2-year survey, the company decided to change its whole operation over to the latest automated machinery. To house this new operation it was necessary to construct an entire new plant. There was a 2-year span between the time of the decision to automate and the completion of the new operating unit. The union was informed immediately after the decision to automate was made and negotiations to iron out the matters affecting workers were begun. Where jobs were eliminated or the nature of specific jobs changed, workers were shifted to other jobs whenever possible. If the new jobs were lower graded, as far as skill requirements, the shifted worker was paid at the scale of his former job. Where new and/or higher skilled positions were created, every effort was made to fill these jobs from the existing work force. News of the company's attitude toward the displacement problem eliminated the natural anxiety which occurred with the news of the new plant. Furthermore, the company's pledge to maintain the pay scale of any downgraded employee was incorporated in a contract negotiated before the new plant opened. In the process of screening displaced employees, many talents were uncovered which could be used to fill openings created by the more highly technical nature of the new machinery. Some workers were laid off as they could not be fitted into the employment scheme of the

[4] "A Case Study of a Large Mechanized Bakery," Bureau of Labor Statistics Report No. 109, U.S. Department of Labor, September 1956.

new plant. Employment dropped 4.4 percent in the first year of operation of the new plant as a result of layoffs and normal attrition. In the following year employment rose 3.6 percent and by 1955, 3 years later, employment had surpassed the preautomated high year by 6 percent. During the same period 1952–56, the average wage rate increased by almost 60 cents an hour and fringe benefits were expanded.

The tables which follow show the employment and wage rate picture before and after 1953 when the automated bakery began to operate:

Z Co. bakery—Employment trend, 1951–55

Year	All employees	Production workers	Nonproduction workers
1951	554	447	107
1952	550	441	109
1953	526	404	122
1954	545	420	125
1955	586	450	136

Z Co. bakery—Across-the-board increases

[Cents per hour increase in wage rates]

1952	0.175
1953	.080
1954	.125
1955	.080
1956	.135

MODERN PETROLEUM REFINERY[5]

Petroleum refining has been regarded as the outstanding example of an automated industry. Nevertheless, even though the "continuous flow" process has been used for over 30 years, newer, more highly automated refineries are built each year. The trend has been to build a smaller number of refineries but to build larger individual units with greatly expanded capacities. Since the control of the refining process depends on continuous measurement of operating conditions of the refinery—the flow, temperature, level, and pressure of the fluids and gases—instruments are essential parts of the processing operation. In recent years the big innovations made in refineries result from the development of improved measuring and controlling devices and not in any revolutionary change in the processing technique such as the changeover from the distillation process to the thermal-cracking process which was introduced in 1913.

In the case study made by the Bureau of Labor Statistics, the refinery underwent two important technological changes; one in 1948 and another in 1954. The change in 1948 affected 164 workers—about one-quarter of all employees. The 1954 change did not create any displacement problem as only 12 people were involved. In both changeover periods not one employee was laid off.

Fifteen months prior to the 1948 changeover, the company notified the union of its plans and a union-management committee was set up

[5] "A Case Study of a Modernized Petroleum Refinery," Bureau of Labor Statistics Report No. 120, U.S. Department of Labor.

to deal with the possible displacement problem. Of the 164 persons whose jobs were affected by the changeover, 96 were transferred to other units at the same pay rate, 5 were raised in job scale, 62 were downgraded, and 1 employee quit to become a union officer. Under terms of the agreement the 62 downgraded workers were paid at their former pay rate for the first 6 months after the transfer. Prior to their transfer all employees were trained on company time in the skills required for their new jobs.

In the 1954 changeover, 15 months notice was also given to the union and a joint union-management committee was again set up. The pattern set in 1948 with respect to reassignment, retraining, staffing, and seniority protection was followed. Only 12 jobs were affected and all employees were reassigned without any downgrading. The 1949 union contract provided for severance payments to workers who might be laid off through no fault of their own. At the time the study was completed, 1957, no payments were necessary under this provision.

Between 1948 and 1956 this refinery spent $33.5 million on improvements in its processing facilities. During this time the number of workers required for a standard processing week increased from 556 employees to 561 employees—or 9 percent. Across-the-board pay increases totaled .556 cents per hour during the same period.

ELECTRONIC DATA PROCESSING IN BUSINESS OFFICES [6]

In the April 1960 Monthly Labor Review, the Bureau of Labor Statistics published its findings on the employee displacement record of 20 companies which installed electronic data processing equipment.

All 20 offices were the central offices of larger companies, the companies ranging in size from about 700 employees to 14,000 employees. Seven companies were insurance firms. The type of computers installed sell for $1 million or rent for over $25,000 per month. Installation time averaged 3 years allowing enough time for the preparation and planning required to solve the displacement problem. In 7 of the companies the negotiations were carried out with union officials and in the remaining 13, where there were no collective bargaining relationships, the necessary screening and reassigning was carried out by the company personnel departments. Hiring was curtailed to provide employment opportunities for the reassigned personnel.

In all, 2,808 jobs were affected by the introduction of the computers. About one-half of the employees remained in the same position, one-third of the employees were reassigned to other positions. The remaining one-sixth had quit, retired, taken leave of absence, or died. Nine persons were laid off and 13 discharged.

Job status of affected units 1 year after introduction of computers

	Number	Percent
All employees	2,808	100.0
No change in position	1,498	53.3
Position changed	883	31.4
Quits	328	11.7
Retirement and deaths	42	1.5
Discharges	13	.5
Leaves of absence	35	1.2
Layoffs	9	.3

[6] Monthly Labor Review, April 1960.

One-third of the employees in the affected group were promoted to a higher grade. Only a negligible number were downgraded. Between 1953 and 1957 total office employment in the companies studied increased on the average of 7 percent. This was about half of the average increase of 15 percent reported in similar businesses across the Nation.

SUMMARY

In the five case histories reviewed above, these important facts are worth noting:

1. Out of a total of 3,906 jobs affected by automated innovations, layoffs and discharges were negligible.
2. Installation time allowed plenty of time to plan and prepare reassignments for employees affected by new equipment.
3. Management and labor, in cases where union representation prevailed, cooperated to minimize the impact of dislocation. In addition, retraining was provided by the employer.
4. Downgrading was kept to a minimum and pay rates were kept at the old scale in most instances. In a substantial number of cases employees were upgraded with resulting pay increases.
5. Wage rates were increased during the period.
6. Management was satisfied with the increased efficiency and the employees adjusted to the technological skills associated with their new job ratings.

IV. Automation and Employment Since 1946

The case histories reviewed in the previous section indicate that layoffs and discharges were inconsequential as a result of automation. The situation in these particular cases had an opposite result; i.e., additional jobs were created above those necessary for the reassignment of employees from eliminated jobs to new jobs. Although there are no such data available for the labor force in general, the employment picture has been a healthy one since World War II. Between 1946 and 1960 there was a net increase of more than 10 million jobs. Concurrently unemployment has not been a serious problem for the economy as a whole except in a few periods where the underlying cause has been a recession in business activity. Certainly, automation cannot be cited as a principal cause of unemployment. In fact, the opening up of new automated industries has been an antidote to unemployment. Industries, such as color television and the manufacture of widely used plastics would never be possible without the technical process used in their production.

Over the period there has been a definite shift in the makeup of the labor force. The number of people engaged in service industries has been increasing and the number of people engaged in goods-producing industries has been declining relatively. Even within goods-producing industries there has been a decrease in the number of production workers in relation to the number of supervisors and office personnel. All these intra-work force shifts have taken place while output has been expanding. In most instances these shifts represent an enhancement in the technical skill of the labor force and lead to higher compensation.

There have been two types of shifts within the labor force since the turn of the century. One shift has been in the industrial makeup of the labor force and the other has occurred in the occupational classification within industries. These trends continued since World War II with increasing employment in all main sectors. Unquestionably some individual displacement problems arose, but the overall transition of the labor force was accomplished at a healthy economic pace.

Since World War II the industrial transition of the labor force, following the trend, has passed the turning point in the ratio of employment in goods-producing industries to employment in service industries. In this breakdown goods-producing industries include manufacturing, agriculture, construction, and mining. Service industries include trade, transportation, public utilities, finance, real estate, insurance, government, and all other services. In 1945 the ratio was 53 percent of employment in goods-producing industries as against 47 percent in service industries. The ratio continued to approach an even breakdown until the year 1949 when the number of service workers topped the number of workers in production industries for the first time. The differential continued the same trend. In 1960 the ratio is 55 percent service industry workers versus 45 percent production industry employees.

Technological improvements had a great deal to do with this change. The prime example over the longer term is the reduction in the agricultural work force accompanied by large increases in output resulting from improved machines and the application of scientific methods in farming. Similar recent examples of technological application are discernible in manufacturing, mining, and construction. At the same time technological advances have been introduced in the service industries. While these innovations in the service industries produced labor savings and increased the volume and quality of services, still the increased demand for services resulted in increases in the proportion of workers in service industries in addition to an increase in the absolute number of people employed in the service industries.

In the occupational classification, employment has experienced a gradual change since the turn of the century also. White collar occupations accounted for 22 percent of total employment in 1910, while blue collar employment accounted for 78 percent. White collar occupations include professional, managerial, clerical, and sales workers and blue collar workers include craftsmen, operatives, service workers, industrial workers, and farmers. In 1947 the ratio of white collar workers to blue collar workers was 35:65. Today, the white collar workers comprise 41 percent of the labor force against 59 percent for the blue collar workers. Within the white collar group the biggest gains have occurred in the professional and technical groups since 1947. While the professional group had gradually increased, the largest spurt within this group has been in scientists and technicians. This is partly in response to the demands of automation. Other white collar occupations, i.e., managers, office workers, and sales personnel have also shown substantial increases.

In the blue collar occupational classifications, craftsmen and operatives and service workers have gained while industrial laborers and farmworkers have declined sharply, both in absolute numbers and in percentage makeup of the occupational labor force. This is the group which experienced displacement as technological advance eliminated unskilled manual operations.

Since 1947 we have experienced an extensive change in the composition of our labor force, both on an industrial and occupational basis. Some general conclusions can be drawn from these changes regarding labor's ability to adapt to changing needs whether as a result of automation or a change in consumption patterns. Except in individual cases, the reasons for the shifts are indiscernible between the two causes.

1. Labor has been flexible. In addition to movements in and out of the labor force described in the review of Mr. Munce's testimony, labor has made industrial and occupational shifts.

2. The type of work performed by the labor force represented a distinct advance as the number and proportion of skilled jobs increased while unskilled manual work decreased.

3. The labor force has moved geographically with the population movements.

4. Labor has demonstrated its adaptability to programs of retraining to develop the skills necessary to man modern production processes. This has been the key to the acceptance and adoption of automation thus far.

V. Automation and Future Employment

The Bureau of Labor Statistics recently published a study [7] which projects the supply and the demand for labor through the year 1970. These projections show a continuation, and some acceleration, of the trends which occurred in the 1946–60 period.

Between 1960 and 1970 total employment will increase by 20 percent. At the same time the service industries (construction, finance, real estate, insurance, trade, government service, and all other services) will experience a faster rate of increase in employment than the 20 percent increase in total employment. Manufacturing employment will increase at about the same rate as total employment, i.e., at about 20 percent. Transportation, public utilities, and mining will increase at a slower rate. Agriculture will experience a decline.

On an occupational classification between 1960 and 1970, professional and technical personnel will increase by 40 percent, according to projections of the Bureau of Labor Statistics. Proprietors, managers, and skilled workers will increase by better than 20 percent. Clerical, sales, and semiskilled workers will increase by about 25 percent. No increase is forecast in the unskilled worker group and a decline is predicted in the number of farmers and farmworkers.

Equally important is the age composition of the 1970 employment force. Between 1960 and 1970, workers under 25 years of age will increase by 46 percent. The 25 to 34 age group will account for only a 12-percent increase. Most distressing is the fact that there will be a decline in the number of workers aged 35 to 44 years of age. This is the group which normally supplies the managerial manpower. The over-45 age group will experience a 20-percent increase between 1960 and 1970.

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[7] "Manpower—Challenge of the 1960's," Bureau of Labor Statistics, U.S. Department of Labor.

The introduction of technological improvements will place an obligation on the labor force but at the same time it will help solve some of the problems associated with efficient utilization of our manpower. The most serious need will be for technical and skilled personnel to develop, produce, and operate the new equipment. This will require expanded educational and training facilities. Thus far our labor force has shown it has the flexibility to adjust to this upgrading in technology and skills. Concurrently automation, by eliminating manual jobs, can release manpower for use in the more skilled jobs. The chain reaction can proceed all the way up the scale of technical skills. Actually, this process has been going on with our technological development. The accelerated rate of future development of manpower skills requires only that we proceed with this upgrading in labor skills so as to minimize the hardship of any employment displacement that might possibly ensue. In this development process it is in the older age group where problems may arise. The ability of this group to adapt themselves to new jobs is restricted by human nature. Understanding this problem and skillful utilization or redirection of their present skills will require expert personnel administration on the part of management.

The prediction of a very material increase in workers under 25 years of age is a distinct advantage to the economy as we progress further with automation. These young workers will be better educated than their predecessors and, hence, will be more flexible. These younger workers will understand that the development of technological improvements requires changing skills and that the development of one particular skill is only one step up the ladder and not the establishment of a lifelong job niche.

Automation will present many opportunities for young people to move up the economic ladder. Let us hope, however, that their incentive for doing so will not continue to be impaired by our Federal tax system. Let us hope, also, that restrictive work rules imposed by unions do not keep our young people from developing their full potentials.

VI. Automation and Investment

While there is available a whole host of information about automation and future employment, there is not much information available on the amount of capital that will be needed to finance the development and installation of automated processes. Actually, no one knows how much capital will be needed. We do know that the sum will be quite large, as the expenditures already made stagger the imagination—a large electronic computer costs in excess of $1 million.

An indication of the sums involved may be gathered from the trend of business expenditures for new plant and equipment since World War II. Business spent $96 billion in the 5 years 1945–49, $128 billion during 1950–54, and $164 billion during 1955–59. While we do not know the amount spent in each period for automation, a larger percentage of the total is now being spent for automation devices than during the earlier years. The upward trend for the total as well as that part devoted to automation progress seems assured if the funds spent on research and development bear fruit. Research and development expenditures by business increased from $3.6 billion in 1953 to

$9.4 billion in 1959.[8] The effects of this seed money on automation will be felt far into the future.

The individual decisions by firms to automate either all or part of their plant and/or office will be based on business judgment and not on whims resulting from a fascination with automated machines. The huge cost of automation must be balanced by the soundest estimates of the possible return. Machines should pay for themselves over their useful life, and produce a profit, without which there is little reason to make such investment. In addition to paying for itself, machines must generate new capital for expansion. This is the system upon which the private enterprise system was built and expanded, and which must be maintained if the economy is to grow and prosper.

The availability of capital will affect the rate at which automation is introduced. In the final analysis the availability of capital is dependent upon the savings of individuals and corporations.

One of the most important factors affecting the availability of capital is the tax system. Under present laws, the excessive rates applied to the sources of investment capital are a serious deterrent to growth in two ways. In the first place, the present high rates reduce the actual amount of money that is available for investment. Secondly, and equally important, the realization that any gains earned through investments will be subject to the very high tax rates seriously reduces the incentive to invest. The retention of present tax rates is completely incompatible with the principles of the free market system upon which our economy is built.

VII. Challenges Associated With Automation

While automation can bring us new, more, better, and cheaper goods plus an easier way of life, the innovation of automation is not automated. Adjustments to promote a systematic inculcation of automation into our economy presents a challenge to American labor, management, and government.

In the case studies reviewed earlier in this statement, we had some fine examples of labor's cooperation in ironing out displacement problems arising out of automation. The forward-looking approach exemplified by these labor leaders made for an orderly transition to the automated machines and plants. As a result the employment rate was maintained and in most cases the affected employees were kept at their regular or higher pay scale. The union not only cooperated with management in setting job specifications and pay scales and setting up training programs, but it assumed the very important task of notifying and instructing the employees on the changes which would occur. By so doing the personal anxiety of the workers involved was greatly reduced. Such cooperation did much to ease the problems arising out of the shifts to automated production. The reward for this union cooperation was soon received in expanded job opportunities and wage increases that were negotiated during and after the switch over to automated processes.

Unfortunately, the record of union cooperation evidenced in the case histories mentioned earlier in this statement is not reflected in

[8] "Reviews of Data on Research and Development," December 1959, National Science Foundation.

the speeches and actions of many national labor leaders. While paying lipservice to the desire and need for automation many of these labor leaders have thrown or threaten to throw up roadblocks against automation. Despite the past record of the flexibility and adaptability of the labor force to technological advances there is an apparent fear on the part of some labor leaders that, in the immediate future, advances will be too rapid to allow for an orderly transition and that large-scale unemployment is inevitable. The great technological advances of the past, electricity, oil, automotive power, and radio, increased employment in this country rather than unemployment. There is nothing on the horizon to indicate that new technologies will have vastly different effects on employment and the economy than those of the past.

There is one type of situation in which this optimistic conclusion may not apply. That is the case where labor costs are pushed up so rapidly that, in order to survive, the industry must automate "under forced draft." This is what happened in the bituminous coal industry. In order to offset the rapid rise in wage and fringe-benefit levels, the industry was forced to change its technology at a rate which has left the bituminous coal mining areas with considerable unemployment. Had it not been for the monopolistic power of the union to force wages up in this industry, automation might have been achieved at a more normal pace, with a much less severe impact on employment.

(In such cases, union pressure does not really accelerate technological progress in the economy as a whole. A larger part of the supply of capital available to society is allocated to the industry which is under such pressure. The result is that less capital is available for other industries, and hence their opportunities for technological progress are reduced.)

On the other side of the picture, labor can halt or seriously deter the orderly process of technological change by appropriating the benefits of automation. The west coast longshoremen's union and some meatpacker unions have obtained contracts providing for royalty payments, from savings due to automation, to a fund. In less than a year from the contract date the longshoremen have proposed that the annual payments into the fund be doubled. Both funds are in addition to contractual wages, pensions, welfare and vacation provisions. A continuation of this trend to siphon off part of the savings from automation—even before they are known—or to load special costs on those who adopt improvement is the surest way to bring technological change to a halt.

Such policies are shortsighted and self-destructive. It has already been noted that we must keep pace with automation if we are to maintain our competitive position as a nation, a position which has already been jeopardized by the uneconomic wage gains squeezed out of management through the exercise of unbridled union monopoly power. The legitimate function of labor unions is to improve and protect the living standards and the working conditions of its members; it is not to freeze men in their current positions, nor to limit their future opportunities. In carrying out their proper function, labor can depend on the cooperation of American management. Such practices are plain good business which bring benefits to all concerned.

American labor has reached a point of critical decision. It must cooperate with management in the exercise of its legitimate functions and participate in the fruits of automation. The alternative course of forcing uneconomic wage increases and fostering featherbedding through the exercise of its monopoly power will bring economic stagnation, not only to the labor movement but to the entire American economy. This is especially true in view of the serious competition American business is experiencing from foreign producers.

Automation presents challenges to management also. In the labor force projections produced by the Bureau of Labor Statistics, one of the most serious manpower shortages facing us is the shrinkage which will occur in the 35–44 age group. This is the group which, by experience, is the normal age sector to assume the role of leadership and management. With this paucity facing us, it behooves American management to work for the best utilization of the existing labor force in this age group. In addition, the development of the skills of the entire labor force needed to man our automation processes will need the wholehearted cooperation of management.

Management will face challenges on the social plane also. In the case studies reviewed earlier, management, through advanced planning, eliminated hardships created by employee displacement by retraining and/or reassigning displaced employees. Such programs are not always practical, but management must be aware of their advantage wherever such policies are applicable.

Automating our economy is basically a job of American management. While the success of automation is dependent upon the constructive cooperation of labor and Government, it is American management that will perform the tasks essential for automation. It must underwrite research and development. It must construct and equip the automated plants. And finally, it must operate these plants profitably. To face these challenges management must make decisions and carry them out without restrictions that hamper its right to manage.

Government, which today is so enmeshed in our economic life, also faces challenges associated with automation. Taxation and monetary policies will directly affect the availability of capital. In the legislative field, successful automation will require sensible and just labor policies. On the State and local level, automation will require an educational program capable of adequately training our young people in the skills which automation demands. Fundamentally, Government must permit an economic climate that fosters national growth. Without that, minor adjustment problems are magnified and management, labor, and the consumer all suffer.

VIII. Conclusions

The possibilities of automation are so great and extend so far into the future that I can only suggest very general policies which should be followed to prevent excessive unemployment and to maintain economic stability.

Technological change has been going on continuously and our economy has assimilated these innovations and prospered. The primary reason for the dynamic success of our economy has been the Nation's proclivity to create, promote, and protect an economic climate which favors the free market system. Under such conditions the economy has developed the flexibility to adapt itself to technological changes in the production of goods and services to the benefit of all.

Essential to the maintenance of this economic climate which guarantee the necessary flexibility to adjust to automation is understanding. Work such as that being done by this subcommittee in collecting the ideas, experiences, and recommendations of people who are dealing with automation problems and disseminating this material can do much to promote the needed understanding.

Automation should be welcomed by all segments of American life. The assimilation and success of automation is dependent upon our positive actions to accept, promote, and protect policies propitious to automation and eliminate any barriers which might possibly prolong its innovation.

STATEMENT OF CLEDO BRUNETTI, PRESIDENT, GRAND CENTRAL ROCKET CO., REDLANDS, CALIF.

The remarkable scientific developments of the last 5 years have moved our technological progress several notches up the ladder. Today our space vehicles are propelled beyond the force of gravity of the earth out into space and around other heavenly bodies, guided by electromechanical and other devices. These vehicles are completely automatic and are capable of determining the direction they should go, gathering scientific data of all types and varieties, photographing and radioing back their information from millions of miles out in space.

While this remarkable development would seem to signal the end of the need of man-in-space vehicles and even more, in the simpler machines used to create a living on earth, this truly is farthest from what is happening. It seems inevitable that the more we learn about automation, the more we need man in the picture. Five years ago, we said that science had not created in a package, weighing 150 to 200 pounds, anything that could be compared with the performance of a human being, particularly in the observing of a situation and making decisions, today, we are benefiting from the use of many electronic and mechanical devices that do things we did not even think possible 5 years ago. Despite this, there is still nothing planned or even anticipated on the long-range horizon that will make it possible for industry to operate without workers and hard workers.

Modern military devices are not made in quantities of millions at a time. They are turned out in dozens or hundreds. Their much greater complexity, as many as a half-million components in some missiles, requires not only more skillful manual laborers than previous weapons but dozens of new skills such as were enumerated in our presentation before the Subcommittee on Economic Stabilization in 1955. The number of people required to build a guided missile today far exceeds that required to build one of the bombers of the past.

We have learned an important lesson over the last few years, namely, that complete automation is seldom economically attractive. We have come to understand that automation must take place step by step, improving a part of the process at a time. Those industries that have tried to develop and market completely automatic machines have found that the cost of the machine was so high and the additional attention in maintenance needed so costly that in the main they have settled for what we now call semiautomation. This is machinery, electronically controlled if necessary, that still requires a man as part of the system. Machines can work and do what we design them to do, but they cannot make the type of decisions man can do. A human operator over a period of years can be much cheaper and much more flexible to changing industrial production requirements than a complex piece of machinery. Thus, we conclude, after 5 years of operation, that it is still machine and man that will bring the progress in the many, many years to come.

The impact of foreign products on the shelves of our distributors in the United States has taught us another lesson. We have found that the American labor costs cannot compete with Japanese labor for example. We can, if we want, put up high trade barriers to keep their products out of the United States, but that will not prevent them from capturing our own foreign markets. Ultimately, there is only one answer: to continue to increase our productivity per man by giving him better and better tools through automation.

As the machines become more complex in design, operation, and maintenance, the skills required of the attendants must increase. A man and a machine can always turn out more products so that the man's effort is worth more money than if the man were working alone. We must, therefore, continue to demand improved machinery and meet the challenge by increasing the skills of our labor force. Workers have begun to take a serious interest in improving their skills by first learning about the new jobs and then setting out to prepare themselves for the job. The demand for technicians and maintenance men of all varieties has been increasing year after year. Machine operators, programers, instrument mechanics, and control equipment technicians, and the like have been finding more opportunities for their services each year. As before, the employee himself must provide the initiative to obtain the basic skills necessary to accomplish the job of his selection. There are many good public and vocational trade schools, although we still need to expand and reorient our community facilities. Industry must continue its practice of training on the job.

Revisiting our thinking of several years ago, we find that automation has become a great boon to the small business as well as to the big businesses. As the products turned out by industry have become more complex, the large industries have found that they cannot compete with smaller companies in making the specialized components needed. Many of the specialized components are made by small companies with less than a hundred employees, using a large amount of machinery. Big industry has learned that it cannot live without these small businesses where the smaller number of people makes it possible to apply a higher concentration of mental attention to the development and production of the component than is possible in larger companies. Small companies that have concentrated on certain select parts of larger systems have prospered as they have provided the parts which the big companies assemble into products for both the civilian and military market.

Large industries simply cannot muster and manage the tremendous management manpower that would be required to turn out all of the components needed for their products. Thus they depend on the small businessman. The small businessman supplying several large industries with the same type of component is able to turn out a much superior product at a lower cost. If one were to examine the machinery in the smaller company, one would find a machinery investment ratio per dollar of sale as high if not higher than most large companies. These small companies must continue to examine the availability of new machines which will allow them to turn out more products per man-hour. The upshot is an increased total output for these companies, allowing them to hire more people and to pay better wages. The growth of the gross national product shows that there is a steadily increasing market for the increased products turned out by industry. There have been many where our production capacity has been greater than the demands, but one finds that new demands are soon created to use up this capacity and the industries go on expanding.

The advantage of the semiautomation concept, in which the processes are automated degree by degree, year by year, has been proven in experiences such as that of the manufacturers of electronic equipment. Five years ago, we were very enthusiastic about large machines that would take in all the varieties of components needed and wire up a television set without the use of human beings. However, back of that machine there were thousands and thousands of man-hours of work preparing the components, building and selling the machines. The cost of all the labor and materials that went into making the machine and the operation of it was greater than the cost of using machines that did only part of the job mechanically plus hand labor or the assembly-line approach for the balance. Components today have become even more complex than they were years ago and, though we know how to make the machines function more skillfully and can apply electronic computers to guide them, we find the complexity of the output product increasing faster. Thus, a machine and a man have turned out to be the best answer; the combination not only represents a lower investment for the industry but it is a protection against obsolescence.

Modern machinery is finding that the 2-year obsolescence period is still pretty much the rule. If a machine cannot pay for itself in 2 years, it is usually not worth the investment and may cost the industry more in the long run. There are, of course, many examples of machines that have functioned and can continue to function for many years. The newer types of machines, however, are more complex and costly devices, and studies show their application requires a large output to pay off. Automation requires that industry have a continuing market for the product because, once the plan is tooled up for a given item, the expense of making modification to the product is large. The unpredictable customers' wants are further specters in the eyes of the automatic machinery designer. The customer usually does not keep his wants standardized long enough to allow the company to liquidate the cost of an expensive piece of automatic equipment. On the other hand, if the designer automates degree by degree instead, he not only provides himself with a better economic situation but he

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allows the worker to catch up with the machine to learn and to grow with it.

In conclusion, let me say that it is no longer a matter of whether we want or do not want automation: It is a matter of the rate at which automation will enter our lives and the rate at which we will prepare ourselves to deal with it. The growth of economic strength of foreign countries has made it clear that this is not the time, nor will there ever be a time, when the United States can let up on increasing its productivity. The guidelines are clearly drawn:

First, we must design the machines with an eye to the overall economy based on the market potential.

Second, labor and industry must recognize their duty to instill within the worker the interest and challenge of increased earnings through automation and the desire to improve his skills year by year.

There will never again be a time when a skilled worker, or any worker for that matter, can rest on his present education. Our education must be a continuing matter throughout all of our lives.

STATEMENT OF HAROLD E. CHURCHILL, PRESIDENT, STUDEBAKER-PACKARD CORP.

This statement is submitted by Studebaker-Packard Corp. at the request of the chairman of the Subcommittee on Automation and Energy Resources to bring up to date the statement submitted by the corporation in November 1955 on the industrial and social effects of the trend to automation.

Specifically, the subcommittee has requested that information be furnished on (1) the amount of automation which has taken place since the corporation's statement in 1955; (2) the amount of new investment which may come in the foreseeable future as a result of further developments in the field of automation; (3) the extent and types of employee displacement which may have resulted and which seem to be in prospect from automation; (4) how the problems of retraining and reallocation of workers have been and should be solved and (5) what the policy of Government in respect to this development should be.

Automation has been a gradual process at this corporation with no large groups of employees having been displaced at any one time. It is anticipated that this trend will continue in the future with continual investments being made by the corporation to stay competitive in is industry and take advantage of future improvements in equipment and processes.

No serious impact on the corporation's employees as a result of automation has occurred in the past and none is contemplated in the foreseeable future. This is in part attributable to the fact that labor savings resulting from automation have not caused reductions in the corporation's overall work force. In fact, despite the effects of automation, the corporation has been expanding its work force. This expansion is traced to certain increases in production and rate of production and the bringing into the corporation's facilities work previously performed by outside suppliers. Furthermore, automated equipment requires increased maintenance resulting in new hiring of skilled help to provide such maintenance or the hiring and/or training of unskilled employees in the corporation's apprentice program.

The impact of automation is slight in the perspective of the much more substantial effects on employment resulting from the varying demands of the public for the corporation's products. In the recession year of 1958, the active factory employment in the automotive division (the group affected by automation) was less than 5,000 compared with almost 8,000 employees at the present time when the industry is at a higher level of production.

Mechanics exist to ease the problems of those workers who have their jobs eliminated because of automation.

Senior employees who have been displaced have rights to other preferential jobs and have proven capable of performing work available to them with a minimum of acquaintance time. Junior employees, invariably younger and more easily adjusted, have been assimilated into other occupations without serious difficulty.

Because of the rapid changes in demand which occur in the auto industry, the corporation's production schedules are subject to continuous adjustment, upward or downward, as circumstances require. This has resulted in a work force generally experienced in a variety of skills and familiar with change, lessening the psychological impact of automation.

Looking ahead, it would appear that while modernizing equipment and improving methods of manufacture are important goals, changes will be gradual enough so that automation will increase without creating serious economic or emotional problems for this corporation's employees.

Such problems as we have encountered in retraining and reallocation of workers have been resolved under the normal procedures established by our labor agreement or developed as a matter of enlightened corporate policy. Only if automation outstripped the growth of the corporation would we anticipate serious dislocation of personnel.

Should this occur, we believe these basic problems might exist:

(1) Emotional adjustment of older workers to unfamiliar work assignments.

(2) Humane and reasonable disposition of surplus personnel.

Our labor agreement provides considerable latitude in the selection of jobs by senior employees who might be displaced from their regular work assignments. Inasmuch as age and seniority progress apace, it appears logical to conclude that the elder, more rigid employee would take over a job compatible with his experience and temperament with little or no emotional problem.

Younger employees, who adjust more readily, would be available for training in the higher skills, or because of less seniority would gravitate to less desirable jobs. As older employees retired, or others left our employ for various reasons, opportunities would arise for these younger employees to obtain better paying or more desirable positions.

The corporation has termination pay provisions for employees determined to be permanently surplus, and privately financed unemployment benefits to supplement State benefits over substantial periods for those temporarily in excess of needs.

Depending on length of service, our termination pay plan provides up to 1,200 hours' pay for a permanently separated employee. Coupled with State unemployment compensation, a temporarily idled employee may draw appoximately 65 percent of his regular take-home pay up to 26 weeks of unemployment. These programs provide a very substantial cushioning effect for employees affected by automation, and represent equally substantial contributions by our corporation.

In addition, the corporation would assist in locating employment for its permanently displaced personnel.

We believe that this corporation presently is prepared, as outlined above, to cope adequately, and with a minimum of disruption, with any future problems resulting from further automation of its facilities.

This corporation believes that the Government's role in the years ahead in meeting this problem should be confined primarily to studying the effects of automation, publicizing the results and divulging the problems uncovered to management, labor, and the public, and encouraging them to embark on sound programs, either alone or cooperatively, which will allow everyone to meet the problems confidently and skillfully.

Many companies have annual improvement factor increases whereby employees' wage rates are increased each year. Our labor agreement[1] provides:

> The annual improvement factor recognizes that a continuing improvement in the standard of living of employees depends upon technological progress, better tools, methods, processes, and equipment, and a cooperative attitude on the part of all parties in such progress. It further recognizes the principle that to produce more with the same amount of human effort is a sound economic and social objective.

The understanding and philosophy voiced in this labor agreement clause was arrived at in the auto industry during collective bargaining in 1950. It is common to labor agreements not only in the auto industry but in other major industries as well.

This understanding is evidence that a very large segment of labor and industry accept automation as a positive force in our economy. It should set to rest any continuing conjecture that automation per se is objectionable to the two segments of America most directly concerned, and clear the way to the serious consideration needed for resolving automation-caused problems.

We do not feel that the Government has responsibility beyond education, advice, and encouragement to the people involved. We believe that collective bargaining between sincere, honest, and informed parties, with give and take on both sides, will be the most effective way of meeting and resolving the problem of people affected by continuing automation.

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[1] Agreement between Studebaker-Packard Corp. and UAW–AFL–CIO dated Sept. 1, 1959.

STATEMENT OF RALPH J. CORDINER, CHAIRMAN OF THE BOARD, GENERAL ELECTRIC CO.

In the 5 years since I had the opportunity to testify before your subcommittee, events have substantially confirmed the views on automation and technological change that I set forth at that time. If anything, it has become even more urgent that automation techniques be applied wherever possible throughout the national economy, in the national interest.

In 1955, speaking for the General Electric Co., I said that our views on automation could be summarized as follows:

1. Increased automation is necessary in order to maintain the national security.
2. It is necessary if we are to continue to raise the American standard of living even at the same rate as in the last decade. It is even more urgent if we are to accelerate the rate of progress.
3. Increased automation is also necessary from the point of view of individual companies. Only those companies, large or small, which continually modernize in order to serve their customers better will survive and prosper in our competitive enterprise system.
4. Progress toward greater mechanization and automation is in the best interests of all those that business must serve—as customers, share owners, employees, suppliers, and the public.
5. Technological change is an evolutionary process which creates employment and exerts a stimulating and stabilizing effect on the economy. This can and will continue as long as business has the incentives and freedom to grow, and to create new products and industries.
6. The benefits of mechanization and automation are so profound—and so urgently needed—that we must encourage those companies that push the advances which make the economy more productive.

Now let me comment briefly on how events in recent years have confirmed these views.

Automation and National Security

First, the view that automation and technological change are necessary for national security.

Military power once was measured by the size of a nation's standing army and its manpower reserves. If that were true today, the world would stand helpless before the armed millions of Communist China and Communist Russia. But the United States, to offset its manpower limitations, has relied increasingly on the exploitation of its scientific and technological capacity to build up striking power, speed, and maneuverability; and the Soviet Union has responded in kind, so that today national security depends primarily on the capacity for technological maneuver.

The Nation's major instruments of defense and deterrence today—the intercontinental early warning systems and the complex weapon systems—are themselves gigantic applications of the automation principle, providing "pushbutton readiness." These could not operate except by a high degree of automation, and they could not be produced without the extensive application of automation principles in the factories.

Like other manufacturers, General Electric has introduced advanced automation techniques into its production of defense materials, components, and systems. Today's missiles, radar, nuclear submarines, aircraft, and communication systems would be literally impossible to build without the substantial investment in automation equipment over the past 5 years; neither the quality nor the quantity standards could be met. In one sense, military leadership in today's world belongs to the nation (or bloc) that most successfully applies the automation principle to military design and production.

But the struggle with communism is something more than a military competition; in recent years increasing emphasis has shifted to economic and industrial competition.

The Soviet Union has achieved its industrial growth primarily by directing a high proportion of its national income to investment in plant and equipment and by transferring manpower from agriculture to industry. Now, with its trained manpower reserves pressed, the Soviet Union has begun to concentrate serious attention on industrial efficiency. Thoroughgoing application of automation techniques to the Soviet industrial machine is an announced goal of Soviet policy, enunciated by Nikita Khrushchev at the 1959 Congress of the Communist Party. If past Soviet performance is a guide, this program will be ruthlessly pursued, with compelling incentives and rewards for those who can make Soviet industry more productive, and corresponding penalties for failure.

At the present time, economic competition from the Soviet Union is hardly making itself felt in the markets served by U.S. industry. But let us not be complacent about Soviet competition; the Soviet economy has arrived at that degree of maturity where it can—and will—invest increasing amounts of its production in economic warfare with the free world in order to achieve political objectives. It can and will compete with increasing effectiveness, establishing Soviet technology, Soviet financial power, and Soviet manpower in strategic areas throughout the world. Surely the United States cannot allow a groundless fear of automation to hinder its own drive to greater competitiveness in world markets, in the face of the Soviet challenge. Automation is a necessary weapon not only in military competition but also in political and economic competition with the Communist bloc.

Automation and Economic Growth

The second major point in my 1955 testimony was that automation must be extensively applied throughout industry, commerce, and Government if the people of the United States are to continue to increase their standard of living—in both the private sector and the tax-supported public sector—at only the same rate as in the past. Increasing the rate of economic growth, however measured, will require increasing productivity by such techniques as automation. The rate of real economic growth cannot be improved by increased Government spending, as some have advocated. In fact, the inflation induced by Government deficits, the siphoning off of investment capital into taxes, the unwise diversion of resources into unproductive governmental activities, and the consequent reduction in both the incentive and ability to invest in technological progress, could have the effect of slowing advance or actually lowering the productivity of the economy as a whole.

A new element in the picture since your 1955 hearings is the increased public awareness of the destructive impact of inflation on everyone's level of living. Public opinion surveys, as well as the pressures felt by most Congressmen from their constituents, confirm that the public is deeply concerned with inflation, and is no longer as naive as it once was about the role of excessive Government spending and monopolistic labor unions in creating destructive inflationary pressures.

One of the most effective means to counter the ballooning costs of Government and labor, with their inflationary effects on all prices, is to increase the efficiency of industry and commerce by means of automation techniques. Automation, as it enables the economy to produce more goods and services in relation to the cost of the resources utilized, is an essential weapon in the continuing fight against inflation.

AUTOMATION TO MEET COMPETITION

The third major point of the testimony in 1955 was that individual companies have no choice but to apply automation and other techniques to increase their efficiency, simply to meet competition. If they cannot meet competition, their business and their employment will decline.

Probably the most significant new economic factor for the United States is the resurgence of aggressive foreign competition. Europe and Japan have staged brilliant economic recoveries. Their new factories have machinery that is as advanced as anything in the United States. This news is greeted with mixed emotions. It is better to have our allies strong and self-reliant than to have them sick and vulnerable to communism. But they are now demonstrating a disturbing capacity to take business away from American companies not only in oversea markets, but right here in the United States.

To the degree that this new competition has awakened the United States out of complacency, its effects will be good. It should stimulate more innovation, higher efficiency, better products and services, lower prices, more aggressive salesmanship, and a more competitive spirit among employees. This is good for everybody.

But there is just so much that any company can do against foreign competition within the national structure of inflated costs and the national acceptance of artificial restrictions on productive efficiency. Thus it must be emphasized and reemphasized that the fate of thousands of American business firms and millions of jobs depends on this Nation's ability to hold the line against further inflation and eliminate the artificial restrictions on output. Automation is urgently needed to help individual companies, and the Nation as a whole, try to be able to meet the new competition from abroad.

General Electric as Case History

In 1955, I testified that automation and technological change are in the best interests of all who participate in the business system—as customers, share owners, employees, suppliers, distributors, dealers, and as citizens in a productive economy. In that testimony, we presented General Electric as a case history of a company that has adopted mechanization, automation, and other technological changes as rapidly as was economically feasible, for the benefit of everyone concerned.

In the 5 years since that testimony, this progress has continued.

The company's customers, for example, have continued to benefit from innovations in both products and processes at General Electric.

How increased efficiency helps to offset the rising costs of labor and materials is demonstrated by these facts: Since 1939, prices of materials purchased by General Electric have gone up 153 percent, and the average annual earnings and benefits of General Electric employees have gone up 257 percent. But in that same period, General Electric prices on the average have gone up only 79 percent.

What is more, the products that our customers buy are constantly being improved. Twenty years ago, for example, a ton of coal would generate 1,504 kilowatt-hours of electricity. Today, General Electric equipment can generate 2,242 kilowatt-hours with a ton of coal. Similar progress in other General Electric equipment for power generation and distribution has helped utilities keep pace with the economy's demands for more power at bargain rates which are truly remarkable. The price of electricity has gone up only 2 percent since 1939, while the Consumer Price Index rose 112 percent.

Improved designs and manufacturing techniques have also enabled General Electric to offer better values to consumers. Simply to compare the electrical appliances of 1950 with those of 1960 is to realize what great advances have been made in appliance design. The modern appliances are safer, more reliable, more useful, more automatic, and more pleasing to the eye. In spite of these significant advances in product quality, the prices of electrical appliances continue to go down. Here is an updating of the General Electric appliance prices reported in the 1955 testimony:

	1950	1955	1960
Vacuum cleaner	$89.95	$79.95	$59.95
Television	230.90	199.95	189.95
Automatic blanket	52.95	34.95	29.95
Refrigerator	329.95	228.00	199.00
Automatic washer	394.95	279.95	249.95
Automatic dryer	249.95	189.95	189.95

The biggest price reductions took place in the 1950–55 period, when General Electric built its great new appliance production facilities at Louisville, achieving a remarkable advance in the mechanization and automation of appliance manufacture. But continued investments in new machinery and new designs have made possible the still lower prices reported above, even though the appliances themselves continue to be much improved over the earlier models.

For the 417,054 owners of General Electric, their equity in the company—their money in the business—has quadrupled since 1939, rising from $325 million in 1939 to $1,458 million in 1959. Most of this increase was achieved through reinvested earnings. But their percentage return on the equity has stayed about the same.

Truly remarkable progress has been achieved by the employees of the company. In 1939 the average General Electric employee earned $2,026 a year including the cost of benefit programs. In 1955 the average had risen to $5,483. Today, a General Electric position is worth $7,226 a year, on the average, and that includes a splendid package of pensions, life and health insurance, vacations, holidays, stock and bond savings, and other benefits providing better economic security. When you take out the effect of inflation, since 1939 the average employee has had a 70 percent increase in real purchasing power, except for taxes. This increase reflects the general upgrading of jobs as we advance toward greater automation, with a higher proportion of upper skills.

Total employment at General Electric has moved sideways since the 1955 testimony, averaging 246,000 in 1959. This reflects trends in manufacturing generally; the Department of Labor reports that manufacturing employment in the economy averaged 16.6 million in 1955 and 16.2 million in 1959 and was at 16.5 million (seasonally adjusted) in May 1960. This sideways movement in manufacturing employment results from the general shift of employment from manufacturing to service industries in the national economy, a shift that may well be characteristic of advanced technological societies. Civilian employment for the economy as a whole increased from 62,994,000 in 1955 to 68,570,000 in June 1960.

Other businesses have also shared in General Electric's progress. Since 1939 our payments for materials, supplies, and services have gone up more than 10 times, totaling $2 billion in 1959. At the present time, we have more than 45,000 suppliers, most of them small businesses, and many of them aggressively mechanizing and automating their operations. In addition, roughly 400,000 small companies gain all or part of their income from selling and servicing our products.

The public and its representative, government, have also shared in the benefits of automation at General Electric in two principal ways: First, there are the improved product values and new products to which I have already referred. Second, there is the effect on national security, with General Electric's experience in automation techniques resulting in better design and production of advanced defense systems.

In these and other ways, people have benefited from General Electric's unremitting efforts to apply automation and other technological advances to its business operations.

Automation Stimulates Employment

Because automation usually involves the installation of laborsaving machinery, those who fear automation cannot understand the paradoxical fact that automation and technological change have always stimulated and created new employment opportunities. Yet this fact, which was pointed out in our 1955 testimony, is one of the keys to an expanding economy.

The installation of laborsaving machinery may—and should—reduce the number of persons required to produce a given amount of goods and services, but this increase in efficiency is precisely what creates both the attractive values and additional ability to support expanded output, new industries, and new services for an evermore diverse economy. Since 1955 civilian employment has increased from 62,994,000 to 68,579,000 in June of 1960. Unemployment in 1955 averaged 4.4 percent of the civilian labor force, and now stands at about 5 percent.[1] In spite of the pessimistic predictions of some of the witnesses, notably the union witnesses, in the 1955 hearings, automation and technological change have not created intolerable unemployment, but have helped stimulate the economy to provide 5 million new employment opportunities.

Furthermore, in spite of the pessimistic predictions, the vast majority of American workers have proved to have enough initiative and adaptability to follow the changing trends in employment opportunities, as in the past. In a growing, changing economy, to have 1 out of 20 labor force participants in search of new employment is evidence of a vigorous mobility in the labor force. The States have rightfully assumed the responsibility of seeing that those who want to work and have not found employment are provided with unemployment compensation; but it must be recognized that a sizable proportion of the unemployed are people who are quitting one job to get another that is better, moving from one community to another, searching or waiting for the kind of work they want, coming into the labor force or going out of the labor force for reasons of their own, or following seasonal occupations.

In evaluating unemployment statistics, one should bear these facts in mind: Census Bureau data indicate that in manufacturing, in typical prosperous years, the number of persons who voluntarily quit their jobs each month runs at over 2 percent of the labor force. Over an entire year, the total number of quits in manufacturing is equal to about one-quarter of the total number of jobs. Altogether more than 8 million persons move into or out of the labor force, or change their status in it, each month.

Every effort must be made to encourage such mobility and adaptability if our country is to continue to grow. The various proposals to freeze employees in unnecessary jobs, slow down the installation of more productive methods, impose penalties and extra costs on the companies who are willing to invest in advanced facilities, subsidize uncompetitive industries and communities, and otherwise stifle the pace of progress, must be adamantly opposed. Individual and company adaptability to change must be encouraged.

As was indicated in the 1955 testimony, automation and technological change stimulate greater economic activity and greater employment opportunities in a number of specific ways.

The area of employment growth has shifted from the manufacturing sector to the service sector. As our economy progresses toward greater automation, it spends less of its effort (proportionately) in making things, and more in selling, servicing, and using things. In 1947 purchase of services accounted for 31 cents of the consumer dollar. In 1955 the figure was 36 cents, and today the figure is 39 cents—up 25 percent in 12 years. Technological progress creates more wealth and more leisure for cultural and educational activities. It invigor-

[1] Unemployment statistics for June are always inflated by students newly entering the work force.

ates commerce, and makes possible higher levels of medical care, insurance, and public services. Retail trade, travel, education, music and art, recreation, research, government, and many other service "industries" are increasingly important sources of employment in our advanced technological society. And they are supported by a highly productive agriculture and industry.

Automation itself—the designing, building, installing, and servicing of automation equipment—is becoming a major source of expanding employment. Industrial electronics and business machines are two of the most vigorous growth industries today, stimulated by the application of automation principles in industry and commerce. General Electric's employment depends heavily on the expanding market for automation equipment and the electric power it requires.

Then, too, whole new manufacturing industries are created by automation techniques. As technology advances, wholly new products are developed that could not be made in any acceptable quantity and quality except by automation techniques. These are the foundations of new industries: the rare chemicals and metals; the new pharmaceuticals; the large-molecule plastics and other special materials; the cryogenic and pyrogenic materials and processes; the nuclear power equipment, the computers and data-processing systems; and many other products of advanced technology. The United States has invested something like $100 billion in research and development in the past decade, and the results of this unprecedented effort to find and apply new knowledge are only starting to appear on the economic scene. The melding of newly developed products with new automation techniques should create new industries, and hence new employment opportunities.

Encouraging Automation

For the reasons cited above—the enhancement of national security, the acceleration of economic growth, the improvement of living standards, the challenge of foreign competition, and the creation of new industries and new employment opportunities—it is important that automation and technological change be encouraged.

Perhaps the most important single step required to encourage modernization of the Nation's industrial capacity is the reduction of Government spending. As more and more of the national income is diverted into Government activities, less is available for savings and investment. Yet it is of profound importance—if this Nation is to meet not only the Soviet economic challenge but also the challenge of other foreign competition—that capital formation in the United States be accelerated. The current levels of Government expenditure not only siphon off savings needed for capital investment but also kill the incentive to save and invest, and poison the private economy with inflation. What is so discouraging is that so many of these unwarranted Government expenditures, which dissipate the Nation's economic gains on unproductive political largesse, are being presented as expenditures "to increase economic growth." Their real effect, of course, is to inhibit economic growth.

The next Congress should undertake the long-postponed work of reforming the Federal tax structure, which is satisfactory to no one.

This structure now stands as a solid obstacle to industrial progress and economic growth. Whereas other governments are reorganizing their tax structures to encourage capital investment and individual initiative, and the Soviet Union is becoming ever more sophisticated in the use of economic incentives, the United States continues to struggle under a tax structure that specifically penalizes initiative, work, savings, investment, and success. The confiscatory character of the progressive income tax rates at the middle and upper levels must be remedied. In addition, any program of tax reform should include a more realistic depreciation policy that recognizes modern rates of machine obsolescence and thus encourages rather than retards investment in automation.

The work of reforming the tax structure, without losing the revenues required to support the burdensome cost of government, is no easy task. It will take objective thought, political courage, and a willingness to recognize the fact that releasing the economy from the repressive effect of the present structure will in itself provide the necessary base broadening to avoid a reduction in revenue except for possible short-term fluctuations. Despite the temporary adjustment required, tax reform must be done—or the sources of personal initiative, capital investment, and increasing productivity will be dried up.

There must also be public support for efforts to remove work rules which operate to place artificial restrictions on output and hamper this country's competitiveness. In my opinion, a major source of these artificial restrictions lies in the legal immunities and powers of the labor union officials. During the steel strike last year, we saw again how a single union can bring the whole economy to a halt on the issue of adjusting work rules which, in the opinion of management, may place artificial restrictions on the operating effectiveness which means progress in values and growth in the economy.

Technological change inevitably means shifts in employment from one industry to another, and from one community to another. This is no new phenomenon; it has been taking place here ever since the early 1800's, when the United States began to shift from an agricultural society to an industrial society, and from a nation huddled on the east coast to a nation spanning a continent. In its great period of growth and expansion, the United States did not emphasize "cushioning the shock" and "controlling the pace" of industrial advance. Instead, the emphasis was on the personal incentives to seize opportunities, to risk careers and fortunes on new ventures, to move to new lands, new trades, new skills, where the rewards were higher. Thus we grew to world leadership on the adventuresome spirit of risk, initiative, and work.

We at General Electric have heartily supported such plans as State unemployment compensation, to ease the period of adjustment for individuals between jobs. We have worked to increase the levels of unemployment compensation in State after State, to keep up with changing conditions. We have also, as you know, conducted extensive inplant training costing on the order of $35 to $40 million a year, to help employees learn new skills and qualify for better positions. Such activities are both in the public interest and the company's interest, and they help ease the adjustment to technological change.

Nevertheless, it is our conviction that our country will only meet its worldwide challenges, will only live up to its destiny, if it can find again the spirit of risk, adventure, and personal achievement that marks a great nation. Whether the opportunities of automation and technological change will be fulfilled depends, in the end, on the spirit of the people.

STATEMENT OF RALPH E. CROSS, EXECUTIVE VICE PRESIDENT, THE CROSS CO., DETROIT, MICH.

I have reviewed the testimony that I submitted to your committee in 1955, and find it quite appropriate for today's conditions. Nevertheless, I would like to comment as follows:

BACKGROUND

My capacity with the Cross Co. is the same as it was in 1955, i.e., I am executive vice president in charge of sales, engineering, service, advertising, and public relations. My experience in the business of making automated machines now covers a period of 28 years.

DEFINITION OF AUTOMATION

At this time, I would like to withdraw my former definition of automation and submit the following:

> Automation is the art of combining operations to improve productivity.

The motivating forces for the application of automation are (1) higher wages, (2) lower prices, (3) higher profits, (4) improved product quality, and (5) greater safety.

AUTOMATION IS GROWING UP

The glamor that once was attached to the word "automation" has largely disappeared. The science-fiction writers have, in large measure, dropped the subject and, as a result, today we are hearing less about giant brains, robots, and the second industrial revolution. The field is now, with few exceptions, in the hands of engineers and scientists who have from the beginning been endeavoring to improve the lot of humanity with sane, sensible machines.

PRESENT-DAY TECHNOLOGY IN THE MACHINE TOOL FIELD

The Transfer-matics described in my previous testimony are substantially the same as the machines we are producing today. The automation principles that are incorporated in these machines are as sound today as they were 5 years ago. There is no reason to expect any revolutionary changes in the next 5 or 10 years. Progress will be orderly and gradual.

Newer developments in the past 2 or 3 years include machines for lower volume production. In contrast to the large multiple-station Transfer-matics, these machines are relatively small, single-station units. They are flexible, and can be changed over from one job to another in a minimum amount of time and at a minimum expense.

Within their capabilities, they have the capacity to combine a limited number of operations. The operation sequences are generally programed by punched or magnetic tapes.

INTRODUCING NEW MACHINES

The procedures used to create, sell, manufacture, and install automation machinery are the same as described in my previous testimony.

Economic principles have not changed. We still endeavor to balance mechanization with manual labor to provide the lowest possible cost. The introduction of new, improved machines is still rigidly controlled by the stock of unamortized machines in operation.

FOREIGN COMPETITION

I think the following comments from my previous testimony about foreign competition are worth repeating at this time.

> Most of us assume that automation is something that belongs to America. Americans have no monopoly on automation; it is growing rapidly in other parts of the world, and particularly in Europe. The productivity of the European worker is growing rapidly. It is time we ask ourselves how the American worker is going to compete with the European in the years to come.
>
> When I was in Europe in 1954 I visited some of the automobile plants and talked with many of the engineering firms that make their machines. I saw automation being applied in every auto factory. In some instances European plants are more advanced than our own.
>
> Sometime during the past 5 years Europeans have come to realize that the key to their future lies in increased worker productivity. They have already had a taste of the benefits of automation and they are hungry for more. This new European viewpoint is a good thing, and I think in the long run the world will benefit, but we in the United States must remember that wages, prices, and markets in most European countries are controlled either directly or indirectly. European wages are 50 to 75 cents per hour as compared to $2 to $2.50 per hour in the United States for the same kind of labor. In my own mind, I am convinced that European wages are going to be kept at this low level or very close to it. This means that the Europeans will have a tremendous competitive advantage over us if they continue to improve their productivity. By applying automation they see an opportunity to capture a larger share of the U.S. market. They are already enjoying some success with products that have a high labor content. One company has discontinued manufacturing printing presses in the United States and is now the sales agent for a European manufacturer. Some companies are building plants in Europe to maintain their share of the European market, but I am convinced that they are looking forward to the time when competition may force them to supply the American market from their European plants.

If the situation gets serious, higher tariffs will help very little. Tariff rates could not be changed in time to avoid hardship, and in addition, European countries would probably retaliate and further aggravate the situation.

Estimates show that the American work force will not increase as fast as the population increases in the next 15 years, and we must, therefore, increase our productivity to maintain our present standard of living. If American productivity does not increase during this period, it is quite possible that the void may be filled with goods and services supplied by Europeans. If Europeans do get a hand on our markets, I think we will have a hard time getting them back. Some people will argue that we can ship more goods abroad if our import trade increases; this is not necessarily true. American prices are much too high for the purchasing power (controlled wages) of the European consumer.

As I see it, the United States has but one course open to it. It must continue to improve its productivity and it must not look for additional social gains, such as the shorter workweek, or higher wages, unless they are definitely earned by productivity increases.

In addition, the following questions and answers from the 1955 hearing seem significant:

Mr. ENSLEY. Mr. Cross, I am very interested in your report on the rapid technological development in Western Europe.

Mr. CROSS. Yes.

Mr. ENSLEY. Just so that we don't misunderstand you, you don't in any way begrudge that remarkable development and recovery of recent years in Western Europe, do you?

Mr. CROSS. No; I do not.

Mr. ENSLEY. Your fear is that it might put us in a competitive position in some respects and squeeze some of our producers here; is that your fear?

Mr. CROSS. Yes; I feel that is true, and I feel the Europeans could capture some of our markets, and I think we have forgotten that the balance of trade could go against us.

Mr. ENSLEY. You mentioned that during the next decade when we may have relatively labor shortage we might find ourselves increasing tremendously our imports from Western Europe; is that right?

Mr. CROSS. I think that could happen, yes.

Mr. ENSLEY. How would you visualize that we would pay for those imports?

Mr. CROSS. From our gold reserves, as long as we had them.

Mr. ENSLEY. These reserves wouldn't last very long, though, if there was a predominant drift the other way. Wouldn't it boil down really to the fact that we would have to start shipping them goods in return?

Mr. CROSS. We would have to if we were going to maintain our position, but that is my point. I think that we might lose our position, and if the pressure is there for the goods and we have the reserves with which to buy them, the pressures from the people might be such that they would be willing to spend that money to maintain our standard of living.

Mr. Ensley. You mean export gold reserves?

Mr. Cross. Export the gold and that would bring the goods in. Of course, it couldn't go on forever, because we would run out, but by that time we would be in a very unfortunate position.

Mr. Ensley. Well, I am not quite as pessimistic with respect to our ability to compete with foreign producers. I am rather disturbed to find that you feel there is danger for our whole economy in competition from Western Europe.

As you know, in the last 2 years, 1958 and 1959, the United States has had a deficit in its balance of international payments of about $7 billion, and gold reserves have declined about $3 billion. This situation has come about because productivity has not kept pace with wage and price increases. American industry has done a remarkable job of increasing productivity, but the increases have not been sufficient to keep ahead of the demands of organized labor. The disparities in wages between America and Europe must eventually be reckoned with.

In your letter, you asked for answers to specific questions. All of these questions presuppose that automation is displacing workers and creating unemployment. This supposition is one of the great fallacies of our time. The truth is the exact opposite.

Automation has, in fact, created thousands of new jobs and has prevented the destruction of many others.

In the coal fields, for example, there wouldn't be any employment to speak about, if it were not for the fact that automation has increased the productivity of the coal miners so that coal can be competitive with other fuels. Automation has likewise created many jobs in the automotive industry, by reducing the costs and expanding the markets of the more sophisticated designs that are in demand today, such as power steering, automatic transmissions, power brakes, etc.

OBSOLESCENCE

Obsolescence continues to be one of American industry's greatest problems. Whenever industry invests in new machinery (and jobs), it strives to get its capital back as quickly as possible. Obsolescence is a serious factor in every capital investment. No one can know whether capital invested in machinery and jobs today will provide profits 5 to 10 years from now. Fast capital recovery is essential for the orderly growth of new technology; it provides the wherewithal for new investment and new jobs. Because of our antiquated depreciation policies, capital recovery in the United States is the slowest of any industrial country in the world. It takes from 12 to 30 years to recover capital invested in machine tools in United States as opposed to 4 to 8 years in the industrial countries of Europe. Congress should act now to provide tax regulations that will permit industry to deal with obsolescence.

SUMMARY

1. Automation is creating new jobs by lowering prices and expanding markets.

2. Wage and price differentials between the United States and Europe must eventually be reduced; in the meantime, social gains must be earned by increasing productivity.

3. Congress should immediately take steps to liberalize the depreciation practices of the Internal Revenue Service, which are currently restricting new capital investments and the creation of new jobs.

I am very grateful for the opportunity of presenting this statement, and hope that you and your committee will find it helpful.

STATEMENT OF MR. D. J. DAVIS, DIRECTOR, MANUFACTURING RESEARCH OFFICE, FORD MOTOR CO.

I am pleased to have this opportunity to bring up to date the information concerning the development and economic impact of automation at Ford Motor Co. that I furnished to the Subcommittee on Economic Stabilization in 1955.

In my testimony at that time, I traced the development of production techniques at Ford Motor Co. from early mass production methods such as the moving assembly line to the in-line transfer machines in our engine operations and the automatic presses in our stamping plants.

Because this development occurred as a gradual process over a period of many years, it was considered evolutionary in nature—the natural consequence of man's constant search for better ways of doing things.

At Ford, we see today no reason to change this view of automation, which is simply the development of better methods for doing old jobs. This development must continue if the American automobile industry is to meet the challenge of the European industry, which will be discussed in detail later in this statement.

During the decade of the 1950's, Ford Motor Co. greatly expanded its production capacity by building many new plants which were equipped with the most advanced and efficient facilities that the machine tool and press builders could develop at the time.

Prior to 1955, our first large-scale use of in-line transfer machines with mechanical handling devices between stations was in our Cleveland and Dearborn engine plants for machining operations. During the same period, automated equipment was installed in our Dearborn, Buffalo, and Cleveland stamping plants.

Between 1955 and 1960, we installed the latest developments in production facilities in our new Lima engine plant, and in several other new plants for producing transmissions, chassis parts, and hardware and accessories. Automated press lines were installed in our new Chicago stamping plant.

The productive capability of these manufacturing facilities was limited by the ingenuity and knowledge of the design engineers. This same limiting factor exists and operates today, and will continue to exist and operate as long as the human acquisition of knowledge and its application is a gradual, cumulative process.

Of course, the rate of technological development is not the only factor limiting the increase in industrial productivity. The decision to purchase and use more efficient production tools as they are developed is based on economic factors such as the amount of investment relative to the cost savings to be achieved, and the return on that investment which can reasonably be expected in view of the present and future economic climates.

In essence, then, the observations I made before the committee in 1955 are still valid in 1960.

We can expect no sudden revolution in automobile manufacturing techniques on an industrywide scale.

Accordingly, the effect of automation on employment should follow the trend of the recent past. The gradual shift to job opportunities into maintenance and other types of work should continue on a small and localized scale.

The committee is undoubtedly concerned with the effect of automation on employment. There is danger in overgeneralization in this area. The effects can differ greatly in various industries, between different companies in the same industry, and between different applications within the same company.

The situation at Ford was described by Mr. Malcolm L. Denise, vice president, labor relations, in testimony before the Special Committee on Unemployment Problems, U.S. Senate, in November 1959. Mr. Denise said:

> Our experience also has a bearing on the notion apparently prevailing in some quarters that people displaced by automation or other technological change constitute an identifiable group with respect to whom separate governmental policies can be formulated and applied. We have found it impossible to identify any group of laid-off Ford employees whose unemployment is attributable to automation as such. The fact is that changes in processes and technology occur simultaneously with changes in demand, product design, product mix and sourcing, with normal attrition in our work force, and with other factors.

Some displacement of employees does occur from time to time, and the reasons for this displacement are less important than the remedial action taken. At Ford, we meet the problems of retraining and reemployment in several ways wherever and whenever they occur.

It has been pointed out many times in the past that where older production machines are replaced by more efficient facilities, there is usually a need for additional skilled maintenance help. This is particularly true in the area of electrical maintenance, because of the tremendously complex control systems required for automated facilities.

In recent years, Ford training programs have included the retraining of employees to meet the needs for maintaining new equipment. In this respect, we have instituted special courses, especially in the areas of hydraulics maintenance, electrical maintenance, electronic maintenance, lubrication, and welding. Each individual has received from 5 to 200 hours of company-paid instruction.

In those cases where another job is not available within the plant, a displaced employee is given hiring preference in another company plant in the same labor market area.

Furthermore, under the company's retirement plans, an employee who is 60 or more years old with 10 or more years of service who is retired at the option of the company or under mutually satisfactory conditions may be eligible for a special early retirement benefit equal to twice the normal retirement benefit. This special benefit continues until he reaches the normal retirement age of 65 (or until social security becomes payable), at which time his benefit continues at the normal retirement level.

In addition, provision has been made under the company's supplemental unemployment benefit plan for separation payments to eligible laid-off employees who have not been reassigned to another job within a specified period of time.

These are the specific provisions established by Ford Motor Co. for meeting the short-range problem of the individual employee who is displaced due to the variety of factors which combine to cause local shifts in employment. Mr. Denise's testimony, referred to earlier, contained considerable additional details concerning these Ford programs. A copy of his testimony is attached. So far as can be determined, the action taken by Ford is typical of the entire automobile industry.

Taking the overall view, it is increasingly evident today that the net result of the introduction of more productive machinery and other efficiencies in our production processes has been to increase, rather than decrease, total employment in Ford Motor Co.—despite the fact that Ford's hourly labor rates (including the cost of fringe benefits) for each hour worked have more than doubled since 1946. We are convinced that without the increased efficiency made possible by technological development to partially offset this rising labor cost, Ford Motor Co. could not have prospered and grown in one of the most highly competitive industries in the economy. Rather than providing more jobs, we would have had fewer jobs, and possibly none at all.

The need for further technological development in the automobile industry will become increasingly acute because of one factor in particular. Since 1955, sales of foreign-made cars in this country have had a tremendous impact on the American automobile market.

According to the Automobile Manufacturers Association, foreign automobile producers exported 57,000 passenger cars to this country in 1955. By the end of 1959, this figure had grown to 668,000, more than 11 times as many.

In the same period, exports of American passenger cars dropped from 254,000 in 1955 to 116,000 in 1959.

In comparing the years 1955 and 1959, the net shift in the export-import relationship amounted to 749,000 units. If we assume that all of this change was a loss to the American auto industry, it represents enough production to employ a large number of workers.

Of course, the lower labor rates paid by foreign manufacturers are a major factor in their ability to compete pricewise in our domestic market. Less well understood, however, is the contribution of technological progress in reducing their manufacturing costs.

In 1957, I saw firsthand evidence of the improvements that European automobile companies are making in production techniques. Because of their advancing technology, some English, French, German, and Italian plants are more highly automated than many American automobile plants.

It is particularly significant to note that despite the lower wage rates prevailing in Europe, European auto manufacturers are developing and using automatic equipment in two areas of manufacturing which have seen little application of technological progress in the American industry. I refer to low-volume parts manufacturing operations, which, in the United States, often will not pay for the high investment costs in automated equipment, and to component assembly operations, which are still largely manual in our plants.

Europeans have begun to overcome the risk involved in low-volume jobs by designing more versatility into their automatic machines, so that the equipment can be used to machine several different parts, rather than just one, thus reducing piece costs. They are also assembling more components by automatic methods than we are. In fact, at the Renault assembly plant at Flins, France, the entire unitized body is assembled almost completely without manual effort through the use of automated handling, fixturing and welding devices.

In fairness, it should be recognized that investment in automated facilities involves less financial risk to the European automobile industry than to our own, because they make fewer models and fewer design changes in their car lines. This advantage emphasizes, however, the seriousness of their competitive capability.

To meet the challenge of foreign automobile manufacturers, we in this country must use every possible means to encourage development and application of more efficient production facilities.

Some progress has been made in reducing the risk of obsolescence involved in a facilities investment decision. American builders of automated machinery and presses are standardizing many of their dimensions so that these facilities will accommodate a greater degree of product design change than previously. These improvements also tend to reduce initial investment costs.

However, application of automation principles is not feasible in some automobile production operations, because our yearly model changes continue to impose a major limitation on the rate of such development.

If we are to continue our past rate of technological improvement, efforts by the American automobile industry to develop more productive machinery and equipment should be especially concentrated in two areas. The first of these is in that phase of the production process which involves the transfer of the part between operations. Even today, the handling or transfer cycle requires more time than the machine cycle in about 70 percent of production processes. The second area is that of component assembly operations. Development here, however, is limited to those vehicle components upon which only minor changes are made from year to year. For example, some progress has been made in the development of automatic assembly of front suspension systems.

In closing, several observations are in order.

During the past decade, the use of automated machinery and equipment by the automobile industry during a period of plant expansion undoubtedly helped in the effort to hold the line against the constant pressure of rising material and labor costs. At the same time, the greater productivity of our facilities enabled us to meet the demands of a growing market.

The use of automated equipment where feasible enabled the industry to improve the general quality of a product which continually grew more complex in styling and engineering, while eliminating much of the hard physical labor in many production jobs. More important, the rate of injuries to workers fell off drastically, particularly in stamping operations.

The periods of unemployment which occurred from time to time in the industry were due primarily to a combination of factors in the national economic climate.

Looking toward the future, it is perhaps ironic, but nevertheless true, that the same technological progress which was considered by some to be a threat to the automobile worker may prove to be his greatest security in the 1960's.

Recently, support for this view came from an unexpected quarter. In April of this year, delegates attending a meeting of the Industrial Union Department, AFL-CIO, Machine Tool Industry Committee heard a special report on the industry by Prof. Seymour Melman of Columbia University.

According to the news dispatch from the industrial union department:

> (Professor Melman) asserted that increased efficiency for the U.S. machine tool industry would not result in fewer jobs or in job downgrading in the industry. Unless such greater efficiency is achieved, he pointed out, the U.S. industry may lose present markets. He noted that "on the other hand, a more efficient industry will mean broader markets at home, and the best hope for successful competition in world markets." In this industry, efficiency is the key to job protection.

The news dispatch went on to say that:

> Melman's report was corroborated by a lengthy study made by the industrial union department's own researchers.

I would add to this that the economic laws which operate in the machine tool industry operate also in the automobile industry.

Automation offers the best defense we can see at this time against the challenge of a foreign industry which is strong principally because it is fully utilizing the fruits of technological progress.

The lesson to American industry is clear.

For the subcommittee's reference I should like also to attach a copy of a statement by Malcolm L. Denise, vice president, labor relations, Ford Motor Co., submitted to the Special Committee on Unemployment Problems, U.S. Senate, on November 12, 1959:

STATEMENT OF FORD MOTOR CO. TO THE SPECIAL SENATE COMMITTEE ON UNEMPLOYMENT PROBLEMS, DETROIT, MICH., NOVEMBER 12, 1959

My name is Malcolm L. Denise. I am vice president, labor relations, Ford Motor Co. I am here in response to the committee's request to the company for assistance in the investigation of unemployment conditions in the United States, by detailing our own experience and knowledge in this field.

We at Ford Motor Co. are very much interested in the subject of unemployment. It is a matter of deep concern to us. As I shall explain in more detail later in this statement, our company has adopted many specific programs and policies to minimize unemployment among Ford employees and to alleviate the effects of unemployment on them.

But the principal contribution that we, or any business organization, can make to the solution of unemployment problems is to provide employment opportunities. In the long run, an employer can do this only by providing better and more attractive products for consumers, at the lowest possible cost.

In a free enterprise, free market economy, the consumer is the final authority. By his dollar vote in the marketplace he determines whether any business will expand or contract; and whether and how it will change its products. Indirectly, the consumer thus determines where labor will go and how much labor will be employed. Needless to say, he is far from being completely predictable, and thereby he imposes risk as a condition of doing business.

To the extent that a company satisfies the desires of the consumer at a price he is willing to pay, it can grow and create employment. To the extent that a company does not meet consumer demands at a price he is willing to pay, it will wither and create unemployment.

At Ford Motor Co., our maximum effort is dedicated to designing and manufacturing, at the lowest possible cost, products that customers will find attractive.

Our 1960 lines of motor vehicles represent, in our belief, the best values in Ford's history. We are particularly hopeful that our new economy car lines—the Falcon, already introduced, and the Comet, to be introduced early next year—will help to stimulate a substantial increase in the car market, and in Ford's share of that market.

The company would be unable to offer these values and the increased employment opportunities that it expects them to provide were it not for the measures that it has taken during the postwar period to improve and expand its methods and facilities.

As Ford Motor Co. entered the post-World War II period, an assessment of its ability to survive revealed serious defects in its management structure, its efficiency, its plant and equipment, and its capacity to participate fully in the anticipated growing markets for automotive products. In a highly competitive industry, it appears that the company was not equipped to compete effectively, in terms of costs or products, when the seller's market created by pent-up wartime demand should change to a buyer's market.

As one of several actions to remedy the situation, Ford undertook an expansion and modernization program which involved the expenditure of over $2½ billion on plants and facilities through 1957.

During this period, the company acquired 58 new plants and parts depots. Most of these plants represented new facilities aimed at expanding the company's capacity. In some instances, however, the new facilities were designed to replace existing facilities, and operations were transferred in whole or in part from the old to the new.

At the same time, hundreds of millions of these dollars were expended in modernizing and, in some cases, expanding existing facilities.

The company sought to equip these plants, both old and new, with the most modern and efficient equipment and processes for performing its various operations. Virtually all of what is commonly referred to as "automation equipment" was installed during the period 1951–57, with the bulk of it in operation by the end of 1954.

In the course of this experience, Ford Motor Co. developed and pursued policies designed to minimize layoffs in connection with the movement of operations, and particularly the difficulties that might confront older workers seeking jobs elsewhere. These policies had to be developed and carried out, of course, within limitations dictated by the company's need to achieve and maintain competitive costs. We will detail later in this statement what some of these policies were and how they worked.

During this same period, the company's production was in a generally and markedly upward trend. Where it had been able to produce and sell only slightly more than 1 million vehicles per year in 1947–48, by 1953 it produced almost 2 million units. Each year thereafter it exceeded that figure by varying amounts until the recession year of 1958. Ford employment also was in a generally upward trend during these years. The company was able to absorb seniority employees whose jobs had been affected by the plant movements and new processes, and who had not declined opportunities for other company employment, after only relatively brief periods of unemployment, at worst.

The extensive layoffs which commenced in the latter part of 1957 and worsened during 1958 were not the result of automation; they were the result of the sharp decline in car and truck sales.

It seems clear, then, that the net result of the introduction of automation and other efficiencies in our productive processes has been to increase, rather than decrease, our employment—despite the fact that Ford's hourly labor rates (including the cost of fringe benefits) for each hour worked have more than doubled since 1946.[1] We are convinced that had we not made these improvements in efficiency, Ford Motor Co. could not have prospered and grown; rather than having higher employment, it would have far less, and very possibly none.

A striking example of how improved technology can generate employment in this industry is furnished by Ford's experience in the manufacture of transmissions. In 1950 nearly all Ford vehicles were equipped with manual transmissions produced by the company. Some 3,100 employees were engaged in their manufacture.

In subsequent years, improvements in design and technology brought automatic transmissions—vastly more complicated mechanisms—within the reach of the mass market. As a consequence, there are currently some 10,200 Ford employees—more than three times the number in 1959—engaged in the manufacture of transmissions for its products.

Our experience also has a bearing on the notion apparently prevailing in some quarters that people displaced by automation or other technological change constitute an identifiable group, with respect to whom separate governmental policies can be formulated and applied. We have found it impossible to identify any group of laid-off Ford employees whose unemployment is attributable to automation as such. The fact is that changes in processes and technology occur simultaneously with changes in demand, product design, product mix and sourscing, with normal attrition in our work force, and with other factors. All of these, in the aggregate, affect employment levels and placement opportunities, both companywide and in particular plants.

We turn now to a discussion of certain Ford policies and experiences concerned with the minimizing of layoffs and the amelioration of their effects when they do occur.

FORD PROGRAMS TO MINIMIZE AND ALLEVIATE UNEMPLOYMENT

Shortened model change time

We have improved our planning for model changeovers to such an extent that, of the approximately one-third of our hourly work force who are laid off during the changeover, the great majority now are idled for only 2 or 3

[1] The 1959 rate is about 115 percent higher than the 1946 rate. This represents a compound annual rise of over 6 percent.

weeks. This is in marked contrast to our earlier experience when the model change extended for a much longer period of time. It might be noted that in many cases employees have scheduled their paid vacations during these model change periods, thus tending to further minimize the unemployment effect of the model change.

Supplemental unemployment benefit plan

In 1955, as you know, Ford pioneered in the area of supplemental unemployment benefits. We felt that while State benefits might well be adequate in most situations, there was some basis for providing a higher level of benefits for the relatively higher paid Ford worker. As a consequence, we established the Ford SUB plan, which ties in very closely with State unemployment insurance systems. We believe that an individual employer should be permitted to establish such a plan for his own employees. And we are gratified that all but two States permit the payment of SUB concurrently with State system benefits. At the same time, we feel that the State should retain the authority to establish general benefit levels in terms of the broad overall needs of the covered workers in that State, since it is closest to the problem in its area.

Supplemental unemployment benefits are available to eligible employees during periods of layoff to supplement their State system benefits and/or weekly earnings up to 65 percent of their 40-hour straight-time after-tax pay. These benefits can be paid for up to 26 weeks, and for longer periods—up to 39 weeks—where State benefit duration exceeds 26 weeks.

It may interest the committee to know that during the period June 1956 (when SUB benefits first became payable) through September 1959, the Ford SUB plan has paid out over $20 million in benefits. The bulk of these payments were made during the 1958 recession and amounted to over $13 million in that year. In addition, during the year 1958, Ford employees received more than $45 million in State unemployment compensation benefits. Such private transfer payments at Ford and elsewhere, together with State system unemployment compensation payments financed exclusively through employer taxes, unquestionably helped maintain the relatively high level of personal income during the 1958 recession.

Training programs

Ford Motor Co. engages extensively in training programs at all levels of its activities. We believe, however, that the type of training in which the committee will be primarily interested is that involving production and maintenance employees.

The most outstanding activity of a continuing nature in this category is the Ford apprentice training program.

This program is not a recent innovation. It was first established in 1915, when the company recognized the need for an orderly technique whereby we could meet our growing demand for skilled employees. The program has, of course, expanded and been refined over the years and today covers 26 trades. A joint company-union program was established in 1941 when Ford and the UAW first entered into a contractual relationship. Approximately 2,000 employes are "on course" each year.

One notable development was the elimination in 1957 of the age limit on seniority employees desiring to enter the program. Formerly, applicants had to be between the ages of 18 and 27. In that year the age 27 ceiling was eliminated, and the program was opened (subject to a ratio limitation of one worker over 27 to two under) to any production worker who could meet the basic requirements. This revision served two purposes: first, it provided an expanded source of labor to meet company skilled worker requirements, and second, it provided training possibilities to otherwise qualified older workers. We feel that this could be a significant and meaningful contribution toward making these Ford workers more employable. It should be noted that, although some 200 employees over age 27 have been accepted for apprentice training, relatively few employees over age 45 have applied for the program.

Ford is proud of the fact that the Bureau of Apprenticeship and Training, U.S. Department of Labor, has used the Ford apprenticeship standards as a model in describing such a training program to other companies and industries.

In recent years, Ford training programs have also included the retraining of employees to meet the needs for maintaining new equipment. In this respect, we have instituted special courses, especially in the areas of hydraulics maintenance, electrical maintenance, electronic maintenance, lubrication, and welding. Each individual has received from 5 to 200 hours of company-paid instruction.

Although some formal retraining courses such as the foregoing have been necessary, especially in skilled occupations, we have found direct on-the-job instruction quite adequate in training production workers in most circumstances. It has not been necessary to establish a significant number of formal and detailed retraining programs as a consequence of the introduction of new equipment.

Our experience in the area of training for industrial employment leads us to some general observations on the subject which may be of interest to the committee.

The company believes that formal and continuing training programs for factory workers are useful primarily in developing trade skills which require long periods of training. Its experience suggests, however, that few older workers are willing or able to undertake such training when given the opportunity.

For the great bulk of production work of the type that exists in the auto industry, generalized training programs would not appear to offer a fruitful solution to unemployment problems. This is not to say, of course, that in particular instances some specific training directed at specific job openings could not be of some value. In any consideration of training programs in connection with unemployment problems, however, we believe two principles should be observed.

The first principle is that such programs should not become a matter of training for the sake of training, without reference to known and specific employment opportunities, lest the training effort be largely wasted. This suggests that the decision to enter into any such programs should be a local responsibility, in order to maximize assurance that they will be worth while and tailored to meet the local situation. The second principle is that such programs should not be tied in with the unemployment compensation systems, or be financed in whole or in part from unemployment compensation funds. Such a tie-in would tend to divert these funds from their intended purpose, and to extend by indirection the duration of unemployment compensation payments. It would greatly increase the pressures for the adoption of training programs of no practical value.

Job preference

When Ford employees in one of our plants are affected by a reduction in force, they normally have the right to displace lesser seniority employees in their own plant only. As a result of these seniority adjustments within a plant, normally it is the least seniority employees within the plant affected who find themselves unemployed.

In 1951, we negotiated with the UAW an area availability agreement. This agreement provides that employes on laid-off status from any of our Detroit area activities shall have employment preference at any other Ford Detroit area plant requiring additional personnel, and provides for an interplant referral system. Since 1951, this agreement has resulted in over 34,000 job referrals and in excess of 25,000 job placements in the Detroit area.

Additionally, in other multiplant areas such as Cleveland, Chicago, and Buffalo, employees affected by long-term layoffs at one plant have been given hiring preference at other Ford plants in the same labor market area.

Plant closings and transfers of operations

In recent years the company, for various reasons, has found it necessary to close several of its plants and reassign the work to other facilities.

In every automotive plant closing, we have offered employment at other company activities to the affected employees. In all cases, the employees who moved retained their total company seniority for fringe benefit purposes. In addition, in many cases employees were able to transfer their entire company seniority for purposes of layoff and recall. Such transfer of seniority increases employee mobility since it encourages an employee to move to a new plant. It thereby also helps to minimize the impact of the plant closing on a community. (A number of specific plant closings and transfers of operations are discussed later in this statement.)

Retirement plan

Generally, older workers are not interested in relocating to a new community in the event of a plant closing or transfer of an operation. Frequently, they encounter difficulty in securing employment in their own communities. The Ford retirement plan helps to alleviate the problems of these employees.

Under this plan, established in 1950, normal retirement is available at age 65 and automatic at age 68. Early retirement benefits are provided at age 60 on a reduced basis. The service requirement for this benefit was reduced from 30 to 10 years in 1955.

In 1958, a special early retirement benefit feature was added. This applies to individuals age 60 with 10 years of service who retire, "* * * at the option of the company or under mutually satisfactory conditions * * *." This special benefit is equal to twice the normal retirement benefit, but reverts to the regular normal benefit at age 65, or when social security becomes payable, whichever occurs first.

Retirement under this new provision is applied to employees unemployed as a result of a plant closing, or a transfer of an operation.

In the absence of this special benefit, these employees might find it necessary to remain in the labor force and might well become part of the unemployment in their area. (Parenthetically, it may be noted that employees so retired—as well as those who receive normal-age retirement benefits—may get into the statistical count of the "unemployed" simply by indicating a desire to find another job.)

Separation payments

Effective in 1958, the company negotiated with the UAW provisions for a lump-sum separation allowance to permanently laid-off individuals under age 60. It also applies to those totally and permanently disabled but not eligible for a disability benefit under the company's retirement plan, and to certain other terminated employees who do not qualify for retirement benefits. Payments are made under a special section of the SUB plan, in progressive amounts ranging up to 30 weeks' pay in accordance with a schedule based on years of seniority at the time of separation.

These payments provide workers with a source of emergency funds to assist in tiding them over until they find new employment.

Specific applications of Ford programs and policies

Briefly, let us illustrate, by examples, how some of our programs and policies have operated in connection with several major plant closings and transfers of operations.

Iron Mountain

In late 1951, the company discontinued its operations at Iron Mountain, Mich. At the time the plant was closed there were 1,323 hourly employees in the plant. All of these employees were offered work at company activities in other parts of the country. In addition, the new employer to whom we sold our plant was encouraged to give employment preferences to laid-off Ford workers.

Of this number, approximately 25 percent transferred to other company locations; an additional 18 percent first accepted and subsequently refused prearranged employment at other company locations; 25 percent were employed by the firm that took over local company facilities; 6 percent retired under the retirement plan; and the remaining 26 percent turned down the company offer of employment because they were not interested in relocating or had found other work in the community.

Buffalo assembly plant

The Buffalo, N.Y., assembly plant was closed in February 1958 and its opertions were absorbed by the Lorain, Ohio, assembly plant. At the time of the plant closing, there were 1,135 hourly employees in the plant. All of these employees were offered work at the Lorain plant—and about 33 percent accepted. In addition, about 22 percent of the employees were placed in the Ford Buffalo stamping plant. Most of these employees were given on-the-job training in the stamping plant since their assembly operation skills were not immediately transferable. Those employees electing to remain in Buffalo and who were not absorbed at the stamping plant, where eligible, have been covered by the Ford retirement programs.

Somerville assembly plant

The Somerville, Mass., assembly plant was closed in March 1958. A total of 1,344 hourly employees were affected. All of these employees were offered work at Lorain, and at the Mahwah, N.J., assembly plant. Only 13 percent accepted employment at Lorain, and only 25 employees or less than 2 percent moved to Mahwah. In practically all cases the employees were offered similar work to that which they had performed at Somerville.

Approximately 60 Somerville employees, or about 5 percent, received retirement benefits.

Memphis assembly plant

The Memphis, Tenn., assembly plant was closed in June 1958. This plant closing affected a total of 1,241 hourly employees. All were offered work at Lorain and the Cincinnati Automatic Transmission plants, and certain skilled employees were offered jobs at the Sheffield, Ala., foundry and at the Nashville, Tenn., glass plant. About 40 percent accepted work at Lorain and less than 2 percent moved to Cincinnati. A few employees transferred to Sheffield and Nashville. The employees going to Cincinnati were given certain on-the-job training, because of job differences between the two plants. A number of Memphis employees received retirement benefits.

Employees affected by the Memphis closing also benefited by the separation payment provisions mentioned earlier. Through October 1959, they were paid almost one-quarter million dollars in such benefits.

Chicago Aircraft Engine Division

Ford Motor Co. operated the Chicago Aircraft Engine Division as a licensee in a Government-owned facility for approximately 9 years, and produced both piston and jet aircraft engines under Government defense subcontracts. The contracts expired, and the company was unable to secure additional contracts involving the operation of this facility. Recently the last hourly employees were terminated.

Approximately 150 hourly employees affected by the phasing out of this operation have been placed in our Chicago stamping plant. Furthermore, company personnel spent considerable time and effort in attempting to secure jobs for employees with other companies. It is estimated that more than 1,400 hourly employees found employment directly through these efforts.

Eligible employees who were not placed elsewhere in the company received separation pay. These payments totaled nearly $300,000.

Transfer of certain operations from Monroe plant to Sandusky

In February 1956, we transferred certain manufacturing operations from our Monroe, Mich., plant to a new plant in Sandusky, Ohio. A total of 1,576 hourly employees were affected. All were offered transfers to Sandusky, and 324 accepted. The majority of the remaining employees were soon utilized in other jobs at the Monroe plant.

Transfer of steering gear operation from Rouge to Indianapolis

In November 1956, we transferred the steering gear operation from the Rouge area to the new Indianapolis plant. A total of 812 hourly employees were affected. All of these were offered transfers, but only 45 accepted. All of the remaining 767 personnel were placed in other Detroit area Ford plants.

Transfer of cold heading operation from Rouge to Indianapolis

In March 1957, we transferred the cold heading operation from the Rouge area to the new Indianapolis plant. A total of 800 employees were affected and all were offered transfers. Only 100 accepted the opportunity. All of the remaining 700 employees were promptly placed in other Detroit area Ford plants.

Transfer of Highland Park truck operation to Louisville

In May 1957, we transferred our truck assembly operations from Highland Park, Mich., to the new Louisville, Ky., assembly plant. This affected a total of 953 hourly employees. All were offered transfers to Louisville, but only 36 accepted. The remaining 917 employees were all placed in Detroit area Ford plants.

Transfer of Lincoln engine operation from Rouge to Lima

In July 1957, we transferred the Lincoln engine job from the Dearborn engine plant, Rouge area, to the new Lima, Ohio, plant. A total of 439 employees were affected. All were offered transfers to Lima, but only 16 accepted. The balance were all placed on other jobs in Detroit area Ford plants, the majority in the Rouge.

One proposition that Ford's experience with these matters highlights is that each situation differs from the other in varying degree so far as indicated action is concerned, because of such features as geography, type of operation, volume of operations. labor market conditions, etc. Thus the action in each case has been tailored to fit the particular circumstances.

CONCLUSION

We have presented a brief review of Ford programs and policies which have had the effect of minimizing and alleviating Ford unemployment. These include:

Improved planning to minimize the extent and duration of model change layoff.

Supplemental unemployment benefits to alleviate the loss of income during periods of unemployment or reduced earnings.

Training programs to insure an adequate supply of skilled workers and to equip our employees to adjust to changes in processes and equipment.

A job preference policy minimizing Ford unemployment by giving Ford workers laid off from a plant special consideration in filling job vacancies in other Ford plants.

A policy under which, wherever possible, Ford workers affected by plant closings or transfers of operations are offered the opportunity to transfer with their jobs or are given hiring consideration at other plants.

A special early retirement program for certain older employees, 60–65, who may be laid off because of a plant closing or the transfer of an operation, or who are no longer able to perform their regular duties satisfactorily.

Separation payments to laid off Ford employees whose reemployment prospects with the company appear negligible, thus helping to tide them over until they find other employment.

Comparable programs and policies have been followed with comparable results in respect to Ford salaried employees.

We believe that we have established a record of responsibility and regard for the welfare of affected Ford employees in handling these matters, without losing sight of the fundamental proposition that the greatest good to Ford employees as a whole requires continuous company effort to improve efficiency and its ability to compete.

As I said at the outset, however, increasing employment opportunities is the only sound, longrun solution to unemployment problems. We firmly believe that the Federal Government's efforts should be directed primarily to action within its appropriate sphere to encourage economic growth and the creation of employment opportunities.

STATEMENT OF PAUL A. GORMAN, EXECUTIVE VICE PRESIDENT, AMERICAN TELEPHONE & TELEGRAPH CO., IN BEHALF OF THE COMPANY AND OTHER BELL SYSTEM COMPANIES

Since 1920 the Bell System has been building the word's largest computer—the nationwide dial telephone system. About 96 percent of the 59 million Bell System telephones are now dial operated, compared to 85 percent in 1955. This is therefore an appropriate time for a progress report on Bell System automation.

Mr. Clifton W. Phalen, then president of Michigan Bell Telephone Co., spoke to the Joint Economic Committee 5 years ago on the subject of automation in the Bell System. He explained that we consider automation to be general technological progress, such as has been taking place in our industry and in others for many years. It is the creation of better and better ways to do a job or to produce a product and at the same time to keep prices down.

Because of automation, the people in the telephone business are working at better jobs today. As machines have taken over the more routine tasks, men and women have been freed for more interesting work.

Mr. Phalen described in detail how, before we began installing dial switching equipment in 1920, we worked out carefully a program dealing with the human factors involved. We knew the importance of a job to an individual. The program worked well in practice.

Whenever technological changes are made in the business our long-term objectives are kept in mind; to improve our service and meet the communications needs of the country at reasonable cost. We are certain that these objectives are in the best interests of our customers, our employees and the investors in our business.

Before going into detail on automation in the Bell System, it might be well to summarize briefly what his been accomplished to date, with the system now virtually all dial.

The 730,000 men and women now working for the Bell System companies are more than 2½ times the number employed in 1920, when dial conversion began.

Investment in our business, less than $1.4 billion in 1920, has grown to over $21 billion. Our shareowners total more than 1,850,000, as compared with 140,000 in 1920.

Another measure of our growth is as a taxpayer. Last year we paid $1.7 billion in Federal, State, and local taxes. In addition, in 1959 our telephone users paid directly about $600 million in Federal excise tax. In 1920 we paid $27.5 million in taxes and there was no excise tax imposed on our customers.

Western Electric, the manufacturing and supply arm of the Bell System, last year purchased more than 1 billion dollars' worth of materials from more than 35,000 suppliers for use by the Bell System telephone companies.

Service has improved tremendously. For example, a long-distance call to anywhere in the country goes through in less than a minute on the average, with some calls which are dialed directly going through in as little as 15 seconds. Back in the early 1920's it took about 10 minutes to complete a long-distance call.

A 3-minute cross-country call costs $2.25 today. In 1920 the price was $16.50.

Today it takes the wage earner only half as long to earn enough to have a telephone in his home as it did 20 years ago. This goes far toward explaining why we now have more than 38 million customers.

Because of automation we have the finest communications system anywhere. But the effects of telephone automation have reached far beyond the telephone business. The general economy and the Nation's defense have also benefited greatly.

Many businesses have been created or transformed by Bell System research and automation. The creation of the half-billion dollar semiconductor industry is a case in point. The industry started with the invention of the transistor by Bell Telephone Laboratories only 12 years ago.

Bell System technology is an important factor in the successful development of movies, radio, and television, of plastics and of phonographs and other sound reproduction systems.

Of course, the effect on other industries of technological development in the Bell System cannot be translated into an exact number of jobs created, or into growth measured in dollars. However, the impact has been great.

The progress already achieved as a result of automation in our business has been so extensive, and the further developments now on the horizon are so important, that it will be necessary to select for detailed discussion a few of the more significant items. These will be developed under the following headings:

1. The effect of Bell System automation in improving the communications system of the country, while keeping the cost of service down.
2. The contribution of Bell System technological progress to the general economy, to the creation of new industries, and to the national defense.
3. The effect of Bell System automation on investment in the business.
4. The effect of Bell System automation on telephone employment, and on employment in other industries.
5. What may be expected in the future from continued automation in the Bell System.

1. THE EFFECT OF BELL SYSTEM AUTOMATION IN IMPROVING THE COMMUNICATIONS SYSTEM OF THE COUNTRY, WHILE KEEPING THE COST OF SERVICE DOWN

Rapid, trouble-free telephone service of the highest grade is taken for granted by the American people (except perhaps if they have traveled abroad). But, of course, it has not just happened. Automation brought it about.

Automation is a continuing process. It has affected all types of equipment, all phases of the business. The equipment of 1920 was primitive compared to that being installed today. For example, early dial equipment connected local callers only. As the years passed, the area in which dialing was possible continued to grow. Just before World War II came operator toll dialing, in which the long-distance operator was able to dial through to the party called in the distant city. In 1951, residents of Englewood, N.J., began dialing their own long-distance calls. Now, about half of our 38 million customers can dial calls to almost anywhere in the country. Within a few years, all will have this service.

Today a long-distance call goes through in less than a minute on the average, with some calls which are dialed directly going through in as little as 15 seconds. This compares to about 10 minutes in the early 1920's. And the charge for this quicker service is a small fraction of the charge for the slower call of the past. Today the quality of this service is far better too. When people talk across the continent now, it is the same as though they were only 6 feet apart. Forty years ago, there was good reason for a man to raise his voice during a long-distance call—it was the equivalent of talking to someone 80 feet away.

Local service too has constantly improved, with higher and higher standards of reliability and "hearability." The average telephone goes several years absolutely trouble free. Yet the price for better telephone service has risen less than one-half as much as other prices since 1939.

In addition to steady improvement in service, automation has made possible the continual introduction of new services, new systems, and new instruments for the use of the American people. There are phones in automobiles, airplanes, and boats. There are phones designed for every location and use in the home and office.

Rural areas too are receiving more and better service today. Farms and ranches are reached now through radio links over deserts and mountain ranges that were impractical to cross by pole lines. Rural carrier systems with extremely low power requirements, which enable many conversations to be carried over the same pair of wires, make it possible to supply more service at less cost.

Another significant development has been the ocean telephone cable, which is not subject to fading and atmospheric disturbances that sometimes affect the radiotelephone. The first transatlantic telephone cable system went into service in 1956. The effect on usage was immediate and spectacular. Calls between the United States and England nearly doubled in a year. And, finding it so much easier to talk, people talked longer. Transmission quality of the new cable equaled that of the best land line circuits. It was a great improvement over the radiotelephone, which had been a tremendous technological achievement when it was introduced in the 1920's. Last year there were more than 800,000 transatlantic calls over our cables and radiotelephone circuits. Today, in addition to our Atlantic cables, we have cables to Hawaii, to Alaska, to Cuba, and to Puerto Rico.

Technological developments are constantly increasing the usefulness of the telephone system to commerce, industry, and Government. A recent example is Data-Phone, a Bell System development becoming increasingly important in the automation of industry generally.

Data-Phone makes it possible to send data over regular telephone lines, just as the telephone sends talk. In the past it has been usual to transmit data over special telephone circuits or to transport written records, tapes, or punched cards containing the information. Now it is possible, with Data-Phone, to make an ordinary local or long-distance call and let two business machines transmit information to each other. The business-machine industry is introducing many new devices developed specifically for this new service. Someday there may well be as much data as conversation passing over regular telephone lines.

In addition to carrying data over the regular telephone network, we use special broadband communications circuits to send great quantities of data at high speeds. One such circuit today directly connects computer centers in different plants of a missile manufacturer; it will transmit as much information in 45 seconds as will be found in a 50,000-word book.

2. THE CONTRIBUTION OF BELL SYSTEM TECHNOLOGICAL PROGRESS TO THE GENERAL ECONOMY, TO THE CREATION OF NEW INDUSTRIES, AND TO THE NATIONAL DEFENSE

Rapid and reliable telephone service has been one of the most important factors contributing to the industrial efficiency of this country and to our standard of living. It provides a substantial advantage to American business over competitors in other countries. It is one reason why American production leads the world.

Since 1920, well over a billion dollars has been spent by the Bell System on telephone research and development. While the primary aim has been to assure that the United States will continue to have the best communications service, the side effects on the economy have been many. We have created new products, and whole new industries have arisen for their manufacture. Numerous other industries, by utilizing the results of our research, have achieved greater success than they otherwise might have had.

A keystone of our research policy has long been to announce our inventions and developments promptly and to make our discoveries readily available to all on reasonable terms. This spurs advances in related fields.

Bell System research creates the semiconductor industry

A recent example of a new industry resulting from Bell System research and development is the semiconductor industry. The best known semiconductor is the transistor, a discovery growing out of our search for something better than vacuum tubes for use in amplifying and controlling electrical impulses in our telephone equipment. For this invention at the Bell Telephone Laboratories, three of its physicists were awarded the Nobel Prize in 1956.

The semiconductor industry has had almost explosive growth. Born only a few years ago, the industry is estimated to have had gross sales last year of transistors and kindred devices in the neighborhood of $500 million. Predictions are that sales will be at a $1 billion rate by 1963. Some 90 companies are in the field and they employ about 40,000 people. The success of semiconductors has spurred growth throughout the electronics industry.

The first form of transistor was the point contact transistor, announced by the laboratories in 1948. This was a major breakthrough in the electronics field. Here was a small, relatively simple device, with no parts to wear out, using tiny amounts of power, which could do many of the things a vacuum tube could do and in addition many things a vacuum tube could not do. These early transistors, however, lacked uniformity, and some worked and some didn't. Much still had to be done electrically and mechanically to develop the possibilities of the transistor.

Over the next few years three additional developments came from the Bell Laboratories which made it possible to manufacture transistors of great refinement and accuracy, and at reasonable cost.

First came the junction transistor, which eliminated the need for the point contact and made possible many more useful devices. In 1954 came the invention of zone refining. This was a means of refining the basic metal used and of introducing the necessary impurities under close controls. The next year the laboratories announced a new gas diffusion method of making semiconductors, resulting in still greater refinement and accuracy.

In addition to these four major discoveries, many other inventions and improvements in the semiconductor field have come from the laboratories. As has been the case with developments in all fields, these promptly were made generally available. On March 26, 1960, Business Week, describing the semiconductor industry, said: "Almost 90 percent of the semiconductor items now in commercial production came right out of Mother Bell's Cookbook" (i.e., Bell Telephone Laboratories).

The Bell Telephone Laboratories is continuing research in the semiconductor field. It has just announced a further major discovery—the epitaxial diffused transistor. This new transistor operates 10 times faster than its predecessors and consumes less power, which means that it will be cheaper as well as more efficient in operation. Bell Laboratories predicts that the discovery of this new device will have far-reaching effects in the electronics field.

In addition to their extensive use in our business, semiconductors are used by other industries in many types of equipment ranging from giant computers to midget radios and hearings aids. About half of the sales of the industry are to the U.S. Government in connection with the defense effort, since the transistor plays an important part in the complicated weapons systems on which our Nation relies so heavily for its defense.

"It (the semiconductor industry) is an almost classic example of the particular kind of growth that technological innovation can fire up throughout the U.S. economy," said Business Week.

Other businesses which owe much to Bell System development

The semiconductor industry is only one of a long line of businesses that owe their existence or a vital part of their success to automation in the Bell System.

Much has been contributed to the radio and television broadcasting industries, for example.

The basic structure of network broadcasting grew out of a Bell System experiment which began in 1922. At that time, when radio was still in its infancy, the Bell System began a 4-year project to learn more about this new field of communication and to establish the practicability of commercial radio broadcasting. The experiment proved it was feasible to have a nationwide network of stations connected by lines of the Bell System telephone companies, so that a radio program could be heard simultaneously throughout the country.

This experiment, incidentally, also pioneered the method of financing the industry by selling time on the air to advertisers. First to do this was station WEAF in New York City, owned and operated by the Bell System until 1926.

In 1927, Bell Laboratories arranged the first long-distance television transmission. Herbert Hoover in Washington talked over television to a group of Bell System officers in New York. Two years later a color television system was publicly demonstrated. Bell System scientists and engineers then developed coaxial cable systems and improved microwave radio relay links which made it possible to have national TV networks. By these means the TV industry was begun and was able to flourish. Last year sales of television transmitting and receiving equipment and station time sales amounted to $4 billion.

Present-day movies owe much to Bell System research and development in the field of sound and its transmission. The first successful talking picture, "The Jazz Singer," was produced in 1927 by a process developed by Bell System research. The sound recording method involved is still the one most widely used in the motion picture industry.

Less known to the public than these developments, but fully as significant, has been the development of the negative feedback amplifier. The basis for this was a discovery made in the Bell Laboratories by Harold S. Black. His problem was to design amplifiers to boost voice signals every few miles on a long-distance telephone line without increasing distortions which exist in every signal. The cumulative effect of amplifying even a small distortion greatly reduced the quality of reception.

The solution of the problem by the Bell Laboratories has been exceedingly important in the telephone business. It has been important, too, in other fields, since negative feedback amplifiers are generally used in phonographs, radios, and nearly all other sound reproduction systems.

Bell System research, through these and other developments, devised the method by which the first really high quality phonograph records were manufactured. We conducted the first public demonstrations of stereophonic sound reproduction. The large "hi-fi" and stereo businesses owe much of their present success to Bell System research aimed at improving telephone communications.

Another important contribution has been in the field of plastics. We use plastics in many places: in the telephone itself, to protect wires and cables, to cover delicate equipment.

An example of our work in this field is what has been done with polyethylene, best known to the consumer as the material used for plastic squeeze bottles. As a result of our research polyethylene has largely replaced lead in sheathing our cables. It also can now be used to insulate wires inside the cables, making it unnecessary to seal the cables against moisture. The use of polyethylene cuts down measurably on cable repairs.

When we first considered polyethylene it had many defects from our standpoint. It was not pliable enough, and was subject to cracking. Our research pointed the way to new forms of polyethylene which we could use. This made possible additional uses in other industries, so that today there is a far greater general use of polyethylene. The plastics industry produces over 1 billion pounds of polyethylene a year. We use about 5 percent.

Contribution to the national defense and space programs

Though designed for peacetime use, our telephone network has been called the Nation's greatest defensive weapon.

Since World War II the network has been supplemented by many devices especially designed for defense. An example of these is the SAGE air defense system, for which we are constructing the communications facilities. Nine sectors are now in operation, linking radars, computers, and weapons systems over telephone company lines. These lines carry high-speed data as well as voice.

The Bell System built the DEW line across the top of the continent, and White Alice, which ties Alaskan communications together. We are presently establishing communications for BMEWS (ballistic missile early warning system).

Much of the technology employed in military projects is the outgrowth of studies and development done at Bell Laboratories over many years in connection with the automation of our telephone communications. In World War II, when radar was discovered by the British, we were ready with the basic technology for its exploitation. Bell Laboratories developed substantially all of the fire-control radar for Navy surface ships during the war, as well as submarine radar and other radar. Sonar, a method of locating underwater targets, owes much of its development to the laboratories.

There is much in common between a telephone system and the automatic guidance and control system which zeros a missile on target. It was natural therefore that the Bell System should direct the effort that resulted in Nike-Ajax, this country's first operational guided missile. More than 10,000 of these missiles are now defending our cities. Western Electric, the manufacturing and supply arm of the Bell System, is manufacturing the improved Nike-Hercules developed by Bell Laboratories. Our development work on Nike-Zeus, the antimissile missile, is on schedule, and a number of successful test firings of experimental models have been made.

In the field of space exploration Bell System technology has also been of great importance. The Bell solar battery and the transistor are examples of the contribution in this area. Vanguard I, which has been in orbit for over 2 years, continues to send important messages because its solar cells are taking power from the sun to operate transmitting equipment built in good part from transistors. Vanguard I is expected to be sending signals for a great many years. The Bell solar battery grew out of our semiconductor research and one of its first uses was to supply power for a telephone line in a rural area.

The command guidance system for the larger intercontinental missiles such as the Titan was designed by Bell Laboratories and is being manufactured by Western Electric. It has directed nose cones of missiles right on target. It recently put the weather satellite, Tiros I, into almost circular orbit—the first time this had been done.

Bell System thermistors will report temperature measurements from outer space. The Bell System supplied many of the communications facilities for the Atlantic Missile Range.

A few years ago, the Navy asked Bell Laboratories for assistance in designing a system which would make possible the detection and destruction of an enemy attack force. In 1958 the laboratories was cited by the Navy for bringing "to completion a highly complex family of devices which permit full utilization of the antiaircraft armament of the Navy's guided missile ships * * *."

The command guidance system we developed will be used in Project Echo, on which we are working with the National Aeronautics and Space Administration. This system will guide into orbit a missile carrying a reflecting balloon. Project Echo will determine the feasibility of worldwide communications (including television) by means of microwaves reflected from specially designed satellites orbiting the earth. Such an idea was first advanced by a science fiction writer in 1945. Ten years later, the idea was developed as a real possibility in a technical paper published by Dr. John R. Pierce of the laboratories.

3. THE EFFECT OF BELL SYSTEM AUTOMATION ON INVESTMENT IN THE BUSINESS

The Bell System telephone plant, "the world's largest computer," has been made possible only by the savings of great numbers of people. Share owners of American Telephone & Telegraph Co. now number more than 1,850,000. This is an increase of over 450,000 from the number 5 years ago. (There are only 2 other companies with as many as 450,000 share owners.)

Our total assets, approximately $4.7 billion at the end of World War II, are now about $21 billion, an increase of over $16 billion during this short period.

Savings of the American people must continue to be attracted into the telephone business if this Nation is to have the communications services it needs. In 1959 expenditures for construction totaled $2¼ billion. This year we will spend $2.6 billion. Although these expenditures will be mainly for growth, there will be large amounts expended for improvements and automation. Construction programs of this size require that the business attract nearly $1 billion of new capital each year.

Protecting and paying a fair return on the investment of those who have put their savings in the telephone business are essential to the continued attraction of new capital. The incorporation of improvements into plant will greatly contribute to the profitable employment of the capital invested. However, with the Bell System telephone companies subject to regulation, the extent to which investors can be properly compensated for making improvements and expansion possible depends to no small degree upon the actions of public authorities.

4. THE EFFECT OF BELL SYSTEM AUTOMATION ON TELEPHONE EMPLOYMENT AND ON EMPLOYMENT IN OTHER INDUSTRIES

Notwithstanding the high degree of automation in the Bell System, the backbone of the telephone business continues to be people. All our central offices and equipment are fully effective only when properly staffed by competent people. Automation has meant more employees and higher rated jobs.

At the beginning of this year the operating telephone companies had 582,000 employees, or 2½ times as many as in 1920 when dial conversion began. The Bell System as a whole, including Bell Telephone Laboratories and Western Electric, had 730,000 employees, or 2.7 times as many as in 1920. During the latest 5-year period, 1955 through 1959, there was a small increase in the number of employees in the telephone companies. For the Bell System as a whole, including Western and the laboratories, the increase in the number of employees was over 40,000. Fluctuation in the number of employees took place in both periods with the changes in level of business activity.

The Bell System gives employment to such a large number of people because automation has made it possible to hold the line on costs and to furnish telephone service at a price which virtually every American household can afford. Without automation, telephone service long ago would have been priced out of the reach of a large portion of present subscribers. It is also a fact that, had automation not taken place, it would not now be possible to get enough qualified people to provide the volume and scope of telephone service which the public, industry, and Government need and have today.

In addition to creating more jobs, automation has greatly increased the number of Bell System people in higher graded jobs. Men and women receive much higher pay than the telephone men and women of the past.

The 5-year period 1955 through 1959 illustrates the kind of changes in work force which are brought about through automation. The number of plant craftsmen in the telephone companies increased from 120,000 to 142,000, or 18 percent. Supervisory employees in these companies grew from 88,000 to 103,000, or 17 percent. Business office and sales employees grew from 28,700 to 33,000, or 15 percent. Other instances of increases in the number of people in higher graded jobs could be given. While there was a reduction in the number of operators during the period, this was more than offset by the additions to the work force.

In the past 5 years annual wages and salaries and other payments to employees increased by $997 million, or over 34 percent. This reflects not only higher wage rates and increased benefits but the fact that there are now more people in better jobs.

The changeover from manual to dial

When technological changes occur, they are integrated into our business only after much research, experimentation, and testing. Thus time is assured for adequate planning and consideration of the human as well as the technical problems involved.

With careful planning, normal force turnover can solve most of the personnel problems. This is particularly true in the case of operators, where high force turnover is normal. For example, last year it was necessary for us to hire more than 50,000 operators.

When conversions of manually operated offices to dial have been scheduled, replacements for operators resigning or retiring have been largely from persons seeking temporary jobs. Often these are former operators who gave up their jobs when they married, and are now happy to come back on a temporary basis. As the conversion proceeds, regular employees are offered jobs in other types of work at the same location or in other offices in the same or other communities.

The observation made in 1934 by Frances Perkins, then Secretary of Labor, properly describes the regard for employees which has characterized the Bell System planning:

> Of the hundreds of occupations in which women are listed in the Census of Occupations, only about a dozen employ more women than do the telephone companies. The human problem of the displaced worker when the cutover was made from the manual to the dial system telephone exchanges is an almost perfect example of technological change made with a minimum of disaster. It was accomplished through human as well as technical planning.

Bell System employee training

The Bell System takes the responsibility for retraining employees who are given new assignments because of automation. However, they are but a small part of the employees who change from one job to another for various reasons—to fill a vacancy created by a promotion or a retirement, to balance the force with the workload, to handle growth in the business, or to stimulate the individual's own growth and development. In all of these situations the Bell System provides the training needed to handle the new job well.

Moreover, training of employees going into other positions is only part of the overall training programs enabling employees to carry out their assignments better, and giving them more satisfaction from their jobs. This applies to all levels—to clerks, to skilled carftsmen and on up to top levels of management.

Training is of two kinds: on-the-job, carried out by the individual's supervisor, and off-the-job, carried out in a classroom by an instructor. On-the-job training helps an employee achieve his maximum potential in his present job. Off-the-job training provides a firm foundation for the development of a more highly skilled craftsman or manager.

One department alone, the plant department, has more than 200 schools throughout the country providing classroom facilities for off-the-job training of installers, linemen, repairmen, and other craftsmen who construct, install, and maintain the many different kinds of telephone plant. Courses range from basic subjects such as electricity and electronics, through station installation and maintenance, all the way to crossbar central office maintenance. The periods covered by the courses are as long as 20 weeks or more.

This plant school program is the equivalent of a trade school with a full-time enrollment of 5,000 students.

Since classroom training is usually followed by on-the-job training by the individual's immediate supervisor, it is exceedingly important that the supervisor be well qualified to give maximum assistance. For this purpose, training is given supervisors in new methods and on new tools and new equipment as they are introduced. In addition, last year over 335,000 supervisory man-days were spent in courses dealing with the general subject of human relationships, including employee problems.

The introduction of the computer into accounting operations

Recently a considerable amount of computing equipment has been introduced in our business to handle various accounting operations. This equipment eliminates some jobs and creates other, more stimulating ones. The number of repetitive computing, sorting, and summarizing tasks formerly done by hand is greatly reduced.

The installation of this computing equipment has again shown how our advanced planning with respect to human factors can virtually prevent adverse effects on the work force. Long before such equipment is installed, plans are worked out to transfer to different operations employees whose jobs would be affected. Frequently in such cases the employees receive additional training for their new jobs, much of it provided on the job by the employees' supervisors. Off-the-job training is also provided.

During the past year a total work force of about 42,000 employees was engaged in accounting operations. The number in the force at the end of the year was lower by about 500—a little over 1 percent—than at the beginning of the year. Here again, normal force turnover prevented hardship to personnel as changes were made because of automation. During the year it was necessary to hire 6,900 new employees to replace those leaving for various reasons. Some 8,700 employees were promoted or otherwise moved to other assignments in the department. Nearly $1 million was spent in off-the-job training alone.

Occasionally same employees affected by automation are, for various reasons, unable to accept transfers to other locations, and cannot be placed in other work. In these relatively few cases severance pay plans provide for lump-sum payments varying in accordance with length of service and wage rates.

Effect of Bell System automation on employment in other industries

In a consideration of the effects on employment due to technological advances in the Bell System, a most important aspect is the impact on employment in other parts of the economy.

We have described how the very young semiconductor industry, which owes its origin and much of its success to Bell research, already consists of some 90 companies employing about 40,000 people.

The production of semiconductors has in turn stimulated or created other businesses and products including new forms of radio, television, hearing aids, and similar items, thus producing further employment opportunities. A great number of businesses for servicing these products have grown up or expanded, and thus our contributions to automation created additional job opportunities.

One can only speculate as to the number of persons who owe their present jobs to Bell System developments in movies, radio, television, hi-fi, stereo, and other sound recording and allied fields. It is no exaggeration to say that they total hundreds of thousands.

Any discussion of the effect of technological change and automation in the Bell System should consider the increased employment requirements of suppliers of materials and equipment to the Bell System. Purchases by Western Electric in the year 1959 totaled over $1 billion and were made from 35,000 concerns. The total amount of these purchases contrasts with $678 million 5 years ago. In 1920, Western purchases totaled $152 million—from 3,200 suppliers.

The Bell System is also the Nation's largest customer of the building industry. During 1959 it spent more than $160 million for building construction, a program that required the services of hundreds of architectural firms and thousands of construction firms, employing many thousands of people.

5. WHAT MAY BE EXPECTED IN THE FUTURE FROM CONTINUED AUTOMATION IN THE BELL SYSTEM

Automation will continue to be of major importance in our business. In the next few years the number of dial telephones will reach almost 100 percent. There will be a greater and greater amount of customer dialing of long-distance calls. Yet we will still need about the same number of operators we need now, perhaps more, to handle person-to-person calls and other calls needing operator assistance.

In the years ahead, as in the past, there will be an advance in the quality and a great increase in the quantity of service to far-away places.

Some of the changes which are just around the corner are the extension of the ocean cable system to Bermuda, the Caribbean, South America, and the Far East, and additional ocean cables to Europe. Also near at hand are increased capacities for existing cables and improved high-frequency radiotelephone linkages.

The present automatic switching systems are composed of electromechanical devices which require a few thousandths of a second to operate. An entirely new kind of switching—electronic switching—is on the way. In electronic switching, transistors and other electronic components will perform switching operations in a few millionths of a second. Electronic-telephone exchanges of the future will be highly versatile. They will contain memory facilities which will permit services as simplified codes for reaching frequently-called telephones wherever situated, automatic completion of "line-busy" calls and automatic transfer of incoming calls to any specified telephone.

Further in the future, but offering great possibilities, is radiotelephone communication using satellites. Transmission systems using rapid electrical pulses also offer much promise. One likely application of these pulses is in waveguide transmission systems now under development. The waveguide is a hollow tube through which radio waves will travel. The waves will have a range of frequencies nearly four times as wide as the entire band now used for radio communication, but will not be vulnerable to fading, atmospheric effects, interference or similar troubles that now affect radio transmission. Such a waveguide system may carry as many as 200,000 voice circuits or 200 TV programs.

The Bell System expects to continue its program of research and automation as a necessary means of further improving the speed, accuracy, and convenience of telephone service, increasing its usefulness and broadening its scope. Our aim has been and will continue to be to give to the public, to industry, and to our defense forces the best possible communications service.

As we look to the future we see that it will continue to be necessary to attract very large amounts of money into the business. The American people will continue to be called upon, through their savings, to finance construction needed for the communications service the Nation demands and must have.

Automation will undoubtedly continue to change the nature of some telephone jobs. As in the past, we expect these changes to be of an evolutionary nature. We will, of course, continue to minimize any adverse effect of these changes on our personnel.

In the future as in the past there will probably be some fluctuations in employment. However, we expect an overall upward trend in the number of our employees. This will result in part from the continued expansion of the telephone business brought about by better and better service of wider and wider scope. It will result also from aggressive selling of present and future services.

We see the long-term trend of our business as one of increasing job opportunities. We see technological developments in the Bell System creating new products and new industries. We see more and greater contributions to our general economy and to the national defense.

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STATEMENT OF JOHN J. GREBE, DIRECTOR, NUCLEAR AND BASIC RESEARCH DEPARTMENT, THE DOW CHEMICAL CO., MIDLAND, MICH.

Thank you so much for the invitation to testify again on the subject of automation and energy resources. I have just reread the testimony given in 1956 and find that it was more fundamental than I thought. Very little has changed on the fundamentals to which I addressed myself. We are still too well off as a nation to allow dire necessity to be a real incentive for creative achievement; nor has there been any significant increase in the reward for such extra effort. We have not even substituted for great need and want on the part of the individual the psychological incentive of the attainment of "the whole man." The prime objective of men should be to be as productive and creative and helpful as they possibly can be in the service of God and man.

We still have a substantial portion of our youth that has not had such ideals torn out of their conscience. To survive as a free nation, we must continually strive to the limit to build up rather than to divide.

I do not know of anything further to suggest than what is contained in the enclosed copy of my previous testimony, in which we have italicized the most pertinent points.

> This subject of automation is one dear to my heart, for back in the 1920's a group of my associates and I devised some of the first automation instruments to be applied to the chemical industry. I well remember the struggles we went through to design the instruments and to test them and eventually to find the manufacturers who would and could build them for us. We are still working hard on new and vital instrumentation research.
>
> May I digress for one moment to say your work so far, *The Report of the Joint Committee on the Economic Report to the Congress of the United States of January 5, 1956, is a wonderfully sound statement of the problems to be solved. It emphasizes that education, the development of our human resources, is the most important problem facing us as a nation.*
>
> May I explain what automation means to me. We have had automatic machines for many years, particularly in hydraulic turbine speed control. These machines did a job automatically, which in former times a man would do manually.
>
> Now the difference is that complete automation replaces the operator of the automatic machine with a device that observes or feels the variants to be controlled and makes the proper adjustments so that the automatic machine regularly operates in proper balance. This eliminates much human error. I do not mean that it creates unemployment, for, as I later point out, it is quite the reverse, but it does make it

possible to do with machines what human beings could not do quickly and accurately enough, nor continuously.

THE TYPICAL PLANT

The chemical and the petroleum industries are outstanding examples of the application of instruments and controls to increase productivity and to maintain product quality.

You will forgive a reference to my own company as an example, but my company is typical, I believe, of a diversified chemical operation. To this degree it can serve as a good cross section or example of chemical industry methods of manufacture and automatic control.

Our chief chemical raw materials are water, salt, oil, and coal. Water is brought a distance of 75 miles, from Lake Huron. The salt, as a brine, is pumped from deep wells. Coal, as the energy source, is transferred by boilers and condensing turbines into electrical energy and process heat.

Power and chemical people well understand that water is not a simple substance, but rather H_2O complicated by a vast complex of impurities. Even the term "pure water" has a meaning dependent on the application. The elaborate plant installed to treat the process and powerplant water at Midland cost over $1 million. Mechanically, it is a complex aggregate of tanks, pipes, valves, and pumps. Operationally, it is almost completely automatic. A central control room receives signals of measured quantities from all parts of the system. Changes in all the important variables such as impurities, flow rates, etc., are transmitted and recorded automatically. The control instruments then send back orders to servomechanisms which open and close valves, adjust weights, pressures, temperatures, and so on.

Practically no brawn is required in a plant of this sort, only complex mechanism and enough brains to run it. A single operator, backed up by maintenance crews, keeps the production on the beam.

In the powerplant we find another complex assemblage of instruments and controls. These measure temperatures and the chemical constituents of the stack gas, temperature of water fed to boiler, pressure and temperature of the steam produced, the precise speed of the turbine, etc. They control and allocate loads on the various machines, watch bearings for overheating, check condensers for leaks, and so on.

All this is only a start. Let us look at an average chemical plant. To a large degree it consists of fluid transportation—liquids and gases—flowing through a system of piping and tanks. At hundreds of points instrumentation must measure and adjust pressure, temperature, flow rate, and composition.

Some of the more complex processes require controls that will replace and improve on human judgment. The central brain receives signals from many instruments and meters. It studies their relative values and tests them against prescribed criteria built into the machine. From these it reaches decisions on what's to be done, sends out electronically the orders to servomechanisms, which execute these orders. Finally, another device, known as feedback, reports the extent to which the ordered action failed to create the effect desired. The central brain then sends out corrective reorders.

This feedback is the mechanical equivalent of what one does in driving a car around a curve. As one enters the curve, he turns the wheel an estimated amount. This is never exactly right. His eye notes the car edging toward the shoulder or toward the center and feeds back, or relays, this information to the brain which then estimates the required correction and signals the steering arm to turn the wheel slightly left or right.

Thus, in industrial apparatus, fluid chemical systems, or aggregates of pipes, tanks, valves, and pumps, the direct sensing and controlling elements are connected to meters, valves, and pump motor controls on pumps, to produce the desired changes.

THE TREND IN INSTRUMENTATION

With these examples in mind we can then proceed to look into the additional operations existing in a chemical plant. We can find instrumentation for recording and controlling such basic operations as crushing, grinding, filtering, precipitating, distilling, evaporating, crystallizing, etc., which result in a more uniform product, a reduction in product cost, and an increase in product quality.

A large and constantly growing percentage of the money spent on new plants of many chemical companies go for advanced instrumentation. This year there will be spent many millions of dollars on instruments of all types, including the highest percentage ever for automatic control components. The importance of instruments to today's plant is shown by the fact that a moderately sized manufacturing plant will use from 5 up to 20 percent of its cost for instrumentation.

In addition to our outside purchases of instruments that meet our normal demand and needs, we spend a substantial part of our research dollar on the engineering, design, and fabrication of special purpose instruments. About one-third of the work at testing and engineering laboratories is devoted to research on automatic control components. The chemical industry, as a whole, is more dependent on automatic control than any other large industry. We won our spurs in our industry by doing things automatically that could not be done otherwise.

Keeping track of hundreds of variables and making necessary process adjustments in time and with safety, is a job which can be handled only by automatic control. In the long run, automatic control, like every other technological improvement, will stimulate employment.

NUCLEONICS IMPOSSIBLE WITHOUT INSTRUMENTATION

The whole field of nucleonics is a special case of an industry entirely dependent upon instrumentation. Except for the discovery at the University of Michigan that the water spider somehow senses and knows enough to dodge gamma radiations, we know of no living organism that is directly sensitive to nuclear radiations, unless the rays are intense enough to produce "sensible heat," or obvious physical damage. Indirect sensing through instruments, however, has made possible an extension into qualitative and quantitative analysis that was undreamed of before the invention of the Geiger counter. It, and its many counterparts and improvements, is capable of telling us things about a few out of the 10^{24} (10 with 23 ciphers behind it) number of atoms in an ounce of water. The growth of this industry will continue to follow the lead of automation, particularly the segment consisting of instrumentation, because it is difficult to depend on human beings to do the right thing when they cannot see, hear, feel, taste, or smell any of the things that are going on behind the necessary shielding.

IMPACT ON PRODUCTIVITY

For a concrete example in productivity, let's look at the experience of one chemical company.

In the past 10 years, its total employment has doubled, but the physical output has increased more than fourfold.

	Employment	Output as reported	Output at 1946 values
	Men		
1946	13,500	$101,000,000	$101,000,000
1956	28,072	565,000,000	420,000,000

These same 10 years have seen increasing use of instrumentation. During this period, automatic control equipment was used on a large percentage of its manufacturing processes. This resulted in a reduction in the amount of direct operating labor. This was not all net gain in efficiency, however. It required skilled workers to make and install the control instruments and other highly skilled maintenance men. Many of the former operators have been upgraded to these maintenance jobs.

BETTER INSTRUMENTS—BETTER MEN

In the chemical industry, the instrument groups search the world for the best instruments they can find, and they are encouraged to use vision in planning for the future. They are also encouraged to develop new special instruments not on the market. The total of men employed in this field is large indeed, running surely into the thousands.

There is one additional subject that is most difficult to present. It is bound to be misunderstood and raise hard feelings. We have been speaking about productivity in our industrial output. We have been thankful that our engineers and scientists have made it possible for our Nation to increase its material conversion by a factor of 2, every 25 years, but on the effort of converting human resources we have had no similar increase in efficiency. Some even say a decline. This is well presented by one of our colleagues in instrumentation, Dr. Arnold O. Beckman, in U.S. News & World Report, November 30, 1956. There are, however, many examples of the very best of educational methods and facilities that have reduced the man-hours required to accomplish definite objectives in educating, training, and broadening individuals.

The newest methods and facilities have in common the objective of making higher paid teachers free to be a friend and inspiration to the students, leaving all formal presentations to what the best lecturers can do with films; and the giving of tests, grading, and bookkeeping to machines and student assistants and other nonprofessional people. The full utilization of such technology would greatly increase the flexibility of our educational systems, making it possible to keep all students challenged sufficiently to maintain keen interest without overtaxing and discouraging them.

Much of the "new and better" is being introduced by private and corporate sponsorship. Examples of this type can be found all the way from "Ding Dong School," "Mr. Wizard," "Our Mr. Sun," and other TV programs, as well as interesting church and Boy and Girl Scout activities, little leagues, on-the-job-training, contests, camps, civic activities, on through the methods of graduate schools. Movies, educational toys, models, and hobby shops accomplish wonders. Museums, like the Rosenwald Museum of Science and Industry at Chicago, are most important. The really great developments in these fields, however, are still to be made.

MILITARY TRAINING IMPROVES

The best example of what has been, and should be done, is given by our Armed Forces. The military services improved on old practices in selecting men by a factor of 2 during World War I; again, they doubled the efficiency of utilization of the men in World War II. Now we need another doubling to make the 2 years of service the most worthwhile, the most broadening and educational, in the lives of our youths. *It is being done in spots.*

The SPP program, which uses specialized professional personnel in the armed service at the level and on the jobs that fit the training the men have had, is of tremendous value. They apply the experience they have had, and extend their training by research and development, in badly needed fields of activity.

For example, some of the most highly specialized work in the services is being carried out by draftees in the U.S. Army Chemical Corps, at its various installations. Seminars are held by the men to broaden their interests and education. Their physical training and buildup is also much appreciated. *An inventory of the capabilities of a person before and after military service could, and should, show a rounding out of personality and experience that cannot be attained in any other organization. Measuring this effort and accomplishment alone would lead to new demands being supplied and balanced out in new ways to meet the needs of the complete man.* It is an automatic control technology using instruments that may not yet have become a part of the recognized field of instrumentation and automation. I have talked to many men who were proud of the way the services used them, and thankful for the training. *This can and must become the rule for all service men and women, if we are to keep up with the pace set in many specific instances by the rest of the world.* On the other hand, there may be many sergeants, who would say with the Scotman, philosophizing: "If it gives you pleasure, it's a sin."

WE NEED NEW MOTIVATION—THE WHOLE MAN

Next, we need better motivation for human advancement that will reach more people. The living standard of the average American is on a par with the upper fraction in most other countries. Hence there is less incentive for the average individual to try to improve himself. The young Russian shift workers who work at night and study college texts in the library during the day have two incentives that we do not have. They must make more of themselves, in order to rise above, in freedom and self-expression, the lot of a serf, and to gain the differential in pay and privileges accorded for increased responsibilities. *We have all but lost differential pay incentive in our country, and are thankful that the "hunger for freedom" is so strange to us that it is hard for us to understand.* And so three-fourths of our young people quit school too early, to reap the benefits produced by the other fourth.

Finding and thoroughly establishing a good method of human motivation, and better methods of education, can be the key to the success of attaining our needs in the development of our human resources.

One possibility is to develop a movie presentation of the growth of man, showing how from early youth an individual gradually fills out great fields of knowledge and capabilities in reflexes, thought, and feeling in all the lines of human abilities. One first develops physically, extending coordination, muscular strength, and endurance, in this wide plane of possible applications. It is the first tier of a great pyramid that one builds of himself. Next, there is communication in many ways, including speech, vocabulary, languages, and the like. Finally, one broadens into many other fields, such as music, mathematics, art, science, religion, and the many specialized fields of human activity and employment. At best, a person is "well-rounded," much like a Christmas tree that grew uniformly and completely.

However, no one can possibly extend his background, training, and abilities in any one plane without sacrificing somewhere else. When the going gets tough in one direction on one plane, there are all the other tiers to work on. Of the total range of human capabilities, one could not hope to attain more than a few percent. *Having a clear picture at any age, of what one has attained and some inkling also of what one might attain, would help all of us appreciate one another more—and also, to understand our own limitations. Growing tall and rounding out and bearing much fruit on specific branches, could become a greater motivation for self-improvement than any other inducement that we have left.* A beautiful illustration of the national need for this was presented by Dr. de Bordenave, at the celebration of the 250th birthday anniversary of Benjamin Franklin. I am sure Walt Disney and Cecil B. De Mille would not shy from this job, even if it had to be done in 10 stages to be understood by all the different levels of maturity.

INNOVATORS CAN REVAMP METHODS OF GROWING WHOLE MEN

In this direction, the doubling or even tripling of the private and corporate efforts now amounting to about $538 million—as determined by Dr. Killian, president of MIT—would multiply the rate of development of new methods that accomplish more, in less time. There is no reason to doubt that educational developments can be made by the people who have doubled our instrumentation and automation every 5 years. Tax deductions, to permit these private expenditures to be increased are to be recommended.

THE URGE TO BE CREATIVE CONTINUES

The chemical industry specifically has been the most potent in applying modern technology, in multiplying productivity, in making it possible to increase wages in my 30 years of activity by a factor of six, while the cost of the products that were being produced in quantity has gone up very little. In addition, many products were made available that could not have been commercial without modern automation and new instrumental analysis and control.

While the cost of our production plants per dollar output has remained about constant despite inflation, the application of automatic control equipment has multiplied. Variables have been detected and eliminated that defied analysis only a few years ago. In all of my experience, the upgrading of the manpower working with me has always been the major concern and objective. Even now, with all that has been done to destroy incentive nationally, our youth has retained the spirit of progress.

Notwithstanding the lack of necessity as an incentive, 80 percent of our basic research group—the most prolific inventors—are taking part in advanced training programs, mostly on their own time. Operators, helpers, as well as engineers and scientists take part. Each man knows he has no external limitation to keep him from getting up to a doctor's degree with continuous pay, even during the "in residence" period at a university. But all this is still not enough. We are continually limited by the lack of able men in our objectives for doing new things and making new products for new uses to create new human values and new employment. The perpetual relay race is on. We enjoy it. We need more and better men to carry the torch.

SUMMARY

On the subject of education and better utilization of our human resources, which was considered the major problem, I have the following recomendations.

1. *Utilize the time spent in military service to much greater advantage.*

2. *Encourage increased productivity in education, through new methods and facilities being developed by private and corporate efforts all over the country, by allowing those spending their own earnings to double or triple their expenditures at the same net cost.*

3. *Introduce to each person a clear picture of what his attainments are, in each of the capabilities of the human being, and what they might be at his age. This may substitute for the more severe motivations that our freedom and productivity have eliminated.*

STATEMENT OF C. J. HENRY, CHIEF ENGINEER, THE PENNSYLVANIA RAILROAD CO.

In accordance with Mr. J. P. Newell's letter to you of April 26 in regard to bringing up to date the information presented by Mr. S. R. Hursh before your subcommittee in 1955 on the subject of automation, we are pleased to submit the following data which will bring up to date the information contained in Mr. Hursh's 1955 testimony, and will also reply to your specific questions as requested in the next to last paragraph page 2 of your April 19 letter.

1. Attached as exhibit A are writeups on several subjects, namely, highway grade crossing protection; centralized traffic control; hotbox detectors; interlockings; cab signal system and speed control, in which we have shown the extent to which these various facilities are in use on our system, their approximate cost, and our plans for their use in future years.

2. Generally, the text, detail description of the operation of the various apparatus in use, and conclusion drawn in Mr. Hursh's 1955 testimony are substantially the same. However we attach as exhibit B a two-page list of corrections and additional facilities that have been added which will bring the 1955 testimony up to date.

3. An item of interest, which was not covered in Mr. Hursh's 1955 testimony, but which has developed into an important feature of automation is the mechanization of work in the track, B. and B. and C. and S. departments on most of the railroads in the United States.

On our railroad we have spent approximately $6,400,000 since 1955 in acquiring machinery to enable us to mechanize all possible operations in our maintenance department so that cycle maintenance can be put in effect and resultant benefits obtained from increased efficiency of these operations.

4. As a result of our policy to increase our efficiency of operation by making use of the latest developments of mechanized machinery and equipment and to overcome the adverse effect of continually increasing labor costs it has been necessary to adjust our maintenance forces accordingly. This has resulted in a reduction of our group III employees.

5. However, the changeover from doing maintenance work by hand methods to the use of machinery, for most items of work, has resulted in upgrading a large percentage of our remaining group III employees, and has also resulted in a more stabilized force throughout the year. It is our policy to train our employees in the use of new machinery and equipment, in order that they may benefit from the higher rates of pay that apply to the operation of this equipment, and can also be used during the winter months in repairing and rehabilitating the machinery and equipment, resulting in stabilized employment.

6. It is our firm belief that your committee could render the greatest service to the general economy, by doing all in your power to assist

in enacting legislation that would put the entire railroad industry on an equal competitive basis with other forms of public transportation.

Following are the 10 suggestions, we feel if adopted, would be of considerable benefit toward accomplishing this desirable situation:

1. The Cabinet of the President of the United States should include a Secretary of Transportation.
2. All transportation should be taxed on an equal basis.
3. Suburban rail transportation in metropolitan areas should be incorporated in an overall program for personal transportation of all types, and operated under the direction of an integrated transportation commission without cost to the participating railroads.
4. Repeal the excise tax on passenger fares.
5. Remove all taxes from the deficit-ridden rail passenger facilities and stations.
6. Relieve railroads of the cost of improving highway safety by grade crossing protection and maintenance.
7. The right of one transportation company to engage in other forms of transportation.
8. The encouragement of mergers in the railroad industry.
9. Establish a commission to investigate the extent to which featherbedding is a burden on interstate commerce.
10. Establish a Government agency to lease equipment to railroads so that each of them can participate in furnishing a fair share of the fleet of rolling stock which will be needed in the years immediately ahead.

Exhibit A

Automation on the Pennsylvania Railroad

HIGHWAY GRADE CROSSING PROTECTION

The familiar and well-known flashing-light highway-railroad grade crossing signal is widely used on the Pennsylvania Railroad. Standard practice is to provide automatic operation of the signals by approaching trains on any track in either direction with sufficient warning time to permit highway traffic to clear the crossing.

During recent years the flashing-light signal has been supplemented by the use of the automatic short-arm crossing gate, which provides more positive protection, particularly in multiple-track territory where two or more trains may be approaching the highway crossing at the same time.

The automatic crossing gates are designed to descend across the highway, halting all highway traffic, upon the approach of a train on any track in either direction approximately 25 to 30 seconds before the train reaches the crossing. Automatic flashing-light signals provide a preliminary warning a few seconds before descent of the gates. There is no record of a fatal accident in the United States due to failure of automatic short-arm gates. Tremendous growth of highway traffic has greatly increased the demand for and cost of grade crossing protection.

Automatic highway crossing protection projects presently authorized, contemplated for completion during 1960, consist of the following:

High crossing	53
Estimated cost:	
Pennsylvania RR	$517, 364
States	$593, 389
Total cost	$1, 110, 753
Watchmen, crossing eliminated	37
Net annual saving	$138, 383
Percent of total Pennsylvania RR. expenditure	26. 7

The proposed automatic highway crossing protection, not presently authorized but in course of negotiation with State and local authorities for their approval, consists of the following:

Highway crossings	160
Estimated cost:	
Pennsylvania RR	$3, 474, 422
States	$731, 702
Total cost	$4, 206, 124
Watchmen, crossing, eliminated	264
Net annual saving	$842, 446
Percent of total Pennsylvania RR. expenditure	24. 2

It is contemplated the 160 projects above will be completed during 1961–63.

CENTRALIZED TRAFFIC CONTROL (RULE 261)

A term applied to a system of railroad operation by means of which the movement of trains over routes and through blocks on a designated section of track is directed by signals controlled from a central point without requiring use of train orders and without superiority of trains. "CTC" is the term used to designate the complete modern system to provide an economical means for directing the movement of trains by signal indication. Equipment in the field consists of remotely controlled power-operated switches, signals, and other apparatus, together with track circuits and all other components required in automatic block system and/or cab signal system, speed control, traffic control, and interlocking to provide single-track operation with complete safety and expeditious movement of trains. The first installation of this kind was made in 1927 on the Pennsylvania Railroad west of Indianapolis, Ind.

It is proposed to provide CTC on the single-track line, I. & F. Branch, southwestern region, between Davis and Lebanon, Ind., a distance of 24.7 miles, during 1960, in connection with operation of New York Central trains over this line to and from the new New York Central Avon Yard at Tremont, Ind.

The single-track project on the northern region, involving CTC between Rockville and Emporium, Pa., will be extended during 1960. Work between Rockville and Pine, a distance of 105 miles, has been completed, with the exception of the work in the Williamsport area which should be completed by mid-1960. The work from Pine (McElhatten) westward to Renovo and Emporium will be progressed as finances permit and the territory from Emporium to Buffalo, 121 miles, is now being studied for single-track (CTC) operation.

May 6, 1960.

CAB SIGNAL SYSTEM

In 1923 a continuous inductive cab signal system was devised and later placed in service on several divisions of the Pennsylvania Railroad. This system provides a signal in the cab in constant view of the engineman. It is continuously, electronically controlled to reflect track and traffic conditions ahead, permitting the engineman to safely take full advantage of the power and speed of modern equipment. A change to a more restrictive indication of the cab signal is accompanied by the sounding of a warning whistle, which is silenced only by the engineman acknowledging the change in the cab signal indication.

SPEED CONTROL

In addition to protecting train movement by wayside automatic signals and by cab signals, the Pennsylvania Railroad is providing speed control apparatus on its locomotives. This is the most recent development in the constant search for more effective means of insuring maximum safety in railroad operation. The speed control supplements the wayside and cab signals, automatically applying the brakes to stop the train if the engineman fails to control the speed in accordance with signal indication. If the signals indicate "stop," and the engineman fails to take immediate action to stop the train, the speed control device does. The only way the engineman can prevent the device from making an automatic brake application if the signal indication is other than "clear" is by immediately reducing the speed of the train to comply with the signal indication. He cannot interfere with a brake application, once the device initiates it.

Cab signal and speed control facilities now in service:

Automatic cab signals:	
Miles of road	1,374.8
Miles of track	3,614.9
Locomotives equipped	1,512
Multiple-unit cars equipped	393
Speed control: Locomotives equipped	433

As finances permit, it is proposed to extend the cab signal system from Pittsburgh to Chicago and from Indianapolis to St. Louis, a total distance of 730 road miles.

It is also proposed to equip all road passenger and road freight locomotives with speed control, and ultimately, as funds become available, to equip all multiple-unit cars with speed control.

INTERLOCKINGS

An interlocking is an arrangement of signals and switches so interconnected that their movements must succeed each other in proper sequence so that trains may be routed from one track to another with complete safety and a minimum of delay.

An interlocking was first installed in the United States on the Pennsylvania Railroad in 1870 at Trenton, N.J. The consolidation and remote control of interlocking plants has progressed rapidly in recent years. As an example, in the Philadelphia district switches and signals formerly operated by five interlockings are now handled by zoo interlocking.

At the present time there are 626 interlockings on the Pennsylvania Railroad, maintained by Pennsylvania Railroad forces, divided into the following types:

Automatic interlockings	16
All electric interlocking (manually operated)	61
Electropneumatic interlockings (manually operated)	156
Electromechanical interlockings (manually operated)	61
Mechanical interlockings (manually operated)	42
Remotely controlled interlockings (electric)	113
Remotely controlled interlockings (electropneumatic)	70
Remotely controlled interlockings in centralized traffic control system	107
Total	626

In addition to the 626 interlockings above on the Pennsylvania Railroad, maintained by Pennsylvania Railroad forces, there are approximately 90 interlockings on Pennsylvania Railroad track which are maintained by foreign railroads.

As noted in the tabulation above, there are a total of 306 automatic and remotely controlled interlockings at the present time.

During the next 5 years it is contemplated to convert 12 existing manually operated interlockings to automatic interlockings and 26 existing manually operated interlockings to remotely controlled interlockings.

COMMUNICATION SYSTEMS

The Pennsylvania Railroad has in use every type of communication practical for railroad operation having the largest privately owned and operated communication plant of any railroad in the world.

One of the most vital classes of service on the Pennsylvania Railroad today is the train dispatching and block telephone system which provides means of communication for all train movements with the block and interlocking stations and train dispatchers.

The types and classes of communication facilities in use on the Pennsylvania Railroad include mechanical and semiautomatic private branch exchanges, radio mobile service on tugboats, yard engines, worktrains and motor vehicles; radio commercial telephone service on passenger trains; inductive train communication on trains, yard engines and wayside stations; loudspeaker and public address systems in freight yards, freight and passenger stations; and teletypewriter system to handle message and traffic reports.

During the next 5 years it is contemplated that the mobile radio service will be expanded to cover yard operations in several freight yards not now provided; also, studies are being made to equip maintenance-of-way trucks, automobiles with radio, in order that this type of equipment will be in constant touch with wayside block and interlocking stations, greatly improving efficiency.

MAY 9, 1960.

HOT BOX DETECTOR

The hot box detector is an electronic trackside device, developed over the past 3 years, the purpose of which is to measure and record the heat given off by passing journal boxes.

An infrared heat-sensitive senser, located outside of each rail between the ties, is connected to an electric circuit in such a way that, when exposed to heat, it produces an electrical signal or impulse which is amplified about 100,000 times and transmitted to a nearby control point, block and interlocking station or yard office, where it will inscribe a pattern on graph paper, and can be arranged to sound an alarm and cause the wayside signal involved to assume the "Stop" indication. The scanners or sensers, located outside of each rail, are focused to scan the trailing side of each passing journal box as the train moves by. If any journal is running hot, the detector will so indicate, and necessary action will be taken to stop the train and correct the trouble or set off the car.

Twenty-one hot box detectors are in service at strategic points on the system at present.

Hot box detectors cost approximately $30,000 each.

It is planned to extend their use as conditions warrant, and as finances permit.

MAY 6, 1960.

EXHIBIT B

CONWAY CLASSIFICATION YARD

Page 1, last paragraph:

"Eastward and Westward Conway consists of 54 and 53 classification tracks respectively."

Page 2, third paragraph:

"The eastward yard was placed in service September 20, 1955, and the westward yard was placed in service April 15, 1957."

Page 2, fourth paragraph:

"The pattern of car classification undertaken at Conway supplants work formerly performed at many other terminals, with resulting improvement in freight service through the elimination of duplicate handling and classification. In addition to the benefits of improved service (freight movement has been quickened) the cost of classification work has been substantially reduced."

Page 4, paragraph 7:

"Dragging equipment detectors in advance of the hump were not installed."

Page 19, paragraph 4:
"Dragging equipment detectors were not installed."
Page 21: "Dragging equipment detectors were not installed."

CENTRALIZED TRAFFIC CONTROL

Pages 27–28:
First paragraph: OK.
Second paragraph: OK.
Third paragraph, change:
"On the Pennsylvania Railroad there are 10 installations of centralized traffic control on single track, over which trains are operated by signal indication in both directions. These installations involve 575 miles of track and 531 miles of road. The total cost of the 10 projects was approximately $6,464,717 averaging $11,240 per mile of track and $12,170 per mile of road."
Fourth paragraph, change:
"To the 10 projects on single track additional facilities were added and utilized so that on these 10 projects there are 109 interlockings now coordinated by centralized traffic control."
Fifth paragraph:
Change "76 interlocking plants" to "75 interlockings".

Removed:	
Berlin	Fort Wayne District.
East Jackson	Columbus District.
Jackson	Columbus District.
West Jackson	Columbus District.
Gem	Columbus District.
East Gem	Columbus District.
Installed:	
Roy	Harrisburg District.
Reed	Canton District.
Glencoe	Maryland District.
Walton	Cleveland District.
Maple	Cleveland District.

Sixth paragraph, change:
"In addition to the operation of 575 miles of track operated by signal indication in both directions on single track, there are 697 miles of track in multiple-track territory operated in both directions by signal indication." (Last sentence OK.)
Seventh paragraph:
"There are, therefore, 1,272 miles of track on the Pennsylvania Railroad operated by signal indication in both directions, 575 miles of single track controlled by centralized traffic control, and 697 miles of reverse signaling in multiple-track territory controlled by coordination of adjacent block stations."

58913—60——19

STATEMENT OF JOHN JOHNSTON, JR., PRESIDENT OF THE INSTRUMENT SOCIETY OF AMERICA, PITTSBURGH, PA.

My name is John Johnston, Jr., I am the president (1959–60) of the Instrument Society of America, with headquarters in Pittsburgh, Pa.

The request has been made of the society by the Subcommittee on Economic Stabilization of the Joint Economic Committee of the Congress of the United States to update and/or amplify testimony given before the subcommittee during hearings in Washington, D.C., on December 12, 1956.

At that hearing one of my predecessors in office, Mr. Robert T. Sheen, the 1955–56 president of ISA, in a statement presented to the subcommittee data on the specific growth of the field of automation and automatic controls, and bearing more directly on the role of the Instrument Society of America and its programs of service and education.

(Mr. Sheen's statement, together with those of other witnesses, will be found in U.S. Government Printing Office publication 85561, issued in 1957.)

It was submitted by Mr. Sheen in behalf of ISA that the need for scientific and engineering personnel was particularly pressing in the field serviced by ISA; namely, instrument-automation users and manufacturers.

I would like to emphasize that the same situation in this respect exists today as it did at the time of Mr. Sheen's statement. However, definite steps have been taken during the intervening 4 years to stimulate, organize, promote, and accelerate educational and training programs at all levels to help solve the shortage of skilled labor and technical experts on the industrial front, especially as it applies to instrumentation and automation. The supply still fails to meet the demand, however, so great is the growth in this newest of technologies.

Before I present some of this data let me say that today, as at the time of the 1956 hearings, the Instrument Society of America continues to be the only internationally recognized technical society in the United States exclusively and completely devoted to the interests and problems of instrumentation and automation. This is done through dissemination of information, the stimulation of educational facilities, and the development and establishment of standards and practices within the instrumentation technology. The concepts and equipment of this dynamic technology dominate our daily lives through strengthening our defense, increasing our national productivity and our standards of living.

Organized in 1946 with some 11 local sections, ISA had grown, at the time of the 1956 hearings, to 86 sections with about 10,000 members. As of June 1, 1960, it has grown to encompass 106 local sections in the United States and Canada, with approximately 12,000 members. At least four of its sections are student sections located in institutions of learning, and student members account for some 3 percent of ISA total membership.

In structure ISA is a technical society with membership open to all with an interest in the subjects of instrumentation and automatic controls. Its membership includes instrument, chemical, mechanical, industrial, electrical, electronic, and other engineering personnel; college professors; design and operating engineers; technicians; trained instrument mechanics; medical scientists and biological scientists; meteorologists; outer space and sea space scientists; chemists; and practically every range of activity or interest which, in any way, makes use of instrumentation.

A few of these ranges of interest and/or occupation cover such industries as chemicals and petroleum; metals and ceramics; rubber and plastics; pipe lines, both for gases and liquids; the railroads and the automotive field; pulp and paper; drugs; food; powerplants; the aeronautics and the missiles fields; communications; research and equipment manufacturing.

Some 40 percent of ISA's membership are engineers and technicians. About 30 percent are concerned with financial, business, sales, and production management. Educators account for about 10 percent, as do mechanics. The balance have miscellaneous interests.

Submitted with this statement is the society's latest organization chart, covering the 1959–60 period (exhibit No. 1). This replaces the chart submitted by Mr. Sheen during the 1956 hearings. It includes new committees in both the technical and industries departments, with a reallocation of responsible heads for other society activity.

The chart submitted by Mr. Sheen [exhibit No. 2, hearings on instrumentation and automation, 1956] covering the organization of the technical, industries, and standards and practices divisions, with one industry division shown for illustrative purposes is, in all essentials, the same.

The 1959–60 organization chart shows that the interests of the society embrace virtually all the fundamental areas of our economy. Each department is headed by an operating vice president. Also, you will note, the society has a number of district vice presidents who serve various areas of the United States and Canada to bring the society closer to its various sections.

Prior to the current year (1960), the Instrument Society of America had held one annual conference and exhibit. This year three such major conferences and exhibits were scheduled, with the same number for the year 1961. This expanded schedule also is under consideration for subsequent years.

The decision to increase the number of annual conferences and exhibits was reached so that ISA not only could broaden its field of service to members, but also to enable the society to keep abreast of the rapid progress in instrumentation; also to make its major conferences and exhibits more readily available to interested people throughout the United States and Canada.

During the year that Mr. Sheen gave his testimony (1956) ISA had instituted the holding of symposia, these latter covering applications and techniques in certain industries, or on certain single subjects. During subsequent years the number of ISA-sponsored symposia grew so that in 1957 four were held; with five in 1958, and six each in 1959 and 1960. In addition, ISA each year cooperates with other technical societies in presenting conferences and symposia.

On the national scale I have referred to the major conferences and exhibits. These cover the broad fields of application of instrumentation and automation. They serve both ISA members and industrial management. The major conferences and exhibits, the wholly sponsored conferences and symposia, and those in which ISA participates with other technical societies, are in addition to programs instituted by local sections.

While the major conferences cover broad fields of appplication, other conferences and symposia which ISA either sponsors, or in which it cooperates with other technical societies, cover applications and techniques in certain industries, or on certain single subjects.

Symposia held annually under ISA sponsorship cover chemical and petroleum instrumentation, gas chromatography, power instrumentation, instrumental methods of analysis, aerospace instrumentation, and pulp and paper instrumentation. Biennially ISA sponsors a symposium on nuclear instrumentation.

ISA participates with other technical groups in the annual conference on electrical techniques in medicine and biology, and in the national telemetering conference. During midsummer 1960, ISA also was one of the technical societies sponsoring the First Congress of the International Federation of Automatic Control (IFAC), held in Moscow, U.S.S.R. Later this year ISA is cosponsoring the First Joint Automatic Control Conference, in Cambridge, Mass.

Under ISA's expanded schedule of major conferences and exhibits, the first was held in Houston, Tex., in February this year. The summer conference and exhibit is to be held in New York City's Coliseum in conjunction with the society's 15th annual meeting during the last week in September. During 1961 the program calls for major conferences and exhibits in St. Louis, in January; in Toronto, Canada, in June; and in Los Angeles, in September, in conjunction with the society's 16th anual meeting.

Accompanying (exhibit No. 2) is a chart showing major conference and exhibit attendance from 1946 through 1959, with—from 1957 on—attendance at ISA wholly sponsored symposia included. Also on the chart is given the actual attendance for major conferences and exhibits and symposia up to June 1, 1960. A dotted line rising from the 1959 line to the 1960 line shows the expected total of attendance at all society-sponsored conferences and symposia for the current year.

Indicative of the interest in an annual ISA conference and exhibit is the breakdown of attendance at the 13th international conference and exhibit, held in Philadelphia in 1958 (exhibit 2–A). This shows both industry and positions of attendees.

It was announced at the time of the 1956 hearings that there was in the process of organization the Foundation for Instrumentation Education and Research (FIER), the chief work of which "will be largely conceptional and catalytic to stimulate, organize, and promote educational programs at all levels," and that support of FIER would come largely through donations from industry with some assistance from foundations.

FIER was created through the vision and effort of planners within ISA in order to mobilize an extra-society philanthropic force on the broad problem of establishing instrumentation as a recognized academic and career technology.

During the 3 years since its organization FIER has accomplished much along these lines. In the spring of 1959 the foundation launched a program of graduate fellowships in instrumentation, with six awards for a year of graduate study. In the spring of 1960 the foundation announced 14 fellowships and, in addition, 2 grants to college teachers for an in-industry study in instrumentation, and its first research project grant. Funds for the fellowships come largely through donations from industry.

Coincident with this activity on the part of the foundation to aid in education so as to fill the need for increasing numbers of scientists, engineers, and technicians, I would like to submit a report issued by FIER's executive director, Lloyd Slater, on a just completed resurvey of graduate schools in an effort to gain a total picture of graduate education in its field.

An initial survey was made in 1957, just after FIER was organized. The present resurvey shows a 33 percent gain in activity since then. This resurvey is published in the July 1960 issue of the ISA Journal. It is presented (exhibit No. 3).

The most striking thing this resurvey reveals is the quantitative growth of graduate education in the technology of instrumentation and automatic control in a 3-year period. Also, the resurvey indicates that while the number of courses has increased by one-third over a 3-year period, there is a parallel gain of over one-half in student enrollments. To quote Mr. Slater's report:

> Thus we behold a measure of academic progress in a new technology which suggests the remarkable rate of over 10 percent growth per year.

I have touched upon the Foundation for Instrumentation Education and Research. The society of which I have the honor to be president for the year 1959–60 does not neglect its own responsibility to further education. Local sections of the society are encouraged—indeed, they are charged with a responsibility to program educational activities for their membership. Nearly 75 percent of the sections and districts now have educational chairmen who, working with the national society, foster training and education for careers in instrumentation through provision of course outlines, visual aids, texts, and other material to companies and schools.

Recognition and acknowledgment of contributions and services by individuals to the society and to the science and technology of instrumentation has been set up by the Instrument Society of America in a series of society honors and awards.

What is the outlook for the instrument industry? During the past decade, and more especially within the past 4 years, it has been called upon to provide new and unusual devices, to improve the reliability of existing devices, to reduce them in size, to simplify their operation—to make them operate faster so that much more can be accomplished in less time. This is especially true in the field of computers.

Certain areas of use in addition to lightness of weight, compactness, and reliability require extreme ruggedness while still functioning at far greater efficiency. This has been found to be true in the space age. Instruments have had to be devised to meet the ever-increasing demands of nuclear processing and product use.

Scientists and engineers have increasingly recognized their dependence on measurements and hence on instruments to provide them with the information they require to conduct research or do plant control work.

Instrument manufacturers have kept pace with the demands made upon them so that the scientist today can choose from an almost bewildering array of instruments, but there are many instruments as yet undeveloped. High pressures and very high temperatures as well as high forces all figure in space research, both with regard to missiles and the planned flight of human beings. Manufacturers, working in a competitive economy, are developing the required instrumentation.

In this respect I quote from an article by Charles W. Covey, editor of the ISA Journal, the society's official publication. Writing in the January 1960 issue, Mr. Covey said:

> From sampling of industrial plans for research expenditures in 1960, it is evident that more and more industrial firms are plowing back increasingly higher proportions of income for research and development. * * * For the instrument profession this has three significant points: First, it means that measurement and control will be accorded increased recognition both in the laboratory and the plant; second, it means increased markets for the instrument manufacturer; third, it means sizable increases in manpower to design, build, install, and maintain measurement equipment needed for research and development.

From Government sources it is reported by the Business and Defense Services Administration of the U.S. Department of Commerce under date of December 30, 1959, that—

> Sales of scientific and process control instruments are expected to reach $4.5 billion in 1960, representing about a 15-percent increase over the $3.9 billion estimated for 1959. * * * Most of this increase will occur in the process control instrument field because of significant increases in plant and equipment expenditures by the chemical and petroleum refining industries (18 percent) and the ferrous and nonferrous metals industries (56 percent). A larger portion of these capital outlays is expected to be devoted to modernization in 1960 than in previous years, pointing to a higher ratio of instrument sales per dollar of capital investment. Spending for laboratory facilities in 1960 by Government and private industry is expected to total the same as in 1959.

In the Monthly Business Statistics published in the June 1960 issue of Survey of Current Business by the Office of Business Economics, U.S. Department of Commerce, it was stated that for instruments and related products the index, based on 1957 equals 100, had risen from 106 in April 1959, to 120 in December 1959, and that the preliminary figure for May 1960, was 119.

In the pamphlet "Manpower—Challenge of the 1960's," issued by the U.S. Department of Labor, James P. Mitchell, Secretary (U.S. GPR: 1960-0-535337) the statement is made:

> Our manpower potential is great enough, with an improved technology, to increase the production of goods and services by about 50 percent from 1960 to 1970.

To this I heartily subscribe, and I underscore the words "* * * with an improved technology * * *." I submit that, in addition to education at the college and graduate level, there also must be an education of the current work force at all levels, so that positions of greater responsibility can be assumed by workers in this rapidly expanding age of instrumentation-automation.

This means, in the case of current workers, education of potential users of instrumentation-automation equipment so that the equipment can be introduced and utilized more effectively.

While management is more and more becoming aware of the value of instrumentation, management still needs a greater awareness as to what instrumentation can do, and how it should be applied. It is through such things as the programs of our society—and of many other groups studying and striving toward the objective of the development of future scientists and engineers, and the enlightenment of the present work force and of management—that progress has been made.

Access to know-how on what has been done, or on how something might be done; what equipment is available, and how it can be operated, is being provided by ISA through many sources. The society's programs of conferences and exhibits; its symposia; its management and maintenance clinics, and its many and varied publications. Each year we can report progress. We expect that we can and will play an increasing role in this work.

Previously I gave the reasons which prompted the Instrument Society of America to expand from one to three major conferences and exhibits a year. One was that technical information is constantly being added to and to keep society members up to date required more frequent and more readily available places for exchange of information and for viewing the newest in instrumentation and concepts.

Publications of the society reflect the explosive advances of instrumentation during the past several years. Recognition of the status of the ISA Journal as the principal technical magazine in the United States in the field of instrumentation and control has been attested by increases in circulation and advertising. The ISA journal is the official publication of the Instrument Society of America and is issued monthly. Membership in ISA carries with it a subscription to the ISA Journal. Nonmembers also can receive the ISA Journal through subscription, and its circulation far exceeds ISA membership.

Editorial content of the magazine has expanded so that its coverage includes such new areas as aerospace, underwater, weather, machine-tool, nuclear, and medical instrumentation.

The high-level symposia, which explore in great depth such specialized knowledge as gas chromatography (a chemical analysis technique); electrical safety in hazardous areas and nuclear instrumentation, have generated bound proceedings which give ready access to a body of specialized knowledge in convenient form.

The society also has allocated annual funds for the initiative during 1960 of instrumentation transactions. These transactions sift through the many reports, papers, and documents concerned with ISA's field of interest and record in enduring form for wide dissemination, those contributions to the technology of instrumentation-automation, those that are regarded as mature and worthy.

Other elements of ISA's publications program deal with the issuance of uniform codes of practice and procedures through the society's standards and practices department. These are intended to provide cost and time savings by encouraging uniformity in the more developed and stable areas of the technology. These standards and recommended practices are available to government, industry, and manufacturers.

For instance, to provide industry with an invaluable reference, the work of the ISA's Standards Committee on Wiring for Hazardous Locations resulted, during 1959, in publication of a comprehensive "Electrical Safety Abstract." This covered 251 full abstracts, 356 references, and 116 pages on the principles and practices of electrical safety, including all important material on explosion hazards, intrinsic safety and the electrical ignition of gases, vapors, and dusts published since 1920.

To cope with the dearth of trained specialists in the field, ISA as I have said, is encouraging educators to present instrumentation courses. To further this objective lecture notes and study guides have been published and distributed by the society.

Among the more specialized publications is a "Transducer Compendium" now in preparation which catalogs the characteristics of the thousands of transducers (instrumentation system components) now commercially available, and makes known the suppliers.

Still another aspect of the society's publication program is the translation of four Russian technical journals covering instrumentation. Now in its third year, and working under a grant from the National Science Foundation, and undertaken as a service to American science and industry, the ISA "Soviet Instrumentation and Control Translation Series," affords an excellent means for U.S. scientists and engineers to become better informed on the latest developments in the field of Soviet instrumentation, measurement, and automatic control. The four translated publications include "Automation and Remote Control," "Instruments and Experimental Techniques," "Measurement Techniques," and "Industrial Laboratory."

With Russian technological advances the society believes it must provide the community of instrument engineers in the United States with a knowledge of the progress of their Soviet counterparts.

Finally, at all major conferences and exhibits the technical papers delivered at the many sessions are made available, not only to ISA members, but those nonmembers attending, preprints of each paper. Many of these are made available for publication by technical and trade and industry publications not allied with the society.

I am sure that it is apparent to Congress, as it is to industry and to research, that instrumentation-automation is an essential, both to our domestic economy and to the national defense, and that preparation for instrumentation-automation should be a common goal, not only of management and labor, but of our educators and our Government.

I express the hope that Government and business—classifying business on a broad base—will have a more effective exchange of information regarding instrumentation-automation, so that this technology can be used in as effective a way as possible to enhance both our national economy and our national defense.

For instance: The military can contribute much to industry, and industry can go far in making available its industrial ideas and techniques through some form of central clearinghouse for the rapidly accumulating store of information and knowledge. Through such a central clearinghouse, duplication of time and effort by workers in both industry and the military can be avoided. There have been many instances of two or more groups each working on a similar project, each striving to achieve a common result, but each working without a knowledge of the work of the other. This is waste. Efforts have been made from time to time to avoid this situation, and while much has been accomplished, much more remains to be done.

Briefly stated there are four basic needs that exist today as they did 4 years ago. These are:

(*a*) Education of the current work force; (*b*) movement of more and more engineering and science student graduates into our technological environment; (*c*) an increase in the efficiency of each worker through the availability of instrumentation services and, (*d*) enhancement of the effectiveness of each person in activity through a broader base of communications as to instrumentation techniques and equipment.

Some of these basic needs are being met to an ever-increasing degree as I have indicated, but to obtain a still more efficient meeting of our major needs the same seven steps recommended by Mr. Sheen in 1956, need to be taken. Mr. Sheen recommended that there be:

1. Improvement of curriculums and training of teachers in high schools;
2. The development of technical institutes for vocational training;
3. The establishment of engineering extension services in the land-grant colleges;
4. Effective utilization of the military training period;
5. Enhancement of the programs in the National Science Foundation and in the Foundation for Instrumentation Education and Research;
6. A more active role by the National Bureau of Standards in communication of information, the development of a national information instrumentation-automation center; and
7. A series of systematic military-industrial cooperative studies and liaison activities.

Steps have been taken by several organizations in the matter of the recommendation under point No. 7. The Armed Services Technical Information Agency set up such a program. These efforts are to be commended, but they should be accentuated with the potential users of such service being given a voice in the determination of the machinery and mechanics of operation of an effective information service.

Committees and conferences can provide communication, cross-fertilization, and definitions of problems and ideas, with industry receiving knowledge of militarily developed techniques and equipment, and with the military gaining an appreciation of the requirements of the industrial environment.

I can only repeat that the Instrument Society of America will be most happy to cooperate in any way that it can be furnishing individual representation for any group that will be organized—such as an Instrument-Automation Commission for Effective Productivity and Research, as was suggested by Mr. Sheen.

Our society likewise will be most happy to furnish statistical information, or to contribute in any way possible through our membership and the agencies of our national headquarters, in the studies of the problems faced by our Nation to solve the four basic needs I mentioned previously.

Should such a commission, or task force be formed by Congress or some other proper administrative body of the Government, it should have representative membership from such organizations as the Department of Defense; the Foundation for Instrumentation Education and Research; Land Grant Colleges Association; the Department of Commerce; the American Society of Engineering Education; the Instrument Society of America; the Engineers Joint Council, and from the National Science Foundation.

Your committee, under the Employment Act of 1946, was not given legislative power, instead it was to hold hearings on the subject of automation and technological change. It has held hearings and heard testimony from time to time, and has made available to the Members of the House and Senate the testimony adduced at these hearings.

While considerable progress has been made since the 1956 hearings, it is my belief that necessity for some form of action—possibly the enactment of legislation along certain lines which have been stressed at previous hearings—has become increasingly acute enough, probably, so that the committee could in some respects make recommendations to the legislative committees of Congress. The situation faced by the United States with respect to its national economy and its national defense has in no way eased with the passage of years.

In closing I can only repeat a comment made by Hon. Wright Patman, vice chairman of the Joint Economic Committee, and chairman of the Subcommittee on Economic Stabilization, at the conclusion of the testimony of a witness at the hearing held on the morning of December 12, 1956:

> * * * I state flatly at this moment that automation is being held back and our national security is being jeopardized by the existence of a lack of solution of these problems. * * * we cannot emphasize the solution of these problems too much.

EXHIBITS ACCOMPANYING STATEMENT BY JOHN JOHNSTON, JR., PRESIDENT (1959–60) OF THE INSTRUMENT SOCIETY OF AMERICA

Exhibit No. 1. Organization chart of the society.
Exhibit No. 2. Attendance (1946–60) at society's conferences and exhibits and symposia.
Exhibit No. 2–A. Attendance statistics for a major conference and exhibit of the society.
Exhibit No. 3. Resurvey of university graduate courses in technology of instrumentation and automatic control, made by Foundation for Instrumentation Education and Research (3 pp.).

EXHIBIT 1

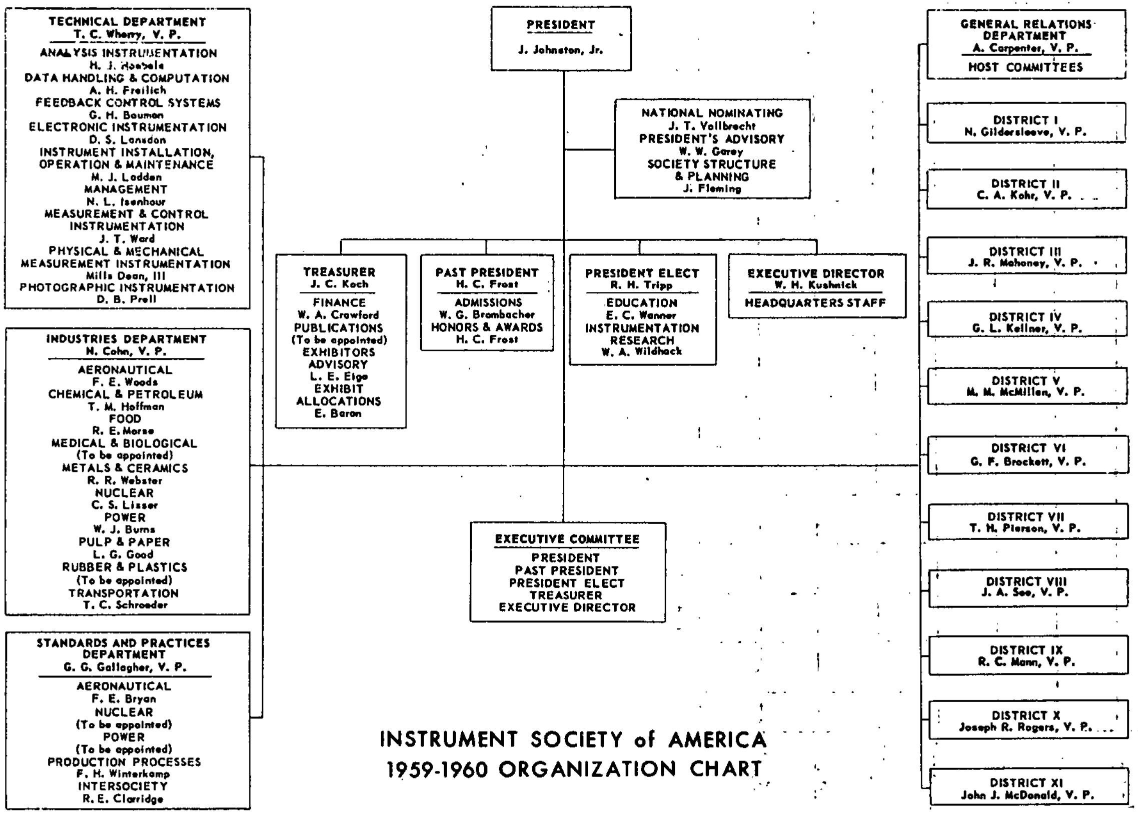
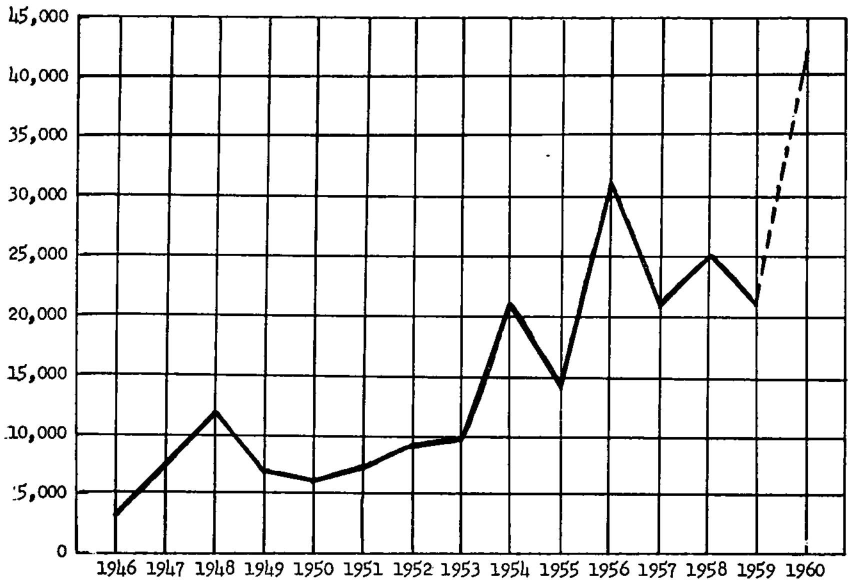

TECHNICAL DEPARTMENT
T. C. Wherry, V. P.
ANALYSIS INSTRUMENTATION
DATA HANDLING & COMPUTATION
A. H. Freilich
FEEDBACK CONTROL SYSTEMS
G. H. Bouman
ELECTRONIC INSTRUMENTATION
D. S. Lonsdon
INSTRUMENT INSTALLATION, OPERATION & MAINTENANCE
M. J. Ladden
MANAGEMENT
N. L. Isenhour
MEASUREMENT & CONTROL INSTRUMENTATION
J. T. Ward
PHYSICAL & MECHANICAL MEASUREMENT INSTRUMENTATION
Mills Dean, III
PHOTOGRAPHIC INSTRUMENTATION
D. B. Prell
INDUSTRIES DEPARTMENT
N. Cohn, V. P.
AERONAUTICAL
F. E. Woods
CHEMICAL & PETROLEUM
T. M. Hoffman
FOOD
R. E. Morse
MEDICAL & BIOLOGICAL
(To be appointed)
METALS & CERAMICS
R. R. Webster
NUCLEAR
C. S. Lisser
POWER
W. J. Burns
PULP & PAPER
L. G. Good
RUBBER & PLASTICS
(To be appointed)
TRANSPORTATION
T. C. Schroeder
STANDARDS AND PRACTICES DEPARTMENT
G. G. Gallagher, V. P.
AERONAUTICAL
F. E. Bryan
NUCLEAR
(To be appointed)
POWER
(To be appointed)
PRODUCTION PROCESSES
F. H. Winterkamp
INTERSOCIETY
R. E. Clarridge
PRESIDENT
J. Johnston, Jr.
NATIONAL NOMINATING
J. T. Vollbrecht
PRESIDENT'S ADVISORY
W. W. Garey
SOCIETY STRUCTURE & PLANNING
J. Fleming
TREASURER
J. C. Koch
FINANCE
W. A. Crawford
PUBLICATIONS
(To be appointed)
EXHIBITORS ADVISORY
L. E. Eige
EXHIBIT ALLOCATIONS
E. Baron
PAST PRESIDENT
H. C. Frost
ADMISSIONS
W. G. Brombacher
HONORS & AWARDS
H. C. Frost
PRESIDENT ELECT
R. H. Tripp
EDUCATION
E. C. Wanner
INSTRUMENTATION RESEARCH
W. A. Wildhack
EXECUTIVE DIRECTOR
W. H. Kushnick
HEADQUARTERS STAFF
EXECUTIVE COMMITTEE
PRESIDENT
PAST PRESIDENT
PRESIDENT ELECT
TREASURER
EXECUTIVE DIRECTOR
GENERAL RELATIONS DEPARTMENT
A. Carpenter, V. P.
HOST COMMITTEES
DISTRICT I
N. Gildersleeve, V. P.
DISTRICT II
C. A. Kohr, V. P.
DISTRICT III
J. R. Mahoney, V. P.
DISTRICT IV
G. L. Kellner, V. P.
DISTRICT V
M. M. McMillen, V. P.
DISTRICT VI
G. F. Brockett, V. P.
DISTRICT VII
T. H. Pierson, V. P.
DISTRICT VIII
J. A. See, V. P.
DISTRICT IX
R. C. Mann, V. P.
DISTRICT X
Joseph R. Rogers, V. P.
DISTRICT XI
John J. McDonald, V. P.
INSTRUMENT SOCIETY of AMERICA
1959-1960 ORGANIZATION CHART

EXHIBIT 2



Attendance At I S A Annual
Conferences and Exhibits and
Symposia - 1946 - 1960 *

(*) Dotted line rising from 1959 line up to the 1960 line is estimate of total attendance for all ISA Conferences and Exhibits and Symposia during year. Up to June 30, 1960 actual attendance figures for ISA-sponsored meetings during the year has been over 12,000.

Exhibit 2A

ATTENDANCE STATISTICS

13th Annual Instrument Automation Conference and Exhibit (International)

Philadelphia Convention Hall • September 15-19, 1958

By INDUSTRY and POSITION

	General Management	Chief Engineer	Director of Research	Research Engineer	Chemical Engineer	Chemist	Electrical Engineer	Mechanical	Instrument Engineer	Instrument Foreman	Instrument Technician	Maintenance Manager	Maintenance Engineer	Production Manager	Process Engineer	Physicist	Mathematician	Test Engineer	Metallurgical	Engineers-General	Teaching	Student	Purchasing	Sales & Advertising	Miscellaneous	Total
Aircraft-Missiles	97	25	6	57	6	9	103	82	141	27	56	3	1	10	6	19	10	52	2	44	2	12	25	143	84	1022
Atomic-Nuclear	23	2	2	14	5	1	29	22	44	7	12	2	3	1	1	17	—	3	1	10	2	1	2	23	14	241
Automotive	10	2	1	5	—	—	3	7	4	1	1	1	—	—	3	3	—	3	1	2	—	—	—	6	5	58
Chemicals	56	23	13	69	119	121	46	46	271	58	113	10	25	10	27	34	1	2	8	36	1	5	21	97	59	1271
Communications	53	10	2	21	4	2	63	15	11	—	16	3	5	—	5	2	3	14	1	18	7	23	3	51	27	359
Design-Engrng-Constrs	52	33	8	19	17	4	39	62	67	4	10	3	3	3	5	3	—	3	2	22	1	11	6	42	24	443
Drugs-Medicines	4	3	1	4	12	16	2	4	7	5	8	6	2	6	2	—	—	1	1	2	4	9	2	4	19	124
Education	18	—	3	9	—	6	8	1	7	—	8	—	2	—	1	5	1	2	—	—	125	117	2	6	14	335
Engrng Consultants	51	8	4	10	4	—	25	25	25	—	3	—	—	1	2	3	3	2	—	10	1	2	2	59	9	249
Electrical Eqpmt	219	62	10	47	4	4	290	98	47	15	45	6	3	8	11	19	6	19	5	39	3	17	37	549	89	1652
Food-Beverages	14	9	3	6	7	12	8	10	15	5	18	1	4	2	7	—	—	—	—	6	—	4	1	7	11	150
Glass-Ceramics	8	1	3	8	3	—	5	3	18	3	12	—	3	1	8	2	—	—	1	4	—	—	4	10	10	107
Govt-Military	32	15	11	71	19	40	89	51	45	10	77	1	14	3	9	69	14	25	6	25	23	8	14	15	143	829
Industrial Mchry	85	35	5	30	7	—	29	83	18	4	5	2	3	8	13	—	—	7	1	27	1	2	11	203	28	607
Instrument Mfg	732	171	64	168	32	19	240	153	339	50	113	11	16	69	28	25	4	44	7	191	12	29	49	2581	404	5551
Paper-Wood	13	5	2	3	1	3	9	13	31	7	15	2	5	5	2	2	—	1	—	7	—	1	—	20	11	158
Petroleum	22	10	4	33	45	41	39	57	131	43	60	4	17	—	11	16	2	4	4	33	2	4	12	25	32	651
Research Orgztn	34	5	13	113	13	36	47	40	25	7	51	3	1	3	3	51	4	9	3	11	1	10	7	25	33	548
Rubber-Plastics	15	7	4	6	6	3	7	8	6	4	7	1	2	3	5	1	—	2	—	2	—	1	1	34	12	137
Steel-Metals	47	16	3	24	2	6	26	26	22	24	25	11	16	5	1	2	1	5	22	31	—	4	3	89	33	444
Textiles	8	7	2	11	5	5	5	4	14	3	5	—	3	2	4	5	—	1	—	7	1	3	7	3	4	109
Transportation	5	3	—	2	—	—	2	5	6	—	—	—	3	—	—	—	—	2	—	10	1	—	—	27	20	86
Utilities-Power	17	5	1	11	5	—	27	59	20	21	39	1	3	—	1	—	—	33	4	15	—	1	—	14	15	292
Utilities-Water & Swg	10	3	1	1	2	2	9	11	5	1	1	1	3	2	—	—	—	—	—	10	—	—	1	13	7	83
Miscellaneous	264	36	12	27	16	17	42	65	43	17	29	14	15	10	5	8	3	13	2	53	15	70	16	654	585	2031
CERTIFIED TOTALS	**1889**	**496**	**178**	**769**	**334**	**347**	**1192**	**950**	**1362**	**316**	**729**	**86**	**152**	**152**	**160**	**286**	**52**	**247**	**71**	**615**	**202**	**334**	**226**	**4700**	**1692**	**17,537**

Exhibitors' plant employees from Pennsylvania and New Jersey 5,863

Students from Pennsylvania University and various student conference groups 475

TOTAL ATTENDANCE 23,875

EXHIBIT No. 3

[From ISA Journal]

FOUNDATION FEEDBACK

(A report of FIER activities by its executive director, Lloyd Slater)

FIER resurvey of graduate schools reveals:
A 33-percent gain in activity since 1957.
Growing interdisciplinary emphasis.
Expanding interest in the Ph. D. degree.

In the December 1957 issue of the ISA Journal (pp. 577–578) the Foundation for Instrumentation Education and Research published a summary of the results of its first nationwide survey of university graduate courses in the technology of instrumentation and automatic control. This issue of the Journal now take a look at this field of education 3 years later.

1957 GAVE ONLY A PARTIAL VIEW

The 1957 survey, of necessity, presented only a partial view of activity in this field by the schools. Ninety of the major institutions were contacted by mail, bringing in 64 responses. Of these, 44 listed two or more graduate courses in instrumentation and automatic control and were tabulated in FIER's report. Unfortunately, several major universities did not return information, hence were not included in this table.

The present resurvey is an attempt by FIER to gain a total picture of graduate education in its field. This time, questionnaires were sent to 133 schools and, after a reasonable amount of followthrough, information gleaned from 128. Among those missing, however, were some schools with well-known activity in this technology (e.g., University of Delaware, Wayne State University). Of the 128 responding, 108 listed at least one or more graduate courses in instrumentation and control. Also note that four of those replying "no courses" did qualify their answer by indicating near future development in this field (University of Dayton, Johns Hopkins, University of Massachusetts, University of Nevada).

HOW 1960 TABULATION WAS MADE

The next two ISAJ pages summarize the 1960 survey. On the facing page are schools replying in 1957, with an analysis of their growth in number of courses and students handled. One basic change from the 1957 technique was made: in 1957 the courses offered were grouped into 12 subject areas in order to analyze the technical "spread" in various schools; this year the courses are grouped according to departmental orientation. This new approach avoids the subjective pitfalls of trying to "pigeonhole" courses, and gains some insight into how this field is developing in disciplines other than electrical engineering.

The tabulation on the third page presents data from nonrespondents to the 1957 survey (or schools which responded too late to be included). Because of space limitations, this table lists only schools offering three or more courses in this field; hence 19 respondents with two courses are omitted. Also, the two excellent Canadian universities that answered are not listed: McGill University with three offerings in control engineering, and University of Toronto with four courses, including one in process control dynamics in the chemical engineering department.

PROGRESS: 10 PERCENT PER YEAR

Perhaps the most striking thing the resurvey reveals is the quantitative growth of graduate education in this technology in 3 years. To highlight this the number of courses and student enrollments are totaled at the end of the facing table (Note: when a school reported no data on number of student enrollments in either 1957 or 1960, both figures were omitted in the addition). Roughly speaking, it appears that the number of courses has increased by one-third with a parallel gain of over one-half in student enrollments. There is no doubt that this general growth could also be extrapolated to include the schools listed in the tabulation on the third page. Thus we behold a measure of academic progress in a new technology which suggests the remarkable rate of over 10 percent growth per year. Incidentally, we suspect that this growth rate is not uniform, but exponential in character (e.g., 5 percent in 1958; 10 percent in 1959; 15 percent in 1960).

CROSSING TRADITIONAL BOUNDARIES

Instrumentation and control technology, its practitioners know, is deeply rooted in all fields of engineering and science. Clearly this fact is being increasingly appreciated in our universities. Until a few years ago, the bulk of courses at graduate level in this technology were centered in electrical engineering departments. As the tabulations show, we now have signs of a substantial growth in instrumentation and control courses within mechanical, chemical and industrial engineering departments.

Another earmark of interdisciplinary progress in instrumentation and control are the integrated graduate programs set up in some of the schools. While only two—Case Institute and Michigan—are clearly shown in the tabulation, there is growing activity of this nature at several others. Noteworthy programs are developing, for example, at Harvard, Northwestern, M.I.T., Purdue, N.Y.U., University of California, and Princeton.

FINALLY—THE PH. D.

Apparently, the most sought after academic commodity by industry and the military today is the man who has achieved his doctorate degree in some advanced area of instrumentation and control. In 1957, only a handful of Ph. D.'s qualified in this field emerged from the universities. The 1960 FIER survey shows that fully 47 schools are now prepared to offer the Ph. D. to students specializing in this technology. It seems reasonable that we plan on a minimum of 100 graduating with this degree in our field in 1963.

58913—60——20

Postgraduate Courses in Instrumentation and Automatic Control, 1960

Updating of the FIER 1957 survey

Institution [1]	Changes since 1957: Number courses offered, 1957	Number courses offered, 1960	Number students per semester, 1957	Number students per semester, 1960	Departmental emphasis of courses in field (number courses offered per department): Electrical Engineering Department	Mechanical Engineering Department	Chemical Engineering Department	Aeronautical Engineering Department	Industrial Engineering Department	General Engineering Department	Others	Offer Ph. D. in this field?
Air Force Institute of Technology	3	8	45	144	7						Math 1	
University of Alabama	2	4	43	75	2		1			1		
University of Arizona	6	8	150	262	8							X
University of Arkansas	3	7	55									
Brooklyn Polytech Institute	18	24	483	796	23	1						X
University of California (Berkeley)	6	8	55	225	6	2						X
Carnegie Institute of Technology	7	8	130	129								X
University of Connecticut	13	16	331	350	15						Civil 1	X
University of Florida	13	10	71	100	8		2					X
Georgia Institute of Technology	7	7		64	6						Cera 1	
Harvard University	5	7		124						7		X
University of Idaho	6	6	17	32	3		3					
Illinois Institute of Technology	4	9	21		4		1			2	Math 2	
Iowa State University	2	8	24	80	3	2	1			2		X
Lehigh University	4	3		32	1		1		1			X
Louisiana State University	2	2		50			2					
Michigan State University	5	9	215	320	5	2	1			1		
University of Michigan	34	22			(2)	(2)	(2)	(2)	(2)	(2)	(2)	
Newark College of Engineering	13	25	203	147	15	3	3			3	Phys 1	
University of New Mexico	3	9			9							X
Northeastern University	3	7	28	190	4	2				1		
Northwestern University	9	24			17	3			2	2		X
University of Notre Dame	5	9	220	90	6	1	1			1		
Ohio State University	2	6	42	50	3	2	1					
Oklahoma State University	7	13	105	520	6		2				Civil 1	
University of Pennsylvania	12	15		290	15							
Pennsylvania State University	8	6	158	240	6							
Princeton University	9	6	79	55	3		1	1			Plas 1	
Purdue University	7	15	110	300	9	4		1	1			
Rensselaer Polytechnic Institute	12	16	371	450	7	5	1				Chem 3	
University of Rochester	4	8	26	100	8							
Rutgers University	3	5	57	47	5							

St. Louis University	4	7	35	170						7		
University of Southern California	8	11	319	400	9	1	1					X
Southern Methodist University	10	14		245	12						Math 2	
Stanford University	12	19	244	260	8		1	2	5		Math 3	
University of Tennessee	6	25	48	430	10		12				Phys 3	X
University of Texas	8	8	117	134	4	2	2					X
Texas A. & M.	9	5	97	42	5							X
University of Virginia	3	5		28	2		3					X
Virginia Polytechnic Institute	4	4	31	50	1	2	1					X
University of Wisconsin	8	12	149	200	9	1	2					X
Yale University	2	7	40	100	7							X
Summary analysis	311	446	4,026	6,477	271	27	43	4	9	27	[3]	27

[1] These respondents were tabulated in the December 1957 listing published in the ISA Journal, p. 578.
[2] All courses in instrumentation graduate program.
[3] Total number of courses, 19.

New respondents—Not included in 1957 survey

Institution [1]	Size program: Number courses offered	Size program: Number students per semester	Departmental emphasis of courses in field: Electrical Engineering Department	Mechanical Engineering Department	Chemical Engineering Department	Aeronautical Engineering Department	Industrial Engineering Department	General Engineering	Other	Offer Ph. D. in this field?
Auburn University	4	75	4							
California Institute of Technology	6	110	3			2		1		X
Case Institute	27		(2)	(2)	(2)	(2)	(2)	(2)	(2)	X
City College of New York	15	256	9	4	2					
Clarkson College of Technology	3	35	1	1	1					
Columbia University	24	600	20	1	3					X
Cornell University	11	200	6	4	1					X
University of Denver	4	29	4							
Drexel Institute	13		8						Bio-el 5	
Duke University	3	60	2	1						
George Washington University	3	30	3							
University of Houston	5	55	3				2			
University of Illinois	4	43	4							X
State University of Iowa	5	22	2	2	1					X
University of Kansas	3	40	3							X
Kansas State University	13	180	7	2	3				Math 1	X
University of Kentucky	4	85	4							
Louisiana Polytechnic Institute	5	34	4		1					
Marquette University	3	15	3							
University of Maryland	5	115	5							X
Massachusetts Institute of Technology	27	300	12	5		10				X
Michigan College of Mining and Technology	16	200	3		5			5	Math 3	
University of Minnesota	5	65	2	1	1				Math 1	X
Mississippi State University	4	44	4							
Missouri School of Mining and Technology	3	25	2		1					
University of Missouri	5	100	3	1	1					X
Montana State College	8	130	5		3					
New Mexico State University	8	71	6	2						X
New York University	18	400	8	1			4	2	Math 3	X
University of North Carolina	5	80	5							X

North Dakota State College	5	51	3	1			1			
Ohio University	3	100	3							
University of Oklahoma	4	135	2	1	1					X
Oregon State College	4	38	3						Chem 1.	X
University of Pittsburgh	18	335	13	2	3					
University of Rhode Island	5	15	4		1					
Utah State University	3	50	3							
University of Utah	3	36	3							X
University of Vermont	4	50	4							
Washington University	6	120	6							X
University of Washington	10	150	5	5						X
Washington State University	4	55	3		1					
Worcester Polytechnic Institute	5	44	4						Phys 1	
University of Wyoming	3	56	2	1						

[1] Answered survey listing 3 or more courses.
[2] All courses in instrumentation, graduate program.

STATEMENT OF CHALMER G. KIRKBRIDE, VICE PRESIDENT IN CHARGE OF RESEARCH AND ENGINEERING, SUN OIL CO.

On December 13, 1956, I appeared before the Subcommittee on Economic Stabilization of the Joint Economic Committee and presented my views on the status and outlook for advanced instrumentation or automation, particularly as it applied to the petroleum industry. I participated in the hearing as a past president of the American Institute of Chemical Engineers. At the time I was president of Houdry Process Corp. but I am now vice president in charge of research and engineering of Sun Oil Co.

I am pleased to accept your current invitation to help in bringing the previous information up to date and to add or amplify information on the basis of developments since 1956. The fast-moving developments in the field during the past 3½ years should help us to focus our sights more exactly on the past, present, and potential impact of automation on our economy.

In an attempt to be of the greatest help to the committee, and avoid duplication of voluminous figures or forecasts from other sources, I will confine my remarks essentially to our experience and accomplishments at Sun Oil Co. in the application of automation.

OPERATING AND ECONOMIC FACTORS

There are a number of factors which have influenced the increasing use of automation, and particularly automatic control instruments in the petroleum industry. Two of these I mentioned previously:

First, petroleum refining operations are conducted on a necessarily large scale and the materials handled include liquids, gases, and agglomerated solids.

Second, the operations consist primarily of continuous processes, involving closely interrelated refining units.

A third factor, of increasing importance, is the problem of producing capital for plant replacement or renewal. Petroleum refiners boasted 25 years ago that technological progress was so rapid new plants were obsolete in 7 years. In many instances this was true, and common for an oil company to write off plants like cracking units in 7 years. Then came zooming corporate taxes, inflation, and lower amortization rates as imposed by the Internal Revenue Service.

Today our situation is drifting rapidly in the direction our British friends have gone years ago. By reinvesting a given percentage of net profit, with today's high level of corporate taxes and inflation, a plant which formerly could be replaced in 7 years must now give about 30 years of service; and it must be able to compete with new plants being built during this 30 years. Refiners have been meeting this challenge by constantly converting, altering, and automating their plants to keep them operating competitively with newer plants although there is a limited amount of progress that can be made in this direction.

PLANNING FOR EMPLOYEES

Along with these almost constant changes required to keep physical plants competitive have been the equally essential changes in work operations and the assignment of personnel.

Most importantly, there has been a deeper realization of the necessity for planning personnel changes as far ahead as changes in plants, and with even greater care. And the need to keep employees informed, to involve them in the problems, and plans and the progress of the business, to encourage their understanding and cooperation, has become unmistakably clear.

Constantly new efficiencies have been sought and must still be sought in order that the petroleum industry may continue to serve our Nation by providing a plentiful supply of energy at reasonable prices, and still pay high wages to its employees.

TRENDS IN REFINING TECHNOLOGY

In 1956 I related some of the steps which have been taken to meet our objective of service to the public, through new processes, larger and more efficient units, and integrated operations. A new trend at that time was the centralized control of related units in a given operating area under the same supervision. This is now being extended to the centralization of a group of related, but separately operated areas.

As our processes have become increasingly complex and interdependent, we have come to recognize automation as a technological necessity. So much information must be received, so many related decisions made and actions taken, that the human mind can no longer absorb all the necessary information and make all the necessary calculations fast enough by the time a decision or action is needed.

Essentially we consider automation as a necessary aid to do things that people are not now doing, cannot do, or relieve them from the boredom of certain repetitive operations.

By harnessing the latest advancements in automation, we are now developing a new concept in plant operation, moving in successive steps from direct control by the line operator.

In this concept, the line operator's functions would be somewhat parallel to those of an airline pilot: to take control when emergencies arise, but otherwise permit the automatic controls to sense the need for and make the calculated adjustments within the framework of the coordinated plan.

The first step would permit control by plant supervision, directing control actions on the basis of coordinated information from various sources in the plant. The final objective is a technically manned computation and data-processing center, coordinating the entire refinery complex, translating management's master plan, and directing individual plant supervision as to control settings and desired results from each operating unit. This visualizes the telemetering of critical plant data to the center, and control instructions to the operating units. Technical coordinators would then know whether or not instructions were understood and carried out.

COORDINATING AUTOMATION PROGRAM

Undoubtedly the most important step we have taken at Sun Oil Co. to meet the challenge presented by our advancing technology is the organization of an advanced management and methods division, including an applied physics laboratory. This division consists of two sections. One, comprised essentially of scientific personnel, studies refinery operations, designs automation systems, assists in their installation, and conducts evaluations of the results. The other is concerned with the application of automation from the standpoint of the required training and reorganization of supervision and personnel. At the present time, the work of this advanced management and methods division is proceeding well in several directions: Studying our processes and plant records, working directly with plant operators, training technicians, applying new instrumentation and control devices, adapting new devices from other industries and inventing needed instruments not commercially available.

It might be helpful if I cite some examples of the work in which this division is currently engaged.

PROCESS OPERATION CONTROL

Until recently, plant operators have been guided in the operation of process units by laboratory tests made on periodic samples of charging stocks and product streams. Because of the time necessarily involved in conventional laboratory testing, the reports of tests would be received several hours later, often by the next shift operator. At best, the test results might indicate process conditions at the time the sample was taken but it would be extremely difficult to correlate them with the physical conditions governing the process at the time the results were received.

Within the past few years a number of continuous and semicontinuous stream analyzers have been developed. Some of these have been developed in our own applied physics section. With these new devices it is now possible for the plant operator to obtain an immediate notification of any variations in certain qualities of products being produced. This enables him to quickly make necessary adjustments to process controls. Also, the stream analyzer may be used to provide information on product quality continuously and directly to control instruments which automatically make the necessary adjustments to the process controls to maintain desired quality.

PRODUCT CONTROL CENTER

We are now using these stream analyzers in a joint project with Genesys Corp., a subsidiary of Chance Vought Aircraft, to develop a special electronic computer-based system for controlling the operation of several separate but related processing units in the same refinery area. These refining units essentially constitute a complete refinery in themselves, representing crude oil distillation, catalytic cracking, vis-breaking, gas recovery, sulfur recovery, and hydrodesulfurization of furnace oil. We have constructed a three-room building as a control center consisting of a recorder room, a calibration, and a data-processing room. Stream analyzers, located at the various units, continuously sample 25 charging stock of product lines. This information is automatically recorded in the control center and is immediately available to plant operators.

In addition to our original plan to develop closed-loop computer control of the processes, we have become increasingly aware of the potentialities inherent in this system. The processes we are automating are very complex, and unsteady operation of any one of the units affects the operation of the other units. By developing and following the trends of dynamic factors in the overall operation, and coordinating the operations of the various units, we can optimize results by recognizing changing conditions or emergencies as they occur and automatically making the necessary control adjustments.

IMPROVING FRACTIONATION EFFICIENCY

Fractionation is one of the most fundemental operations in petroleum refining and has a far-reaching influence on product quality and utility costs. Under conventional control we find that most fractionating units operate at considerably less than their potential capability.

We are now involved in a study incorporating the use of stream analyzers, a Westinghouse Opcon optimizing control, and a Litton 80-digital differential analyzer to obtain the maximum steady-state operation of a fractionating column. In addition to increasing efficiency in the operation of the unit under study, information we have obtained is now being used in the modification of the instrumentation and control of other fractionating units.

AUTOMATIC GAGING

We are moving rapidly ahead with the installation of remote-control gaging devices, developed by our applied physics section, to improve the accuracy of inventory control and oil movements. An analysis of manual gaging methods indicated a possible 15 to 20 chances for human error in each transfer of oil.

With the remote-control device, the gager simply dials the tank number from a central console. The number of the tank he dialed, the level and the temperature of the oil in the tank are flashed on a screen on the console and automatically printed on a tape. This information, at present, is transferred to a card for computer use. Later it will be automatically punched on a tape and fed directly to a computer for translating level into volume, corrected for temperature. Other numbers on the console will be available for various supervisory control actions such as operating motor-controlled valves and starting and stopping pumps.

AUTOMATIC BLENDING

Although we process many types of crude oils, the usual pattern is to blend together several related crudes as determined by product requirements. These mixes are now prepared by blending in batches in large charging tanks, and the blending involves a series of transfers of questionable accuracy followed by an indefinite period of circulating the various components in the tank to obtain the necessary uniformity. In the future we will blend the crude oil mixture for charging to distillation units continuously, using centralized meter control and automatic blending pumps. This will result in a minimum of transfers, accurate proportions of the component crudes oils, and, consequently, smoother operation of our distillation processes.

Another large area to which our attention is currently directed is the automatic blending of finished products. The several projects planned fall into two general categories. One is the continuous blending of the component streams for major products such as gasoline and heating oils, governed by customer specifications. The other consists of the more precise compounding of lubricating oils and waxes and calls for a higher degree of control instrumentation.

AUTOMATION REDUCES UTILITY COSTS

Operating with a diminished profit margin, we have also focused our attention on reducing our utility costs. We have already achieved significant success in increasing the efficiency of a number of our refinery furnaces by the installation of oxygen analyzers and automatic combustion controls as an aid to the firemen.

HIGHER EFFICIENCY IMPERATIVE

It is obvious from these examples that the real advantage of our automation projects will not be the reduction of labor costs but the attainment of a high degree of efficiency heretofore impossible. Because of the keen competition which characterizes the petroleum industry, intensified by the need to keep older processing units competitive with newer ones being built, management requires operating information that has been difficult, time consuming, or impossible to obtain. The efficient day-to-day operation of refining processes must be related to various changing conditions such as price of crude, type of crude, marketability of products in proportion to potential yields, fluctuating product prices, seasonal variations, changes in specifications, and many others.

EFFECT ON EMPLOYMENT

As I have indicated in the foregoing, we have made significant gains in the application of automation to increase the efficiency and profitability of refining operations—and this is the best insurance of job security possible.

Naturally, our automation plans were not conceived overnight or without consideration of their effect on our employees. When we set out toward our goal of keeping our operations competitive, we decided at the start that we would introduce changes in our systems and organization on a schedule that would avoid disruption and hardship to personnel. What we have been doing, and continue to do, is to introduce these improvements at a rate to match our declining manpower created by retirements and other ordinary causes. In other words, our goal is to permit normal attrition to reduce the employment roll on specific operations and to time the installation of advanced methods to coincide accordingly, thus avoiding layoffs. In the meantime we are, of course, creating new opportunities for our employees with a greater number of higher skilled jobs. Additionally, the efficiency and profitability of operations lead to expansion, thus creating jobs for new people.

Since realistic plans take some time to develop fully, we are now looking ahead 3 to 5 years from now. We are reviewing with our Engineering Division projections for proposed construction of new plants including determinations of future obsolescence of existing units. These studies necessarily involve plans for automating existing and future units.

By checking our retirement and normal attrition schedules, we are projecting our work force needs over the same 3- to 5-year period. By knowing these factors, we can determine which employees require training and development.

We have developed tests for evaluating the aptitudes and abilities of these employees and have developed manuals and training aids for specific jobs.

Already we have instituted sreamlined procedures for the reallocation of personnel and both formal and voluntary programs for off-and-on-the-job training along certain craft lines. No individual has been laid off as a direct result of our projects and the morale of our operating personnel remains high.

We have taken great care, right from the start, to make sure that our employees understand our common objectives and mutuality of interest. Consequently, we have received excellent cooperation. We believe it is only in an atmosphere of mutual confidence and trust that business organizations can move forward, with the cooperation of employees and management, to meet the problems thrust upon them by changing conditions. It has been fundamental in our American heritage to welcome progress and it was heartening, indeed, that not a single witness in the previous hearings voiced opposition to the application of automation as a necessary means of assuring our Nation's continuing progress.

INCREASED PRODUCTIVITY

There is only one way to get the same number of larger slices from a pie and that is to increase the size of the pie. This analogy can readily be applied to our competitive enterprise system, with our gross national product representing the pie. Thus, the way to a higher standard of living for all is by increasing individual productivity. It's as basic as that. It was true when my mother and father were pioneers in the Indian territory and it is still true today.

In this regard, I believe it is the committee's wish that I update figures given in my previous testimony, and I will attempt to do so here.

Daily crude runs to U.S. refineries have risen from 5,074,600 barrels per day in 1947 to 7,642,200 barrels per day in 1958. During the same period, total refinery employment increased from 189,000 to 192,000. At first blush one might conclude that productivity per employee in 1958 was 48 percent greater than in 1947. But it was actually even greater than this because the quality of the products produced in 1958 was far superior to that in 1947. This entailed more extensive and more complex new refining processes.

This expansion of refining capacity, and greater productivity per employee, were made possible by the investment of tremendous sums of money. According to Chase Manhattan Bank estimates, capital expenditures in U.S. refining from 1947 to 1958 reached the amazing total of $7.3 billion.

Based on Chase Manhattan Bank figures covering annual capital expenditures in refining, and Bureau of Labor Statistics' employment figures, the gross investment per refinery employee in 1947 was $19,000 compared with $49,000 in 1958. This represents an increase in investment per employee of 158 percent.

REAL WAGES ALSO INCREASED

It is evident that the increased productivity per refinery employee is directly related to the investment per employee. Also, as the larger, more efficient processes enabled the refinery employee to increase his productivity, his earning power also increased.

As I pointed out in my previous testimony, available figures on refinery wages cover only hourly paid employees. These figures, published by the Bureau of Labor Statistics, do not include wages of salaried personnel. As you know, there has been a definite shift of employment to higher skilled jobs and salaried classifications as the growing use of instrumentation and process complexity has increased the need for more technicians, specialists, and supervisors.

However, purely on the basis of statistics covering hourly paid refinery employees, the Bureau's figures show an increase in the annual money wage from $3,270 in 1947 to $5,980 in 1958, which represents an increase of 83 percent. In real annual wages, adjusted for the increase in the Consumer Price Index, the gain is from $3,430 to $4,840 or 41 percent, in the same period.

It is significant, too, that the refinery worker is among the highest paid in American industry. Again using Bureau of Labor Statistics' figures, the average hourly wage for all manufacturing employees in 1958 was $2.13, whereas the average hourly wage of petroleum refining employees was $2.83, an appreciable difference. This would not be possible without automation and the large investment per employee.

One measure of the increased earning power of the refinery worker is in relation to his ability to purchase the products he helps to manufacture. In 1947, with 1 hour's earnings, the average refinery worker could buy 6.8 gallons of gasoline; but in 1958, his hourly wage could purchase 9.3 gallons, or 37 percent more.

There are three other factors which should be considered. First, the refinery worker's hourly wage figures given do not include fringe benefits which now are equivalent to about 25 cents per hour.

Secondly, there has been tremendous improvement in the quality of gasoline over the years.

The third factor is gasoline taxes which average more than 10 cents per gallon nationwide. If it were not for these exorbitant taxes, the average petroleum refining employee could purchase more than 14 gallons of gasoline with 1 hour's pay instead of the 9.3 gallons he actually can buy. Unfortunately, the oil industry has little or no control over gasoline taxes; in fact it is the other way around. Gasoline taxes threaten to throttle the oil industry. Indeed a part of the economic difficulties in which the oil industry now finds itself is attributable to the exorbitant tax vote. Combined State and Federal taxes now amount to 89 percent of the refinery price, 64 percent of the tank wagon price, and 49 percent of the ex-tax retail price. Unfair and burdensome taxes on their principal product may be the most serious threat to the job security of oil-refining workers.

THE FUTURE

Although there are strict limitations to the extent to which automation may be applied, there is much evidence to support the belief that automation represents the type of technological progress we must make if we hope to maintain or improve our standard of living.

According to the Bureau of Labor Statistics, our population is expected to increase from 165 million in 1955 to 193,500,000 in 1965. This is an increase of 28,500,000 persons. (Currently, we seem to be ahead of this predicted growth with a population of 179,500,000.) But the increase in our total labor force from 1955 to 1965, according to the Bureau's estimates, will be only 11 million persons, including all persons over 14 years of age. We know that many young people between the ages of 14 and 21 will not enter the labor force except, perhaps, as part-time workers, and an increasing number of this age group will be in school. We also recognize that more and more persons are retiring at the age of 65 or earlier, and we probably will have about 2,500,000 persons in our Armed Forces.

From the best available estimates, there will be a greater proportionate increase in our population than there will be in the available work force.. Taking into account the trend toward a shorter workweek, longer vacations, and additional holidays, it has been estimated that during the next 15 years the total hours worked per year by our entire labor force may not increase at all.

At the same time, the total output of goods and services (gross national product) may reach $750 billion, or even as high as $800 billion, in terms of 1959 dollars. According to the National Industrial Conference Board, the Joint Economic Committee feels that a trillion dollar economy is feasible in just 15 years, a mark that could not be reached for 25 years if the historic long-term rate of 3 percent a year were maintained.

While projections of national output in the next 5 to 15 years vary over a broad range, depending on population, labor force, and other figures employed, there can be no doubt that individual productivity must be increased. Clearly, the means to meet the tremendous challenge this offers lies in the proper application of automation for the ultimate benefit of our entire Nation.

In order to accomplish this, those charged with management responsibility in our business enterprises must not only serve the best interests of all groups who have a stake in the enterprise, but must help each of these groups to know what the facts are. With understanding comes cooperation; without it, chaos.

As we face the years which lie ahead, with the glorious promise they hold for progress through a vastly advanced technology, no opportunity looms larger than the opportunity to achieve real leadership and teamwork in outproducing our rivals, thus serving the welfare and security of the Republic.

STATEMENT OF ALAN C. MATTISON, PRESIDENT, MATTISON MACHINE WORKS, ROCKFORD, ILL.

My name is Alan C. Mattison. I am president of the Mattison Machine Works, of Rockford, Ill. I am also currently president of the National Machine Tool Builders' Association, a trade association which represents companies that make over 90 percent of this country's machine tools. These companies are largely responsible for the development of the kind of automation that is used in automobile plants and in the metalworking industries generally.

The machine tool industry is principally composed of what you gentlemen would term small businesses. My own company, which manufactures grinders, employs about 400 people. The average machine tool company has less than 200 employees. There are some 350 companies engaged, in whole or in part, in building machine tools. The shipments of the entire industry in 1959 totaled $538 million. As you may know, many individual corporations in other industrial fields have annual sales exceeding that figure.

Despite the industry's relatively small size and sales, it plays a significant and indispensable role in improving our standard of living and maintaining our industrial and military strength.

MACHINE TOOLS AND AUTOMATION

Machine tools are the "master tools of industry" which cut and shape metal. Virtually every product requires machine tools, directly or indirectly, for its manufacture. Machine tools are essential to national defense. Not a single weapon of offense or defense can be made without them. Their strategic importance as a base for the Nation's military strength was graphically demonstrated in World War II, and in the Korean emergency.

In 1955 Mr. M. A. Hollengreen, president of the Landis Tool Co. in Pennsylvania, gave you examples of progressive automation in machine tools. He explained that "automation" as we understand it in the machine tool industry is a general term which covers only some of the most recent developments of the past half century with regard to the speed, productivity, accuracy, and power of machine tools.

Since Mr. Hollengreen appeared before you, even greater strides in this field have been made. Our industry has, I believe, successfully met the challenge of the enormously accelerated pace toward more efficient production and the greater precision required by our modern world.

I am certain that this distinguished committee is fully aware of the nature and importance of automation as it has developed in the industrial history of the United States. It is a concept and approach which, second only to democracy itself, is intimately identified with our country and its unprecedented growth to leadership of the free world. Millions of words have been written on the subject, and even the man on the street is conscious of the fact that the increasing availability and low price of the products which he buys stem directly from the production miracle brought about by increased automation.

Automation is the principal avenue leading to the establishment and maintenance of a consistent, high level of production of parts of maximum accuracy.

It avoids part damage due to careless manual handling. It provides increased flexibility essential to efficient production in an age where requirements may change overnight in the light of new technological changes in the chemical, physical, and engineering sciences. Automation makes it possible to squeeze the most out of a given work space—economizing not only on space but in movement of parts from operation to operation.

There is a very simple reason why the United States enjoys the highest standard of living of any nation in the world: production efficiency—more and better output per man-hour. And a very large measure of that efficiency is attributable to automation and related techniques.

This same efficiency has made it possible to pay the highest wages the world has ever known and yet maintain a price on the product produced which will still be within the consumer's reach and remain competitive with low-labor cost products from abroad.

If that efficiency is not maintained in relation to that of the other industrial facilities of the world, the only hope for competition and industrial survival would be lowered wages, a lower standard of living, and finally a reduction or at least stagnation of our basic productive capacity.

I do not wish to dwell on the underlying internal economic considerations which justify and indeed demand the widespread application of automation concepts in our society. I am sure that others will cover this ground quite adequately. And if coverage is needed from the machine tool industry, I would like to refer the committee again to the excellent testimony given by Mr. Hollengreen during the 1955 hearings on automation.

I should like, instead, to start off by telling you something of the remarkable progress which we have made in the last 5 years in my industry as the fathers of metalworking automation—"Detroit style." And I should also like to tell you in my own words how, apart from classical economic theories, automation is fundamental to our very survival.

Finally, I want to put forward the proposition that unless we change the present environment in this country for the growth of automation and related techniques for production efficiency, we are in for very serious—if not ultimately fatal—troubles.

FIVE YEARS OF PROGRESS

The fruits of 5 years' invention, research, design, and development on the part of individual U.S. tool builders will shortly be on display at the forthcoming machine tool exposition in Chicago. I wish each member of the committee could attend in person to see the promise for tomorrow which the new products forecast.

I can assure you, from my own personal knowledge, that these advances—on an industrywide basis—are incredible. They are so many and so varied that those of us who live daily with the industry cannot keep up with all of them.

The new machine tools are being built to perform operations in sequence, with loading and unloading—the shift of work from one operation to the next—completely automatic. Another development is the inclusion of automatic assembly as a part of the processing sequence. Accuracy in many cases is now assured by completely automatic checking and gaging at successive stations.

A further trend in machine tool automation is toward starting directly with a rough part rather than as in the past with one which has had to be preconditioned by another machine.

I think the advantages of these innovations are apparent. Amazing advances have been made possible in accuracy. Millionths-of-an-inch are now getting to be as common as ten-thousandths used to be. With today's controls, no longer are rate of output and accuracy of performance dependent upon the human operator. These factors are built into the machine itself. Quality of work becomes a known factor. Output per hour, in terms of work pieces machined, becomes a known factor. Costs are thereby accurately determinable. And last, but hardly least, output per man-hour is remarkably increased.

We have been talking about automation in very general terms. Let me give you a concrete example from Mattison's own experience.

In the old days, when a farmer's mule or horsedrawn plow became dull he had it "resharpened" by a skilled metalsmith. Today, that same farmer's plow is probably one of the high-speed, light-draft bottoms, with a share that offers "razor blade" convenience of replacement and throwaway economy. When the share gets dull the farmer simply removes three or four bolts and replaces it. His capital investment is more productive, and cost of replacement—all things considered—is much lower than the cost of reconditioning an old-fashioned share.

When the idea of throwaway shares gained acceptance, John Deere turned to automation to double their capacity to meet the snowballing demand. Now this new share bears little resemblance to some of its ancestors. It is a precision cutting tool, geometrically and metallurgically well formed.

A new type of grinder was needed, a machine that could take parts right from a conveyor; locate and clamp them automatically; finish the bevel from the end position in a single, straight pass; maintain rigid tolerances; unclamp the share; and unload itself—depositing the finished shares on a conveyor leading to the next operation. My company designed the grinder needed—the first of its kind ever used in the farm-equipment industry.

It would take at least two conventional automatic center-column machines and two operators to match this grinding production of one new automated grinder.

The grinding operation is just one of the many continuously performed in the new automated line. Operations include cutoff, forging, blanking, piercing, heat treating, quenching, drawing, roll forming, surface grinding, shot peaning, painting, and packing. I apologize

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for the technical nature of some of these terms, but they will give you an idea of the complexity of the automation line I am talking about. Only two inspectors service this entire line, from forging to packaging, and the line operates at 85-percent efficiency.

This single automated line produces all sizes of share, from 14 to 22 inches, at the rate of 720 per hour.

This year John Deere Plow Works will manufacture 1 million shares, twice as many as could be produced under the old manufacturing method.

AUTOMATION AND NATIONAL SURVIVAL

I have told you something about the benefits of current automation techniques and given you a brief glimpse of the progress machine tool builders have made in developing and introducing some of these new concepts. I have not yet come to the central problem of my industry or that of the industrial complex of the United States.

I think the problem can be stated quite simply. We are losing the race for productive efficiency. The fundamental basis for our high wages and high standard of living is beginning to erode and disappear. In short, our ability to compete in the world has been—and is being—seriously challenged; not only by our European friends but by those ideological enemies who have vowed the destruction of our economic and political system, who are determined to do away with our way of life.

I wish I could tell you that America's production efficiency still makes up for the disparity in wages which exists between this country and our European competitors. I wish I could tell you that American industry has kept pace with technological developments and that our productive capacity is maintained through constant improvement and the revamping or automation of our assembly lines.

In actual fact, I fear that the reverse is true. Due to a combination of factors—antiquated depreciation practices which discourage replacement, high taxes which discourage growth, and the specter of an inflationary wage-material cost spiral—our vital edge in production efficiency is shrinking, and shrinking more rapidly than I suspect many of us realize.

It is hard for us, with our assumption of American superiority in the industrial field, to realize that many of the metalworking plants of the United States are lagging behind those of various parts of the world in production efficiency. But bear in mind that a large number of the European plants have been built and equipped since World War II. By contrast, many of the machine tools still in use in American plants were built to designs crystallized for war production at the start of World War II.

Every 5 years, the American Machinist, a magazine regarded as authoritative, makes a survey of U.S. metalworking equipment. The last survey, made in 1958, showed that at that time 60 percent of the country's metal-cutting machines, and 62 percent of the country's metal-forming machines, were over 10 years old. New equipment buying since that time has not been sufficient to alter these ratios to any appreciable extent.

America builds the machine tools that could revitalize our efficiency and competitive position. We are capable of creating and producing the world's finest automated machines—if there is a demand for the product and the incentive to invest the enormous amount of money, talent, and time required to outpace our European and Sino-Soviet competitors.

Frankly, it is personally discouraging to observe the false complacency of some of our countrymen. You may recall that Johns Hopkins was recently called on to conduct an unclassified study of the Army's production equipment and machine tool program. That study revealed that the Army was resting largely on an antiquated and unsophisticated industrial base. Despite these revelations there are still some in the Army—and perhaps elsewhere in this country—who would prefer to bury the unpleasant truth. The Army hastened to classify the Johns Hopkins report so that its deficiencies would continue, and had it not been for the timely action of Congress in ordering its declassification, this study would still be in limbo.

IMPEDIMENTS TO AUTOMATION AND A MODERN INDUSTRIAL BASE

I have already mentioned several factors which clearly impede or altogether discourage continuing modernization and automation of America's industrial plant. There are undoubtedly other factors and I would urge upon you gentlemen the desirability, indeed, the necessity, of determining all the facts about this situation in the most comprehensive way possible. In my judgement, it is the most important problem before us today.

Nearly everyone realizes, including the Treasury, that we have to discard our outmoded depreciation and replacement practices in this country if we are to modernize our plants, reduce our costs and compete effectively. Many practical solutions have been suggested; none has been adopted. One which has been repeatedly recommended, the so-called bracket method, is similar to the system of depreciation used so effectively in Canada since 1949.

According to the recent Johns Hopkins University study which I have already referred to and which is described in the American Machinist in July of last year, the obsolescence cycle for machine tools has been 8 to 10 years but in 1960 was expected to contract to about 5 years. In other words, machine tool developments and automation innovations are coming so fast that forward-looking plant managers must plan on replacing many of their machines every 5 years and most of them in less than 10 years.

In the United States, writeoff periods for machine tools, for example, vary from 15 to 33½ years. It is now possible, by submitting specific proof to the Internal Revenue Service, to do better than that. But there are thousands of companies in this country still taking an annual 5 percent writeoff. This discourages capital expenditures. The period of capital recovery is extended too far into the future. Funds to replace obsolete equipment must come largely out of earnings after taxes, or borrowed money.

Our foreign competitors do not suffer from such a handicap. They enjoy much shorter writeoff periods and special depreciation allowances designed as incentives to modernization.

In Canada, for example, new machines can be written off at the rate of 20 percent a year; in France, at from 10 to 15 percent; in Sweden, at 20 percent; in Switzerland, at a 25 percent declining balance rate; in Belgium, 15 percent; in Denmark, 10 percent; in Hol-land, 10 percent; in Italy, 15 percent, and so it goes. As to optional incentives: In England, an additional allowance of 30 percent is permitted in the first year; in France, a double writeoff. In Austria, you can write off 40 percent the first year; in Germany, with certain limitations, 50 percent.

Greater allowance should also be made in our tax structure for the high cost of the research and engineering work required for the development of the modern equipment which will keep our Nation competitive.

I would not like you to conclude from what I have said that U.S. manufacturers are always entirely blameless in this matter of modernization and automation. Some of them, for reasons best known to them, just do not take advantage of the long-range benefits to be derived from these new techniques. Again, very high corporate tax rates may act as a deterrent.

For some it may seem to be simply too late: costs have risen, efficiency is lowered or remains the same, and the market is flooded with low wage-low cost imports. What I am saying is that there may well be an educational job here which someone should undertake.

SOVIET AUTOMATION AND PRODUCTION EFFICIENCY

I have one last point I should like to make in urging this committee and Congress to take firm and early steps toward generating a favorable atmosphere for automation and the related techniques which result in increased production efficiency. I refer now to the Sino-Soviet bloc economic and military threat—the competition for survival.

With its directed economy, the Communists have been able to concentrate on those areas which seem to them to be critical on the path to economic superiority. Far from creating artificial barriers to modernization, they have gone all out to increase productive efficiency, irrespective of the cost.

We look down our noses at the Russians because of their lower living standards and their tardy production of consumer goods. But, according to Mr. Allen Dulles of CIA (State Department bulletin of April 1959):

> While the Soviets last year were producing only 1 automobile for every 50 we produced, they were turning out four machine tools to our one.

And just the other day I read the following grim news from the pages of the July 11 issue of the very reliable American Machinist:

> Western experts were flabbergasted by Soviet achievements in automation shown at the First International Congress on Automation held in Moscow. The Russians have skipped the intermediate steps the West had to make. The consensus of Westerners after touring the Soviet Institute of Automation and Telemechanics was that it was far ahead of anything in the West. * * * "We've been a bit shattered," said one Western delegate. "We never dreamed this level had been reached."

If these things are true, I think the problem and the prospects are equally clear. If we cannot compete economically, it is unlikely that we can win ideologically. It will be a tragedy indeed if we fail to face up to this problem squarely, shape our intermediate and long-range solutions, and exert every effort to implement them.

CONCLUSION

I think my industry has some of the keys to the maintenance of our competitive superiority. Many of these new ideas and techniques will be revealed for the first time at the Chicago exhibition. But unless industry and the military services avail themselves of these new machines our old industrial base will just grow older, my industry will lose its incentive and essential capital to research and develop these new machines, and America will lose the competitive struggle to our Western friends—and perhaps ultimately to our Eastern enemies who are confidently expecting to "bury" us.

Finally, I wish to make clear that the ideas I have here expressed do not apply merely to machine tools. They apply as well to all types of cost-reducing equipment. I have naturally talked about machine tools, because, after all, that is my business. I am not making a special plea for machine tools. I am making a broad plea that American industry make—and in every way be encouraged to make—a determined effort to get costs down and maintain our world competitive position through the maximum use of every possible technological and automation advance. The program I urge can be summarized in just three words—"modernization for survival."

STATEMENT OF DON G. MITCHELL, PRESIDENT, GENERAL TELEPHONE & ELECTRONICS CORP., AND CHAIRMAN OF THE BOARD, SYLVANIA ELECTRIC PRODUCTS, INC.

I am extremely pleased to be given the opportunity to report again to this subcommittee. As you requested, I not only will comment upon various major points covered in my previous report, but I should also like to incorporate some additional comments because of the changing environment in which industry is operating today. I am referring, of course, to the greatly intensified economic competition from abroad. This international trend, together with the steadily increasing complexity of our economy here in the United States, is presenting a host of new challenges to America—not only American industry but every segment of our economy. My comments will concern, of course, the challenge facing industry as a whole, with emphasis on the fields in which the General Telephone & Electronics organization operates. Let me sum up the situation this way: All of us in industry must concentrate more than ever before upon finding new and far better ways of doing things.

AMERICAN ECONOMY HAS UNDERGONE LARGE-SCALE REVOLUTION

During the past 15 years, the American economy has gone through a remarkable revolution. This has been characterized by enormous expansion, the steady rise in our standard of living, the unprecedented growth of existing industries and the development of entirely new ones, the major changes in our markets, the greatly increased emphasis on research and the development of new products and services—all of these having been, in effect, a large-scale revolution because of their magnitude, their impact upon all of us, and the speed with which they occurred. Paralleling this economic revolution in the United States, we have witnessed—and have played a major role in—the economic rebirth of countries devastated by the war. This economic rebirth has brought the emergence of an entirely new phenomenon in world history—a world market with every potential that description implies.

We are starting a new decade in which all of this country's businessmen will be faced with more opportunities and more challenges than ever before in our history. For years, American industry has effectively set the pace for the rest of the world, but now the situation has changed. American industry is at the crossroads today—and we have the choice of participating in the growth and development of the new and broader markets opening up throughout the free world, and continuing to be the leading factor in the world economy, or we can miss this opportunity and gradually be outdistanced by our competitors. This not only is a new situation for American businessmen—but it is also a new situation for all Americans—because the great advances in communications, in the ability of the people of the world to maintain effective contact with one another, have combined to reduce remarkably the obstacles of time and distance which in years past have inhibited the expansion of world trade. The trade horizons of every country have greatly broadened, and businessmen throughout the world are seeing opportunities for increased trade that they never saw before.

Moreover, this economic revolution throughout the world is far more than a trend which need concern only large industries. It is profoundly affecting every industry and every business. In its relative way, the small business in a small town is just as deeply involved as the country's major corporations. Every business enterprise, large or small, will be faced with a whole new set of opportunities and challenges during the 1960's.

OPPORTUNITIES AND CHALLENGES OF THE 1960'S

Now I would like to get more specific about these opportunities and challenges. There are five of them:

1. We must place greatly increased emphasis on research and development—or, to put it another way, innovation and invention. Aside from constantly improving our existing goods and services, and producing them at competitive costs, we have the even greater challenge of developing entirely new products and services, new ways of making them, and new ways of getting them to customers here in the United States and throughout the free world.
2. We must assure further automation and mechanization of both our manufacturing and our administrative processes so that we can attain the higher volume, lower costs, greater flexibility, and higher efficiencies which we will need to compete in the marketplaces of the free world.
3. We must be more effective managers and develop new managerial skills—we must do a better job of organizing, of instilling in our management people that dynamic point of view that makes things happen, that encourages teamwork, that encourages the delegation and acceptance of responsibility.
4. We must adapt our entire distributive process more effectively to our existing and potential markets. Worldwide markets require a worldwide viewpoint, and that will mean changing some ideas and practices we have had for years.
5. Finally, and most important of all, we must revitalize the American point of view—and I mean giving a rebirth to the drive and the enthusiasm and the ideals that produced this fantastic economy of ours in the first place. This means taking risks. It means more vigorous entrepreneurship, and business pioneering. It means exercising our ingenuity more fully than ever before.

All five of these challenges really add up to one overriding challenge—and that is the necessity for devoting greatly increased attention to finding entirely new and better ways of doing things. This is symbolized so effectively by the need for further automation and mechanization, and I want to commend the committee for its continuing strong interest in this subject.

ELECTRONICS—FASTEST GROWING MAJOR INDUSTRY

In my report to this committee on October 18, 1955, I described how automation had played a vital role in the development of an entirely new industry—electronics—which today is the fatest growing major industry in this country. By way of review, let me summarize several comments I made at that time.

In approaching mechanization or automation from the standpoint of its influences on the electronics industry as well as other industries, a number of general statements can be made:

1. Without large-scale use of automatic and semiautomatic equipment, the electronics industry, as we know it today, would not exist.

2. Without extensive mechanization, the electronics industry could not even remotely produce the vast volume and variety of goods needed and demanded today by the public, commerce, and industry, and the Armed Forces. Mechanization has been the key to greater production volume, lower costs, higher product quality, improved product performance, and uniformity. In effect, mechanization has actually met what would otherwise have been a long-term labor shortage.

3. The increased demand for, and availability of, the products of the electronics industry has brought a great expansion of the basic materials industries which furnish raw materials and certain components, such as metals, glass, chemicals, plastics.

4. Thousands upon thousands of small businesses have been formed over the past few years, especially the postwar years, to meet the needs of the electronics manufacturers. Even a largely vertically integrated company such as Sylvania Electric Products, which produces most of its own components and materials, places millions of dollars' worth of business with small suppliers and vendors all over the Nation.

5. Hundreds of communities have gained new economic strength, either through the expansion of an existing facility or the construction of a new plant or laboratory facility. Sylvania is a prime example. In 1940, when the electronics industry was in its infancy, Sylvania had 4 plants, 4,600 employees, and an annual payroll of $5 million; today we have 47 plants and 18 laboratories in 38 communities in 13 States, employment of 29,000 (which is 3,000 more than comparable employment in 1955, incidentally). The annual payroll (including employee benefits) was $187 million in 1959.

6. An enormous new business has sprung up, completely outside the electronics manufacturing business. This is the electronics distribution and service industry, whose distributors, jobbers, dealers, servicemen, and others do an estimated volume of nearly $4 billion annually—a business which did not exist a few years ago and which has multiplied manifold since the war.

These are the ramifications of mechanization. It is not a case of putting a machine to work in one plant, or two plants. It is a case of creating an entire set of industries, hundreds of thousands of jobs that did not exist, millions of dollars of personal income, of buying power, new lifeblood for the entire economy.

ELECTRONICS VOLUME EXPANDED 45 PERCENT IN PAST 5 YEARS

In 1955, the electronics industry included a wide variety of enterprises with total sales and revenues of some $9½ billion annually, including manufacturing, distribution, service, and broadcasting. (This was a striking contrast to the size of the industry just before World War II, when the total was about $500 million in annual volume.) The electronics industry has made impressive gains during the past 5 years, gains that were born of intensive research and development, to be sure, but which would not have occurred without the industry's high state of mechanization, particularly in the production of electronic components and materials, as well as television and radio sets. Sales and revenues reached a new record of nearly $14 billion last year, which was an increase of more than 45 percent over 1955. Of this $14 billion total, electronics manufacturing sales (i.e., excluding distribution, service, and broadcasting revenues) were $9.2 billion, which was nearly equal to the entire industry 5 years ago. Employment today in the manufacturing side of the industry alone is estimated at approximately 760,000, in contrast to about 600,000 in 1955. When all segments of the industry are taken into consideration (i.e., not only manufacturing but distribution, service, broadcasting, and related activities) the employment would be at least 1 million, in contrast to probably some 700,000 in 1955, although official total figures are not available. For 1960, according to present indications, sales and revenues should exceed $15 billion, which would represent a 60-percent increase since 1955. (It is interesting to note that a total of $15 billion was the projection made in my 1955 report—and I don't mind saying that we are pleased to see that our 5-year forecast has turned out so well.)

INDUSTRIAL AND COMMERCIAL ELECTRONICS EXPANDING RAPIDLY

Each of the principal areas of the electronics industry continues to have a strong potential, some of course being somewhat larger than the others. The sales of entertainment products continue to grow, but at an understandably lower rate than 5 or 10 years ago when that market was still in a relatively early stage of development. On the other hand, defense electronics has increased 85 percent since 1955, from $2.8 billion to an estimated $5.2 billion this year. But the field which has gone through the most rapid relative growth is industrial and commercial electronics. Here you have a highly unusual phenomenon to consider, an industry which owes much of its growth and development over the years to automation is in turn inventing and producing the devices and equipment which will lead to further automation in industry and in commerce.

The sales of industrial and commercial electronics products, including distribution revenues, totaled $1.3 billion in 1955, and this year we anticipate that the total will reach nearly $3 billion, ranging all the way from tiny transistors to complete communications systems. This increase over a 6-year period would be 120 percent. Looking further ahead, we believe that this segment of the electronics industry will exceed $4.5 billion in 1965 and more than $6 billion annually by 1970.

"ADMINISTRATIVE AUTOMATION"—TO ANSWER A VITAL NEED

Now let's see where this growth in commercial and industrial electronics will come from. The majority of it will come from a rapidly expanding new area of automation which promises over the next 10 years to have great impact on our economy. I am referring to administrative automation—as symbolized by "electronic data processing"—the use of automatic and semiautomatic equipment to answer the vital need for speeding up the entire process of handling the enormous volume of paperwork required in operating a business, and to provide management with more complete and entirely new types of information. To put it another way, the efficiencies in the manufacturing plant have pulled far ahead of the efficiencies in the office, and many managers today are not too unlike a pilot trying to fly a new jet transport without instruments.

In a subsequent section of this report, I will describe in considerable detail administrative automation in Sylvania, because I touched upon it only very briefly in 1955. Our data processing system was not yet completed at that time, and so I devoted the greater portion of my remarks to the manufacturing side of our automation. To return to manufacturing automation for a moment, I presented various case histories on manufacturing automation in my previous report, showing how automation has enabled our company to grow and to provide more and better jobs, how it had proved to be the key to higher production volume, lower costs, higher product quality, greater uniformity, and far more flexibility in producing varieties of items within a product line.

Perhaps the best way to describe what has transpired since 1955 is to point out that Sylvania's sales have climbed from $307 million in 1955 to $454 million in 1959. As I mentioned earlier, our employment was about 26,000 back then, and today comparable employment exceeds 29,000. In that 5-year period we increased our manufacturing plants from a total of 43 to 47, and we created 2 new laboratories. These new facilities, additions to existing facilities, and substantial expenditures for new automatic and semiautomatic equipment represented the expenditure of more than $80 million by Sylvania from 1955 through 1959. Throughout this period, the strongest emphasis was on finding new and better ways of making our products, and as a result Sylvania is a stronger organization and a more diversified competitor than ever before in its history. Whereas we will be frank to admit that we have not been free of employment dislocations in certain operations, the total employment opportunities in our company are stronger than ever before.

Turning now to a review of administrative automation, let me set the stage for a moment by describing the problem that is confronting industry in general before getting specific about Sylvania's data processing system. Every member of this committee is well aware of the enormous number of administrative tasks and the tremendous volume of paperwork which are involved in the running of any large organization.

DATA PROCESSING—TO MEET COMPLEXITY AND COMPETITION

The parents of data processing are complexity and competition. Every aspect of business is far more complex than it was 10 or 15 years ago, and this is true of our entire economy. Much of this is due, of course, to the unprecedented growth and development of technology, particularly in the past 10 years. Today, science has so many facets that it is extremely difficult to measure the potentials in a few of the major fields, let alone grasp the overall picture.

In addition to the increasing complexity brought by the expansion of technology, the emphasis is on speed and more speed. To stay in the competitive race, operating information must be made available at a speed and in a variety that has never been available before. The problem of compiling, transmitting, and processing operating data—such as payrolls, production volume, costs, inventories, shipments, and so on—has become increasingly difficult and increasingly costly. There is less and less time between events in this dynamic economy of 1960, and because management must base its decisions on those events, all levels of management must have more complete and essential information faster than ever before. But, even more importantly, new types of information, new tools for management, must be found. Doing a better job by today's standards is only a very small part of the answer. We must revolutionize administration.

MORE TIMELY INFORMATION NEEDED

One of the most tantalizing temptations for management is to look back at what has happened and talk about what should have been done or could have been done. That is a luxury no company can afford these days, and the management that persists in doing it very often, won't be around very long. They won't have to worry about business problems, because they won't have any business.

Today, management needs information in time to do something about it. Where we were yesterday is significant up to a point, but the real payoff comes in knowing what is happening right now, so that you can better control what will happen tomorrow.

As our economy keeps on growing, there will be an ever-increasing premium on putting machines to work throughout the office to meet the growing demands of the entire economy. Man and present-day machines and methods could never begin to do all the administrative work that will be required of him in the years ahead. Greatly increased use of machines is the only way we will be able to develop procedures to handle the administrative load of the future.

Over the next 20 years there will be a tremendous expansion in the clerical force employed in manufacturing businesses, and in such services as banking, insurance, as well as government. Today in manufacturing the estimated ratio is about one clerical employee to each seven direct-labor employees. Based on the straight line projection of what has happened over the past several years, by the year 1970 business would require one clerical employee for each four factory or direct-labor employees, and there simply will not be that number of people available in the working force at the rate our economy is expanding, even if an administrative load of that magnitude could be tolerated without throwing our competitive cost position completely out of line.

The factors of complexity and speed are greatly affected by the accelerated trend toward decentralization of management, which I described in considerable detail in 1955. You will recall that this trend had begun as industry reverted to a peacetime economy after World War II. It became increasingly evident that no longer could a few men at corporate headquarters make all of the decisions which were required to manage the business. Industry had outgrown that kind of centralized organization. As a result, decentralized management was born, and in the few pioneering companies, of which Sylvania was one, the overall business was broken down into various product areas, and the responsibility and authority for management within those areas was assigned to the lowest possible point in the organization where a decision could be intelligently made. This philosophy, in one form or other, is practiced in many large- and medium-sized companies today. The role of corporate management is to establish the broad framework of policies and controls under which the decentralized divisional organizations operate, and to provide audit, review, counsel, and guidance, but they do not exercise direct management control.

As the various decentralized operating segments of business become more specialized, it is necessary that they have more and more information about their industry and their particular operation. This led to greatly increased emphasis on administrative automation; it was the only way the job could be done fast enough, in sufficient detail, and within reasonable cost limits.

SYLVANIA'S DATA-PROCESSING SYSTEM

As a case history, let me describe to you the contribution of data processing at Sylvania since my 1955 report. Prior to 1955, we had undertaken a comprehensive study of the problem of providing adequate information to our decentralized operations throughout the country, not only from the standpoint of the requirements of our current operations but the trends we could see developing for the future. Our approach was to explore the advisability of automation, specifically from the standpoint of the electronic computer, which appeared to be capable of supplying us with the additional voluminous details needed in all management areas.

It was obvious that we could no longer afford decentralized record-keeping, using conventional methods, since these procedures would not provide adequate details at less than a prohibitive cost in clerical people. It also was obvious that we could not afford the high cost of using electronic computers on a decentralized basis.

Because, as I indicated to you, we had to retain our decentralized operating procedures and philosophies, our problem became one of communications. All of our locations had to be tied together so as to provide a rapid method of passing necessary information from one to the other, and to a central figure-gathering group. Furthermore, the communications system should provide a means of carrying administrative traffic as well as the processing of accounting, sales, and other operating information.

SPECIAL COMMUNICATIONS NETWORK

The communications problem was solved by Western Union's designing special equipment for a 20,000-mile communications network which ties in all of our nationwide operations with our data-processing center in Camillus, N.Y., near Syracuse.

Once the communications problem was solved, the second largest obstacle which faced us was how to obtain the complete understanding of the desirability of centralizing the service or recordkeeping aspects, without affecting the decentralization of managerial authority and responsibility. This primarily was an educational problem, because no operating man wants to give up a recordkeeping function, which, as the result of tremendous personal effort on his part, is now functioning smoothly. He is understandably reluctant to take a chance that someone else 2,000 miles away can do it for him as well or better. It is also most difficult for him to be convinced that he will maintain control of his operation without having direct responsibility for the compilation of figures concerning that operation.

However, in a decentralized company it is important that a so-called service department—such as a data-processing center—be completely divorced from any operating group.

Accordingly, we constructed a facility specifically for the purpose of housing our data-processing activity in an area where we do not have any other operations. The data-processing center houses a computer and its peripheral equipment, and is the focal point for the private-wire communications network. In addition, all of the accounting departments in the company are in the center except those accounting activities directly related to the manufacturing or distribution cost functions.

The manager of the data-processing center maintains complete independence from the other accounting groups in the company. His job and that of his staff is to provide a service to "manufacture" a wide variety of information for the benefit of and use by those persons responsible to make the operating decisions of the company. Our various accounting records have been converted to the Univac, and we have a single accounting department for the entire company at the data-processing center, where the usual financial and operating statements required by all levels of management are compiled.

IMPORTANCE OF EFFECTIVE PROGRAMING

Now, before I complete my presentation, I should like to issue just a word of caution. Giant computers are a wonder of the electronic age, but they are not electronic brains. The brains behind a computer are, and will remain for many years, the departments which supply the source data.

Asking the computer the wrong question has resulted in disappointing results for some companies. This is unfortunate because programing can be an expensive operation and too much amending, modifying, or other changes of programs can cause cost to mount alarmingly. It is necessary to judge the benefits of the output against the cost of programing of an electronic digital computer in the same manner that it is necessary to judge the cost of tooling for a new automobile model against the estimated amortization of that tooling through the model year's sales. There are so many applications which can be profitably applied to electronic digital computers that any proposed application without clearly evident potential savings should be discarded.

DATA PROCESSING OVER REGULAR TELEPHONE LINES

There is no great problem in putting electronic data processing to work in large organizations. It is only a question of learning how to use it. The big field is the extension of data processing to the small business which can neither afford nor justify a large system. To meet this need, we in the communications business are working on a means of using regular telephone lines for data processing. For example, a branch manager would simply dial into the telephone system various types of data on the day's receipts and inventories, and the information would be summarized in a data-processing center, and a detailed report sent back to him in a couple of hours. This is some time off, but it will be here sooner than you think. We already have it in a preliminary form right now. I won't go into the relative merits of various kinds of electronic data-processing equipment and how I think the job can best be done, because we could spend hours on that alone. Suffice it to say, however, that taking the drudgery out of paperwork, making the paperwork job more efficient and less costly, is a major aspect of keeping our costs in line so that we can compete in the world market.

AUTOMATION IN THE TELEPHONE BUSINESS

Now that I have introduced the telephone industry into my report, I would like to reiterate a point that has been made many times over, but which warrants repeating if for no other reason than it is one of the most impressive examples of automation in the history of this country. I am referring, of course, to the automation of our telephone systems in this country. This has been a large-scale revolution in mechanization—and without this revolution this country could never have attained the quality, quantity, and breadth of telephone service it enjoys today. There would not even remotely be enough suitable people available in the working force today to do the job if telephone service had not been automated.

ENORMOUS AMOUNTS OF CAPITAL REQUIRED

Needless to say, automation in the telephone industry has required enormous amounts of capital. The General Telephone System, which serves more than 4 million telephones in the United States and constitutes the country's largest independent telephone system, is now nearly 91 percent dial operated. To reach this point, we had to invest nearly $1 billion in new plant and equipment between 1955 and 1959. This year we are investing a new record total of $214 million, and over the next 5 years at least an additional $1 billion will be invested, although this estimate is undoubtedly on the conservative side. Another way of describing the investment required in the telephone business is to point out that our average investment per telephone is about $353. In 1955, the comparable figure was $267, which reflects a 32-

percent increase in 5 years. However, an average figure does not tell the complete story because the investment represented by each new telephone today is far greater due to steadily rising costs.

The steady expansion of telephone service in our operating areas has been accompanied by increased employment opportunities. In General Telephone of California, for example, there were some 716,000 telephones and 7,200 employees in 1955. Today, there are more than 1 million telephones and 10,100 employees. In General Telephone of Florida, the number of telephones has increased from about 260,000 in 1955 to more than 400,000 today, and employment has grown from 2,500 to nearly 3,800. On a systemwide basis (which includes telephone operations in portions of 31 States), the 4 million telephones we serve today are in contrast to about 3 million in 1955. Employment in these telephone operations exceeds 39,000, against 32,000 5 years ago, although the percentage of dial (i.e., automatic) telephones increased during the same period from about 80 percent of the 3 million telephones in 1955 to nearly 91 percent of the 4 million in the General System today (exclusive of the approximately 600,000 additional telephones served by our international affiliates).

Taking the General System as a whole (including the manufacturing as well as the telephone operating companies), employment (on a comparable basis) has increased from 71,000 in 1955 to nearly 86,000 today. Wages and salaries increased from $270 million paid in 1955 to $400 million in 1959, an increase of 50 percent. This reflected not only a greater total number of jobs but broader employment opportunities and higher pay. Without large-scale automation, growth of this magnitude throughout our operations could not have occurred, because automation was the key to providing new and greatly expanded services.

NEW TRENDS IN COMMUNICATIONS

Aside from the rapid expansion of telephone service as such, an entirely new trend has developed in the telephone industry. It is a far broader approach to communications, which is best described as the job of getting the right information to the right place at the right time. When I say that telephone companies have become communications companies, I mean not only that our entire sphere of activity has broadened to the point that our facilities are being used more and more for other-than-voice communications, but we are thinking in terms of entirely new concepts of communications. We need faster means of communications, and we need more versatile means of communications. At the same time, these faster and more versatile techniques must be convenient and reasonably easy to use, and they must be dependable and reasonable in cost. Needless to say, that is a large order, but it is a job that must be done.

Data processing is the outstanding case in point. Not only data processing but the many other aspects of communications will require a host of new technical developments. One such requirement is the development of new system improvements—improvements that will tie in more effectively a data-processing machine in one location with another machine in a distant location. In other words, we will have to find ways of making these machines practically talk to one another, with the ultimate result that one machine in San Francisco, for example, will, in effect, be right alongside a machine located in New York or London. The communications companies will supply the bridge. Of course, this can be done today, but it can't be done well enough, and we will have to find ways of enabling these machines to talk at the rate of several thousand words a minute.

Another technical challenge is memory, which injects an entirely new dimension into a communications system. Memory, of course, is the ability of equipment to accept and store information for various lengths of time and for various reasons. You can think of any number of direct applications of memory equipment—storing the numbers that are called most often, so that the subscriber can put any of them through almost instantaneously; or using a memory device to hold the calling number, the number called, record the length of the call, and calculate the charges.

Another field that seems to have an extremely large potential is slow-scan video, the use of telephone facilities within a given community to transmit and receive images. This is really a type of business television. Central banks and their branches in various parts of the country already are using this technique to verify signatures, and some companies are using it to transmit maps, technical drawings, and so on. The big advantage is the sender and receiver both have copies and can talk about it. Educational television is, of course, another growing application. These are only the very earliest beginnings, however, because the use of telephone facilities for image transmission has an almost unlimited potential.

My final example is literally as big as the universe. I am referring, of course, to space communications. Where this field is going, what it will do in the years ahead, how it will affect our lives—your guess is as good as mine. However, there certainly is no question about the profound effects that will be exerted upon the lives of everyone by space communications. The scientists in the General Telephone & Electronics Laboratories feel the problem of communicating on a global basis is nearer to solution than most of us might think. They envision a network of satellites circling the earth some 2,000 miles out in space, together with space relay stations 22,000 miles above the earth—and this combined system would provide continued long-range point-to-point communications throughout the world, as well as global television, and reliable radiotelephone contact with manned spaceships.

The obvious obstacle that comes to mind is the language barrier, but they foresee an automatic translation machine which, in effect, will make everyone a first-rate international linguist.

That 2,000-mile satellite network will be the first step, and the preliminary models should be up there in a very few years. In fact, a reasonably reliable 24-hour system could well be a reality by 1970—and it could even be sooner than that, at the rate space technology is moving ahead these days.

INDUSTRYWIDE EXPANSION SPENDING FOR MECHANIZATION

Looking at capital spending from the standpoint of industry as a whole, expenditures for new plants and equipment this year appear to be heading for a new record of nearly $38 billion. A recent survey by

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McGraw-Hill indicates that industry is placing great emphasis on modernization for greater efficiency. The survey points out that manufacturing companies will spend more than $15 billion on capital equipment in 1960, of which almost two-thirds, or about $10 billion, will go for replacement and modernization, rather than for expansion. Of that $10 billion, about $7 billion will be for new machinery and equipment. It seems to me that those figures are especially noteworthy because they indicate industry's determination to put even greater emphasis on finding new and better ways of manufacturing their products.

THE ROLE OF RESEARCH AND DEVELOPMENT

In concentrating our attention on mechanization, i.e., the development of new and improved manufacturing processes, it is extremely important to bear in mind the role played by research and development. Research and development is inseparable from mechanization, because it determines the product which will be made in the first place, it determines the materials and components which will go into that product, and it determines the techniques and processes used to make the product. As a case in point, for many years Sylvania has devoted a considerable portion of its research and engineering expenditures to the development of new and improved manufacturing equipment. Because we were a relatively small company competing with far larger organizations, we found it necesary to concentrate on strengthening our competitive position at the manufacturing level. As you know, increased volume produces lower unit costs, other things being equal, and since our volume wasn't as large as our competitors' we simply had to find better ways of producing our products and equalizing their advantages in volume. More than any other single factor, this enabled Sylvania to grow from a relatively small enterprise into the large diversified organization it is today.

As far as industry as a whole is concerned, expenditures for research and development are increasing at an unprecedented rate. When you bear in mind that it takes from 7 to 10 years on the average to translate the findings of research into a new product, and that from 50 to 75 percent of the products of many large companies today are completely or radically different from their products of 15 years ago, you can see why the emphasis on research has increased so drastically in recent years.

TWENTY-FIVE BILLION DOLLARS FOR RESEARCH BY 1970

Back in 1941, the total spent throughout the economy on research was less than a billion dollars annually. Today it is at the record annual rate of more than $12 billion, of which about 50 percent represents national security projects financed by the Government. The total is climbing all the time. In fact, we foresee an annual rate of at least $25 billion by 1970—and I emphasize those words "at least" because of the pressures of foreign competition. Of that $25 billion total, I would venture the estimate that at least 60 or 65 percent will need to be in fields not directly related to national security, if industry is to do the job that must be done.

For the conservative who wonders whether the expenditure of $12 billion annually is worthwhile, let him remember first the vital importance of research in national defense, and let him also remember that two entirely new major industries have evolved since the war—electronics and plastics. Moreover, such major industries as communications, aviation, and electrical manufacturing have gone through enormous change.

As you will recall, research for many years was identified almost entirely with the highly technical industries, but the picture has changed, and we now find an almost universal interest in research throughout industry—not only in manufacturing but in transportation, agriculture, mining, and most recently in distribution. But this interest, great as it is, must be accelerated and strengthened, and we must find ways of at least doubling our research spending over the next few years. The challenge is as simple as this: What we do in our laboratories today, and tomorrow, and next year, and the skill and speed with which we apply those research findings, will determine the position the United States will hold in world trade in the years ahead. The seeds for the new products which we will need 7 or 8 or 10 years from now must be planted now. We can be sure that some excellent planting is going on right now in the laboratories of other countries.

I realize I have covered many subjects in my report, but this is a reflection of the complex nature of the challenges confronting the American economy. In summary, I would like to say that our steadily rising standard of living in America, the phenomenal growth in the quality and quantity of the goods and services we demand, and the increasing complexity of the economic machine required to produce these goods and services, present all of us with an entirely new set of problems. In addition, if our economy is to continue to grow and to provide expanding opportunities for our people here at home, we must maintain our competitive positions in the world market. This means that we must not only find new and better ways of doing things throughout our economic system, but the benefits of these advances must be apportioned equally among all of the major segments of our economy—the people who have invested their savings in our industries, the people who work in our industries, and the people who buy our products—in fact, everyone. If any one of these groups demands preferential treatment over the others, the future of this country will be severely restricted. By the same token, unless industry and government assure that they understand their respective roles in a free enterprise system, and unless they cooperate with each other in attaining these goals, we will miss the opportunities which lie ahead of us.

I want to commend this committee again for its objective and responsible study of the trends of mutual interest to all of us.

STATEMENT OF JOHN I. SNYDER, JR., CHAIRMAN OF THE BOARD AND PRESIDENT, U.S. INDUSTRIES, INC.

Permit me to express my appreciation to the Joint Economic Committee of the Congress of the United States for this opportunity to present my views on the impact of automation on our American economy and to discuss the problems which automation and rapid technological change may have on our economic stability and level of employment. In 1955 the committee similarly entertained views of various individuals in Government, industry, organized labor, and the universities. I have felt that the report of the subcommittee on economic stabilization, entitled "Automation and Technological Change," which was printed in the latter part of 1955, served an admirable function in summarizing our thinking about automation and providing a better focus than we had previously enjoyed for considering automation problems. It is extremely wise, I believe, for the Joint Economic Committee to review our progress in the field of automation and to invite the views of various elements of the national community concerning automation problems.

The corporation which I am privileged to represent—U.S. Industries, Inc.—has been doing notable work in this field. As I indicated in my testimony 5 years ago, our clearing machine division, which manufactures industrial presses, has through the nature of its product been directly involved in automation processes. In addition, U.S. Industries, Inc., acted as operating agent of the Rockford Ordnance Plant, a Government-owned facility devoted to the manufacture of artillery shells on an automated product basis.

Since 1955 our corporation has been typical of many other industrial producers, in that we have been continuously engaged in research and development in the field of automation. Indeed, we stand at the very threshold of large-scale manufacture of automation machines. Through our USI Robodyne Division, with its headquarters in Silver Spring, Md.; our western design division at Santa Barbara, Calif.; and our USI Research Center at Pompano Beach, Fla., the corporation's engineers and technicians have been designing and preparing for mass production of a number of new automation devices. It is inevitable that as these pieces of equipment come into the market in large quantity, they will have a profound impact on many aspects of the production process. That, of course, will presage changes in the nature of production, the number of jobs, and the type of skills and experience needed by employees of companies using these devices. That will mean also many changes and various new problems for the communities where plants using automation equipment are located.

We in U.S. Industries, Inc., are watching with particular interest the development by our Robodyne Division of a whole family of robot machines which stem from one we have named the TransfeRobot.

The TransfeRobot, which was designed by Mr. Edwin F. Shelley, a vice president of U.S. Industries, Inc., and president of our Robodyne division, together with his associates, represented indeed a new concept in automation.

Permit me to quote from a description of the TransfeRobot which appeared in the New York Times on September 8, 1959:

> A new concept in automatic machinery designed to eliminate the dull, repetitive tasks of employees in small as well as large plants was announced today * * * TransfeRobot is a mechanical version of an arm with a many-fingered hand * * * an an electronic "brain" that can be taught * * * a variety of tasks. Using the principle of a guided missile to look and correct its own course, the machine has manual dexterity and a high degree of precision. Once it has been set up for a task, it will continue that work until it is assigned to another job.

Five years ago, when this committee was studying the impact of automation, automation was to be found primarily in big new plants or in plants redesigned in whole or in part for automation. This "older type" of automation required huge production runs in order to pay the cost of automation equipment designed and built for a single production purpose. Because this type of equipment is extremely expensive and requires a tremendous output to make it economically feasible, even minor changes in style or design can so raise costs or impair production as to imperil the whole investment; and, on the other hand, there is a danger that product design may lose flexibility so that it will imperil the automation process.

There was another factor that must often be computed in assessing the high cost of introducing the older types of automated equipment. Because the production process seemed to require new machinery in new plants, older communities with their older production facilities were scrapped by many corporations alert to the advantages of automation in the production process. The sociological efforts of this mass movement of industry (not always economically justifiable, in the wisdom of hindsight) produced some serious sociological problems in many parts of the country. Jobs that had seemed permanent suddenly vanished. Family living was too often disrupted. In many cases employees could find no other work at income rates comparable to those which they had been enjoying. At best the expense of moving to new positions in new locations was financially expensive and sociologically arduous.

Today we stand on the threshold of a new era in automation. As the earlier phase was dominated by the introduction of giant automated industrial complexes, such as refineries or engine plants, the era which we are now entering will have as its distinguishing factor the introduction of small automation units into existing factories.

In the past the industrial producer has had to go to automation. In the era we are entering automation will come to the producer. That means less disruption of communities and families, perhaps less fear by workers of the effects of automation.

The TransfeRobot and its many descendants will, in my judgment, make the difference. The TransfeRobot is designed to do many tasks, to perform them faultlessly and repetitively until given further instructions, and to learn new tasks in a minimum amount of time.

It is natural that people of lively spirit should at first recoil from the prospect of such a robot entering the industrial process. But I believe a moment's reflection will indicate its very great advantages for our entire society.

Mankind for generations has dreamed of a robot with a strong physique and a mind void of imagination and spirit who can perform the dull repetitive drudgery task which many industrial processes require. The TransfeRobot is a smart and clever machine designed to do these dull jobs and to do them well. The TransfeRobot and the whole family of robot machines which are coming off the designers' tables offer the first opportunity to bring economically feasible automation to older existing plants. No good purpose would be served in denying that robot machines will take the place of workers on many factory jobs. Indeed I think we must realistically look forward to the day, perhaps not more than a generation away, when there will be no human labor, other than supervisory or maintenance, engaged in the manufacture of many of the mass-produced necessities and luxuries of American life—automobiles, radio and television sets, outboard motors, packaged foods, washing machines, ballpoint pens. The drudgery of the routine jobs will be handled by inexpensive robots rather than by sensitive human beings. From both an economic and a human standpoint this will be a great advance, just as the man who operates the giant earthmover on a construction job is a great advance from the slave who carried rocks on his back to build the great landmarks of ancient times. This freedom from terrible drudgery is one which our society, however, must take steps to insure that our people will be able to benefit from and, indeed, enjoy.

It is clear that many small businesses which could not possibly afford the vast expenditures necessary for the older type of automation will be able to utilize the new automation which will bring sophisticated machinery to the manufacturer at relatively inexpensive prices. The benefit to the manufacturer will be direct, in terms of heightened productivity, greater range of production and greater flexibility in the production process. This widely dispersed increase in productivity and production flexibility should bring about an increase in per capita production and should certainly prove beneficial to our competitive position against the output of other nations. Indeed I foresee that robot production may give smaller businesses vast new opportunities to compete effectively. On a national scale it can be foreseen that the great rise in productivity made possible by the families of robot machines will bring us great advantages in our competition with totalitarian powers such as Soviet Russia and Soviet China. Outnumbered as we are by these two nations, the United States will find in the new automation an instrument for raising our productive power to a level far higher than that of either Soviet Russia or Soviet China.

Of course the transition from human power to machine power in the mass production industries will not come easily unless the Nation and its important economic and sociologicial segments recognize that we must work cooperatively to find adequate solutions to the problems which automation creates. These solutions must be more than minimum solutions. We must endeavor to assure that throughout our society the benefits of automation flow equitably to all the people.

The opening of a new era in productivity offers the western world an unparalleled opportunity to share intelligently the great abundance of material wealth—and well being—which can now be created.

When a major technological advance provides an economy with a greatly increased productive capacity, the question inevitably arises, "But what will happen to the people who formerly performed the work which machines can now do?" The answer is that they will do what people have always done since the start of technological innovation—since the invention of agriculture, of the wheel, of the aqueduct, of the steam engine, of the electric motor, of the giant computer. Some people will design, manufacture, supervise and maintain the new robots. Some will fill the increased demand for services—for travel, for entertainment, for recreation. More people will devote themselves to pursuit of literature and the arts—for which the higher pay and shorter hours of the average worker will provide an increased market. And in increasing numbers our people will be drawn to the frontiers of man's great adventures—scientific investigation, the conquest of disease, the exploration of space.

The scope of the automation revolution is so vast, however, that it seems to be bringing about simultaneous problems and solutions. U.S. Industries for instance, before it had very long been involved with the development of the TransfeRobot, found itself engaged in exploring various aspects of the training and retraining of human beings in industry. One result of this activity has been development of the AutoTutor, an electromechanical tutoring system. AutoTutor is an automation device which we believe brings a new perspective to the training and education of personnel in industrial, educational, and military training programs. It continuously tests a student's understanding of all teaching material presented to him and automatically adapts the program to the student's individual needs. AutoTutor, by using the basic principles of automation in presenting material to a student, makes possible significant advances in the speed of training and the retention of material by the individual student. In a period when many adult workers will need complex training or retraining for industrial positions the value of a machine such as AutoTutor can be readily appreciated. In addition, the USI Robodyne Division has been studying with very considerable success various new concepts relating to the use of automation in personnel training. I believe that we may soon be ready to announce quite sensational new machinery to help train, retrain, or upgrade the skills of persons whose jobs must be changed because of the introduction of automation into their job environment.

This use of automation gives me reason to believe that we can rapidly and effectively train people for new jobs and new skills and that the sharp, adverse effect of automation on human lives and fortunes may indeed be blunted.

It is clear that the accelerating use of automation, which I foresee during the next two decades, will affect millions of people and require the development of governmental programs realistically attuned to handling this problem of work displacement. Government as an employer is using automation in many of its departments, and I believe that Government has a social responsibility to provide leadership in this whole process of retraining. The lessons that are learned in Government can and certainly should be quickly applied to help industrial workers who face temporary loss of employment opportunity because of automation. A fair proportion of the great savings that the new automation will make possible for industry must be plowed into the retraining and upgrading of workers just as alert businessmen now reinvest a portion of their profits in order to maintain their competitive position.

Five years ago I expressed the belief that a national labor-management committee on job opportunities should be established to deal with problems of unemployment arising as a result of automation. I renew that proposal today. It seems clear to me on the basis of the various seminars and discussions that have been held throughout the country—in recent months specifically under the auspices of the Governors of New York and Massachusetts—that a national council representing a pledge of cooperative activity by management and labor could sponsor, stimulate, and encourage necessary steps to overcome the temporary adverse effects of automation. Such a national labor-management council could serve as a spokesman for industry and the trade union movement in soliciting the help of Government at every level in meeting the sociological and economic challenges created by the increasing use of automation.

It is clear that automation is rushing into American industry. It is clear that automation brings long-range benefits and short-run disruptions to the economy and to community and family life. It is clear therefore that we cannot close our eyes to the dislocations, while voicing appreciation for automation's benefits. In handling the automation problem America as a leader of the free world and as a mature democracy has a golden opportunity to demonstrate to all the people of this globe that our free economy does indeed operate for the best interests of all of our people and for both the material and the spiritual enrichment of the lives of our human families.

STATEMENT OF R. H. TRIPP, FLIGHT TEST DEPARTMENT, GRUMMAN AIRCRAFT ENGINEERING CORP., PRESIDENT-ELECT-SECRETARY, INSTRUMENT SOCIETY OF AMERICA

The past few years have witnessed a critical change in the aeronautical industry as well as the instrumentation which plays such an important part in every aspect of its existence. Manned military attack aircraft have assumed a new role, that of a missile carrier. Automatic control and guidance will take the place of the pilot during the final phase of weapon delivery in any future conflict that may be thrust upon us. The development of satellites and guided missiles has been made possible by the extensive use of instrumentation and automatic control. In fact, the satellites, which now circle the earth gathering data on space environment as well as data on the shape of the earth and its weather conditions, are useful only due to the instrumentation in the vehicle, commonly referred to as the "payload."

This change in emphasis in the aeronautical industry has led to drastic changes in the type of manpower required, types of machinery employed, and the methods of operation. The ratio of the number of engineers required to the number of shop personnel required has increased markedly. On the one hand, much more time must be spent, in many instances, to use automatic processes for fabrication in order to achieve a miniaturization and precision unattainable by hand operations. A rather large classification of workers intermediate between laborers and designers is beginning to emerge, usually referred to as instrumentation technicians and operators. Due to the complicated, intricate design of instrumentation and automatic control systems, these technicians and operators require extensive experience in addition to a good background of technical education. At the present time, there is a definite shortage of capable instrumentation technicians as well as competent instrumentation engineers.

A few years ago there was a definite skepticism on the part of aircraft pilots toward the use of automatic controls and toward development of unmanned aircraft. Due to post-World War II advancements in instruments to detect, and automatic fire control to destroy attacking targets, the military environment during weapon delivery has become unsuitable for piloted vehicles. In space probing and space research, we would have been seriously handicapped and delayed if it had been impossible or impracticable to utilize unmanned vehicles. In the commercial field, with the advent of larger, faster, and longer range aircraft flying under all weather conditions, present schedules and commitments could not be maintained on a satisfactory basis without extensive use of instrumentation and automatic control. There has been strong emphasis on the importance of instrumentation, especially as it applies to the control of traffic at airports, the avoidance of inflight collisions, and the ability to avoid storms or air disturbances to insure the maximum comfort and safety of passengers.

One of the powerful tools that has enabled the aeronautical industry to develop advanced missile systems and automatic control systems is in itself automation, the high-speed automatic computer. Computers are used extensively for aeronautical research design, and testing. They are also essential as airborne installations for navigation, and fire control. Much of the data recorded during missile and aircraft tests is recorded on magnetic tape and processed through high-speed computers. The engineer is able to obtain precise solutions to many research and design problems that previously were prohibited by cost and time requirements. The designing, programing and operating of high-speed computers has become an important and very rapidly growing profession.

In addition to the instrumentation and automatic control used in aircraft design and development, there has also been a substantial increase in automation during manufacturing processes. The new materials and design techniques necessary to save weight and space for space travel and high-speed flight, have resulted in considerable automation of machine tools. These tools are often controlled by machined cams, punched cards, or magnetic tape.

In summary, the progress and growth of instrumentation and automatic control in the aeronautical industry has been greater than could have been anticipated during the past 5 years. This growth has necessitated on-the-job training to fill the new jobs created for technicians, programers, and machine operators. There is a shortage of properly trained workers in these fields. The Instrument Society of America has dedicated itself to promoting and encouraging instrumentation and automatic control training and research in high schools, vocational schools, colleges, and universities. This effort should be expanded in every practicable way to encourage training in those skills and tools which will qualify more men and women to work in the field of instrumentation and automatic control. School laboratories should be be equipped with modern test equipment and computers for practical training aids. Information on automation and instrumentation should be collated, indexed, and made available to people working in this field so they can keep abreast of the rapid advancements and insure the continuation of progress. Proper training and dissemination of information in the field of instrumentation and automatic control is mandatory if we are to maintain our position of technical leadership in military and economic world competition.

VIEWS OF INDIVIDUALS FROM BANKING

STATEMENT OF JOHN A. KLEY, PRESIDENT, THE COUNTY TRUST CO., WHITE PLAINS, N.Y., AND CHAIRMAN, TECHNICAL COMMITTEE ON MECHANIZATION OF CHECK HANDLING, BANK MANAGEMENT COMMISSION, AMERICAN BANKERS ASSOCIATION

It is a pleasure for me to submit the following information which will update the previous testimony and describe the technological progress in check mechanization that has taken place during the period of almost 3 years since the original testimony.

I call your attention to the conclusion of that testimony which was as follows:

FUTURE CONSIDERATIONS

> At the present time, all of the major manufacturers involved are working on a coordinated basis to specify the ultimate character type fonts to be used for maximum efficiency and accuracy.
>
> The last major remaining problem on which the committee is working in conjunction with representatives of the Federal Reserve System, is the specific area designation on the check for various fields of information to be encoded. These include the amount, the individual customer account number and the transit number-routing symbol system used in the clearance of checks by banks and the Federal Reserve System.
>
> It is our hope that in the very near future the remaining two obstacles may be cleared so that experimentation and hardware development will continue to progress in an orderly fashion.
>
> There can be no accurate determination as to just when commercially marketable equipment will be available. However, the most educated guesses at the present time indicate that it will be between 2 and 3 years from now. While it does not appear feasible that banks of all sizes will be able to take advantage of all of the benefits to be derived from the program to the same degree, it is believed that all banks will gain some benefit, either through collective use of equipment or by the individual use of specific phases of the program.

PRESENT STATUS

The problem of the specific area designation was coordinated and completed with the publishing of Bank Management Publication No. 142 (a copy of which is attached, p. 347) entitled "Location and Arrangement of Magnetic Ink Characters for the Common Machine Language on Checks." This report coordinated the factors of tolerance, standardization of information, and field length for specific information.

During the interim period the major manufacturers worked diligently to reach agreement on the specific type font. Final decision on the font known as E-13-B was reached in December of 1958. This permitted the inclusion of the specific font dimensions in an overall manual, outlining the specifications for the entire program and published as Bank Management Publication 147 entitled "The Common Machine Language for Mechanized Check Handling—Final Specifications and Guides To Implement the Program," April 1959. (A copy of this report, exclusive of appendix II and III, is also included, p. 367.)

During the course of these two projects a progress report (Bank Management Publication No. 146, p. 437) was submitted in July of 1958 outlining the progress being made by the manufacturers to reach the final specifications. There was also published Bank Management Publication No. 144, a report entitled, "Account Numbering and Check Imprinting for Mechanized Check Handling," dated June 1958, page 443, which was issued primarily for the indoctrination and information of both the banking and printing industries. (Copies of these publications are attached.)

As the result of experience gained during the year 1959, a supplemental report on the final specifications was issued. This supplement (Bank Management Publication No. 149) entitled, "A Progress Report, Mechanization of Check Handling" (copy attached, p. 423), did not change materially the original specifications, but was an attempt to clarify and give a greater degree of definition to a number of the factors outlined in Bank Management Publication 147.

SUMMARY

It was indicated at the time of the original testimony that marketable equipment would be available in from 2 to 3 years from that particular date. This prediction has come true and equipment in limited quantities is now being utilized in several banks throughout the country. It is anticipated that this number will continue to expand during the remainder of 1960 and that such equipment will become commonplace in the larger banks within the next 18 to 24 months.

The Bank of America, about which Mr. Zipf will report, has had the greatest amount of experience to date and I feel certain that the results which they have attained from the standpoint of personnel and equipment utilization will be most helpful to your study.

Location and Arrangement

of Magnetic Ink Characters for the Common Machine Language on Checks

BANK MANAGEMENT PUBLICATION 142

AUTOMATION OF BANK OPERATING PROCEDURE

Recommended by
Technical Committee on
Mechanization of Check Handling

JANUARY 9, 1958

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Foreword

Magnetic Ink Character Recognition was adopted in July, 1956, by the Bank Management Commission of the American Bankers Association as the Common Machine Language most suitable for mechanized check handling; and in April, 1957, the bottom edge of checks was designated as the printing location. These recommendations were unanimously accepted by all of the interested bank machine manufacturers of the country and the check printing industry.

These two decisions permitted machine manufacturers to proceed in the design and development of check handling equipment and encoders. The recommendations and specifications contained in the present report cover the items to be encoded, the number of digits allotted to each, and the sequence of the information.

With the issuance of these specifications, the major remaining problem in the establishment of a Common Machine Language is the determination of the type font—the shape of the characters. The machine manufacturers are diligently proceeding with their evaluations of various fonts, and it is expected that the Technical Committee on Mechanization of Check Handling will be in a position to report the results of their cooperative efforts within the reasonably near future.

The Technical Committee has continued to put forth a tremendous amount of time and energy toward the completion of the Common Machine Language phase of automation. The Bank Management Commission is very appreciative of the outstanding work performed by the members of the Technical Committee.

BANK MANAGEMENT COMMISSION
AMERICAN BANKERS ASSOCIATION

Harold E. Randall, *Chairman*

PART I

Activities of Technical Committee

On April 10, 1957, the Technical Committee on Mechanization of Check Handling issued its report "Placement for the Common Machine Language on Checks," covering bottom edge placement. A letter and copy of the report were sent to all member banks of the American Bankers Association over the signature of Harold E. Randall, Chairman of the Bank Management Commission. This report indicated that with one exception all participating manufacturers favored bottom edge encoding. Following the issuance of the report, this one manufacturer pledged its support for bottom edge encoding.

Activities of the Technical Committee since publication of the report follow.

On May 24 and 25, 1957, a meeting was held in New York to discuss account numbering, check imprinting, and the problems involved in allocating fields for magnetic ink character encoding.

At this meeting the following actions were taken:

1. Recommendation that a committee be established within the Bank Management Commission to work with the Federal Reserve System in exploring the possibility of simplifying transit numbers and routing symbols.

2. Decision to gather information on account numbering and check imprinting for possible issuance of a pamphlet on these aspects of the mechanized check handling problem.

On September 26, 27, and 28, 1957, a meeting was held in New York. At this meeting the following was accomplished:

1. Discussions with representatives of the Board of Governors of the Federal Reserve System concerning the possibilities for obtaining better and more comprehensive statistical data as a by-product of mechanized deposit accounting.
2. A verbal progress report from the Chairman of the Office Equipment Manufacturers Committee working with the Technical Committee.
3. A discussion of assignment of digits for transit number-routing symbol as recommended by the committee of the Bank Management Commission established as a result of the Technical Committee's May recommendation.
4. A demonstration of paper handling equipment and systems concepts being laboratory tested by the Burroughs Corporation and the International Business Machines Corporation.
5. A review of the proposed text for account numbering and check imprinting.

In compliance with a request to the American Bankers Association from the Subcommittee on Economic Stabilization of the Joint Committee on the Economic Report to the Congress of the United States to present information on automation trends in banking, John A. Kley and A. R. Zipf appeared at hearings in Washington, D.C., on November 15, 1957.

On December 12, 13, and 14, 1957, a meeting was held in New York:

1. To coordinate with the Federal Reserve System the recommendations to be contained in the Technical Committee's

report and to discuss the Federal Reserve System program for mechanized check handling.

2. To further coordinate the recommendations in this report with representatives of machine manufacturers, the check printing industry, and other interested parties.

In addition to these formal meetings, individual members of the Technical Committee have continued numerous informal discussions with machine manufacturers, check printers, and others.

PART II

Items to be Encoded

In any consideration of the mechanization of check collection and demand deposit accounting, it is imperative that the following items of information be encoded:

1. ***Amount.***

2. ***Transaction codes.***

   To identify or describe a given transaction, i.e., credits, debits, service charges, etc.

3. ***Account number.***

   Identification of account to be posted.

4. ***Transit number-routing symbol.***

   Even though some may not contemplate mechanizing their own demand deposit accounting, this is essential for inter-bank collection procedures.

(Encoding of check serial number will be treated in Part V.)

In analyzing the items to be encoded, it was found that they fell into essentially two basic groupings:

First, those applicable to all banks where rigid requirements are absolutely necessary to permit equipment of various manufacturers to be designed with knowledge that this information will be in standardized format and of standardized length on all checks. Amount and transit number-routing symbol are the items in this category.

Second, those of interest only to the drawee bank where latitude can be permitted to provide for the varying systems concepts of the manufacturers and the different requirements of individual banks. Transaction codes and account number are classed in this category.

Therefore, the Committee in analyzing and evaluating these two basic categories had to relate check collection and deposit accounting applications with the factors involved in the pre-printing and post-printing operations.

PART III

Sequence of Fields of Information

The sequence of the fields of information was selected only after very careful study of many factors. The sequence selected, reading from right to left, is: Amount, transaction codes and account number, and transit number-routing symbol. The major reasons for the sequence selected are set forth below.

AMOUNT

The amount usually will be encoded by "post-printing" devices as a by-product of a proof operation in the check collection system. Because of the large number of "post-printing" devices which will be required, it is important that they be as simple and as inexpensive as possible. It was determined that these requirements could best be met if the amount were assigned to the field at the extreme right of the bottom of the check.

The amount field will be referred to more frequently than other fields (largely because of manual reconciliation of differences) and, therefore, should be as close to the written amount as possible for convenience of verification.

ACCOUNT NUMBER AND TRANSACTION CODES

The transaction codes to describe the types of entries, such as credits, debits, services charges, etc., and the account numbers to identify the accounts to be posted will be selected and assigned for use by the drawee bank.

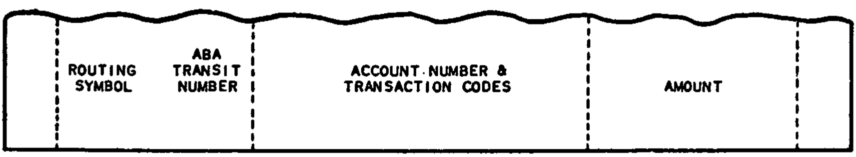
The transaction codes in a great many cases will be post-printed. Therefore, it was advisable to place this information next to the amount so that it could be encoded with the amount in the same operation and with the same device.

The account number will usually be pre-printed prior to the distribution of checks to customers. As to the sequence of this information, it was resolved, on the basis of pre-printing and post-printing considerations, that the placing of the account number to the left of the transaction codes and next to the transit number-routing symbol permits the pre-printing of the account number and transit number-routing symbol at the same time, thereby obtaining the greatest efficiency and economy in printing. In addition, the general requirement that a minimum of two blank spaces must be provided between pre-printed and post-printed fields to avoid the possibility of overprinting is more easily resolved by such an arrangement.

TRANSIT NUMBER-ROUTING SYMBOL

The transit number-routing symbol, like the account number, will usually be pre-printed prior to the distribution of checks to the customer. By placing this to the left of the account number, all pre-printed information may be arranged at the left of the check and all post-printed information at the right. Having all pre-printed information together is highly desirable from the check printers point of view.

Location and arrangement of the fields is illustrated in the following diagram:



PART IV

Number of Digits

In order to encode the minimum data required, the Technical Committee, in cooperation with machine manufacturers and check printers, determined that the minimum length of check necessary was 6″. After considerable study of the reading of Arabic characters, the machine manufacturers decided that characters printed 8 to the inch provided the most reliable and economical reading. With spacing of the digits 8 to the inch, 48 spaces would be available on a 6″ check. However, there will be a requirement of 3/8″ at each end of the check for tolerance and mutilation which will reduce to 42 the number of spaces to be allocated to transit number-routing symbol, account number and transaction codes, and amount. The additional area on checks longer than 6″ may be utilized for the check serial number as will be described later.

AMOUNT

The decision to provide 10 digits for the amount was preceded by a series of surveys in which the Federal Reserve Bank of New York participated. These surveys indicated quite clearly that use of fewer digits would result in a sufficiently large number of rejected items to cause hardship. Moreover, introduction of batch and other total slips, as contemplated by some systems, would be extremely complicated if sufficient digits were not provided for totals. Further reason for 10 digits involved broadening the marketing base for post-printing devices by being able, with 10 digits, to more easily care for amounts under money systems of other countries.

In addition, identical special "start-stop" symbols will precede and follow the 10 digit amount for a total of 12 spaces in this field. These symbols are necessary to indicate to electronic machines when to start and stop reading encoded information.

The amount field will include nonsignificant digits to completely fill the field in every case, enhancing the electronic reading reliability by permitting the counting of digits being read.

ACCOUNT NUMBER AND TRANSACTION CODES

With the assignment of 12 digits for amount and 11 digits for transit number-routing symbol (both of which include "start-stop" symbols) plus 6 for marginal requirements, a total of 19 informational spaces are available and reserved for the exclusive use of the drawee bank. This is the area available for account number and transaction codes, printing tolerances, "start-stop" symbols, etc.

TRANSIT NUMBER-ROUTING SYMBOL

In order to provide sufficient space for other pertinent information, it was believed that the number of digits in the transit number-routing symbol could be reduced without impairing its utilization. This reduction in the number of digits to be sorted will usually result in a reduction of sorting time.

For these reasons a committee was established within the Bank Management Commission to work with representatives of the Federal Reserve System to effect this reduction in the number of digits while still retaining the information required for check collection purposes and bank identification.

It was the recommendation of the above committee that encoding of the transit number-routing symbol should consist of the present routing symbol (4 digits), followed by a hyphen (1 digit), and the suffix of the present transit number (4 digits).

Since the routing symbol identifies the city or state in which the drawee bank is located, it was felt that the prefix to the bank's transit number, which is for the same purpose, could be eliminated for encoding purposes.

Example: $\frac{8\text{-}26}{430}$ would be encoded 0430-0026.

(Note that nonsignificant digits are included.)

To accomplish this objective, approximately 100 banks will be requested to change their assigned transit number to overcome indicated duplications. They will be contacted individually by the American Bankers Association to coordinate these changes. It is anticipated that the far-reaching benefits to be accrued from the system will encourage their wholehearted cooperation.

Since nonpar banks have transit numbers but no routing symbols, this same committee recommended a special prefix number of four digits for encoding purposes, with the first digit being 9, the second digit being 0, and the third and fourth digits being the present prefix number of the state in which the nonpar bank is located. This would be in the same location as the encoded routing symbol used by par banks. Identification of nonpar items by this first digit 9 will not only permit mechanized handling to a degree, but will also readily identify these items which will not be handled by the Federal Reserve banks.

Example: 61-754 would be encoded 9061-0754.

These proposals were presented to the Federal Reserve System by the Bank Management Commission and the Conference of Presidents of the Federal Reserve Banks found them acceptable in so far as the operation of the Federal Reserve banks is concerned.

The transit number-routing symbol will be preceded and followed by an identical but unique "start-stop" symbol for a total of 11 units of information.

It should be clearly understood that, in addition to the encoded shortened transit number-routing symbol, the entire fractional transit number-routing symbol in its present format will continue to be printed in the upper right corner of checks.

Encoding of transit number-routing symbols on checks will, of course, preclude the possibility of the designation of alternate drawee banks. This change in presently accepted practices is further dictated by the fact that an account number will probably pertain to but one bank.

PART V

Check Serial Number

While check serial number is not considered part of Common Machine Language designation, it is of interest to those banks offering account reconciliation and/or dividend disbursing service. It may be of interest also to many large corporate customers.

The printing of check serial numbers in magnetic ink will be optional for banks and their customers and may vary with different systems. On those checks substantially more than 6 inches in length this number may be encoded to the left of the transit number-routing symbol. An alternate procedure will be to substitute the check serial number in magnetic ink for the serial number now printed in conventional ink in the customary location in the upper right corner of the check. The latter procedure will introduce some additional complexity in the sorting and reading equipment because of the placing of coded material outside of the specified coded area.

PART VI

Recommendations

The following are the specific recommendations of the Technical Committee pertaining to the items to be encoded on a check, the number of digits allotted to each item, and the sequence of the information to be encoded.

1. The minimum check length compatible with the system shall be 6".

2. For all checks that are to be encoded, regardless of size, the point of reference from which to measure for the printing of any information field shall be the right edge.

3. Placement of Common Machine Language characters

   a. On all checks except 80-column punch card checks

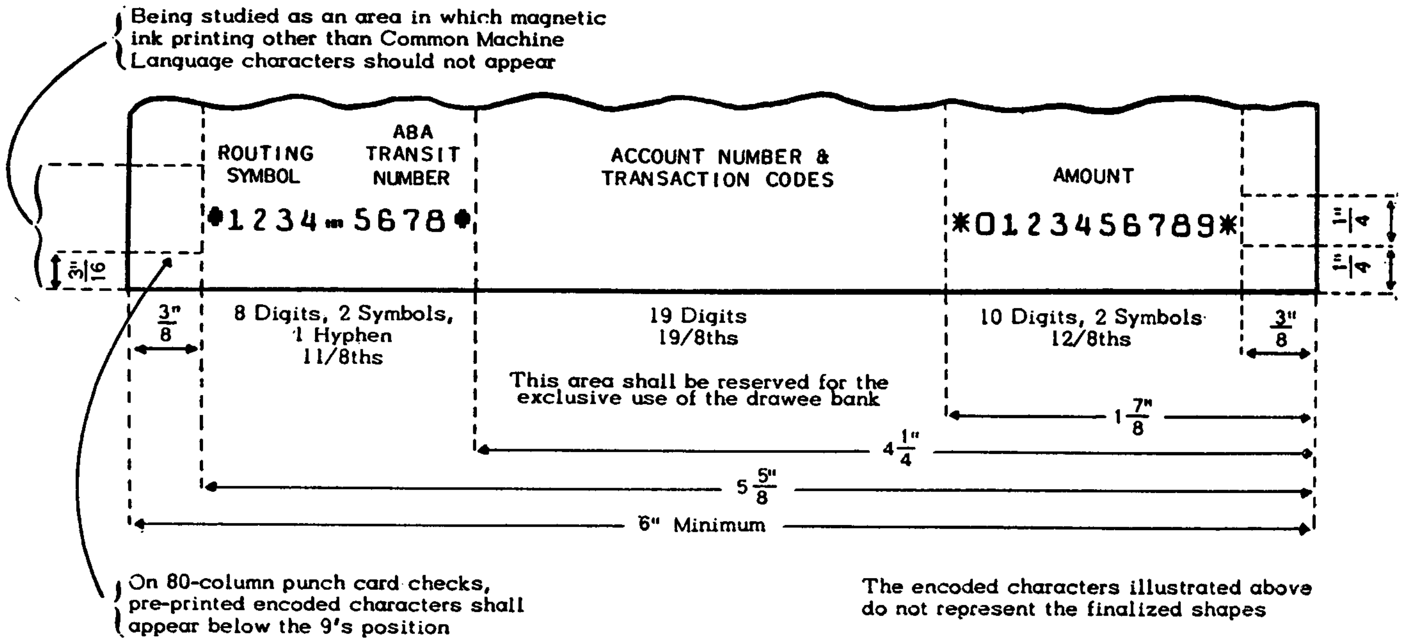
      (1) Both pre-printed and post-printed characters shall be confined *within* a horizontal band ¼" wide extending horizontally across the check.

      (2) The space between the bottom of the band and the bottom edge of the check shall be ¼".

   b. On 80-column punch card checks

      (1) Post-printed *within* a ¼" band, which band is located ¼" above the bottom edge of the punch card, the same as 3-a above.

LOCATION AND ARRANGEMENT OF MAGNETIC INK CHARACTERS ON CHECKS



The encoded characters illustrated above do not represent the finalized shapes

(2) Pre-printed *below* the 9's punched hole position to avoid the negation of significant information by punched holes. (The bottom of the 9's punched hole is 3/16″ from the bottom edge of the punched card.)

(*Note:* Machine manufacturers have indicated a desire to reserve an area above the band, which shall be free of any other magnetic ink imprinting, to facilitate accuracy and reduce the possibility of rejection. The exact dimension of this area is now being studied and its determination will be announced as soon as it is established.)

4. The Common Machine Language shall always be printed within the 6″ overall dimension from the right edge regardless of size of check.

5. The length of the reserved area shall be divided into 48 space allocations ⅛″ in width.

6. Upon the basis of the foregoing, the sequence of information (from right to left) shall be:

a. *Amount*

(1) It shall contain

(a) 10 digits of numeric information.

(b) Identical symbols ("start-stop") indicating the beginning and the ending of the amount field. Both of the "start-stop" symbols shall always be printed as part of the amount field.

(2) It shall be located at least ¼″, but not more than ⅜″, from the right edge of the check.

b. *Account Number and Transaction Codes*

It shall be reserved for the exclusive use of the drawee bank and shall contain a total of nineteen ⅛″ spaces. Such spaces are defined for all systems and machine concepts as including digits, "start-stop" symbols, and a minimum of 2 spaces for printing tolerance between pre-printing and post-printing. The arrangement of

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this information will be transaction codes to the right and account number to the left.

c. *Transit Number-Routing Symbol*

It shall contain

(1) 4 digits—prefix
   (a) Par banks—routing symbol. (Preceded by a 0 where only 3 digits.)
   (b) Nonpar banks—state prefix number preceded by 90.

(2) 1 separation symbol (a hyphen)

(3) 4 digits—suffix
   Bank transit number including non-significant digits.

(4) 2 identical symbols ("start-stop") to indicate the beginning and the end of the transit number-routing symbol field.
   (a) The left edge of the last such symbol indicating the end of the field shall be no more than 5¾" but no less than 5⅝" from the right edge reference point.

To summarize, the information reference from the right edge (lower) shall contain as a maximum the following space allocations:

Spaces	
3	Tolerance
12	Amount (Including "start-stop" symbols, which shall always be printed as part of the amount field.)
19	Reserved for the exclusive use of drawee banks—for account number, transaction codes, printing tolerance, "start-stop" symbol, etc.
11	Transit number-routing symbol field, including "start-stop" symbols.
3	Tolerance (6" check)
48	Total

PART VII

Summary

This report marks the third significant milestone of progress in our program of check mechanization.

The final style of character shapes must be determined through the technical facilities and by the cooperative action of the machine manufacturers themselves. Recent developments in this area give us cause for great optimism that this action will be accomplished in a relatively short period of time.

A report will be issued setting forth the specifications for the type font as well as the area above the band which must be free of any other magnetic ink printing as soon as these decisions have been reached.

The Technical Committee acknowledges with gratitude the wholehearted assistance and cooperation of the Federal Reserve System, machine manufacturers, check printers, and others that have made these decisions possible. The continued support of these groups and the banks of the country will assure the successful completion of this program.

Respectfully submitted,
JOHN A. KLEY
Chairman

Technical Committee on Mechanization of Check Handling

John A. Kley, Executive Vice President, The County Trust Company, White Plains, New York, *Chairman*

Herbert R. Corey, Vice President, The First National Bank of Boston, Boston, Massachusetts

L. A. Erickson, Vice President, First National City Bank of New York, New York, N. Y.

David H. Hinkel, Assistant Secretary, First National Bank of Chicago, Chicago, Illinois

Raymond C. Kolb, Assistant Vice President, Mellon National Bank and Trust Company, Pittsburgh, Pennsylvania

Edward T. Shipley, Auditor, Wachovia Bank and Trust Company, Winston-Salem, North Carolina

A. R. Zipf, Vice President, Bank of America N.T. & S.A., San Francisco, California

Melvin C. Miller, Deputy Manager, American Bankers Association, 12 East 36 Street, New York, N. Y., *Secretary*

The Common Machine Language

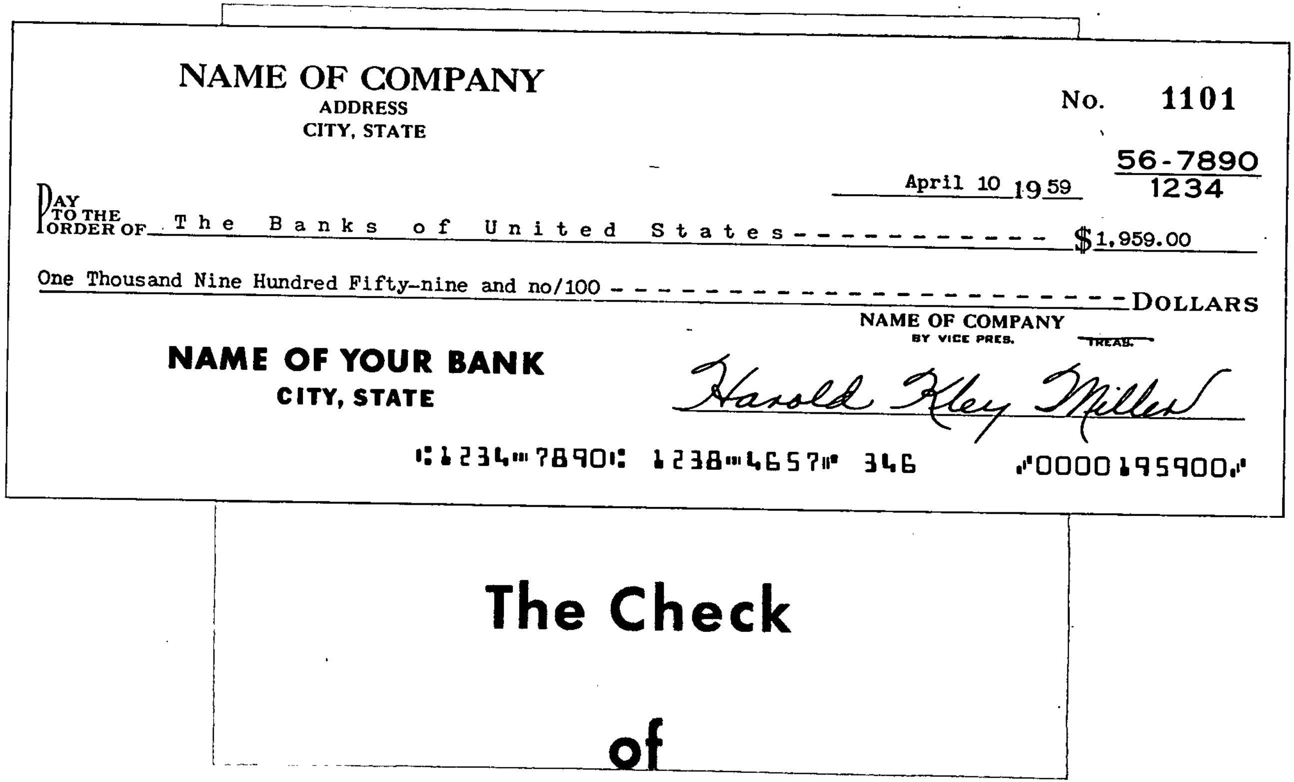
For Mechanized Check Handling

Final Specifications
and Guides
To Implement the Program

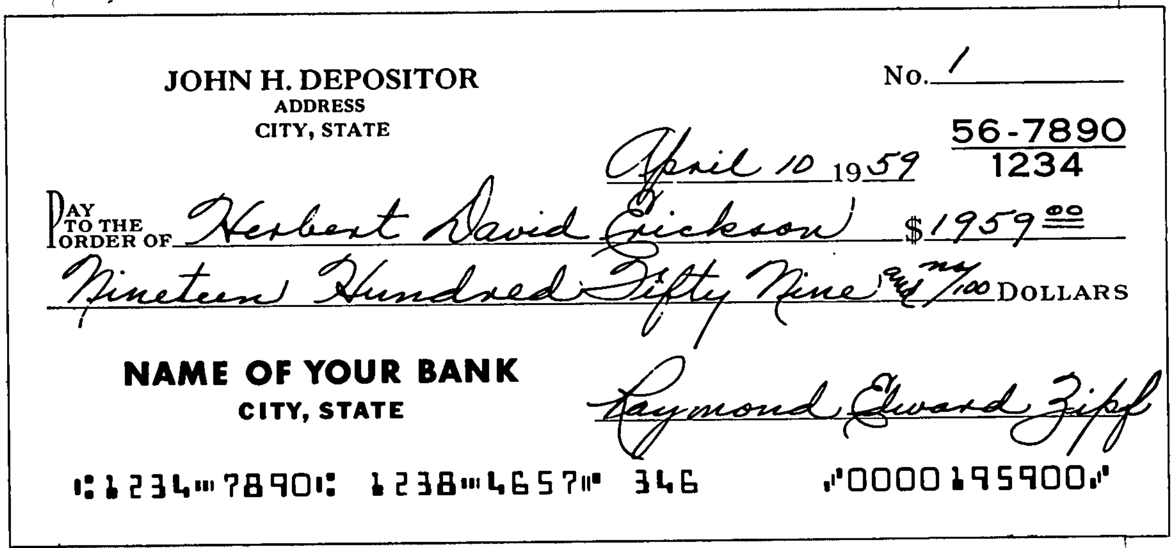
BANK MANAGEMENT PUBLICATION 147
AUTOMATION OF BANK OPERATING PROCEDURE

Recommended by
Technical Committee on
Mechanization of Check Handling

APRIL 1959


NAME OF COMPANY
ADDRESS
CITY, STATE
No. 1101
56-7890
1234
April 10 1959
PAY TO THE ORDER OF The Banks of United States $1,959.00
One Thousand Nine Hundred Fifty-nine and no/100 DOLLARS
NAME OF COMPANY
BY VICE PRES. TREAS.
NAME OF YOUR BANK
CITY, STATE
Harold Kley Miller
⑆1234⑈7890⑆ 1238⑈4657⑈ 346 ⑇0000195900⑇
The Check
of

the Future


JOHN H. DEPOSITOR
ADDRESS
CITY, STATE

No. 1

56-7890
1234

April 10 1959

PAY TO THE ORDER OF Herbert David Erickson $1959 00

Nineteen Hundred Fifty Nine and no/100 DOLLARS

NAME OF YOUR BANK
CITY, STATE

Raymond Edward Zipf

⑆1234⑈7890⑆ 1238⑈4657⑈ 346 ⑉0000195900⑉

Foreword

This booklet containing the report of the Technical Committee on Mechanization of Check Handling completes the Common Machine Language phase of the check mechanization project. Outlined herein are the specifications of the type font and also guides for banks, office machine manufacturers, and check printers to help implement the program. This project is one of the most difficult and, at the same time, one of the most worthwhile ever undertaken by a committee of the Bank Management Commission.

The Technical Committee, working in cooperation with committees representing the office equipment manufacturers, the check printers of the country, and the Federal Reserve System, has had the responsibility of making decisions which will have a far-reaching impact on banks' check handling problems for many years to come. The accomplishments of these men in evolving the common language concept will undoubtedly prove to be one of the most significant developments in the history of bank operations.

This report, containing dimensional specifications for the printed image of the characters to be used, horizontal and vertical field boundaries, minimum and maximum check sizes, and printing tolerances, has been prepared only after most diligent study and exhaustive field-testing. The decisions contained therein forge the final link in a chain of events which has brought the common language phase of the check mechanization program to the very threshold of reality.

Sufficient time must be allowed, of course, for the check printers of the country to work out the changes that magnetic ink imprinting procedures will necessitate, as well as for the manufacturers to produce the new check handling equipment. However, automation in check handling is now in sight, and sincere thanks are due to each and every member of the several teams which have worked so hard to bring this about.

Special credit, of course, is due the Technical Committee on Mechanization of Check Handling which, under the able and inspiring leadership of John A. Kley, Executive Vice President of The County Trust Company, White Plains, New York, has spearheaded this drive which has resulted in this new and evolutionary method of check processing. In addition to Mr. Kley the members of the committee are:

Herbert R. Corey, Vice President, The First National Bank of Boston, Boston, Massachusetts

L. A. Erickson, Vice President, The First National City Bank of New York, New York, N. Y.

David H. Hinkel, Assistant Cashier, The First National Bank of Chicago, Chicago, Illinois

Raymond C. Kolb, Vice President, Mellon National Bank and Trust Company, Pittsburgh, Pennsylvania

Edward T. Shipley, Auditor, Wachovia Bank and Trust Company, Winston-Salem, North Carolina

A. R. Zipf, Vice President, Bank of America N.T. & S.A., San Francisco, California

Melvin C. Miller, Deputy Manager, American Bankers Association, 12 East 36 Street, New York, N. Y., *Secretary*

Liaison Representatives from the Federal Reserve System:

Clair B. Strathy, Vice President and Secretary, Federal Reserve Bank of Richmond, Richmond, Virginia, *Member*

Marcus A. Harris, Vice President, Federal Reserve Bank of New York, New York, N. Y., *Alternate*

Substantial credit, too, must go to the committees representing the office equipment manufacturers and the check printing industry and to their companies for the contributions they have made to the success of this undertaking. Appreciation is also due these committees for their willingness to make available the minutes of all their meetings so that the American Bankers Association might have this information available for any interested manufacturers.

The banking industry for years to come will derive untold benefits from the foresight and ingenuity of these men, and they may well take considerable pride in the contributions they have made to better banking operations.

The Bank Management Commission plans to continue a Technical Committee on Mechanization of Check Handling for the purpose of coordinating the activities of the banking industry, office machine manufacturers, and the check printers in implementing this program.

BANK MANAGEMENT COMMISSION
AMERICAN BANKERS ASSOCIATION
Harold E. Randall, *Chairman*

Table of Contents

PART I

Introduction

A little over two and one-half years have elapsed since the recommendation of magnetic ink characters as the Common Machine Language most suitable for check handling was approved in July of 1956. To some, this may seem like an inordinate length of time to be engaged in developing and completing a program of this kind. Actually, however, this period of time has been extremely short, especially when one considers the many problems and the magnitude of some of the issues which had to be resolved. To acquaint the reader with the scope of some of these problems and to present this report in proper perspective, some of the background details and highlights of the program are outlined.

Following this recommendation in July, 1956, all of the major machine manufacturers involved, representatives of the printing industry, and the Federal Reserve System indicated their concurrence. For many manufacturers this meant not only an abrupt halt in the research and physical expansion programs they were then pursuing but also a re-evaluation of their thinking and concepts. A number of people are under the misapprehension that this represents merely a turning off of one faucet and a turning on of another. When a major organization is required to ask its research and planning people to modify their basic concepts and to apply with their full energies any knowledge which may have been gained in these concepts to an entirely new one, a major evolution occurs. When we realize that this is precisely what took place, the period of two and one-half years is relatively short, particularly when we consider that during this period of time all the major machine manufacturers had to subordinate individual interests and band together, at considerable sacrifice and expense, to achieve the goal of a Common Machine Language. This voluntary and unselfish action is probably without parallel and is truly the most prodigious facet of the entire check mechanization program.

Following concurrence of all the machine manufacturers in the magnetic ink character concept, it was thought that the most difficult problem had been solved. However, as part of the process of channeling diverse concepts and findings into a single language, other problems loomed almost as large. The next major decision involved was that of determining the actual location of the common language on checks; and after careful and thorough consideration of all the factors involved, a decision was finally reached to use the bottom location. The reasons for selecting this location were outlined in Bank Management Publication 141, published in April, 1957, entitled *Placement for the Common Machine Language on Checks.*

Following this, the next major issue to be resolved was that of coordinating the location and arrangement of the characters within the designated area on the checks. Here, again, concerted efforts were required by all of the participants due to varying approaches to systems concepts and the need to consider the modification of designs of existing equipment. After all of the findings had been coordinated, the results were published on January 9, 1958, in Bank Management Publication 142 entitled *Location and Arrangement of Magnetic Ink Characters for the Common Machine Language on Checks.*

Next was the problem concerning the width of the band at the bottom of checks to be free of magnetic ink printing, other than the magnetic ink character coding itself. After considerable study and testing, a decision was finally reached in this regard, the details of which were duly published and distributed in Bank Management Publication 146 entitled *A Progress Report — Mechanization of Check Handling,* dated July 7, 1958.

The one remaining major problem to be solved was that of determining the character shape. We are delighted to report that after a great deal of research and development by the major office machine manufacturers and the printing industry, final agreement has been reached on a font which will henceforth be known as *Type E-13B*.

This decision was made only after constant revision, testing and retesting, and, finally, a thorough evaluation which employed the efforts of some fifty printers and the resources of a leading independent research organization. It was essential that the character shape have the approval of all of the major manufacturers involved. Their unanimous approval was obtained on December 16, 1958, at which time an announcement of the fact was made.

This brochure presents not only the specifications of the printed image, but a review of all the final technical specifications for the program. These specifications are necessarily recited in highly technical language. The average banker will undoubtedly refer this phase of the brochure to persons involved with the operational aspects of his bank.

The attention of all bankers, however, is especially directed to Part II entitled "Implementing the Program." A program possessing such an advanced technology and enormous impact obviously cannot be launched at a moment's notice. Banks are urgently requested to read thoroughly the precautions contained in this chapter and adhere to them as closely as their situation permits, in order that the full benefits of the program will not be hindered by premature or ill-advised action.

PART II

Implementing the Program

With presentation of the technical specifications for the Common Machine Language in this booklet, the way is cleared for actual implementation of the program by the three interested groups—equipment manufacturers, check printers, and the banks themselves.

At this point, however, the Technical Committee feels it important to stress the fact that such implementation, if it is to be successful, must be done in an orderly manner, carefully coordinated by each individual bank with its printer and equipment supplier. This readily becomes apparent when one considers that automatic check handling equipment will be of little use to banks unless a large proportion of checks in circulation are qualified (encoded) with the Common Machine Language. Further, the printing of the Common Machine Language must be within tolerances capable of being handled by the equipment. In addition, such printing and use of qualified checks cannot be accomplished without some redesign of check formats which, in turn, will involve customer education and acceptance. Banks must also give careful thought to the progressive steps necessary to the implementation and timing of their programs.

BANKS

Check Supply

One of the first steps a bank may want to take is to determine the present supply of stock checks and estimate the number of months this supply will last. There should be no need to discard any existing stock of checks as normally most banks do not carry over a year's supply, and there is no expectation now that check handling equipment will be in general use within that time. If a bank's supply is low, however, and the bank expects to reorder very shortly, then it might be advisable to order only a limited quantity now and reorder later when the printers are prepared to handle orders for magnetically imprinted checks. Check printers will be faced with a number of problems in connection with preparing for printing in magnetic ink, and banks and their customers should recognize this in their ordering.

Redesign of Checks

Irrespective of how soon a bank may expect to reorder checks, all banks should consider starting now to redesign their checks for magnetic ink encoding. They should also consider contacting customers who design and order their checks directly from printers so that these customers will be aware of the need to redesign checks for magnetic ink encoding.

In this connection it may be well to highlight here the major changes in format which will be required and indicate some of the possibilities that should be considered.

The minimum check length is 6″, and the bottom $\frac{5}{8}$″ along the entire length of this size check should be kept free of any magnetic printing other than the prescribed characters. On checks longer than 6″, the $\frac{5}{8}$″ band extends beyond 6″ in cases where the auxiliary On Us Field is used. Also on such checks magnetic ink printing other than the prescribed characters may be placed to the left of the $\frac{5}{8}$″ band as long as such printing is not closer than $\frac{1}{4}$″ from the nearest encoded character. This will permit those banks planning to print their checks entirely in magnetic ink to make full use of all available space. It follows, of course, that regular ink may also appear in this area. Regular ink may also appear in the area reserved for encoded characters and this will permit banks to continue to print borders on the checks immediately below the encoded characters. Care should be exercised, however, that this printing does not interfere with the visual reading of the characters.

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The space required for the encoded characters may, in some cases, require an increase in the height of the check, but most banks will wish to avoid this so as not to obsolete checkbook covers, wallets, etc. The preferred way would be to close up the present format to pick up the necessary $\frac{5}{8}''$. Because this may cause some congestion at the top of the check, the check printers have raised the question of the possibility of eliminating the printing of the town and state on the date line. Furthermore, they question the need for such printing and point out that this printing calls for exact registration which adds to the cost of imprinted checks. This subject has been studied by the Legal Department of the American Bankers Association, and they have informed the Technical Committee that there appears to be no legal objection to omitting the town and state from the date line.

The check printers have also pointed out that the $\frac{5}{8}''$ reserved area presents some imprinting problems on those checks where the title or designation of a person signing in an official or agency capacity appears below the signature line. The A.B.A. Legal Department has informed the Technical Committee that printing the agent's title above the signature line would not appear to destroy the "representative capacity" of the agent's signature.

Routing Symbol—Transit Number

From the point of view of the check collection system of the country, the most important item to be encoded is the combined routing symbol-transit number of the drawee bank. As indicated in the booklet entitled *Location and Arrangement of Magnetic Ink Characters for the Common Machine Language on Checks,* this will consist in the case of par banks of the present routing symbol followed by the suffix of the transit number. *For example,* $\frac{8\text{-}26}{430}$ would be encoded in magnetic ink in the prescribed location as 0430-0026. Notice that the prefix "8" has been dropped and non-significant zeros have been added so that there will always be eight digits and a hyphen in the routing symbol-transit number. The fractional form of transit number-routing symbol will continue to be printed in its present form and in its present location.

In the case of nonpar banks, the encoded transit number will consist of the present transit number preceded by the figure 90 and with non-significant zeros added where necessary. *For example,* 61-754 would be encoded 9061-0754.

In the case of checks drawn against a number of banks (multiple drawee checks), obviously only one routing symbol-transit number can be encoded in the prescribed location. Drawers may continue, of course, to designate on their checks a series of banks through which their checks are payable, even though only one of these banks' routing symbol-transit numbers may be encoded in magnetic ink. This subject is under further study by a committee of the Bank Management Commission.

In any event, all banks—par and nonpar—are urged to plan now to encode their routing symbol-transit number on all their checks. This is requested even though individual banks may not themselves plan at this time to install check handling equipment. The prime purpose, of course, of developing a Common Machine Language is to mechanize the check collection process; and until a great percentage of the checks circulating through the check collection system carry magnetically printed routing symbols and transit numbers, this objective cannot be reached.

In this endeavor, banks should consider not only the checks they themselves print or have printed, but also checks that their customers order from printers. Most customers will, no doubt, cooperate in this regard, as the improved accuracy and speed in check collections will prove mutually beneficial to customers and banks. Any sizable number of checks not pre-qualified with magnetic ink will have a serious deterrent effect on this check mechanization program.

Amount Encoding

Ordinarily, checks will be issued without the amount being encoded in magnetic ink, and this operation will necessarily have to be performed subsequently. The concept of the Common Machine Language, of course, is for the amount to be encoded by the first bank receiving the item for collection. This would permit all further handling in intermediate and paying banks to be primarily mechanical, resulting in tremendous economies in the banking system. These economies will vary, of course, from bank to bank. Banks are urged, however, to give this possibility serious consideration, as the reciprocal benefits to be obtained from coding of the amount by the first collecting bank are obviously great.

Where banks do encode checks drawn on other banks, they should restrict their encoding to the amount only; even in instances where post-encoding equipment will have type bars which will permit encoding transaction code and batch control numbers. The encoding of this latter information is reserved exclusively for payor banks, and space is provided for use of payor banks for such encoding in the On Us Field.

Punched Card Checks

Both the pre-printed and post-printed information to be encoded on 80-column and 66-column card checks is identical to that encoded on paper checks. The only variation is in the location of the pre-printed information which because of the holes in card checks must be below the 9's punched hole position. This is feasible, of course, on pre-printed information; but because in post-printing, paper and card checks are generally intermixed, the post-printing location on both must be the same.

Because the post-printed information will be in the 9 punched hole positions on card checks, punching in the post-printing encoding area must be avoided. This necessitates the discontinuance of punching in columns 51-80 on 80-column card checks and in columns 37-66 on 66-column card checks (at least any punching in the 9 holes) until after their clearance through the check collection system. For this reason banks should examine card checks they themselves may issue and plan now to relocate any punchings now located in the restricted area. Customers' card checks should also be examined; and where necessary, these customers should be asked to rearrange their fields of punching.

Punching and pre-printing of continuous form card checks with bottom perforations are subject to special limitations. Banks which issue such checks or have customers who issue such checks should be familiar with the detailed specifications covering this type of check (see Part III).

Deposit Tickets

Many banks will, no doubt, find it advisable for internal operating reasons to provide their customers with a supply of imprinted deposit tickets in addition to imprinted checks. Where a bank does its own imprinting, or where its volume is such that it stocks a supply of printed checks and deposit tickets with its printer for subsequent imprinting of the customer's name and number, no serious problem is anticipated. However, where a bank does not follow such practices, personalizing deposit tickets in small gang press runs could be prohibitively expensive if each bank insists on its own special format of ticket and its own deposit legend. These costs can be reduced, however, if deposit tickets can be standardized. One of the major factors involved in obtaining standardization of deposit tickets is the varying check collection legends now used by the banks. The check printers have suggested that contracts between depositors and banks, including the collection agreement, be eliminated from deposit tickets and replaced by a short legend which would be suitable for use by all banks. This matter was referred to the Legal Department of the American Bankers Association and their opinion is as follows:

> In order to be binding upon the depositor, the collection agreement must be assented to by him, either expressed or implied. Many banks have incorporated the collection agreement on their signature cards and thus have an expressed assent from their depositor. It has become fairly common practice to incorporate the collection agreement on the deposit ticket, as the most convenient manner of obtaining an implied assent as well as continuously bringing the terms of the collection agreement to the attention of the depositor. However, this implied assent can be obtained in other ways, such as printing the terms in depositors' passbooks or on validated receipt forms and on periodic customers' statements of account.
>
> The elimination of the full collection legend from the deposit ticket should not prove too serious provided alternate methods of obtaining the expressed or implied assent of the depositor are adopted. Where alternate methods are adopted, the following legend could be printed on the face of the deposit ticket:
>
> > "Checks and other items are received for deposit subject to the terms and conditions of this Bank's collection agreement."
>
> Banks may, of course, wish to discuss this matter with their own counsel.

CHECK PRINTERS

The printing of the Common Machine Language involves entirely new problems which exist regardless of the printing or imprinting process involved. New standards with respect to style, size, configuration, ink coverage, and signal strength have been established, and printers must equip themselves with type font and quality testing devices new to their industry. In addition, printers will have to redesign equipment used on their presses, educate their production people to new techniques, establish satisfactory inspection procedures, and, in general, adhere to closer tolerances than were heretofore required in the check printing industry. It should also be pointed out that these problems are no less real for those who may wish to engage in on-premises printing or imprinting.

It is obvious, then, that some time will be required to overcome these problems. Banks are urged to refrain from making impulsive demands upon their printers until the printers have had time to familiarize themselves with the new techniques, accomplish necessary changes in their plants, and assure themselves of the acceptability of their product.

EQUIPMENT MANUFACTURERS

The prime problem of equipment manufacturers is to finalize their systems concepts and to translate the current stage of development of their various pieces of equipment into production line models capable of being installed and operating on their customers' premises. With all equipment development, there is an appreciable time lag between prototype engineering models and production line models. When working on specific installations, manufacturers —as well as the banks involved and their check printers—will be well advised to insure that the checks to be used will meet equipment requirements and that the bank's program is coordinated with equipment delivery dates.

GENERAL

The Common Machine Language concept for checks will, undoubtedly, have a profound and beneficial effect on the banking industry of the country. This is not going to happen overnight, and it may be some time before this evolutionary change is fully effective. The potential is here now, however, and it is up to the individual banks all over the country as to how soon this potential will be realized. Banks are not expected to, nor should they, move into this magnetic ink program without full consideration of all factors involved. They should, however, consider not only the benefits that they themselves will obtain, but also the benefits provided the whole check collection system. The industry, to some extent, is unique in that close cooperation between individual competitive units is essential to its proper functioning. Banks have an opportunity now to demonstrate this cooperation in the endeavor to mechanize the check collection system.

PART III

Specifications for the Common Machine Language

The following detailed description of the specifications for the Common Machine Language was prepared by committees representing the office equipment manufacturers and the check printers, and approved by the Technical Committee. It describes dimensional specifications for the printed image of the characters to be used, horizontal and vertical field boundaries, minimum and maximum check sizes, and printing tolerances. These specifications were developed only after most diligent study and exhaustive field testing, thus assuring the banking industry an effective and reliable Common Machine Language.

I. *Character Configuration*

A. *Designation:* E-13B (comprising 14 characters—10 numeric figures 0-9 and 4 symbols)

B. *Description:*

1. Ten digits — Strokes 0-9
2. Four symbols

   ⑆ Transit Number Symbol — Stroke 10

   [*Note:* In the following text these three words refer to the start-stop signals illustrated rather than the normal terminology of transit number-routing symbol.]

⑇	Amount Symbol	Stroke 11
⑈	On Us Symbol	Stroke 12
⑉	Dash Symbol	Stroke 13

3. Nominal Character Height .117 inches
   Nominal Character Width varies .052; .065; .078; .091 inches
   Nominal Width of Horizontal and Vertical Bars .013 inches

C. *Dimensions:* Detailed dimensions and the horizontal centerline (℄$_H$) of the *Printed* Character are shown on drawings covering Strokes 0 through 13. These drawings, dated November 21, 1958, are contained on pages 55 to 68.

II. *Description of Fields and Use of Symbols*

A. *Amount Field* defines boundaries within which the Amount data shall appear. The Amount data shall always consist of ten digits bracketed by two Amount Symbols (⑇). This symbol must not be used in any other field.

B. *Transit Number Field* defines boundaries within which the combined Routing Symbol-Transit Number of the drawee bank shall appear. This data, hereinafter referred to as Transit Number data, shall always consist of two groups of four digits each, separated by a Dash Symbol (⑉) and bracketed by two Transit Number Symbols (⑆).

   The encoded Transit Number Symbol must not be used in any other field.

   The Dash Symbol may also be used as a separator in the On Us Fields described below.

C. *On Us Field* consisting of 19 spaces is located between the Amount and Transit Number Fields and defines the boundaries within which On Us data may appear. It may not be possible to print 19 characters (digits and symbols) in this Field as tolerance requirements between pre-printed and post-printed encoded information may possibly absorb the space equivalent of two characters.

The On Us Field dimensions have purposely not been defined in terms of specific number of spaces to be used but rather in terms of the maximum allowable. This action was taken to provide each bank the widest latitude in designing for its own internal system requirements. Likewise, it will permit each machine manufacturer an opportunity to apply its own competitive ingenuity within the framework of the Common Machine Language specifications. Accordingly, each bank's account number and transaction code assignments should be coordinated with the manufacturer selected.

An Auxiliary On Us Field (usually Check Serial Number) to the left of the Transit Number Field is permitted on documents having sufficient length. The number of characters in the Auxiliary On Us Field will depend upon the length of the check.

The On Us Symbol (⑈) is to be used only in the On Us Fields.

III. *Reference Edges of Document*

A. All *Horizontal* format dimensions are measured from the right edge of the document.

B. All *Vertical* format dimensions are measured from the bottom edge of the document.

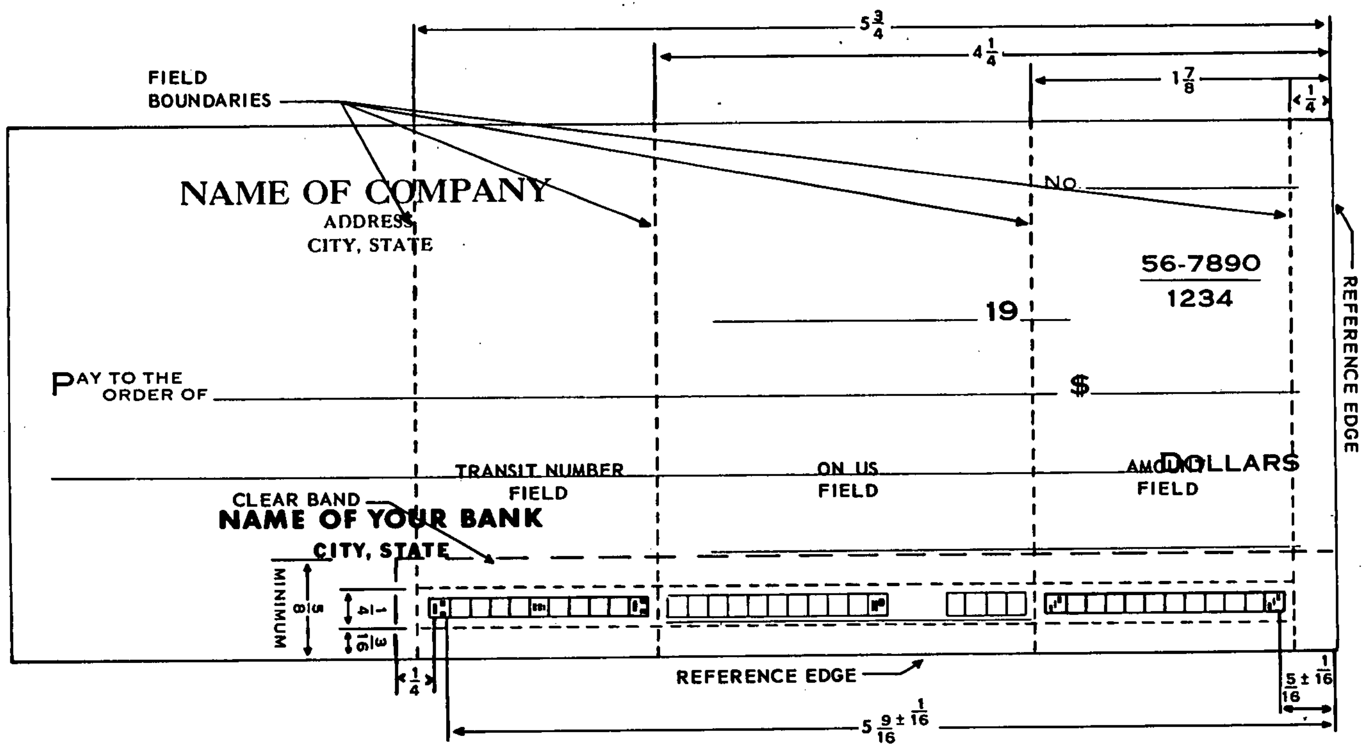
IV. *Format — Paper Checks*

A. *Horizontal Location and Field Boundaries:*

1. a. The Amount Field boundaries are located $\frac{1}{4}$" and $1\frac{7}{8}$" from the right reference edge.

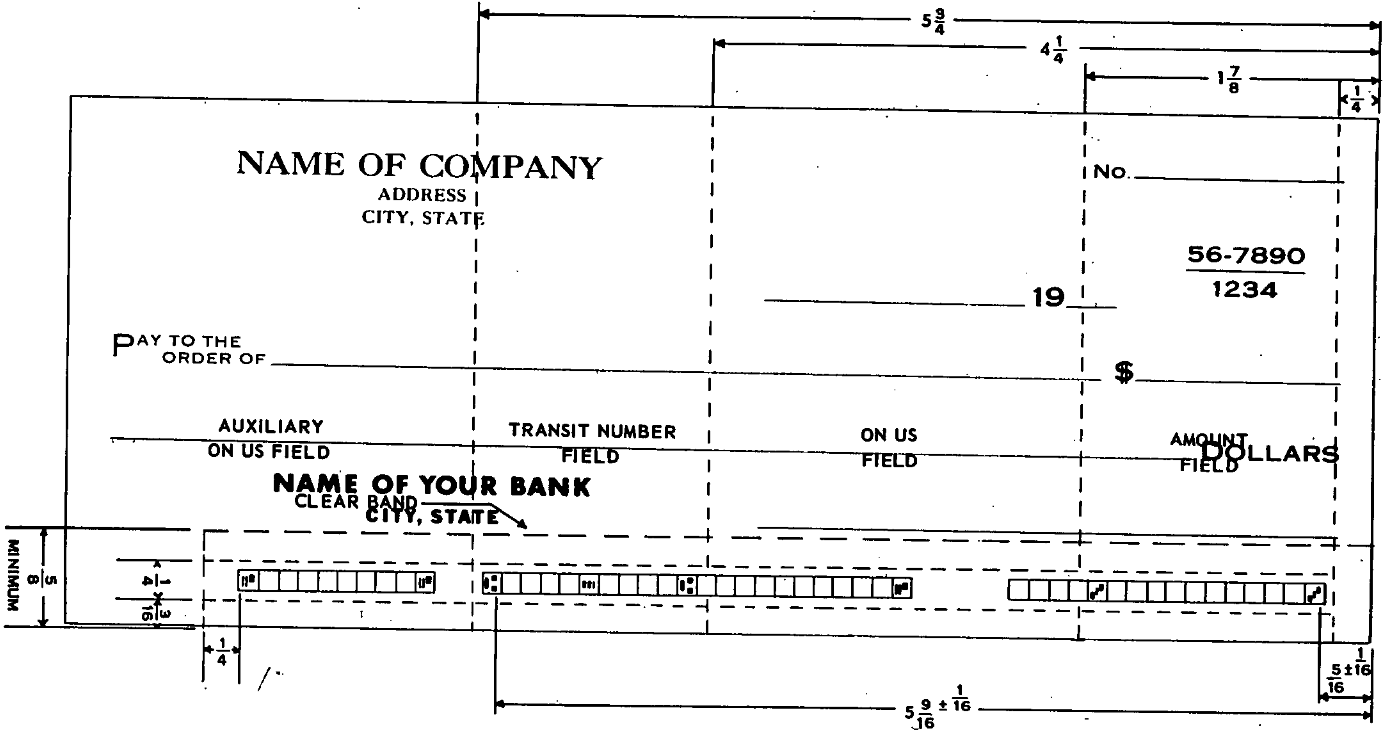
   b. The Amount data must always lie within these boundaries. The right edge of the first or right symbol must be located $\frac{5}{16}$" plus or minus $\frac{1}{16}$" from the reference edge.

2. a. The Transit Number Field boundaries are located $4\frac{1}{4}$" and $5\frac{3}{4}$" from the reference edge.



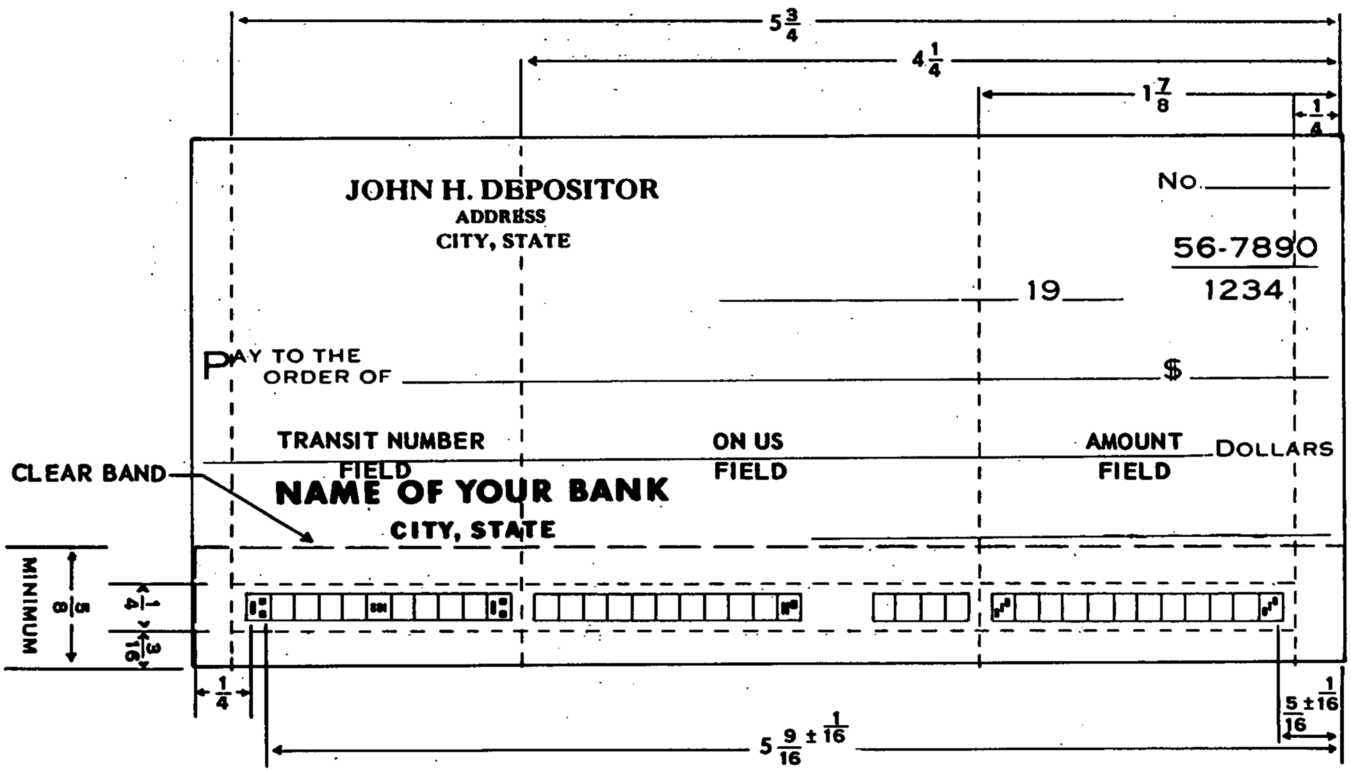
FORMAT—Paper Checks

The clear band extends from right edge to ¼" beyond last or left character printed. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in ON US Field(s) varies with banks and machine manufacturers.



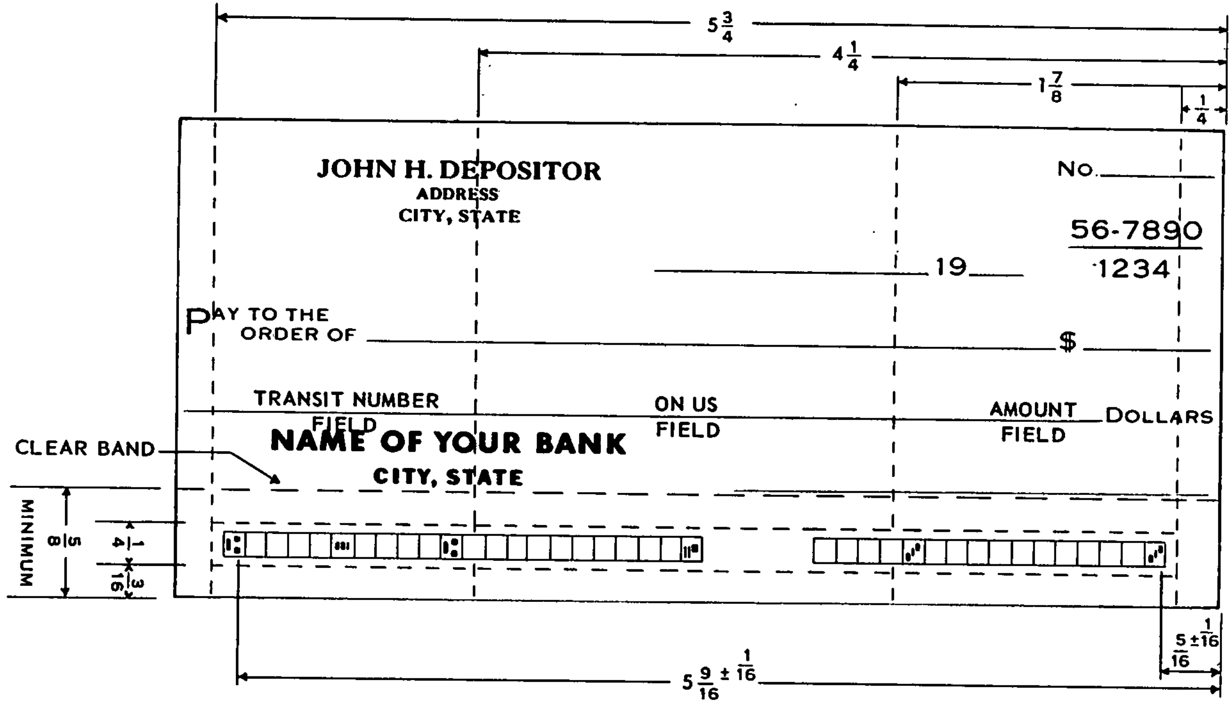
FORMAT—Paper Checks

Illustrates Auxiliary On Us Field on checks having sufficient length. Also illustrates how portion of On Us data may extend slightly into both Amount Field and Transit Number Field. This can occur only when any printing in the On Us Field is done simultaneously with either the Transit Number Field or the Amount Field. The clear band extends from right edge to ¼" beyond last or left character printed. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in On Us Field(s) varies with banks and machine manufacturers.



FORMAT—Paper Checks

Illustrates a typical 6″ check. The clear band extends from right edge to ¼″ beyond left Transit Number Symbol. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in On Us Field varies with banks and machine manufacturers.



FORMAT—Paper Checks

Illustrates a typical 6″ check. Also illustrates how portion of On Us data may extend slightly into both Amount Field and Transit Number Field. This can occur only when any printing in the On Us Field is done simultaneously with either the Transit Number Field or the Amount Field. The clear band extends from right edge to ¼″ beyond left Transit Number Symbol—or in this case to left edge. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in On Us Field varies with banks and machine manufacturers.

b. The Transit Number data must always lie within these boundaries. The right edge of the last or left symbol must be located $5\frac{9}{16}''$ plus or minus $\frac{1}{16}''$ from the reference edge.

3. a. The On Us Field (usually Account Number and Transaction Codes) boundaries are located $1\frac{7}{8}''$ and $4\frac{1}{4}''$ from the reference edge.

b. Whenever any portion of the On Us data is printed simultaneously with the Amount data, it may appear immediately adjacent to the left Amount Symbol even though this brings the On Us data slightly into the Amount Field.

c. Whenever any portion of the On Us data is printed simultaneously with the Transit Number data, it may appear immediately adjacent to the right Transit Number Symbol even though this brings the On Us data slightly into the Transit Number Field.

d. On documents having sufficient length, an Auxiliary On Us Field (usually Check Serial Number) may appear immediately adjacent to the left boundary of the Transit Number Field. Whenever any Auxiliary On Us data is printed simultaneously with the Transit Number data it may appear immediately adjacent to the left Transit Number Symbol even though this brings the Auxiliary On Us data slightly into the Transit Number Field.

Note: In the On Us Fields the number of characters to be encoded does not have to be uniform among all banks as is the case with the Amount and Transit Number Fields.

B. *Vertical Location:* All E-13B magnetic characters shall be located in a horizontal band $\frac{1}{4}''$ wide. The bottom edge of this band is $\frac{3}{16}''$ above and parallel to the bottom reference edge.

V. *Format — 80-Column Punched Card Checks* ***Without*** *Bottom Perforations*

A. *Horizontal Location and Field Boundaries:*

1. a. The Amount Field boundaries are located $\frac{1}{4}$" and $1\frac{7}{8}$" from the right reference edge.

   b. The Amount data must always lie within these boundaries. The right edge of the first or right symbol must be located $\frac{5}{16}$" plus or minus $\frac{1}{16}$" from the reference edge.

2. a. The Transit Number Field boundaries are located $4\frac{1}{4}$" and $5\frac{3}{4}$" from the reference edge.

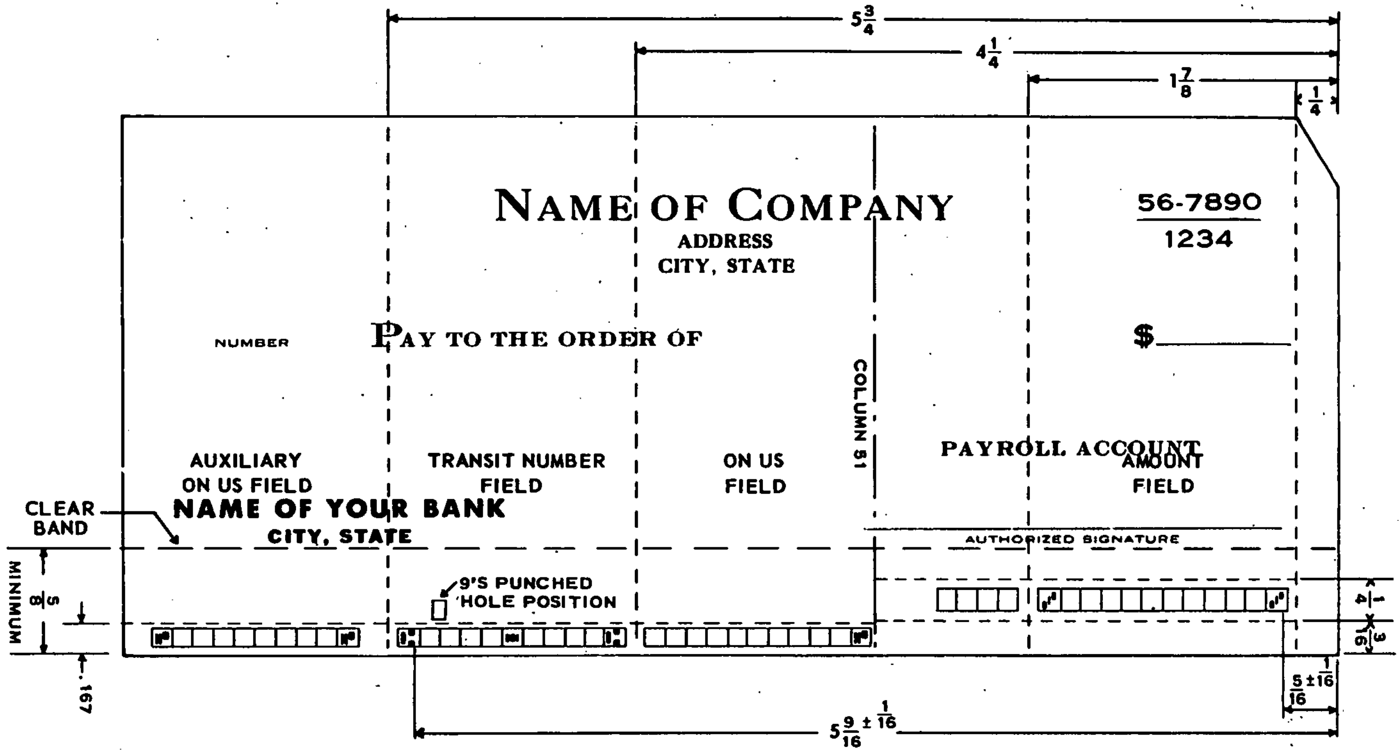
   b. The Transit Number data must always lie within these boundaries. The right edge of the last or left symbol must be located $5\frac{9}{16}$" plus or minus $\frac{1}{16}$" from the reference edge.

3. a. The On Us Field (usually Account Number and Transaction Codes) boundaries are located $1\frac{7}{8}$" and $4\frac{1}{4}$" from the reference edge.

   b. Whenever any portion of the On Us data is printed simultaneously with the Amount data it may appear immediately adjacent to the left Amount Symbol even though this brings the On Us data slightly into the Amount Field.

   c. Whenever any portion of the On Us data is printed simultaneously with the Transit Number data it may appear immediately adjacent to the right Transit Number Symbol even though this brings the On Us data slightly into the Transit Number Field.

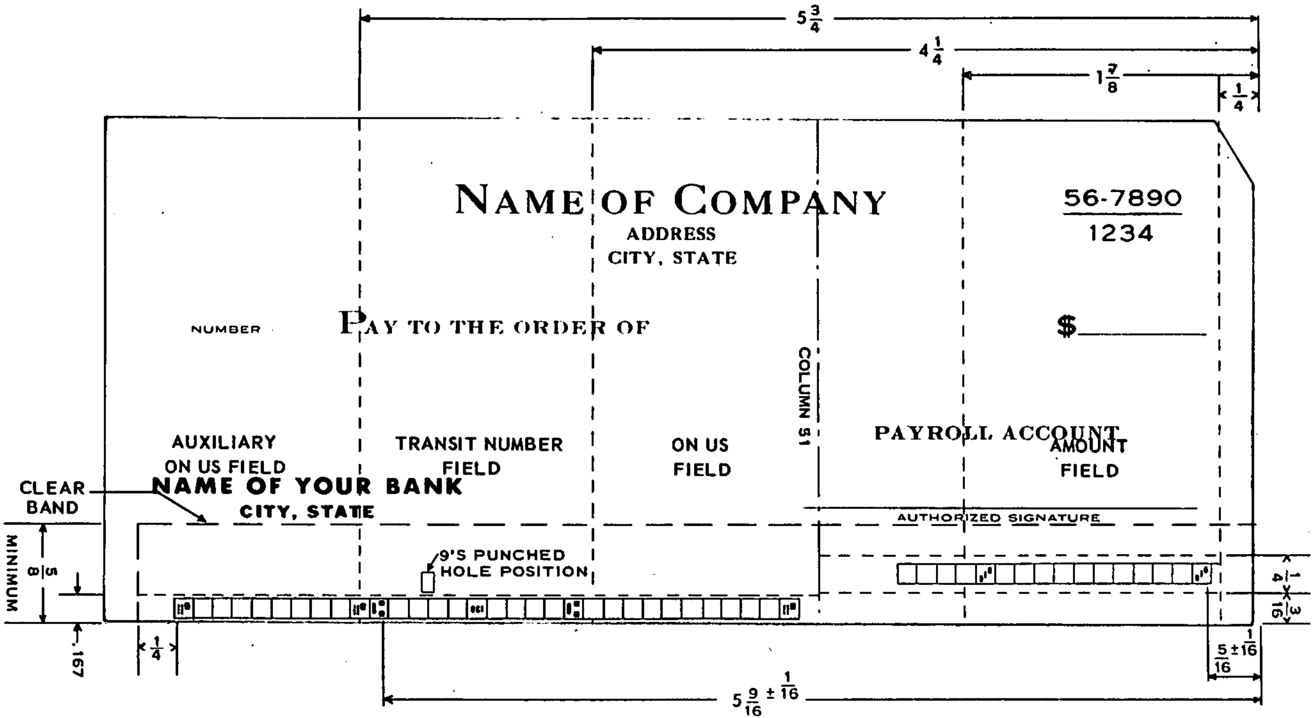
   d. An Auxiliary On Us Field (usually Check Serial Number) may appear immediately adjacent to the left boundary of the Transit Number Field. Whenever any Auxiliary On Us data is printed simultaneously with the Transit Number data it may appear immediately adjacent to the left Transit Number Sym-



FORMAT—80-Column Punched Card Checks WITHOUT Bottom Perforations

Illustrates the use of an auxiliary On Us Field. The clear band extends from right edge to ¼" beyond last or left character printed or in this case to left edge. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in On Us Field(s) varies with banks and machine manufacturers.

58913 O—60——26



FORMAT—80-Column Punched Card Checks WITHOUT Bottom Perforations

Illustrates how portion of On Us data may extend slightly into both Amount Field and Transit Number Field. This can occur only when any printing in the On Us Field is done simultaneously with either the Transit Number Field or the Amount Field. The clear band extends from right edge to ¼" beyond last or left character printed. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in On Us Field(s) varies with banks and machine manufacturers.

bol even though this brings the Auxiliary On Us data slightly into the Transit Number Field.

Note: In the On Us Fields the number of characters to be encoded does not have to be uniform among all banks as is the case with the Amount and Transit Number Fields.

B. *Vertical Location:*

1. The Amount data shall be located in a horizontal band $\frac{1}{4}''$ wide. The bottom edge of this band is $\frac{3}{16}''$ above and parallel to the bottom reference edge.
2. The portion of the On Us data (usually Transaction Code) adjacent to the Amount Field may appear in a horizontal band $\frac{1}{4}''$ wide located $\frac{3}{16}''$ above and parallel to the bottom reference edge, provided that it does not extend beyond $2\frac{13}{16}''$ (column 51) from the right reference edge.
3. The Transit Number data shall be located below the 9's punched hole position. (The 9-holes are located .167" from the bottom reference edge—refer to illustration, page 30).
4. The portion of the On Us data (usually Account Number) adjacent and to the right of the Transit Number Field is to appear below the 9's punched hole position.
5. The Auxiliary On Us data (usually Check Serial Number) is to appear below the 9's punched hole position.

VI. *Format — 80-Column Punched Card Checks With Bottom Perforations*

A. *Horizontal Location and Field Boundaries:*

1. a. The Amount Field boundaries are located $\frac{1}{4}''$ and $1\frac{7}{8}''$ from the right reference edge.

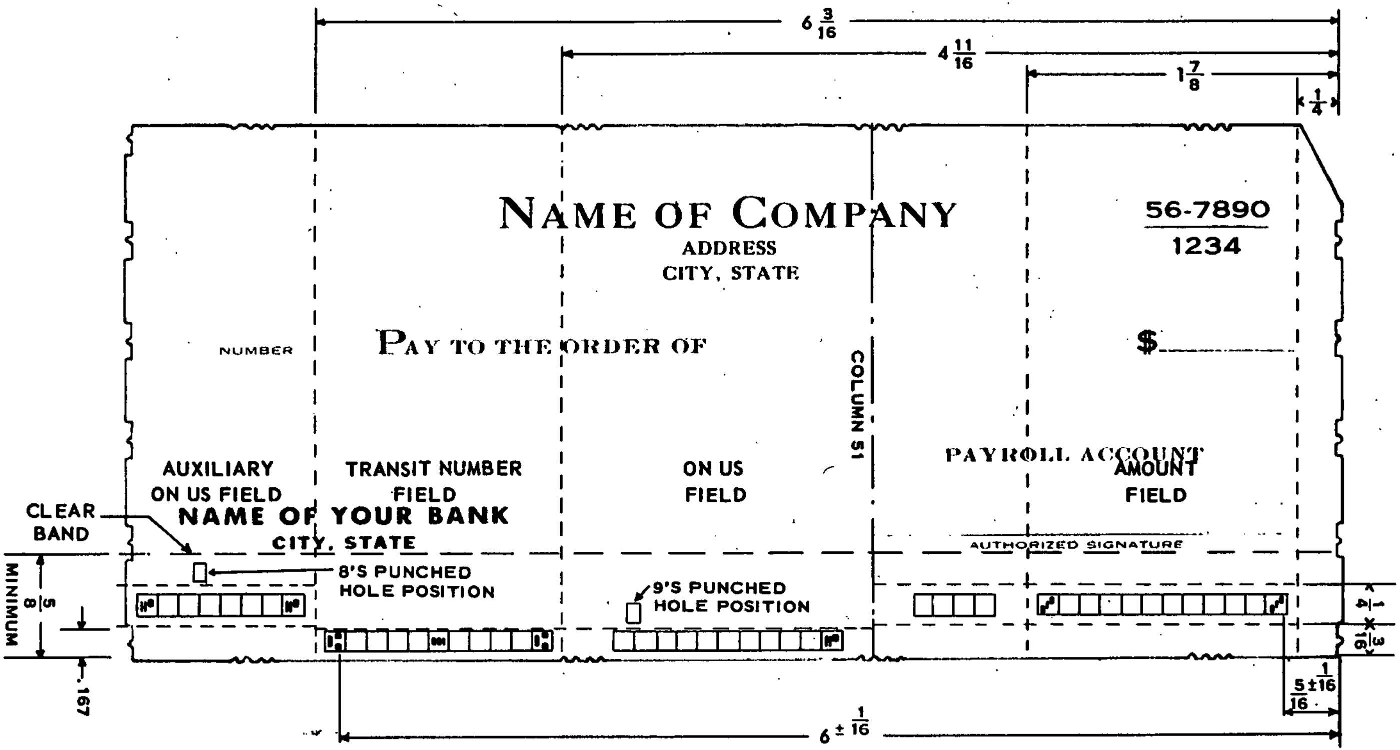
   b. The Amount data must always lie within these boundaries. The right edge of the first or right symbol must be located $\frac{5}{16}''$ plus or minus $\frac{1}{16}''$ from the reference edge.

2. a. The Transit Number Field boundaries are located $4\frac{11}{16}''$ and $6\frac{3}{16}''$ from the reference edge.
   b. The Transit Number data must always lie within these boundaries. The right edge of the last or left symbol must be located 6″ plus or minus $\frac{1}{16}''$ from the reference edge.
3. a. The On Us Field (usually Account Number and Transaction Codes) boundaries are located $1\frac{7}{8}''$ and $4\frac{11}{16}''$ from the reference edge.
   b. Whenever any portion of the On Us data is printed simultaneously with the Amount data it may appear immediately adjacent to the left Amount Symbol even though this brings the On Us data slightly into the Amount Field.
   c. An Auxiliary On Us Field (usually Check Serial Number) may appear immediately adjacent to the left boundary of the Transit Number Field. Whenever any Auxiliary On Us data is printed simultaneously with the Transit Number data it may appear immediately to the left and slightly above the left Transit Number Symbol even though this brings the Auxiliary On Us data slightly into the Transit Number Field.
   d. All of the On Us coding printed below the 9's punched hole position must be positioned *between* the bottom grip perforation groups located within this field. This limits the number of spaces available for this printing to eleven.

   Note: In the On Us Fields the number of characters to be encoded does not have to be uniform among all banks as is the case with the Amount and Transit Number Fields.

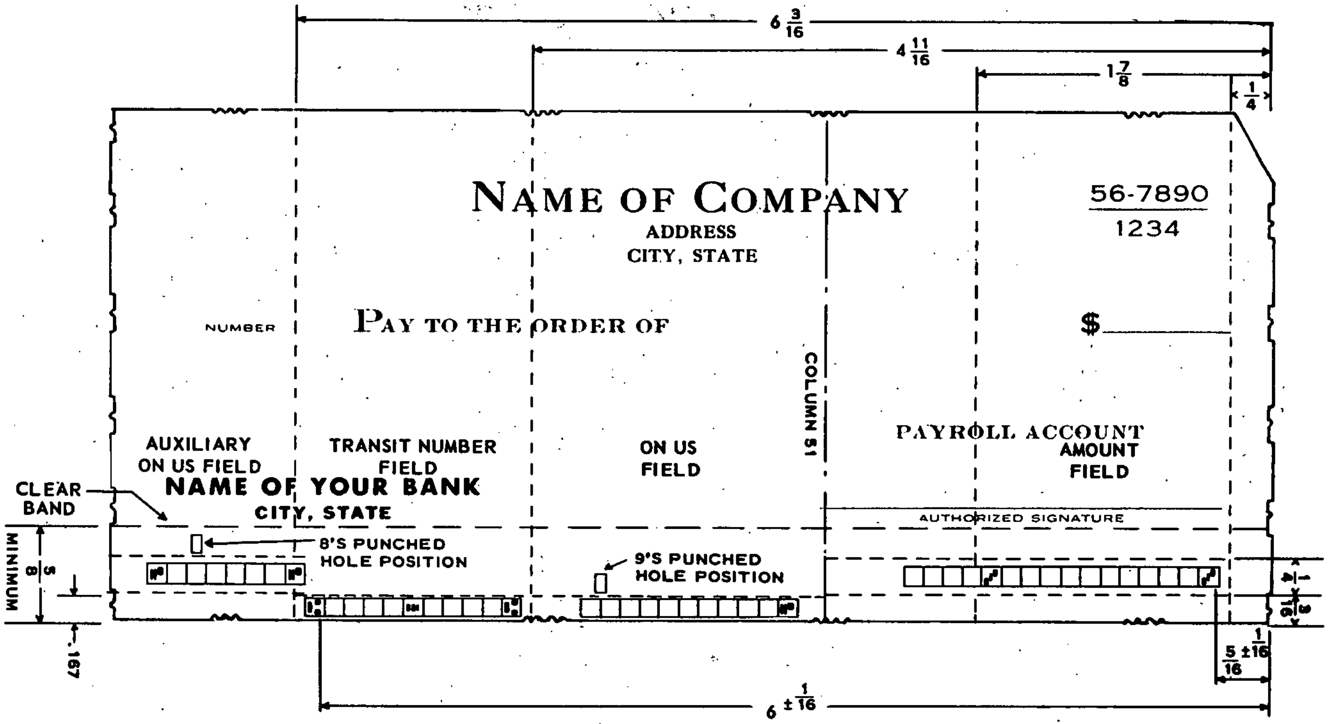
B. <u>*Vertical Location:*</u>

1. The Amount data shall be located in a horizontal band $\frac{1}{4}''$ wide. The bottom edge of this band is $\frac{3}{16}''$ above and parallel to the bottom reference edge.
2. The portion of the On Us data (usually Transaction



FORMAT—80-Column Punched Card WITH Bottom Perforations

The clear band extends from right edge to ¼" beyond last or left character printed or in this case to left edge. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in On Us Field(s) varies with banks and machine manufacturers.



FORMAT—80-Column Punched Card WITH Bottom Perforations

Illustrates how portion of On Us data may extend slightly into both Amount Field and Transit Number Field. This can occur only when any printing in the On Us Field is done simultaneously with either the Transit Number Field or the Amount Field. The clear band extends from right edge to ¼" beyond last or left character printed or in this case to left edge. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in On Us Field(s) varies with banks and machine manufacturers.

Code) adjacent to the Amount Field may appear in a horizontal band $\frac{1}{4}$" wide located $\frac{3}{16}$" above and parallel to the bottom reference edge, provided that it does not extend beyond $2\frac{13}{16}$" (column 51) from the right reference edge.

3. The Transit Number data shall be located below the 9's punched hole position. (The 9-holes are located .167" from the bottom reference edge—refer to illustration, page 34.)
4. The portion of the On Us data (usually Account Number) to the right of the Transit Number Field is to appear below the 9's punched hole position.
5. The Auxiliary On Us data (usually Check Serial Number) is to appear in a horizontal band $\frac{1}{4}$" wide. The bottom edge of this band is $\frac{3}{16}$" above and parallel to the bottom reference edge. This is not below the 9's punched hole position because of the interference from the perforations. Consequently, when this field is used for encoding purposes no punchings (at least in 9's position) should be permitted in the Auxiliary On Us Field.

VII. *Format — 66-Column Punched Card Checks* ***Without*** *Bottom Perforations*

A. *Horizontal Location and Field Boundaries:*

1. a. The Amount Field boundaries are located $\frac{1}{4}$" and $1\frac{7}{8}$" from the right reference edge.
   b. The Amount data must always lie within these boundaries. The right edge of the first or right symbol must be located $\frac{5}{16}$" plus or minus $\frac{1}{16}$" from the reference edge.
2. a. The Transit Number Field boundaries are located $4\frac{1}{4}$" and $5\frac{3}{4}$" from the reference edge.
   b. The Transit Number data must always lie within these boundaries. The right edge of the last or left

symbol must be located $5\frac{9}{16}''$ plus or minus $\frac{1}{16}''$ from the reference edge.

3. a. The On Us Field (usually Account Number and Transaction Codes) boundaries are located $1\frac{7}{8}''$ and $4\frac{1}{4}''$ from the reference edge.

   b. Whenever any portion of the On Us data is printed simultaneously with the Amount data it may appear immediately adjacent to the left Amount Symbol even though this brings the On Us data slightly into the Amount Field.

   c. Whenever any portion of the On Us data is printed simultaneously with the Transit Number data it may appear immediately adjacent to the right Transit Number Symbol even though this brings the On Us data slightly into the Transit Number Field.

Note: In the On Us Field the number of characters to be encoded does not have to be uniform among all banks as is the case with the Amount and Transit Number Fields.

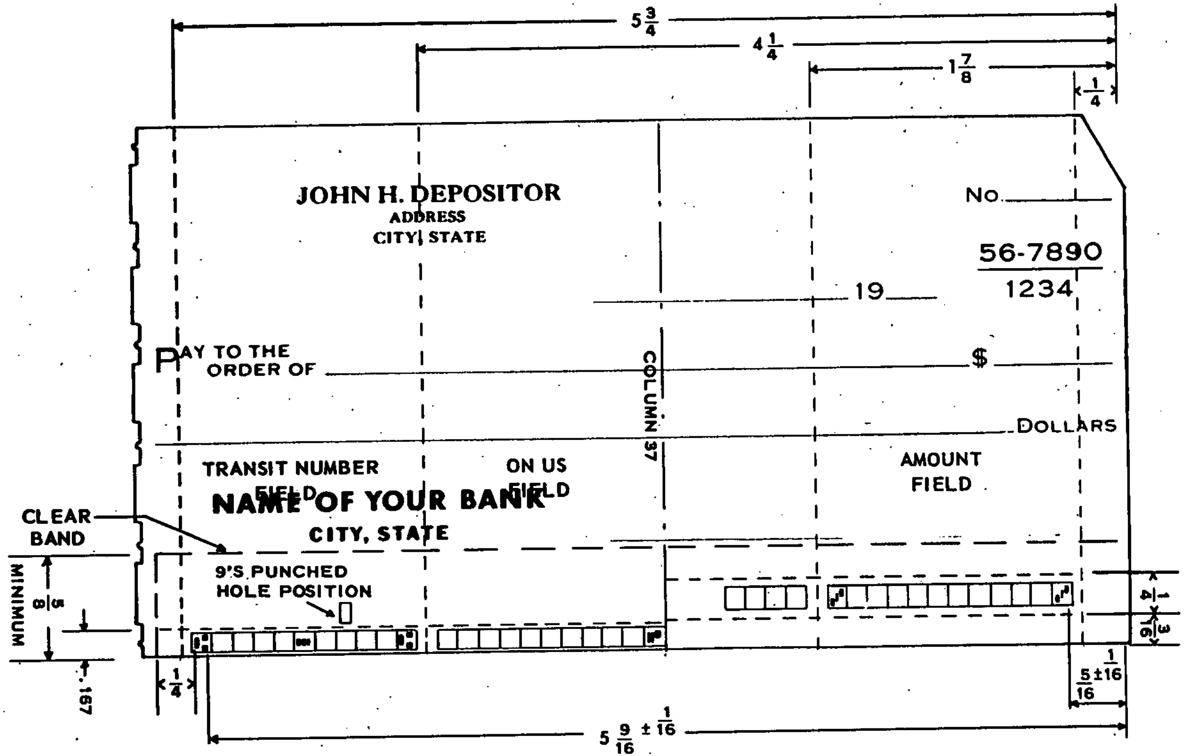
B. *Vertical Location:*

1. The amount data shall be located in a horizontal band $\frac{1}{4}''$ wide. The bottom edge of this band is $\frac{3}{16}''$ above and parallel to the bottom reference edge.

2. The portion of the On Us data (usually Transaction Code) adjacent to the Amount Field may appear in a horizontal band $\frac{1}{4}''$ wide located $\frac{3}{16}''$ above and parallel to the bottom reference edge, provided that it does not extend beyond $2\frac{13}{16}''$ (column 37) from the right reference edge.

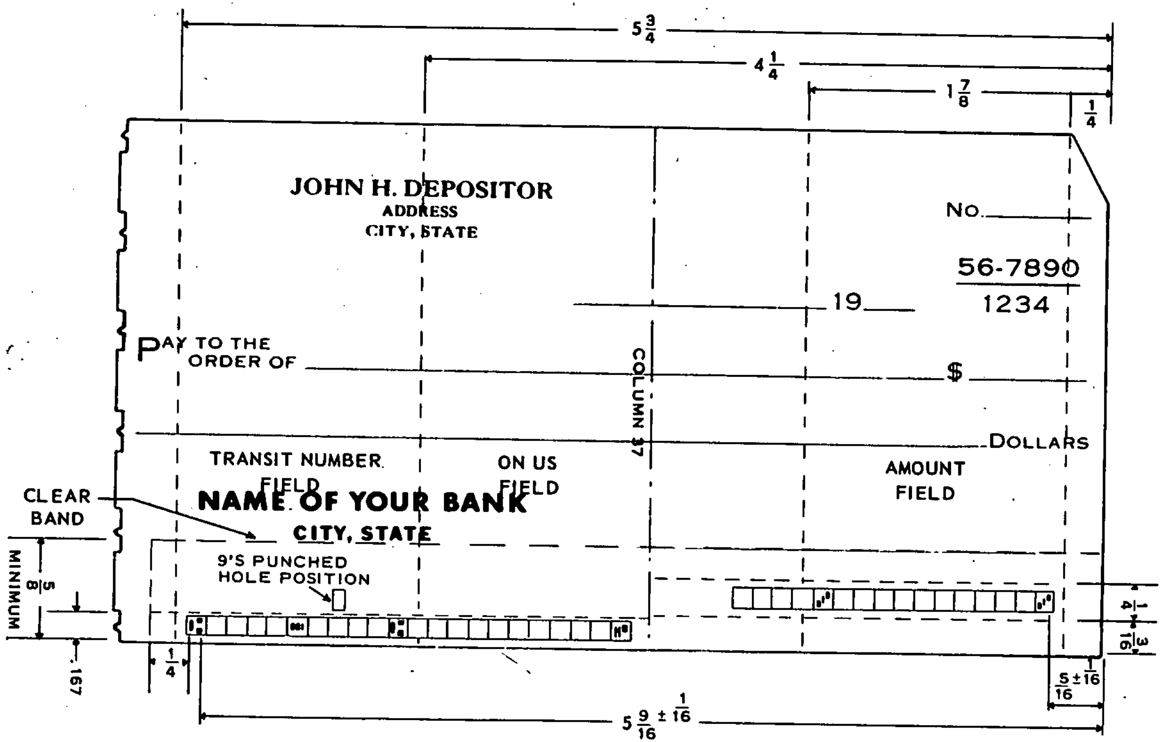
3. The Transit Number data shall be located below the 9's punched hole position. (The 9-holes are located .167″ from the bottom reference edge—refer to illustration, page 38.)

4. The portion of the On Us data (usually Account Number) adjacent and to the right of the Transit Number Field is to appear below the 9's punched hole position.



FORMAT—66-Column Punched Card Checks WITHOUT Bottom Perforations

The clear band extends from right edge to ¼" beyond left Transit Number Symbol. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in On Us Field varies with banks and machine manufacturers.



FORMAT—66-Column Punched Card Checks WITHOUT Bottom Perforations

Illustrates how portion of On Us data extends slightly into both Amount Field and Transit Number Field. This can occur only when any printing in the On Us Field is done simultaneously with either the Transit Number Field or the Amount Field. The clear band extends from right edge to ¼" beyond left Transit Number Symbol. Field boundaries are defined by dimensions shown. The number of digits, spaces, use of symbols, etc., in On Us Field varies with banks and machine manufacturers.

VIII. Common Language Clear Band

A band 5/8" wide, measured from the bottom reference edge, must be free of any magnetic ink other than E-13B magnetic characters.

The length of this band extends from the right reference edge to 1/4" beyond the left edge of the left Transit Number Symbol if an Auxiliary On Us Field is not used.

In the event an Auxiliary On Us Field (usually Check Serial Number) is printed, the length of the band then extends from the right reference edge to 1/4" beyond the left edge of the last or left character printed.

IX. Check Size

Width	Minimum 2 3/4" Maximum 3 2/3"
Length	Minimum 6" Maximum 8 3/4"

Note: The common language format is not adaptable to 51-column punched card checks, such as U. S. Postal Money Orders, because their length (4 7/8") is less than minimum standards.

X. Character Spacing and Alignment

A. *Spacing*

1. Amount Field and Transit Number Field:

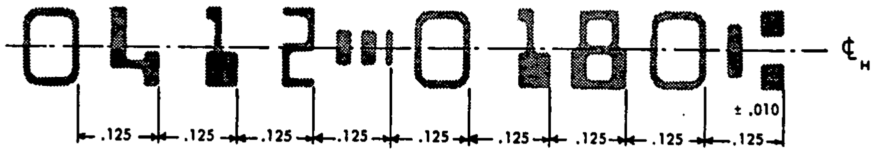
   a. The distance between the right average edge of adjacent characters is to be .125" plus or minus .010". This applies to the Amount Field and the Transit Number Field. (Average edge is defined and discussed under "Character Tolerances.")

   b. The accumulation of spacing tolerances in the Amount Field and Transit Number Field is limited to the extent that the accumulation does not infringe upon the boundaries defining these fields.

2. Minimum Space—Any Field:

   The minimum space between the right average edge of adjacent characters, whether they be in the same field or adjoining fields, can never be less than .115".

This also applies to both On Us Fields. Maximum or other spacing requirements in both On Us Fields are to be specified by the individual machine manufacturer involved.

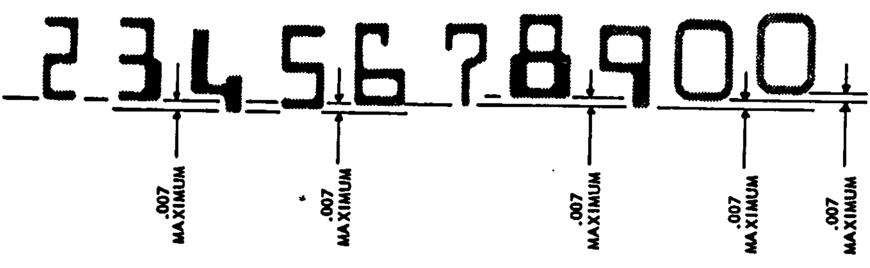


B. *Alignment*

The horizontal centerline of each character is indicated on any drawings of the printed character (¢ H).
These centerlines serve to establish vertical alignment of all characters since all characters are designed about the same horizontal centerline.

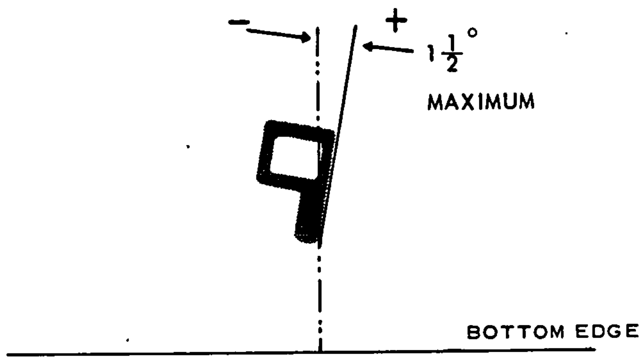
Vertical alignment tolerance is that which is consistent with good printing practice. *For example,* alignment of the bottom edge of a line of characters, within any group printed at one time (such as Account Number in On Us Field), should be such that adjacent characters do not vary vertically more than .007″.

On characters that do not come down to the "base" line the same tolerance will be applied to the horizontal centerline.



XI. *Character Skew*

The maximum allowable character skew is plus or minus $1\frac{1}{2}$ degrees measured with respect to the bottom edge of the document.



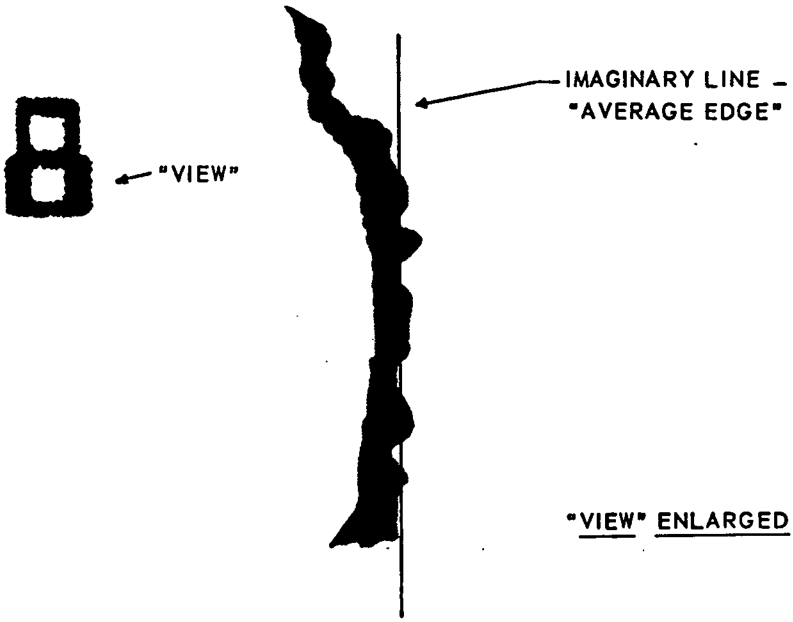
Note: This specification applies to each character printed and is not to be interpreted as "line skew."

XII. *Character Tolerances*

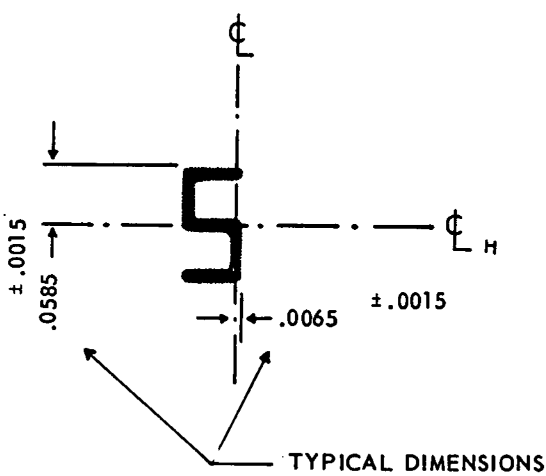
A. *Dimension:* (Refer to drawings of the printed character on pages 55 to 68.)

1. Definition of Average Edge: It is recognized that the typical edge of a printed character is not a straight line. The term *average edge* will be used and is defined as an imaginary line which divides the irregularities. The result is that the summation of the white areas on one side of the line is equal to the summation of the black areas on the other side. (See illustration opposite page.)

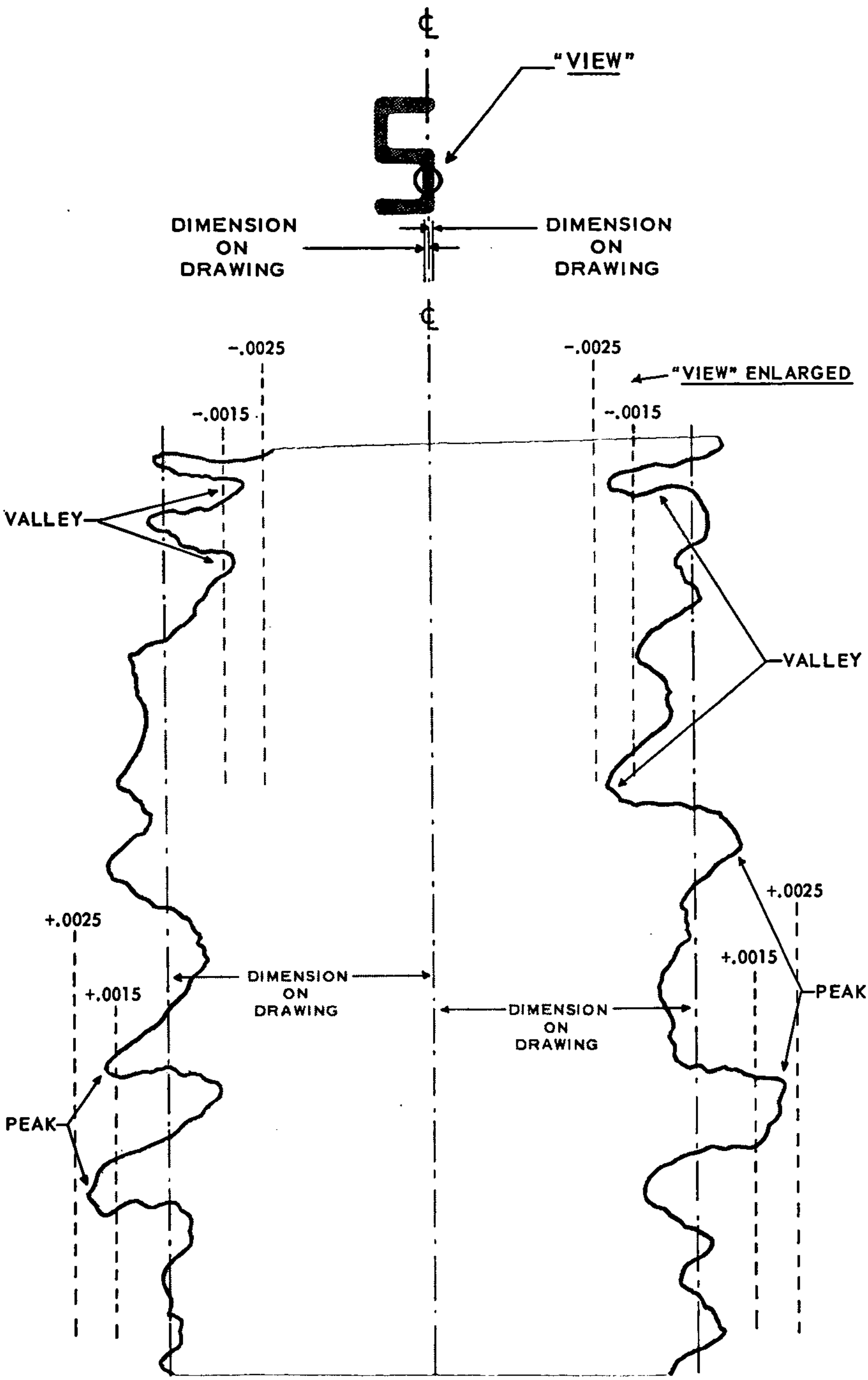
2. Average Edge Tolerance: The average edge tolerance shall be plus or minus .0015″ measured from the nominal dimension locating the edge. The nominal dimension appears on the drawing of the printed character together with the average edge tolerance. (See illustration opposite page.)



Average Edge



Average Edge Tolerance



Edge Irregularity Tolerance

3. Edge Irregularity Tolerance:
   a. Peaks and valleys about the average edge are permitted to extend to plus or minus .0025″ *from* the *nominal* edge dimension.
   b. However, when these occur the summation of the edge present in the .0015″ to .0025″ zone shall not exceed one quarter of the total edge.
   c. It is recognized that an occasional void (defined under "Voids," below) can be present at the edge and cause a valley which exceeds the limits mentioned above. The maximum allowable size of such voids is discussed under a separate specification—"Voids."

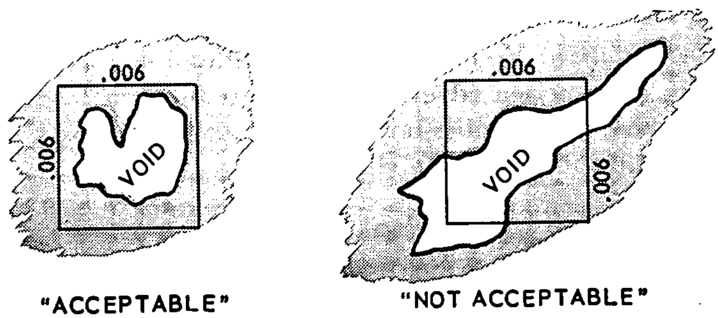
B. *Minimum Width of Horizontal Bars:* The distance between the average edges of any horizontal bar shall be at least .011″. (This specification is an adjunct to the dimension specification locating each edge. This specification does not apply to vertical bars since vertical bars are controlled entirely by dimensions locating each edge.)

XIII. *Voids*

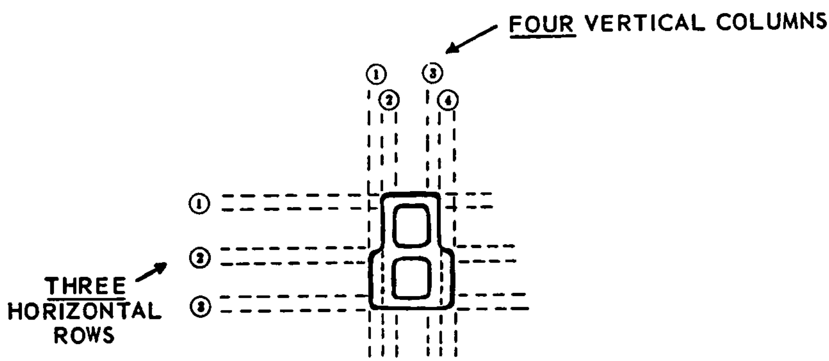
A. *Definition:* Voids are defined as the absence of ink within the specified outline of the printed character.

B. *Maximum Allowable Single Void:* The size of the maximum allowable single void anywhere in the character shall be limited to the extent that it is contained entirely within the boundary of a .006″ by .006″ square.

C. *Maximum Allowable Combined Smaller Voids:* The combined area of smaller voids, in any vertical column or horizontal row nominally .013″ wide, shall not exceed 20% of the total area of the column or row.



Example of Single Voids



Example of Rows and Columns

XIV. *Uniformity of Ink Film*

The ink deposited is to be uniformly distributed within the outlines of each character. Conditions to be avoided include excessive squeeze-out, halo, and other uneven deposits.

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XV. *Extraneous Ink (Magnetic)*

A. *Definition:* Extraneous Ink is defined as magnetic ink, other than the printed character, located within the $\frac{5}{8}$″ common language clear band. It is usually described as splatter, smear, tracking, feathering, stringing out, toning, back offset, background, etc.

B. *Limitation:* No extraneous ink is allowable if it is visible to an experienced eye without the aid of a magnifying device. This applies both to the front and the back of the document within the clear band.

XVI. *Embossment (Impression) — Letterpress*

Not to exceed that which is barely detectable to the experienced feel or eye.

Barely detectable is defined as the condition when the embossment of the printed character is not more than .0005″. This is measured as the depth of the embossment on the front of the document.

GENERAL COMMENT

Conditions specified under "XIV—Uniformity of Ink Film"; "XV – Extraneous Ink" and "XVI – Embossment" can be a cause for "machine reading rejects" and should be kept to a *minimum* consistent with good printing practice.

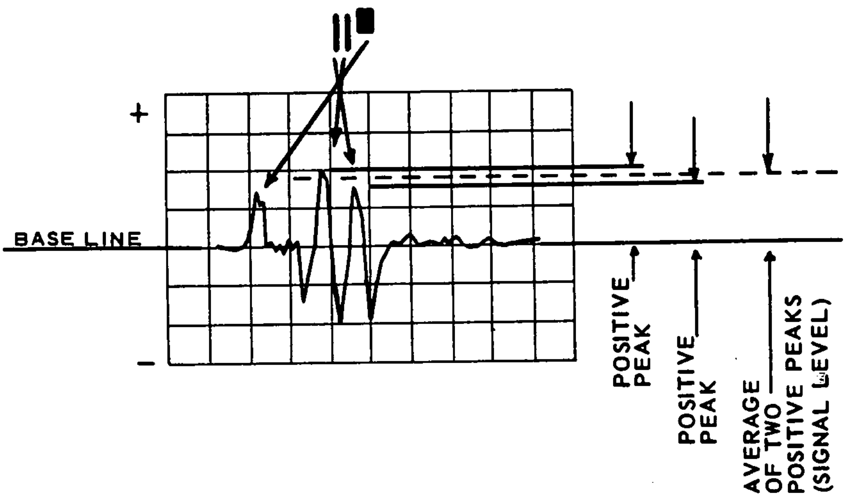
XVII. *Signal Level*

A. *Definition:* Signal level is defined as the voltage waveform obtained when D.C. magnetized printed characters are scanned with a magnetic reading head.

B. *Nominal Level:* Nominal level is the signal level obtained from a standard printing sample (designated as "May 27, 1958 Reference") when using a General Electric Company Magnetic Printing Tester or equivalent. The signal level is measured using the average of the base line to positive peak voltage from the two left bars of the On Us Symbol (⑈). (Refer to descriptions or literature on the "Magnetic Printing Tester," page 91, for further clarification.)

Literature and the standard printing samples can be obtained by writing the Industrial Sales Manager—General Electric Company, Computer Department, Phoenix, Arizona.

Caution: Accurate signal level measurements cannot be obtained by visually comparing ink density or coverage with that of the standard printing sample.



Waveform As It Appears on Face of Oscilloscope

(Instrument for visually displaying the changes in a varying current)

C. *Allowable Signal Level Range:* The signal level from any printed character may vary from 50% to 200% of the nominal signal level.

XVIII. *Paper*

It is recognized that certain particles embedded in paper can be a cause for machine reading reject.

Paper manufacturers are urged to take steps to eliminate or reduce to a minimum the presence of magnetic particles such as iron and iron oxide.

PART IV

Summary

There are undoubtedly some additional problems that will require coordination in the future. While it is felt that these problems will be dwarfed by the enormity of the decisions already reached during the course of this program, the Bank Management Commission will maintain the Technical Committee as a committee for this purpose. A number of office machine manufacturers and representatives of the printing industry have been invited to serve as consultants to the Technical Committee in order to preserve the liaison which has existed up to now.

The decisions which have been made during the course of the promulgation of the Common Machine Language program would never have been achieved without the technical genius, cooperation, and research performed by the office machine manufacturers who had originally indicated their desire to participate in this program and who agreed to pursue the course of magnetic ink character recognition as the Common Machine Language. The willingness of these manufacturers to subordinate individual proprietary interests to the pursuit of a common ideal is most unusual and certainly exemplary in the solution of problems of this scope.

It is, perhaps, improper in a technical manual such as this to set forth anything in other than an impersonal vein. However, at this time I would like to give public recognition to the present members of the Technical Committee, as well as to C. M. Weaver, formerly Assistant Vice President of The First National Bank of Chicago, an original member who has since retired. By adding their skill, wisdom, and tireless energy to those of the office machine manufacturers and check printers, it became obvious that the time would arrive when a Common Machine Language for the mechanized handling of checks in our country would become a reality. That time is now.

Respectfully submitted,

JOHN A. KLEY
Chairman

APPENDIX I

Ink

Definition of Terms Used in This Appendix

HYSTERESIS: Magnetizing force and magnetic induction have a cause and effect relationship. Hysteresis refers to the lag in the build up and fall off of magnetic induction when a magnetic substance is subject to a changing magnetizing force. If this "lag" is plotted in relation to the value of the magnetizing force, a "hysteresis" curve (magnetization curve) will be formed. This property is very useful in measuring and defining magnetic materials.

OERSTED: A unit of measurement of magnetizing force. Magnetizing force will vary with the number of turns of a coil, the current through it, the length of the coil, and the location of the point of measurement.

GAUSS: A unit of measurement of magnetic induction (flux density); i.e., the strength of a magnetic field within a magnetic substance.

SATURATION FORCE: The magnetizing force that will yield a magnetic flux density of approximately maximum value for a given sample of material; i.e., the saturation magnetization.

REMANENCE: The residual induction (or flux density) which remains when a magnetizing force is reduced to zero from a value sufficient to saturate a material.

COERCIVE FORCE: The reverse magnetizing force required to reduce the residual induction (remanence) to zero.

* * *

MAGNETIC INK

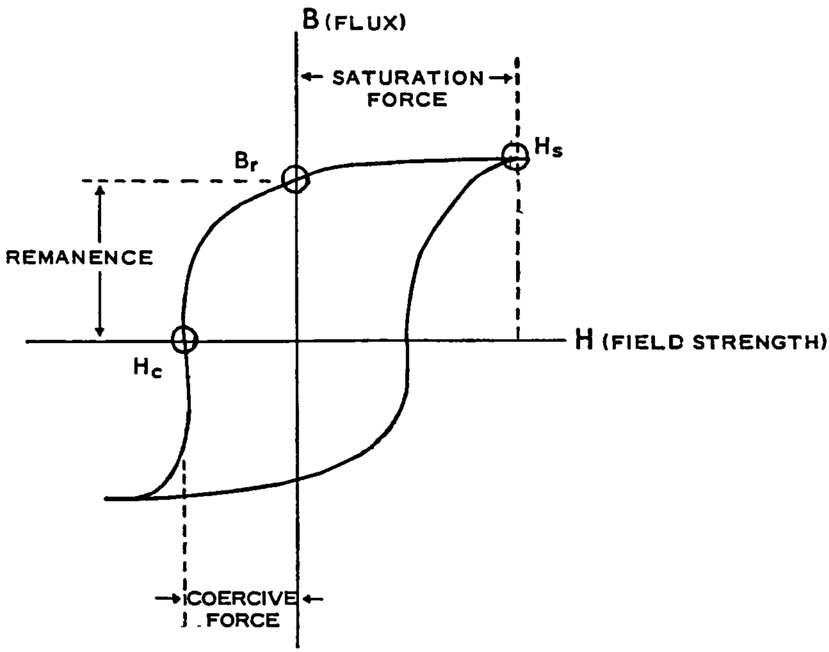
Recognizing that magnetic printing inks will be made available commercially and that detailed specifications for inks are not within the scope of these "Printing Specifications," the following covers two outstanding properties required in magnetic inks. These do not include the usual press performance requirements.

A. *Resistance to Abrasion.* The ink should be resistant to the abrasive effects of consumer handling and also automatic check handling equipment.

B. *Magnetic Requirements:* In addition to the magnetic evaluation of the printed character measured by the printer as described under "Signal Level," page 47, hysteresis data may be used by the ink manufacturer in order to establish the magnetic potential of an ink in its bulk state.

Testing devices such as the General Electric D.C. Hysteresigraph may be used. In this instance a 10″ long solid plug of ink contained in a precision glass tube ⅜″ inside diameter and 1.5 mm wall thickness should possess the following magnetic properties:

Saturation Force	(H_s):	1000-1500 oersted
Coercive Force	(H_c):	250- 350 oersted
Remanence	(B_r):	
Letterpress Inks		500- 650 gauss
Lithographic Inks		600- 900 gauss



It is emphasized that the ranges mentioned above are not to be interpreted as ink manufacturing tolerances. On the other hand, the ink manufacturer should make every effort to maintain maximum uniformity of product having once established the magnetic relationship, within these ranges, which produces a signal level optimized for the printing process. A recommended tolerance for each magnetic property, once optimized, is plus or minus 10%.

(Appendix II, entitled "Printed Character—E-13B Common Language Standards," and appendix III, entitled "Guide to Printers," are not here reproduced.)

APPENDIX IV

Activities of Technical Committee

The Technical Committee on Mechanization of Check Handling, on January 9, 1958, issued its report *Location and Arrangement of Magnetic Ink Characters for the Common Machine Language on Checks.* This report recommended the items of information to be encoded, the sequence of the fields of information, and the number of digits to be included in each field.

Activities of the Technical Committee since publication of the January, 1958, report follow:

On March 7 and 8, 1958, a meeting was held in Dayton, Ohio, for a demonstration of paper handling equipment and systems concepts being tested by the National Cash Register Company.

On March 20 and 21, 1958, D. H. Hinkel attended a meeting of the Rotary Business Forms Section of the Printing Industry of America, Inc., in Chicago, Illinois, at which a review of the progress, the present status of the common language concept, and the objectives of the Technical Committee on Mechanization of Check Handling were discussed.

On May 12 and 13, 1958, John A. Kley and Herbert R. Corey attended a meeting with the Technical Subcommittee on Type Design of the Office Equipment Manufacturers in Detroit, Michigan. At this meeting agreement was reached on the specific vertical location of the magnetic ink printing and on the general purpose of the proposed field evaluation test.

On June 12 and 13, 1958, D. H. Hinkel attended a meeting in Chicago, Illinois, of the Bank Stationers Section of the Lithographers National Association, Inc., for a general discussion of the development of the type font and the problems involved in the printing of the Common Machine Language on checks.

At the request of the Bank Management Commission, the Technical Committee in June of 1958 issued its report *Account Numbering and Check Imprinting*. This report explained the basic types of account numbering systems, the factors involved in the selection of a system, some of the considerations of check imprinting and the public relations aspects relative thereto.

A *Progress Report* was issued July 7, 1958, indicating the dimensions of the area along the bottom of the check to be used for the magnetic ink encoding. This report also announced that the machine manufacturers had recommended a type font for field evaluation tests. These tests were conducted by the Battelle Memorial Institute of Columbus, Ohio, to determine the overall reliability of the type font and, in addition, the accuracy, tolerances, and economy of the printing and imprinting.

On November 13 and 14, 1958, R. C. Kolb attended a meeting of the Bank Stationers Section of the Lithographers National Association, Inc., in Washington, D. C. This meeting was devoted to a discussion of problems having to do with magnetic ink imprinting, current automation developments, and plant education programs.

On November 20 and 21, 1958, A. R. Zipf attended the meeting of the Technical Subcommittee on Type Design of the Office Equipment Manufacturers in Palo Alto, California. The following was accomplished at this meeting:

1. Reviewed the results of the field evaluation tests. Directed the submission of a report to the participating printers to be prepared and distributed by the Battelle Memorial Institute.

2. Reached unanimous agreement to recommend for adoption the E-13B character as the standard for the Common Machine Language.

3. Established tolerances for the printed image of the E-13B characters.

4. Finalized specifications for the check format, maximum and minimum check size and defined the area reserved exclusively for the Common Machine Language on checks.

On December 15, 16, and 17, 1958, a joint meeting with the Office Equipment Manufacturers' Committee and its Technical Subcommittee; representatives of the check printing industry; and liaison officers of the Federal Reserve System was held in New York. The following was accomplished at this meeting:

1. Adopted the printed character shape known technically as E-13B for the magnetic ink character recognition Common Machine Language for checks.

2. Publicly announced the unanimous agreement upon the adoption of the printed character shape E-13B.

3. Prepared letters to banks relative to changes of duplicate transit numbers and routing symbols.

4. Outlined the final report on the Common Machine Language program.

In addition to the formal meetings outlined above, individual members of the Technical Committee have held numerous informal discussions with machine manufacturers, check printers, and others concerned with the program.

A PROGRESS REPORT

Mechanization of Check Handling

SUPPLEMENT TO PART III

OF BANK MANAGEMENT PUBLICATION 147

December 30, 1959

Bank Management Commission—1959-1960

G. Edward Cooper, Senior Vice President, The Philadelphia National Bank, Philadelphia, Pennsylvania, *Chairman*

Melvin C. Miller, Deputy Manager, The American Bankers Association, 12 East 36 Street, New York, N. Y., *Secretary*

R. A. Bezoier, President, First National Bank, Rochester, Minnesota

Russell A. Blanchard, Executive Vice President, Georgia Railroad Bank and Trust Company, Augusta, Georgia

Philip A. Cordes, Assistant Comptroller, Continental Illinois National Bank and Trust Company, Chicago, Illinois

Oliver L. Dalrymple, Vice President and Cashier, Seattle-First National Bank, Seattle, Washington

Frank M. Dana, Executive Vice President, Bank of America N.T. & S.A., San Francisco, California

John A. Kley, President, The County Trust Company, White Plains, New York

Raymond C. Kolb, Vice President, Mellon National Bank and Trust Company, Pittsburgh, Pennsylvania

Wesley Lindow, Vice President and Secretary, Irving Trust Company, New York, N. Y.

Moncure P. Patteson, Vice President, State-Planters Bank of Commerce and Trusts, Richmond, Virginia

Harold E. Randall, Vice President and Comptroller, The First National Bank of Boston, Boston, Massachusetts

J. Robert Sherwood, President, Suburban Trust Company, Hyattsville, Maryland

E. C. Underhill, Cashier, Idaho First National Bank, Boise, Idaho

Fred H. Waterhouse, Vice President, First National Bank of Minneapolis, Minneapolis, Minnesota

John H. Wurts, President, Marine Midland Trust Company of Southern New York, Binghamton, New York

Technical Committee on Mechanization of Check Handling

John A. Kley, President, The County Trust Company, White Plains, New York, *Chairman*

Herbert R. Corey, Vice President, The First National Bank of Boston, Boston, Massachusetts

L. A. Erickson, Vice President, The First National City Bank of New York, New York, N. Y.

David H. Hinkel, Assistant Cashier, First National Bank of Chicago, Chicago, Illinois

Raymond C. Kolb, Vice President, Mellon National Bank and Trust Company, Pittsburgh, Pennsylvania

Edward T. Shipley, Comptroller and Auditor, Wachovia Bank and Trust Company, Winston-Salem, North Carolina

A. R. Zipf, Vice President, Bank of America N.T. & S.A., San Francisco, California

Melvin C. Miller, Deputy Manager, The American Bankers Association, 12 East 36 Street, New York, N. Y., *Secretary*

Liaison Representative from the Federal Reserve System:

Marcus A. Harris, Vice President, Federal Reserve Bank of New York, New York, N. Y.

BANK MANAGEMENT COMMISSION
THE AMERICAN BANKERS ASSOCIATION
TWELVE EAST THIRTY-SIXTH STREET
NEW YORK 16, N. Y.

CHAIRMAN
G. EDWARD COOPER
SENIOR VICE PRESIDENT
THE PHILADELPHIA NATIONAL BANK
PHILADELPHIA 1, PENNSYLVANIA

SECRETARY
MELVIN C. MILLER
DEPUTY MANAGER

December 30, 1959

To: MEMBER BANKS
THE AMERICAN BANKERS ASSOCIATION

Following is a progress report of the Technical Committee on Mechanization of Check Handling of the Bank Management Commission of The American Bankers Association. This report outlines modifications of certain of the printing tolerances established in Bank Management Publication 147.

Careful study by the committee, by the office equipment industry, and by printers during the six months subsequent to the issuance of original specifications in April, 1959 has shown the desirability and practicability of relaxing tolerances in some areas. This step should do much to facilitate and expedite the job of getting a substantial flow of imprinted and encoded checks into the check collection process.

This refinement of the Common Machine Language is still another of the important steps along the road to the mechanization of check handling toward which we all look so eagerly.

Sincerely,

G. EDWARD COOPER
Chairman
Bank Management Commission

A PROGRESS REPORT

Mechanization of Check Handling

This report is a supplement to Part III of Bank Management Publication 147, *The Common Machine Language for Mechanized Check Handling, Final Specifications and Guides to Implement the Program,* and sets forth relaxation of tolerances in certain specifications as well as clarification of others.

In Publication 147 there were 18 specifications set forth for the guidance of banks, office equipment manufacturers, and printers. None of these specifications has caused any serious problem for equipment manufacturers, but some printers have had difficulty in meeting certain tolerances prescribed in 5 of the specifications. Experience gained since the publication was issued indicates that some tolerances can now safely be broadened. The 5 specifications in which broader tolerances can now be permitted are:

Character spacing and alignment
Character tolerances
Voids
Extraneous ink
Embossment

The technical details involved in these specifications changes are included in this report to assist the technicians and operating people in the banking, office equipment manufacturing, and printing industries who are working on the check mechanization program.

The tremendous progress during the last six months by the office equipment manufacturing and the printing industries, as well as the experience gained to date by all concerned, has made possible this announcement which should serve as a further stimulus to the progress of the Common Machine Language program.

The Technical Committee wishes at this time to express its sincere appreciation to the representatives of the office equipment manufacturing and printing industries for their continued cooperation and wholehearted support.

Respectfully submitted,

JOHN A. KLEY
Chairman
Technical Committee on
Mechanization of Check Handling

58913 O—60——28

Supplement to Part III of Bank Management Publication 147

The general format of Publication 147, *The Common Machine Language for Mechanized Check Handling, Final Specifications and Guides to Implement the Program,* is retained in this report; however, the changes in wording or new material are indicated by bold type.

X. *Character Spacing and Alignment* — (Pages 40-41)

A. *Spacing*

No change.

B. *Alignment*

Alignment is the relative vertical location of a character with respect to adjacent characters within a given field.

The horizontal centerline of each character is indicated on any drawings of the printed character ($℄_{H}$). These centerlines serve to establish vertical alignment of all characters since all characters are designed about the same horizontal centerline.

Vertical alignment tolerance is that which is consistent with good printing practice **and subject to the following interpretations:**

Alignment of a line of characters printed in any field should be such that the bottom edges of adjacent characters within each field do not vary vertically more than .007″.

However, alignment of the bottom edge of adjacent characters printed in either On Us Fields may vary vertically more than .007″ if permitted by the manufacturer of the paper handling equipment to be used.

On characters that do not come down to the "base" line, the same tolerance will apply to the horizontal centerline.

This specification does not apply to the vertical location of the fields themselves since vertical location of fields is specified under Sections IV, V, VI and VII—Format.

No change in illustrations on Page 41.

Note: **The intent of this change is to allow misalignment in both On Us Fields to the extent permissible by the vertical location specification set forth in Sections IV, V, VI, and VII Format—since these fields are not involved in transit operations. It is expected that imprinters will be available that will print portions of the On Us Field at different times and may or may not be able to control alignment within .007″ between printings. The tolerance is, therefore, left variable to meet the requirements of the specific equipment being used.**

XII. *Character Tolerances* — (Pages 42-45)

A. *Dimension:* (Refer to drawings of the printed character on Pages 55 to 68.)

1. Definition of Average Edge:

   No change.

2. Average Edge Tolerance:

   No change.

3. Edge Irregularity Tolerance:

   a. Peaks and valleys about the average edge are permitted to extend to plus or minus **.0035″** *from nominal* edge dimension **that appears on the illustration on Page 44.**

b. However, when these occur the summation of the edge present in the .0015″ to **.0035″** zone shall not exceed one quarter of the total edge.

c. It is recognized that an occasional void (defined under "Voids," below) can be present at the edge and cause a valley which exceeds the limits mentioned above. The maximum allowable size of such voids is discussed under a separate specification – "Voids."

d. It is recognized that an occasional excursion (such as feathering or stringing out) can be present at the edge and extend beyond the .0015″ to .0035″ zone. Such occasional excursions are not considered to be edge irregularities and are defined as extraneous ink that is "attached" to the character. The maximum allowable size and quantity that would be permissible is covered under "Extraneous Ink front."

In measuring the size of such excursions, one should only consider that portion that extends beyond the .0035″ limit mentioned under item (a), since the portion of the excursion in the .0015″ to .0035″ zone is controlled by character edge irregularity limit under item (b).

Illustration on page 44 should be revised to show .0035″ instead of .0025″.

B. *Minimum Width of Horizontal Bars:*

No change.

Note: **The intent is to open tolerance as much as possible by allowing .001″ additional on character edge irregularity and also clarify the point on extraneous ink that may be attached to characters. At times, this latter condition has been classified as edge irregularity although the edges were generally "sharp."**

XIII. *Voids* — (Pages 45-46)

A. *Definition:*

No change.

B. *Maximum Allowable Single Void:*

1. The size of the maximum allowable single void anywhere in the character, **including at an edge,** shall be limited to the extent that it is contained entirely within the boundary of an **.008″** by **.008″** square. **An exception is provided under item (2) as follows:**

2. **If the portion of the character involving a single void is two or more zones wide (each zone is .013″ wide), then the maximum allowable single void shall be limited to the extent that it must be completely surrounded by ink and is contained entirely within the boundary of an .010″ x .010″ square. In this case, voids at edges are not included and are, therefore, limited to an .008″ x .008″ square.**

3. **It is recognized that single voids can exist which are long and narrow. These "needle" type voids are allowable in any length anywhere on the character, provided they are no wider than .002″ average edge to average edge.**

C. *Maximum Allowable Combined Voids:*

The combined area of **all** voids, in any vertical column or horizontal row nominally .013″ wide, shall not exceed 20% of the column or row.

The illustration on Page 46 — Example of Single Voids — should be revised to show .008 x .008, instead of .006 x .006.

Note: **The intent is to open void tolerances as much as possible.**

XIV. *Uniformity of Ink Film* – (Page 46)

The ink deposited is to be uniformly distributed within the outlines of each character. Conditions to be avoided include excessive squeeze-out, halo, and other uneven deposits.

Acceptable as uniformly distributed is the condition where a character appears outlined with a dense ridge of ink (appears dense in relation to the ink deposited within the character) but the ridge does not exceed more than .0015″ from average edge to average edge. This condition is predominant in letterpress printing and some impact printing.

Note: **The intent is to define what is acceptable under uniformly distributed.**

XV. *Extraneous Ink (Magnetic)* – (Page 47)

A. *Definition:*

Extraneous ink is defined as magnetic ink, other than the printed character, located within the ⅝″ common language clear band. It is usually described as splatter, smear, tracking, feathering, stringing out, toning, back offset, background, etc.

B. *Limitations:*

1. **Extraneous ink front: Extraneous magnetic ink on the front of the document is not acceptable** if it is "visible" to the experienced eye without the aid of a magnifying device.

   The above is subject to the following interpretation:

   Spots which cannot be contained in a .003″ x .003″ square are defined as "visible"; however, random occasional spots which are "visible" may exist provided they can be contained in a .004″ x .004″ square, and they are limited to one per ⅛″ character space and a

total of not more than five per field. Spots that cannot be contained in a .004″ x .004″ square are not acceptable.

Spots that are found to be located within the outermost limits established by the character edge irregularity tolerance are to be considered under the character edge irregularity specifications.

The printer is asked to make every reasonable effort to eliminate extraneous ink front for its presence can be a cause for "machine reading rejects."

2. **Extraneous ink back: Extraneous magnetic ink on the back of the document is not acceptable if it is more than barely visible to the unaided eye.**

   The above is subject to the following interpretation:

   Spots that cannot be contained in a .006″ x .006″ square, or its equivalent area, are not acceptable.

   ***Note:* The intent is to define what is visible to the experienced unaided eye. In addition, it was found that in extraneous ink front, one would have to consider the number of fields to be printed at different times; hence the interpretation was made to allow five spots per field, rather than five spots per document.**

XVI. *Embossment (Impression)* – (Page 47)

Embossment should not exceed that which is barely detectable to the experienced feel or eye.

Barely detectable is defined as the condition where the embossment of the printed character is not more than **.001″**. This is measured as the depth of the embossment on the front of the document.

This specification applies to any mode of printing — letterpress or ribbon printing.

***Note:* The intent is to open the embossment specification and clarify the point that this specification also applies to post printing.**

GENERAL COMMENT

Deleted.

XVII. *Signal Level* — (Page 47)

A. *Definition:* Signal level is defined as the voltage waveform obtained when D.C. magnetized printed characters are scanned with a magnetic reading head.

B. *Nominal Level:* Nominal level is the signal level obtained from a standard printing sample (designated as the "May 27, 1958 Reference") when using a General Electric Company Magnetic Printing Tester or equivalent **as described on Page 91 of the A.B.A. Bank Management Publication 147.**

The signal level **may be** measured **from any of the characters designated as suitable for this purpose on the standard printing sample document. Each character so designated can therefore serve as a standard for its corresponding character on any printing to be measured.**

Standard printing samples with accuracy specified and with detailed instructions can be obtained by writing the Industrial Sales Manager, General Electric Company, Computer Department, Phoenix, Arizona.

Refer to descriptions and literature on the "Magnetic Printing Tester," Page 91 of the A.B.A. Bank Management Publication 147 for further clarification.

In general, as an example, signal level is measured using the average of the base line to positive peak voltage from the two left bars of the On Us Symbol (⑈). **The detailed instructions will advise on how other characters may be measured.**

Caution: Accurate signal level measurements cannot be obtained by visually comparing ink density or coverage with that of the standard printing sample.

No change in illustration on Page 48.

C. *Allowable Signal Level Range:* The signal level from any printed character may vary from 50% to 200% of the nominal signal **established by its standard. The nominal signal is usually designated as 100% reference printing.**

Note: **The intent is to clarify the point that reference standard documents are available from General Electric Company and that more than one character can serve as reference since each character has its own prescribed reference waveform.**

A PROGRESS REPORT

Mechanization of Check Handling

BANK MANAGEMENT PUBLICATION 146

July 7, 1958

Technical Committee on Mechanization of Check Handling

John A. Kley, Executive Vice President, The County Trust Company, White Plains, New York, *Chairman*

Herbert R. Corey, Vice President, The First National Bank of Boston, Boston, Massachusetts

L. A. Erickson, Vice President, The First National City Bank of New York, New York, N. Y.

David H. Hinkel, Assistant Cashier, First National Bank of Chicago, Chicago, Illinois

Raymond C. Kolb, Assistant Vice President, Mellon National Bank and Trust Company, Pittsburgh, Pennsylvania

Edward T. Shipley, Auditor, Wachovia Bank and Trust Company, Winston-Salem, North Carolina

A. R. Zipf, Vice President, Bank of America N.T. & S.A., San Francisco, California

Melvin C. Miller, Deputy Manager, American Bankers Association, 12 East 36 Street, New York, N. Y., *Secretary*

Liaison Representatives from the Federal Reserve System:

Clair B. Strathy, Vice President and Secretary, Federal Reserve Bank of Richmond, Richmond, Virginia, *Member*

Marcus A. Harris, Vice President, Federal Reserve Bank of New York, New York, N. Y., *Alternate*

BANK MANAGEMENT COMMISSION

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July 7, 1958

To: MEMBER BANKS
AMERICAN BANKERS ASSOCIATION

Following is a progress report made by the Technical Committee on Mechanization of Check Handling of the Bank Management Commission of the American Bankers Association. This report announces that the type font for magnetic ink imprinting has been agreed upon by the machine manufacturers, the printers, and the Technical Committee and that they are planning to move on to the next phase of the program—that being a field evaluation of the type font. The field evaluation test is designed to determine not only the over-all reliability of the type font but also the accuracy of registration, tolerance requirements, and economy of the printing and imprinting program. All banks will agree, we are sure, that the importance of this whole program from a long-range standpoint warrants a thorough and careful test before releasing the final and exact specifications for the Common Machine Language.

The following report also announces agreement on the band width at the bottom of checks which must be kept free of magnetic ink printing, except for the recommended characters.

This is another milestone in our progress toward a Common Machine Language and automation of check handling. The cooperation that exists between the committees of the office equipment manufacturers, the printers, and the Technical Committee on Mechanization of Check Handling is truly outstanding, and all of them are to be complimented on the progress that is being made.

Sincerely,

HAROLD E. RANDALL
Chairman
Bank Management Commission

A PROGRESS REPORT

Mechanization of Check Handling

A publication of the Technical Committee on Mechanization of Check Handling entitled *Location and Arrangement of Magnetic Ink Characters for the Common Machine Language on Checks* was issued on January 9, 1958. In the summary, it was indicated that the remaining items to be resolved were the finalization of the type font and the determination of the band width at the bottom of the checks, which must be free of magnetic ink printing other than the recommended characters.

The Committee of Office Equipment Manufacturers and its Technical Sub-committee have been working diligently in attempting to resolve these two areas. It is now possible to report the specific progress which has been made in the solution of these two problems:

1. The width of the band at the bottom of checks to be free of magnetic ink printing, except for magnetic ink coding, has been established as extending up 5/8 of an inch from the bottom of the check. In effect, the bottom edge of the 1/4 inch band for magnetic ink encoding, which was previously designated as being 1/4 of an inch from the bottom of the check, has been relocated to 3/16 of an inch from

the bottom. This modification was made to provide both the machine manufacturers and check printers maximum tolerance consistent with acceptable check design. All other specifications outlined in previous Technical Committee publications remain the same.

2. The machine manufacturers, through their committees, have agreed upon an acceptable type font. However, because of the tremendous importance of this project, the Committee of Office Equipment Manufacturers and its Technical Sub-committee have recommended a field evaluation test to determine the over-all reliability of the type font and the accuracy, tolerances, and economy of the printing and imprinting. The Technical Committee on Mechanization of Check Handling of the Bank Management Commission is in complete accord with this recommendation as the importance of this program from a long range standpoint warrants a comprehensive testing before the release of the final and exact specifications for the Common Machine Language.

The manufacturers' committees have spent considerable time in developing plans and specifications for the field evaluation test. During July, a limited group of printers will be formally requested to print and submit samples for the field evaluation. Inasmuch as the facilities available for evaluation are necessarily limited, the number of printers being asked to participate in the field evaluation will be only a small percentage of the whole industry. However, in the selection of these printers, representation is being given to their respective trade organizations and to the various types of printing equipment being used.

As soon as these tests are complete and the results announced, banks may then proceed fairly rapidly with printing or imprinting their checks with the Magnetic Ink Common Machine Language. To do so beforehand would result in considerable unnecessary expense and inconvenience on the part of depositors, banks, and printers. Attempts have been made to establish a date as to when the announcement of an acceptable font can be made. While this cannot be pinpointed precisely, it is possible that this announcement may be forthcoming any time from the middle of August to the end of December of this year.

During the field evaluation, additional work will be conducted with the makers of type, ink, and numbering units, as well as with various known methods of evaluating the quality of magnetic ink printing.

No general release of drawings of the presently developed font will be made until the results of the field evaluation prove the final acceptability of this font. However, when the evaluation is completed and final agreement is reached, a formal report will be sent by our Technical Committee to all member banks. That report will be prepared in coordination with the machine manufacturers and their committees and will contain detailed specifications covering all phases of the check mechanization program.

Respectfully submitted,

JOHN A. KLEY
Chairman

Technical Committee on
Mechanization of Check Handling

Account Numbering and Check Imprinting

for Mechanized Check Handling

Prepared by
Technical Committee on
Mechanization of Check Handling

BANK MANAGEMENT PUBLICATION 144

AUTOMATION OF BANK OPERATING PROCEDURE

JUNE 1958

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Table of Contents

Foreword

The general interest indicated by bankers throughout the country in the mechanized check handling program has prompted a great number of inquiries in two general areas:

What type of numbering system should be used for checking accounts?

How should the cost of code imprinting on checks be handled?

There has been a substantial increase in interest since the introduction of semi-automatic bookkeeping equipment. This type of equipment, as well as the more fully automatic equipment, requires an account numbering system in order to achieve maximum benefit.

Because of the current interest in account numbering and in the cost of encoding and imprinting checks, and because of the very close relationship of these subjects to the work of the Technical Committee on Mechanization of Check Handling in connection with finalizing the Common Machine Language, the Bank Management Commission has asked the Technical Committee to present material on these two subjects.

A description of the two general categories of numbering systems is outlined, together with a series of factors to be considered in making a selection. Inasmuch as the various characteristics involved in each numbering system must be related to the problems of a particular bank, no attempt is being made to recommend a single system specifically as the best one.

Finally, a discussion of check imprinting costs and the public relations aspects of the account numbering program is also presented. These subjects have received comparatively little mention to date, but both are of considerable importance and will have a vital bearing on the economic feasibility of any system involved.

BANK MANAGEMENT COMMISSION
AMERICAN BANKERS ASSOCIATION
Harold E. Randall, *Chairman*

PART I

Account Numbering Systems

Machine equipment manufacturers have developed, or are developing, equipment designed to sort, list, and post checks and deposits automatically or semi-automatically. However, this equipment requires the use of account numbers; consequently, banks will need to number their accounts to obtain the speed, accuracy, and economy of operation provided by these machines.

That no one system of account numbering can be considered best for all banks has also become increasingly apparent. The size of the bank, its operating procedures and objectives, and its future aims regarding automation will all have a direct and important bearing on the selection of a system. Basically, however, there are only two account numbering systems: *alpha-numeric* and *straight numeric*. The principal difference between the two systems follows:

Alpha-numeric refers to the assignment of numbers to accounts at such numeric intervals as will permit the assignment of numbers to new accounts while maintaining the alphabetic integrity of the file.

Straight numeric refers to the assignment of account numbers on a consecutive number basis under an arrangement whereby new accounts are simply given the next unassigned number. Modifications of the straight numeric system may include the assignment of broad ranges of numbers to different categories of accounts under an arrangement whereby consecutive sequence will be maintained within each category.

BASIC TYPES

Alpha-Numeric System

An alpha-numeric system, as its name implies, involves maintaining the accounts in both alphabetical and numerical sequence. This is accomplished by leaving a gap between numbers originally assigned, so that, as new accounts are opened, they may be assigned numbers which will place them in their proper alphabetical location. *To illustrate:* a bank has an account, Arthur A. Smith numbered 80640; the account following is John C. Smith and this is numbered 80892. If a Chester B. Smith should open an account, he would be assigned a number somewhere between these two.

The size of the original gap will depend, to a great extent, on the potential growth of the bank—including the possibility of mergers—and the number of digits a bank desires to have in its account numbers. Too many digits, of course, are undesirable from an operating as well as a customer relations point of view; but too few could also be undesirable if this results in a bank's running out of numbers so that accounts could no longer be maintained in alphabetical sequence.

There have been a number of methods developed for numbering accounts on an alpha-numeric basis, and two of these—one developed by the Central National Bank in Chicago and the other developed by the Whitney National Bank of New Orleans—are shown in the Appendix.

There are, of course, other effective plans of numbering accounts alphabetically involving varying degrees of complexity in both number assignment and record keeping. Two such rather widely publicized and basically different plans are the Crocker-merical system developed by the Crocker First National Bank of San Francisco (now the Crocker-Anglo National Bank) and the Arans system (Alphabetic Random Access-Numeric Sequence) developed by the LeFebure Corporation of Cedar Rapids, Iowa. Some of the larger machine manufacturers have also made extensive studies of the various aspects of both alpha-numeric and straight numeric account numbering and have prepared brochures on the subject which can be very helpful to banks.

Straight Numeric System

Under the straight numeric system of coding, no attempt is made to keep accounts in strict alphabetical order. Modifications of the straight numeric system are possible, however, whereby accounts may be grouped alphabetically under broad general classifications. Modifications may also permit grouping by branches or other classifications, and examples of methods of segregating accounts under a straight numeric system are shown below. In general, numbers are assigned in one of three ways:[1]

1. By assigning from a single series of numbers in strict consecutive order.

2. By assigning to each different group of accounts a certain range of numbers from one common series. The first example shows accounts grouped by branches, thus eliminating the need of incorporating a letter or digit in the account number to indicate the branch. The second example shows accounts (except those with heavy volume) grouped by alphabetical units. One of the advantages of this approach is to facilitate directing incoming calls and inquiries to the proper section of the bookkeeping department when only the name is given.

FIRST EXAMPLE

Branch	Number of Accounts	Numbers Assigned	
		From	Through
1 (Main Office)	26,700	1	99,999
2	15,300	100,000	149,999
3	3,100	150,000	169,999
4	1,000	170,000	179,999
5	4,000	180,000	199,999
6	3,400	200,000	219,999
26	1,000	580,000	589,999
27	1,200	590,000	599,999
Numbers available for new branches		600,000	999,999

[1] *Note:* The Technical Committee recognizes that other more involved or complicated applications of the straight numeric system may be devised, but it is felt that such applications would be limited and tailored to fit individual requirements.

SECOND EXAMPLE

Alphabetical Unit	Number of Accounts	Numbers Assigned From	Numbers Assigned Through
Heavy-Volume Accounts	1,000	1	9,999
A-B	9,000	10,000	39,999
C	6,700	40,000	69,999
D-E-F	9,000	70,000	99,999
S	7,300	210,000	239,999
T through Z	8,000	240,000	269,999
Numbers available for other groupings		270,000	999,999

3. By assigning to each different group of accounts a distinguishing prefix and its own series of numbers instead of assigning a range of numbers from one common series. In this method of numbering, numbers will be duplicated between groups; and, therefore, some means of distinguishing and identifying the different groups or types is required. The most common method of doing this is to use a digit* as a prefix to the account number.

For example:

Branch	Numbers Assigned
1 (Main Office)	1–1 through 1–99,999
2	2–1 through 2–99,999
3	3–1 through 3–99,999

FACTORS INVOLVED IN SELECTING A NUMBERING SYSTEM

The foregoing discussion of the basic numbering systems and modifications thereof is not intended as a recommendation for adoption, but rather an illustration of some of the approaches that may be taken by a bank in solving problems of account numbering. A full understanding of the various factors involved and a careful analysis of particular problems in one's own bank are necessary

* *Note:* The prefix could be a letter if desired, but any bank anticipating the use of automatic check handling equipment should avoid letters in its account numbers as this equipment, as of now, is designed to read numerals only.

before a sound decision may be reached as to the particular system to be used. Failure to take into consideration developments which might call for changing or modifying an account numbering system after installation is certain to prove a most expensive oversight and be a source of irritation to customers.

There are many factors that should be considered in selecting an efficient numbering system. These factors must be considered in the light of their relative importance, and since they obviously pose some measure of conflict, one to another, the problem of numbering must, in each case, be resolved by individual evaluation and compromise. A discussion of them follows:

Equipment To Be Used

The type of equipment has a very important bearing on the selection of an account numbering system, for some systems will be more efficient with certain equipment than others. A straight numeric system is probably more adaptable to more fully automatic computer systems than an alpha-numeric system. A straight numeric system can also be advantageous in minimizing the number of sorts when automatic digital sorting equipment is used, as will be discussed in another section of this booklet.

Adaptation to Future Growth

This factor will likely prove to be very important, and also may be difficult to solve. The system selected should provide flexibility and be capable of adaptation to future growth. It will require taking into consideration a number of probabilities and/or possibilities, such as:

Growth due to new accounts
Mergers
New types of checking account service, such as special checking accounts, check-credit accounts, etc.
Change in number of branches
Changes which involve some measure of centralization or decentralization of the deposit accounting function
Conversion to more automatic systems of accounting.

All reasonable care should be exercised in order to avoid the necessity of making subsequent changes in account number designations. A too frugal allocation of numbers in order to satisfy present requirements only might have far-reaching implications. An overly optimistic appraisal of growth potential resulting in the use of unnecessarily large numbers might, on the other hand, result in inefficiency in item handling and sorting.

Number of Digits

There are many good reasons for limiting the number of digits used. Fewer digits will mean less work in assigning, recording, printing, coding, and in other day-to-day operations involving account numbers. Sorting will be simplified, and fewer errors can be expected to be experienced in transcribing and recording information. It will also make it easier for the customer to remember his account number. These benefits all argue well for a straight numeric system of numbering.

Under an alpha-numeric system, at least one more digit is usually required than under a straight numeric system in order to provide necessary number gaps between accounts for growth. In instances where a 5-digit series of numbers would ordinarily suffice in a straight numeric system, it is probable that 6 or 7 digits would be required for an alpha-numeric system.

Then, too, despite the fact that a substantial expansion gap may be provided between accounts, it is still possible to "run out" of account numbers. Should this occur—and it is more likely to result from incorrect assignment of numbers than from unusual and unanticipated growth within a particular section—re-allocation of numbers would, in all likelihood, be necessary. Under these circumstances, resort to decimal fractions of numbers as an alternative may not be a satisfactory or available remedy.

Ease of Assigning Numbers

The work involved in assigning numbers to accounts should be made as easy as possible.

As a general rule, under a straight numeric system, initial conversion or assignment of numbers to new accounts is a straightforward and simple procedure. On the other hand, under alpha-numeric numbering, initial conversion or assignment of new account numbers may be moderately or extremely complicated, depending on the formula used.

There is, however, another factor connected with ease of account numbering which should be considered—namely, the advantage in being able to maintain a temporary supply of account-number-imprinted checks at each new account desk which can be delivered immediately to each new account customer. This can readily be done under some methods of straight numeric numbering. *For example,* under a branch grouping, if numbers are assigned from one common series or if each branch is assigned its own series of numbers, it is quite possible to maintain a stock supply of pre-numbered checks. In the case of alpha-numeric numbering, since each account number is established by the relationship of the new account name to alphabetically adjacent names in the existing file, numbers cannot be determined in advance but must be computed when the account is opened. This makes it impossible to maintain pre-numbered stock for immediate customer use under an alpha-numeric system.

Ease of Reference to Basic Files and Records

Accounts should be numbered in such a manner that references to basic records can be made easily and readily, whether inquiry is based on name or account number. A disadvantage of a straight numeric system is that a cross-index file must be maintained. In this regard the alpha-numeric system of numbering, which permits the continuance of traditional alphabetical filing, is decidedly superior to the straight numeric, since both alphabetical and numerical sequence is maintained and reference to a cross-index file is unnecessary. A modified straight numeric system whereby accounts are grouped under broad alphabetical classifications permits some improvement in ease of reference over a straight numeric system, but it is still inferior in this respect to alpha-numeric.

Efficiency in Item Sorting

From the standpoint of efficiency in sorting, the straight numeric system generally offers considerable advantages over the alpha-numeric system, since one of the important benefits to be gained from straight numerics is that fewer digits are required. The greater the volume of items to be sorted, the more important this advantage becomes.

Where automatic check sorters designed to operate on a digit sort selection principle are employed, the savings of only one digit in account identification results in very real and tangible economies when measured in the time and cost involved in making one additional sorter pass on every item handled during the course of a bookkeeping operation.

Because numbers can be arbitrarily assigned under a modified straight numeric system, it is possible to assign a certain range of numbers within a number series to large-volume accounts in such a manner as to permit fewer sorts when automatic digital sorting equipment is used. *For example,* by reserving a certain range of numbers within a series–such as 100,000 through 199,999–and assigning only those numbers within the series that have zeros in the 3 low order positions, thus using only 100 numbers (100,000, 101,000, 102,000, 103,000, etc.), the items on accounts assigned these numbers can be completely sorted by only 3 passes through the sorter instead of 6 which normally would be required. This is accomplished by sorting initially on the high order digit (1̲00,000); then sorting this group separately on the following two̅ digits; ignoring the remaining three digits as they are not significant, being all zeroes.

In cases where sorting is done manually, fewer digits likewise permit fewer sorts to get the items down to account and, therefore, should result in faster handling of the items.

Indication of Branch, Type of Account, Controls, Alphabetic Breaks, etc.

In some bank systems it is important that account numbers be as indicative of general account information as is practicable.

In the case of decentralized accounting, digits in the account number designating branch classification may be desired as a means of routing work directly to the point at which accounting records are maintained. Likewise, a digit in the account number indicating type of account, control or general alphabetical break can be of material advantage in the sorting, routing, and control of items.

Distribution of New Accounts

Under conventional systems of bookkeeping, the need for even distribution of new accounts among the various ledgers has always been recognized. For similar reasons, the need is of equal importance under semi-automatic systems of bookkeeping. Under fully automatic systems, although accounts are not broken down ledgerwise, it will generally be necessary to maintain even controls over accounts for statement cycling and other control purposes.

Both the alpha-numeric and modified straight numeric systems of numbering can be considered equally adaptable in this respect. However, in the case of a straight numeric system of account numbering where new accounts are always given the next highest number from a single sequence of numbers, the number of accounts in the last ledger or control will continually increase while the number of accounts in other ledgers or controls will continually decrease owing to normal closing of accounts. This can be overcome to a degree if a reasonable maturity date for re-use of an account number can be established, and closed account numbers are reassigned. This matter of uneven distribution of accounts will not, of course, arise in those cases where a terminal digit method of filing is employed. (See Bank Management Commission Publication No. 132 *Terminal Digit Method of Filing* for an explanation of this method of filing.)

Check Digits

Whenever an account number is copied from one source to another, there is always the possibility of making an error in copying; and where accounting procedures provide for posting by number selection alone, there is considerable danger of misposting.

These risks can be overcome, to a great extent, by providing for a check digit as a supplement to the basic account number. Basically there are two methods of determining check digits:

1. By an arbitrary selection of a series of numbers, such as 1 through 9 or 1 through 7, and the assignment of these numbers in sequence to the accounts. This type of check digit will serve the purpose of a direct-number comparison and may be used satisfactorily with semi-automatic but not fully automatic accounting equipment.

2. By computation applied to the digits of the basic account number. This type of check digit is determined by applying a mathematical formula to the digits in the account number which results in a self-checking account number—a basic requirement under fully automatic systems.

Detailed illustrations of these two types of check digits appear on the following pages.

It should be pointed out that banks which expect to use semi-automatic bookkeeping machines initially, but which plan ultimately to convert to fully automatic equipment, should very seriously consider using check digits based on a computation, since this type of check digit is a necessity under a fully automatic electronic system. By making initial provision for such a check digit, banks will be able to avoid having to make subsequent changes in account numbers which, in turn, would be found to present problems with respect to check reissuance and various related account records.

When a check digit is to be used, it can be determined either in advance of or at the time account numbers are assigned. It has no influence on number sequence or number assignment; and although the check digit may be ignored when sorting and filing, it should be considered an integral part of the account number for posting and reference purposes. It should be pointed out that providing for a check digit is a practical safeguard with a varying degree of accuracy, depending on the method used in determining it.

SEMI-AUTOMATIC ACCOUNTING (STRAIGHT NUMERIC CODING)

A check digit is a general requirement under a semi-automatic method of accounting when a straight numeric system of coding is employed, since checks and deposits are sorted by number and customer records are maintained and selected in the same fashion.

For example, where straight numerics are used under the Burroughs' Sensitronic and National Cash Register's Post-Tronic bookkeeping systems, the use of a check digit in the account number is recommended by both manufacturers for accuracy of posting to the correct account. Under these systems the check digit does not appear as a part of the basic account number printed on the face of the ledger sheet although it is included in the account number magnetically recorded on the reverse side of the ledger sheet. In posting, the bookkeeper indexes, in the keyboard, the two terminal digits of the basic account number and the check digit appearing on the check. The bookkeeper then selects the ledger sheet by the basic account number appearing on the check and inserts the ledger sheet in the machine. This procedure prevents mispostings since it forces the bookkeeper to index from the item to be posted rather than from the number appearing on the ledger sheet. The machine will not function if the number indexed on the keyboard does not correspond to the number magnetically recorded on the back of the ledger sheet selected.

To illustrate:

Number on check reads	123456-8
Number on statement reads	123456
Number magnetically recorded on statement	568
Bookkeeper indexes from check	568

This verifies that the proper ledger sheet was selected because even though the bookkeeper selected another account ending in 56, the check digit would have little mathematical probability of being an 8 and, therefore, the machine would lock.

The assignment of check digits for use with semi-automatic posting equipment can be a simple matter. *For example,* numbers could be assigned in sequence under a cycle pattern as follows:

Account No.	Check Digit	Account No.	Check Digit
1	1	11	4
2	2	12	5
3	3	13	6
4	4	14	7
5	5	15	1
6	6	16	2
7	7	17	3
8	1	18	4
9	2	19	5
10	3	20	6

Each time a new account is opened, the next highest digit is assigned; no computation is needed. If desired, a double check can be made very easily by dividing the account number by seven; the remainder should be the check digit. If there is no remainder, the check digit is seven.

SEMI-AUTOMATIC ACCOUNTING (ALPHA-NUMERIC CODING)

A check digit is not ordinarily required for an alpha-numeric system of coding when bookkeeping is done on semi-automatic equipment, as the accuracy of the postings is double checked by (1) alphabetical selection of the ledger sheet and (2) automatic comparison of the account number on the check with that magnetically coded on the back of the ledger sheet.

For example, the proposed procedure with Burroughs' Sensitronic or National Cash Register's Post-Tronic bookkeeping system, where accounts are alpha-numerically numbered, is as follows:

The account number is magnetically recorded on the back of the ledger sheet. It is not printed, however, on the face of the sheet, so as to prevent the bookkeeper from indexing the number from the sheet rather than from the item itself. Checks and deposits are sorted numerically (alphabetically as well), and ledger sheets are filed alphabetically (numerically as well). In the posting operation the bookkeeper selects the appropriate ledger sheet from the name appearing on the check and inserts the sheet in the machine. From the account number appearing on the check the bookkeeper indexes the three terminal digits in the keyboard of the machine, and the machine makes a comparison of the number indexed with that magnetically recorded on the back of the ledger sheet. If the numbers agree, the machine completes the cycle updating the records. If the numbers do not agree, however, the machine locks, indicating a selection of a wrong account or incorrect indexing of the account number.

Even though a check digit is not required under this system of bookkeeping, banks which anticipate the use of automatic check handling equipment should still seriously consider incorporating a calculated check digit in their account numbers. Several manufacturers are planning to incorporate a check digit verification feature in their forthcoming check handling equipment. The encoder which will be used for encoding account numbers in magnetic ink on credits, debits, and other non-encoded items will be equipped with this feature; and errors in transcribing account numbers will thus be detected at the source. This same feature may also be on the check sorter to detect errors before they enter the accounting system.

FULLY AUTOMATIC ACCOUNTING (STRAIGHT NUMERIC CODING OR ALPHA-NUMERIC CODING)

A check digit is generally a requirement under a fully automatic method of accounting regardless of the type of numbering system used.

Providing for a check digit that would eliminate most error hazards under more fully automatic systems of accounting requires a more involved procedure. This is because the equipment must have some means of testing itself to insure that no error has been made in reading the account number, and this is accomplished by the machine making a computation on every account number it reads and verifying the computed check digit to the check digit it has read. It is important, therefore, in developing the formula to be used for the check digit, that care be exercised to make sure that excessive computor time will not be required in making the calculation on every item handled. One formula that is commonly used in proving accuracy of key punching is that developed by International Business Machines Corporation. The International Business Machines Corporation is developing other formulae for account number verification but the following will serve to illus-

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trate the steps involved in providing for a self-checking number.

1. The terminal digit and every alternate digit of the basic code number are multiplied by 2.

2. The digits in the product and the digits in the basic code number not multiplied by 2 are cross-added.

3. The crossfooted total is subtracted from the next higher number ending in zero.

4. The difference is the check digit.

Example:

Basic code number	6 1 2 4 8
Terminal digit and every alternate digit of the basic account number	6 2 8
Multiply by 2	×2
	12 5 6
Digits not multiplied by 2	1 4
Cross add	1+2+1+5+4+6=19
Next higher number ending in zero	20
Subtract crossfooted total	19
Check digit	1
Self-checking number	6 1 2 4 8 1

Other machine manufacturers have developed formulas for computing check digits, and some companies, as an added service to banks, will provide printed lists of account numbers including a check digit which the bank can use in assigning numbers to their accounts.

• • •

As mentioned heretofore, there are many ways of determining a check digit, some of which are more effective than others in detecting errors. The examples presented herein are merely illustrations of the typical steps involved in providing for such a check digit, and should not in any way be construed as recommendations of the Technical Committee. Whatever method may be employed to provide for a check digit, the important considerations are that it should amply serve to eliminate error, be adequate to fill future as well as present requirements, and be compatible with the equipment the bank plans to use.

Provision for Statement Cycling

In any evaluation of an account numbering system, consideration should be given to the subject of statement cycling in order to alleviate activity peaks in preparation and issuance of statements. It is important that a method of numbering be adopted that will retain a fairly equal distribution of statements rendered on each cycling date, so that it will not be necessary to reassign statement dates from time to time.

Where an alpha-numeric numbering system is used or where number assignment is made on a branch or alphabetical grouping, statement periods can be established that should remain fairly constant as accounts within the various groupings are opened and closed.

If a straight numeric system is selected, however, the problem of statement cycling may become more serious. In cases where it is feasible, a terminal digit method of record maintenance and filing can be used to solve this problem.

Summarization of Factors

The type of equipment to be used will have an important bearing on the account numbering system selected. Most semiautomatic accounting machines will work equally well with either a straight numeric or alpha-numeric numbering system. More advanced equipment, however, will, in most cases, be more efficient with a straight or modified straight numeric system, and banks should have this in mind now even though they may not be anticipating the installation of such equipment for some years to come.

The straight and modified straight numeric systems are more adaptable to unusual growth which might result from mergers, establishment of new branches, and centralization of the bookkeeping function. They also permit easier assignment of account numbers not only at initial conversion, but subsequently. They also have greater possibilities of indicating, without the need of additional digits, types of accounts and branch classifications. Their fewer digits, too, have work-saving possibilities in day-to-day operations, and this is one of their outstanding features. This can be particularly important when magnetic ink sorters become available.

The alpha-numeric system, however, is definitely superior in respect to ease of reference as it permits retention of the conventional alphabetical sequence of accounts, thereby eliminating the need for cross-index files which are necessary under the straight numeric or modified straight numeric system. The alpha-numeric system, as well as the modified straight numeric system, permits more even distribution of new accounts throughout the ledgers, and this can be very important not only for equalization of work load among the bookkeepers, but also for equalization of work load with respect to statement cycling operations.

A check digit is essential under fully automatic systems. A check digit is also essential where check handling equipment incorporating the self checking account number feature is to be used to detect errors in account numbers before they enter the accounting system. All banks, therefore, should seriously consider incorporating a calculated check digit in their numbering system.

PART II

Check Imprinting

Account numbering entails more than mere numeric designation of ledger records. Provision must also be made for similar designation of the checks and deposits which are to be posted on those records. The manner of providing for such identification of checks and deposits will have a decided influence on the usefulness of the program as a whole.

IMPRINTING ACCOUNT NUMBER

Practical considerations rule out the feasibility of having the customer write his account number on checks, except in isolated situations. It is also apparent that if a bank were to attempt to encode the identifying number on each individual item after presentation to the bank, any measure of gain expected from numbering would be largely eliminated. It would appear, therefore, that the best approach to the problem would be to have all checks and deposit tickets imprinted with identifying account numbers before delivery to the customer. Following this approach, an extremely high percentage of the day's transactions will already be qualified as to account number when it reaches the bank—a situation that should achieve the maximum results possible at the lowest cost.

The account number imprinting of all checks and deposits will not, of course, eliminate the problems incidental to irregular items, such as counter checks, internal debits and credits, blank checks, borrowed checks, odd deposit tickets, etc. When these irregularities are considered in their proper light, however, it must be agreed that their number will be relatively few compared with the total checks and deposits with pre-imprinted account numbers; and that if efforts are made to obtain customer cooperation, the problems incidental to the processing of irregular items will be of modest dimension. Ultimately, of course, under the fully automatic system it is expected that post-printing equipment will be available to encode the account number and amount simultaneously on these irregular items.

IMPRINTING CUSTOMERS' NAMES

Name imprinting, although not an absolute *must* under a numbering system, can be helpful to a bank in many ways, such as in assisting a teller to know the customers' names; in identifying items when the account numbers are mutilated; as a double check against missorts, mispostings, and misfilings; in expediting the handling of imprinted check orders; and as a double check against delivery of these orders to the wrong customer. Imprinting the name as well as the account number will also tend to reduce the practice of one customer borrowing another's check; and when that does occur, the borrowing customer is more apt to strike out or change the imprinting than would be the case when only the account number is imprinted. Such a marked-over check should serve as a flag to the bank that the item is in improper form and will need recoding before it can be handled automatically.

Name-imprinted checks are also desirable from the customers' viewpoint. Most customers like to see their name in print and feel that such imprinting adds prestige to their business transactions. Therefore, in view of the advantages to both the bank and the customer, and because the cost of adding the name when imprinting the account number will be relatively insignificant, it would seem desirable to have all checks imprinted with both name and account number.

PLACEMENT

Account Numbers

Until such time as the magnetic ink encoding program is finalized, banks are free, with minor reservations, to imprint the account number in regular ink in any area on the check that is best suited for their purposes. If, however, they decide to use the area presently reserved for magnetic ink encoding, the account number should be placed in the area reserved for the account number, as defined in A.B.A. Bank Management Commission Publication No. 142, *Location and Arrangement of Magnetic Ink Characters for the Common Machine Language on Checks.* It is extremely important that the account number not be located in the areas reserved for the A.B.A. transit number-routing symbol and the amount.

Customers' Names

Inasmuch as the customer's name is not a part of the Common Machine Language, it can be printed elsewhere on the check, such as in the upper left corner or over the signature line, according to the individual bank's preference. (If such printing is done in magnetic ink, however, care must be exercised to see that it is kept outside the area reserved for magnetic ink encoding.) The manufacturers of specialized check imprinting equipment that requires the use of type or type slugs are currently redesigning their equipment to provide for the simultaneous imprinting of the account number in one position and the name in another.

With offset imprinting machines, where copy is reproduced from data typed on paper masters, no change in the present equipment is necessary—the proper positioning of the typing on the master will cause the account number and name to be imprinted in the desired location on checks.

ON-PREMISES IMPRINTING

With the advent of automatic check handling, the facilities of the check printers of the country may become overtaxed, and it is quite possible that the volume of on-premises imprinting; that is, imprinting within the bank through the utilization of bank-owned or rented equipment, may increase. It is quite probable, however, that many banks will still prefer to continue to have all imprinting done outside the bank, while others will only have the imprinting of commercial-size checks and fully imprinted checks of all sizes done by outside printers. These printers are generally much better equipped than banks for numbering checks serially, interleaving various styled stubs, and binding checks and stubs into a variety of checkbook cover styles.

The magnetic ink program will, of course, require more exact registration of the preprinted encoded information and adherence to stricter standards with respect to the cutting, perforating, and binding of checks. It is expected, however, that banks can continue to imprint their own checks without serious difficulty provided somewhat greater care is exercised.

The time required for preparation and delivery of checks to customers can be an important factor from a public relations standpoint. If outside printing service is not available to meet a bank's requirements, on-premises imprinting may be the solution to providing for faster delivery of checks to new account customers, as well as for the efficient handling of subsequent reorders. A number of banks are now imprinting checks on the premises for certain types of accounts with satisfactory results. At the present time most of this on-premises imprinting is confined to a limited number of styles of pocket-size stock checks which are later bound and packaged in the usual manner.

COST OF IMPRINTING PROGRAM

Before embarking on an imprinting program, a bank should study the average check utilization by type of account and compare these results with economical printing and packaging quantities to determine the number of checks to an imprinted order. It is axiomatic that the larger the number of checks included in each order, the lower the imprinting cost per check. On the other hand, the per-check cost can go up through wastage if customers are supplied with more checks than they can use and also through increased shipping charges if too many checks are packaged in a single order. In determining the number of checks per order, consideration must also be given to the average active life of each type of account, as well as to the ratio of closed accounts to the total number of accounts maintained. For these reasons, each bank should establish its own checks-per-order figure.

Justification of Added Costs

The imprinting cost of any mechanized program of check handling is a significant factor which must be given major consideration. Some estimates have indicated that minimum imprinting requirements may as much as double a bank's present stock costs. The reduction of wastage in giving customers the more-personalized imprinted checks as against supplying them with unimprinted checks, which they do not appear to treat with a great deal of care, may partially offset the cost of imprinting but only in a very minor way. The justification of the additional imprinting cost is that it is essential to attaining automatic check handling, and automatic check handling is expected to result in overall savings through greater reduction in other bank operating costs.

PART III

Public Relations Aspects

ACCOUNT NUMBERING

A requirement that all accounts be numbered will admittedly have some impact on existing customer relationships.

Advantages to Customer and Bank

If customers are given a frank and adequate explanation of the bank's need for automation to meet the tremendous expected increase in volume and its desire to hold costs and fees in line, there is no reason to doubt but that they will be more than willing to cooperate. It goes without saying that the advantages accruing to customer and bank alike from numbering are deserving of the best selling techniques that can be employed.

Conversion to Numbers

Account numbering is not entirely new to banks nor to their customers. Savings accounts are customarily identified by number, as are most special checking accounts, instalment loan accounts, safe deposit rentals, and, in many instances, mortgage loans. The general public has also had further indoctrination with account numbers through various charge account services of other types of businesses.

Adding the name to the imprinting, as suggested previously, should serve to make conversion to an account numbering system more acceptable to the customer and aid banks in convincing their customers that the entire program contains benefits for all concerned.

Check Format Problem

A problem of check format may well be encountered in connection with checks of business account customers. The Technical Committee was made aware of this check format problem as a result of its research dealing with the study of placement for the Common Machine Language on checks, and, partly for this reason, recommended the area at the bottom of the check for coded data. Its studies revealed that this area posed fewer problems with reference to revision of existing check format than did other possible areas of encoding. In most instances it would appear that moving the printing higher up on the check or simply eliminating the border is entirely feasible while, in other cases, checks may possibly need to be heightened to accommodate the magnetic ink coding.

In certain circumstances, it may be necessary for the bank to assume the cost of any redesign that may be necessary.

INCREASED IMPRINTING COSTS

The addition of an account number to presently imprinted checks should add little, if any, to imprinting costs. Therefore, in those cases where bank customers purchase their own imprinted checks, no significant problem exists.

Where customers do not use imprinted checks, the cost of providing account-numbered—and possibly name-imprinted—checks will be much more significant and will probably need to be borne by the banks.

SALE OF CHECKS

A large number of banks have made considerable progress in selling fully imprinted checks to their personal-account customers with results that suggest that such a program might well be expanded. Certainly there is no desire on the part of banks to depart from this procedure and assume this expense. So far as is possible, then, every effort should be made to maintain or improve the bank's position in this regard, since it will be apparent that each such sale will reduce the overall imprinting cost to the bank of its automatic check handling program.

Free Line Check Programs

For a number of years some banks have been providing their customers with free "line" checks (those containing a single line of imprinting which shows just the name and a sorting symbol or number). Some of these banks report that their free line check program has not affected the sale of fully imprinted checks but has, in fact, presented them with an opportunity to sell such fully imprinted checks to more of their customers.

Contrasting Checkbooks

Common sense merchandising dictates that there should be a marked difference between the checkbook package to be provided free and the one to be sold. To promote sales, the free checkbooks need not be of inferior quality—they merely have to meet standard requirements without having special features which are not absolutely necessary to the operation of a checking account. These special features are: unusually attractive checks in a variety of colors, the imprinting of the customer's address as well as his name, the serial numbering of checks to meet the customer's requirements, and extra fine quality covers. It is highly desirable, therefore, to reserve these features for the checkbook packages to be sold.

The Technical Committee recognizes that some outside printers, and a few of the banks that do on-premises imprinting, can provide some of these features (serial numbering of checks or the addition of the address to the imprinting) as a part of their standard package at little additional cost. However, banks should realize that in providing these features they narrow the difference between the free and the salable checkbook packages and thus weaken the salability of fully imprinted checks by banks as a whole.

PART IV

Summary

Account numbering is foremost in many bankers' minds, at the moment, because of the advent of semi-automatic and fully automatic bookkeeping systems either available now or coming in the near future. Basically, however, there are only two distinctive numbering systems—alpha-numeric and straight numeric. An alpha-numeric system retains the traditional alphabetic sequence of accounts, thus permitting easy reference to records where either the name or number is given. However, an alpha-numeric numbering system will require at least one—and in most cases two—more digits in the number than a straight numeric system, and these additional digits may prove very costly when automatic check handling equipment is available.

A straight numeric system, as a rule, permits easier conversion, greater efficiency in sorting, and more opportunity to show general account information, such as branch, type of account, etc. Because all accounts are not in alphabetical sequence, however, it does require establishment of a cross-index file, thus slowing down references to basic records when the account numbers are not known.

The use of a check digit should be carefully considered in any study of account numbering as it provides greater accuracy under most systems at little or no additional cost.

Both numbering systems have their good points, and banks will need to analyze their own situations carefully to determine which is best for them.

No matter which is adopted, consideration must be given to the problem of encoding the numbers on checks and deposit tickets. Many banks will no doubt imprint the numbers on the checks, at least, and, in so doing, may decide to include the customers' names in the imprinting. Care should be exercised in attempting to pass any specific increased imprinting cost on to the customers, as the entire success of the program depends on customer acceptance of account numbers, and it would seem to be poor public relations to penalize the customer for improved efficiency within the bank. Continued efforts should be made, however, to sell fully imprinted checks, with name, address, and check serial number, as each such sale will reduce the overall imprinting cost to the bank.

PART V

Appendix

CENTRAL NATIONAL BANK IN CHICAGO ALPHA-NUMERICAL NUMBERING SYSTEM

The basic principle underlying the alpha-numeric system of account numbering developed by the Central National Bank in Chicago requires the use of a standard expansion gap divisible by 2 throughout its entire range. That means the gap must be either 2, 4, 8, 16, 32, 64, 128, etc.; the reason for this being that as new accounts are added, they may be given a number midway between the numbers of the two existing accounts between which the new accounts are to be interfiled. *For example,* if the two existing accounts were numbered 32 and 64 (a gap of 32), the new account would be numbered 48. If a new account opened between 32 and 48, it would be numbered 40; a new account between 32 and 40 would be 36; an account between 32 and 36 would be 34; and, of course, an account between 32 and 34 would be 33.

It can be seen from this that with an original gap of 32 numbers and with the addition of only 5 new accounts, it would not be possible to place another new account which alphabetically belongs between 32 and 33 or between 33 and 34 in its proper alphabetical order. Mathematically, of course, the probability of such an occurrence as we have described is very small.

The Central National Bank in Chicago selected 128 as its standard expansion gap; and mathematical studies have indicated that even though it should double its accounts, the probability of not being able to place a new account in its proper alphabetical location is only 1 in 50,000.

The standard expansion gap selected by any bank must be related, of course, to the maximum number of digits the bank will wish in its account numbers. The Central National's maximum was 6 digits (999,999). They had approximately 7,500 accounts on their books at the time, and they used an expansion gap of 128 between unrelated accounts and a gap of only 8 numbers between related accounts. *Related accounts* are defined as accounts having the same name and ownership. (Examples of related accounts are: Smith Company, Smith Company Payroll, Smith Company Petty Cash, etc.) The need for a greater gap between such accounts is negligible.

Banks with 7,800 accounts or less could adopt a standard gap of 128 for all accounts, related or otherwise, and still restrict their highest number to 6 digits. Of course, too, banks with a greater number of accounts could establish a standard gap of 64 and still have 6-digit account numbers. The maximum number of accounts a bank could have with a gap of 64 and a 6-digit account number would be slightly over 15,600 (999,999 ÷ 64). This is assuming, of course, they do not wish to establish a smaller gap for related accounts which, if established, would permit even a greater number of accounts to be handled on a 6-digit basis.

It is questionable whether any bank would want to establish a standard gap of 32 or less, but it is possible that under certain circumstances a bank might wish to do so. The risk is, of course, that it might get a new account that could not be given a number which would place it in strict alphabetical sequence. The result, however, should not be too serious as it should be possible to assign it a number not too far removed from its proper alphabetical location. The fact that the account has a number would still permit it to be found without difficulty; and if the result is that, by having a 32- or even 16-number standard gap, one less digit would be needed in the account number, the risk might well be taken.

58913 O—60——31

WHITNEY NATIONAL BANK OF NEW ORLEANS ALPHA-NUMERICAL NUMBERING SYSTEM

The Whitney system of alpha-numerical account numbering developed by the Whitney National Bank of New Orleans is based on the local community telephone directory. Under their system, account numbers are assigned by numbering each column in the directory and then, in effect, numbering each name in each column by the use of a pre-numbered cardboard strip with printed numbers spaced to correspond to name spacing in the directory (see illustration, page 35).

The procedure used in numbering the columns is as follows:

A determination is made of the most active letter in the directory.

A count is made of the number of columns making up that letter.

The number of columns is then divided into the figure 999,999, and the result is rounded out to the next lowest thousand and becomes a common column value. *For example,* supposing the letter "S" were the most active letter in the directory and comprised 192 columns. Dividing this figure into 999,999 results in a quotient of 5,208 which rounded out to the next lowest thousand becomes 5,000.

Beginning with the letter "A," each column under this letter is numbered in ascending fashion (i.e., 000; 5,000; 10,000; 15,000; etc.). The process is then repeated with the letter "B," again starting with 000, and continued until every column in the directory has been numbered.

After a column value has been established, the next step is to determine the average number of names in each column. If this figure were determined to be 110—and this is generally about the average in a metropolitan directory—the spacing or gap between numbers would be 45 (5,000 divided by 110). However, to overcome the incidence of having the same last digit appearing in every other account number (i.e., 045, 090, 135, 180, etc.), an alternating progression may be employed, resulting in, for example, the first number being 45; the second 91 (45 + 46); the third 136 (91 + 45); the fourth 182, etc. These numbers are then printed on a cardboard strip with spacing corresponding to spacing of names in the directory.

To assign a number to an account, all that is necessary is to lay this cardboard strip beside the appropriate column, find the

20000

A&Ada Radio Cab Serv 1200-9thNBergn UN 3-2030
A Aiello Jr Movg Co
131FtLeeRdLeonia.WIndsr 7-1700
A Amer Auto Driving Acad
7506BgnlineAvNBergn.UNion 6-5410
A-1 Auto Driving School
60-SipAvJCy.JOurnlSq 5-1072
A-1 Clnr-Tailor-Furrier 417-37thUnCy UN 7-1818
A-1 Clnrs 6304ParkAvWNY ....UN 3-7334
A-1 Sewer Clng Serv 408-33rdUnCy ..UNion 5-8052
A-1 Typwrtr Exch 626-61stWNY ..UNion 6-4524
A & A AUTO BODY SHOP
418-10thUnCy.UN 4-4220
A&A Bowling Shirts Co 122-48thUnCy ..UN 4-2614
A&A Bowling Shirts&Emblem Co
122-48thUnCy.UN 4-2614
A&A Frt&Veg Mkt
5105BgnlineAvWNY.UNion 3-5050
A&A Glass Co 2120HudBlvdUnCy ...UNion 3-1890
A A Lexington Movg&Storg Co
202W89thNYCNY.MArkt 3-0375
A A N J 7919HudBlvdNBergn ......UNion 6-0800
AANJ branch ofc
706HudBlvdUnCy.UNion 7-9074
A&A Refrigeration Service
301-77thNBergn.UN 3-4450
A A A Aabaddon Extrmtg Co
101-34thUnCy.UNion 4-0501
A A A Club 2330BlvdJCy ....HEndrsn 4-3500
From 5 PM to 9 AM weekdays from noon
Sat until 9 AM Mon&Hol call.HEndrsn 4-4300
A A A Sales&Serv Inc 610-3rdUnCy .UNion 4-0489
A A A Taxi Serv 723-6thUnCy ....UN 3-1123
A A A Taxi Serv 723-6thUnCy .....UNion 3-4900
A A A Washing Machine Serv Inc
535BergenBlvdRdgfld.UN 6-8700
A-B Emblem Corp 519-30thUnCy ....UN 4-1513
A & B RADIO CO
2027BgnlineAvUnCy.UNion 5-5932
A B C Auth Factory Serv
426BayWayEliz.ELizbth 4-4120
A B C Clnrs 201-60thWNY ....UN 3-1072
A B C Discount Corp
6318BergenlineAvWNY.UNion 7-1370
A B C Dress Mfg Co 711-SipUnCy ..UN ion 7-6663
A B C Elec Sewer Serv
600-82ndNBergn.UNion 3-0604
A B C Home Laundry Equip Serv
535BergenBlvdRdgfld UN 6-8700
A B C Motors Inc
508AndrsnAvClfsdPk.CLifsd 6-9000
A B C Refrig Serv Co 15MtVernRdgfldPk.UN 7-1337
A B C Textile Machn Co
7212BgnlineAvNBergn.UNion 6-6268
A B C Three Hour Clnrs
201-60thWNY.UNion 3-1072
A O CHEVROLET CO
3085BlvdJCy.JOurnlSq 3-8000
A&C Knitting Mill 541-40thUnCy ...UNion 3-0558

25000

Aarons Jos Inc embrdy
6128ParkAvWNY.UNion 6-6906
Aaronson M Mrs 8301-4thAvNBergn ..UN 4-4765
Abahoonie C 431GrgryAvWehwkn ...UNion 7-1529
Abahoonie J r 122-18thUnCy......UN ion 3-7590
Abalsamo E 1450-67thNBergn ......UN 7-2371
Abalsamo P 1452-67thNBergn .....UNion 3-8967
Abate C Mrs 4527HarlsnPlUnCy ......UN 3-6918
Abate F r 142-34thUnCy ....UN ion 7-6466
Abate J P 290MtnRdUnCy ....UNion 4-6979
Abate J R 27-66thWNY ....UN 3-5347
Abate Jas r 6011FillmorePlWNY ...UN ion 6-8108
Abate Jos R 4908HudAvWNY ....UNion 6-5662
Abate Margaret Mrs
6811HudBlvdNBergn.UNion 5-1155
Abate P 608-17thUnCy ....UNion 4-1572
Abate P Sr r 110-67thWNY.......UN ion 3-5235
Abato A 1317-14thNBergn ....UNion 7-2085
Abato C C 6515BlvdE-WNY ....UN 6-7139
Abato E r 4711HudsonAvUnCy .....UN ion 7-4207
Abato L Miss r 1115-SummitAvUnCy UN ion 3-0757
Abbadessa A 309-58thWNY .....UNion 5-8347
Abbadessa J P 6047PlsdAvWNY .....UNion 6-0701
Abbate F G 5410MadsnWNY ....UN 3-5568
Abbate J G r 215JaneWehwkn ....UN ion 3-8985
Abbatello J 5608HudAvWNY ....UNion 5-4287
Abbatiello P 1440-51stNBergn ....UNion 5-6444
ABBE—See also ABBEY
Abbey A Mrs 609CntrlAvUnCy ......UNion 4-2329
Abbey Cutting Serv 7709BwayNBergn UNion 7-4386
Abbey Refrig Serv 411MonstryPlUnCy UNion 7-1205
411MonstryPlUnCy .... UNion 7-2868
Abbey Taxi Serv 517-22ndUnCy ....UN ion 5-5500
Abbey Washing Machn Serv
411MonstryPlUnCy.UNion 7-1205
Abblate Wm 275CntrAvSec ....UN 5-6180
Abble Robt 2805-SumitAvUnCy ....UN 4-6171
Abbot Elec Roto-Rooter Sewer Serv
131HlcrstPlNBergn.UN 7-2616
Abbott Gertrude E 1312PlsdAvUnCy ..UNion 6-0327
Abbott Laboratories
200GreenTetrbro.HAsbkHts 8-1431
Abbott R D r 113-59thWNY.......UN ion 5-5673
Abbott W G 130DoddWehwkn ....UN 4-3436
Abco Vending Serv Inc 5012PlsdAvWNY UN 4-3800
Abco Vending Serv Inc 5012PlsdAvWNY UN 7-9244
Abderhalden Embrdy 763-8thSec ...UNion 6-3893
Abderholden Geo 70-2ndAvSec .....UN ion 5-5983
Abel A E 6315PlsdAvWNY ....UNion 5-2985
Abel Alfred Sr r 137-64thWNY.....UN ion 3-7075
Abel Carl r 106HighpointAvWkn....UN ion 3-7340
Abel J&H hardware 504-43rdUnCy..UN ion 5-6116
Abele C H 8300BlvdE-NBergn ....UN 4-9638
Abeles-Lewit Inc 1094MainAvClftn ...UN 4-3180
ABELL—See also ABEL
Abell R D r 148EdgarWkn........UN ion 3-5466
Abels R 420-73rdNBergn ....UNion 6-3414

30000

Abramson A H veterinary surgeon
5206HudsonBlvdWNY.UN ion 5-6055
Abramson Alex A atty 412-60thWNY.UNion 6-2200
Abramson F 8700BlvdE-NBergn ....UNion 4-4824
Abramson H 714-87thNBergn ......UNion 5-6630
Abramson Ida Mrs r 302-52ndWNY..UN ion 3-3933
Abramson L 309-6thUnCy ....UN 7-7635
Abramson L confcnry 517NYAvUnCy..UNion 3-9810
Abramson L Mrs 325-79thNBergn .....UN 5-0227
Abramson M 6404HudsonAvWNY ....UNion 3-3510
Abramson M cigars 6320BgnlineAvWNY UN 5-9616
Abramson Pauline Mrs
5213BgnlineAvWNY.UNion 5-3611
Abruscato Chas 6608HudBlvdWNY ..UNion 4-7000
Abruscato L Mrs 8508-4thAvNBergn ..UN 5-4743
Abrutyn Louis 1004-SumitAvUnCy ..UN ion 3-3886
Abruzzi Anna F 713-22ndUnCy .....UNion 5-4193
Abruzzi Jos 401-3rdUnCy ....UN 7-3207
Abry H E r 1115-80thNBergn......UN ion 7-2982
Absalom Wm 609NYAvUnCy ....UN 4-0584
Abseiz J L 319-41stUnCy ....UN 7-8139
Acanfora M N 1807CliffUnCy ....UN 6-8419
Accardo R 3817HudsonBlvdUnCy ......UN 6-5880
Accelerated Transport-Pony Exprs Inc
18th&HackAvWehwkn.UNion 4-9100
Acciardi D Miss 411-43rdUnCy ....UNion 6-8777
Acciardi P 5902MadsnWNY ....UNion 4-7659
Acciardo N W 515LincolnUnCy ....UN 6-7213
Acciardo R 4202PalisadeAvUnCy ....UNion 6-9523
Accordino R 731-7thUnCy ....UNion 4-1995
Accucraft Inc wdwkrs
1435-51stNBergn.UNion 4-2889
Accurate Answering Serv
101-34thUnCy.UNion 3-3370
Accurate Metal Products Co
709-SipUnCy.UNion 5-9200
Accurate Metal Weather Strip Co
374ParkAvFrvw.CLifsd 6-1364
Ace Auto Laundry 608TonnelAvNBergn UNion 6-9870
Ace Auto Wreckers 6215AdamsWNY UN ion 3-2437
Ace Bar&Grill 1515-SummitAvUnCy .UN ion 3-9651
ACE EMBROIDERY FINISHING CO
336-70thGutnbg.UNion 5-2970
Ace Extrmtg Co 1204CntrlAvUnCy ..UN ion 5-5919
Ace Food Products Co 726-5thUnCy .UN ion 5-3777
Ace Furniture Co 4430BgnlineAvUnCy UN ion 7-2965
Ace Mattress&Bedding Co
4430BergenlineAvUnCy.UN ion 7-2965
Ace O'Hearts tavrn 107-48thUnCy...UNion 3-9218
Ace Red Ball Moving Serv
1172RymndBlvdNwk.MItchl 2-0055
Ace Schiffli Embrdy Co Inc
5610ParkAvWNY.UN ion 6-6400
Ace Tile Co Inc 7400BwayNBergn ...UNion 3-7856
Ace United Van Serv
1172RymndBlvdNwk.MItchl 2-0055
ACH—See also ASH
[illegible]

35000

Acme Modern Radio&TV Shop
1415-SumitAvUnCy.UNion 3-5326
Acme Plmbg Htg&Oil Burner Co
6206JefrsnWNY.UNion 7-5660
If no ans call ....UNion 6-1755
Acme Realty Co 409-77thNBergn ..UNion 4-8266
Acme Refrig Serv 3519HudAvUnCy..UN ion 5-5820
Acme Roofing&Sheet Metal Works
800BroadwayBayone.HEmlk 6-3158
Acme Surgical Serv 418-59thWNY...UNion 3-1029
Acme TV&Radio Shop
1415-SumitAvUnCy.UN 3-5326
Acme Tailor 728-11thUnCy ....UNion 5-7685
Acme Theatre Ticket Serv
3214BgnlineAvUnCy.UNion 7-9160
Acme Transfer&Storg Co Inc
677GroveJCy.JOurnlSq 2-4867
Acme Washing Machn Serv
3519HudAvUnCy.UNion 5-5820
Acme Window Cleaning Serv
5127BgnlineAvWNY.UN ion 5-2257
Acocella B A r 113-67thWNY ....UN ion 6-3935
Acorn Beauty Shoppe
6217BergenlineAvWNY.UN ion 5-7376
Acousticon of North Hudson Hearing Aid Cntr
3802BgnlineAvUnCy.UN 4-1170
If no ans call ....JOurnlSq 2-3314
Acquafredda E 647-60thWNY .....UNion 5-8933
Acquafredda E J 645-60thWNY .....UNion 5-4285
Acquaviva C W r 313-11thUnCy ....UN ion 3-7298
Acres G C 120-77thNBergn ......UNion 6-5172
Acterfield J F 7207BwayNBergn ...UNion 6-1966
Active Pest Control 3409PlsdAvUnCy ..UN 7-3412
Actuated Doors Co Inc
15MtVernRdgfldPk.DImnd 3-5130
Adair A C 1506-39thNBergn ......UNion 7-7929
Adair G S Mrs r 57a-46thWehwkn..UN ion 3-0557
Adair G Stewart 57-46thWehwkn ..UNion 3-7945
Adair R 303-4thUnCy ....UNion 5-8981
Adair W E r 322-59thWNY ....UN ion 5-4434
Adam E r 1230-83rdNBergn.......UN ion 3-4689
Adam Hat&Haberdashery Str
5914BgnlineAvWNY.UNion 7-9889
Adam Hat Stores Inc
3720BgnlineAvUnCy.UNion 3-3454
Adam Jos 5608JefrsnWNY ....UN 6-7965
Adamchak M 827-4thSec ....UNion 4-2579
Adami Embrdy Co embrdy 591-60thWNY UN 7-2718
Adami J E r 300-61stWNY....... UN ion 5-1253
Adami Louis 125HlcrstPlNBergn ......UN 4-6381
Adamo John T 111-78thNBergn ....UNion 6-6821
Adamo V J 421-53rdWNY ....UNion 7-0729
Adamovic John J r 69-70thGutnbg .UN ion 3-1147
Adamovic Jos r 69-70thGutnbg ....UN ion 3-8292
Adamowicz J C 255-SecaucusRdSec ....UN 6-4690
Adamowicz S 731-4thSec ....UNion 4-7211
Adams A 28-64thWNY ....UNion 6-3820
Adams A Miss 403-35thUnCy ......UNion 6-5852
Adam's Auto Parts Inc

name, and add the number as shown by the strip to the column number. If the particular name does not appear in the directory, then the name closest to it is taken and its number increased or decreased an appropriate amount.

The Whitney National Bank provides for having the customer's name imprinted on checks, which makes it possible to group sort items without the need for an identifying letter or other distinguishing symbol being prefixed to the account number. Banks which anticipate using automatic check handling equipment will probably wish to have a number prefix before the number, so that the manual group sorting of items may be eliminated.

There is one important stipulation in using a system of this kind and, that is, that the same edition of the directory must be used from year to year. To do otherwise would most certainly result in a complete breakdown of the pattern of number assignment.

STATEMENT OF A. R. ZIPF, VICE PRESIDENT, BANK OF AMERICA, NATIONAL TRUST & SAVINGS ASSOCIATION, SAN FRANCISCO, CALIF., AND MEMBER, TECHNICAL COMMITTEE ON MECHANIZATION OF CHECK HANDLING, BANK MANAGEMENT COMMISSION, AMERICAN BANKERS ASSOCIATION

We are pleased to give you a progress report since my statement to your committee November 15, 1957.

Since our testimony in November 1957 substantial progress has been made in the mechanization of check handling and many banks of all sizes have enjoyed the elimination of much clerical drudgery associated with commercial bookkeeping. In the main this has been accomplished with more sophisticated electronic bookkeeping machines known as Tronics. These machines relieve the operator of many tedious operations, including the time-consuming task of locating errors. They give depositors a statement superior to appearance and accuracy to anything they have received previously. Bank of America uses Tronics in 23 geographically isolated branches. These machines will enable banks to improve service. By eliminating drudgery they will help reduce turnover and thus assist in stabilizing operating costs. Bank of America expects them to help stabilize operating costs rather than to reduce them.

To my knowledge Bank of America is the only bank presently operating an automatic check-handling system on an extensive basis. Therefore, my comments hereafter are about our operation known as ERMA which means electronic recording method of accounting. I hope our experience will be helpful to you.

During 1958 our first ERMA center, in San Jose, began operation and in 1959 the center in Los Angeles began operation. By December 1959 these two centers were processing almost 200,000 accounts for 53 branches. Since that time additional centers in North Hollywood and Berkeley have been activated and as of April 30, 1960, these four centers were processing accounts for branches. As other centers are activated we expect to convert 100,000 accounts to ERMA every month. Our objective is for ERMA centers to handle 2,500,000 accounts before the end of 1962.

In reviewing progress since November 1957, it is particularly interesting to compare staff figures for November 1957 to April 30, 1960. Some of these figures follow:

	1957	1959
Turnover:		
Bookkeepers:		
Average staff	2,350	2,338
Separations	2,042	1,768
Percent turnover	86.9	75.6
Tellers:		
Average staff	4,387	4,682
Separations	2,726	2,590
Percent turnover	62.1	55.3

	November 1957	April 1960	Percent
Total payroll staff	23,750	27,169	+14.4
Number of domestic branches	613	675	
New employments:			
Male	114	171	
Female	428	551	
Total	542	722	

	Year ending April 1958	Year ending April 1960	Percent
New employments	9,715	12,995	+33.8

The percentage of tellers who resign each year has increased from 50 percent in 1956 to 55.3 percent in 1959. This increase follows the normal increase associated with a higher percentage of female tellers, 84.5 percent in 1959 compared to 77.8 percent in 1957. As reported in our earlier testimony, female employees generally are interested in working only during the transitory period between school and marriage. It follows that the majority of female separations are occasioned by marriage and other family reasons.

As we anticipated, the new ERMA centers have created many new positions, all above the level of conventional bookkeepers. The 4 centers now in operation employ 174 people—133 are new employments and 41 are new positions of substantially higher grade and salary filled from within after training periods of as much as 1 year.

As a matter of policy every employee has been assured that he or she will not be eliminated by automation; rather it will increase their opportunities to improve their own position. Within 1 year before a branch is converted to ERMA and again within 3 months of that time we talk to each bookkeeper in that branch about her future work after ERMA takes over her bookkeeping chores. To date the ERMA centers have made 496 bookkeepers available for other positions. One hundred and fifty-five has been reassigned at the same level and 162 have been upgraded one or more salary grades. One hundred and thirteen have been separated voluntarily for normal reasons. One hundred and twenty-five other employees (proof machine operators) have been upgraded one salary grade with immediate salary increase as a direct result of the added challenge of their duties because of ERMA.

Our employment situation is well illustrated by comparing the outstanding orders for new employments (bookkeepers, tellers, etc.) in the two periods. In November 1957 there were 77 open requisitions; in April 1960, 197. These figures cover only the Greater San Francisco and Los Angeles area comprising 256 branches—in which automation has had the most profound affect. The comparison would be even more glaring if it included all branches.

We are pleased with our system as we think our depositors and employees are also. We are pushing ahead with it, as I have indicated. Our experience and judgment is that it is beneficial to our depositors, our employees, and thus to our bank.

June 8, 1960.

STATEMENT OF LEONARD P. CHAMBERLAIN, VICE PRESIDENT, THE PROVIDENT INSTITUTION FOR SAVINGS IN THE TOWN OF BOSTON, MASS., AND CHAIRMAN, COMMITTEE ON SAVINGS MANAGEMENT AND OPERATIONS, SAVINGS AND MORTGAGE DIVISION, AMERICAN BANKERS ASSOCIATION, UPDATING STATEMENT OF EVERETT J. LIVESEY, VICE PRESIDENT AND SECRETARY, THE DIME SAVINGS BANK OF BROOKLYN, N.Y., AND CHAIRMAN, COMMITTEE ON SAVINGS MANAGEMENT AND OPERATIONS, SAVINGS AND MORTGAGE DIVISION, AMERICAN BANKERS ASSOCIATION, NOVEMBER 15, 1957.

Growth of savings institutions.—At the present rate of growth, electronic data processing—automation, if you will—will soon become a necessity in the handling of savings and mortgage operations by the thrift institutions of the Nation.

In the past 10 years, the savings held by these institutions (mutual savings banks, commercial banks, savings associations, and credit unions) have exactly doubled—from $59 billion to $118 billion. There has been a 60-percent increase in the number of accounts held by mutual savings banks and savings and loan associations alone. School savings deposits in mutual savings banks have increased 272 percent. Life insurance in force in these banks has gone up 141 percent.

In my own institution alone, there has been an increase of 183 percent in the number of mortgages held, and peak days see over 60,000 transactions, excluding inquiries from mortgagors for information on their loans, which total an additional 7,000 a week.

Much additional statistical data could be presented to show the tremendous increase in the load which savings institutions must handle now as compared with 10 years ago—and the burden is increasing tremendously as each year goes by. It is impossible to handle this volume by merely hiring additional personnel. The labor market is too tight. Many of the tasks are monotonous and repetitive. Machines can handle these duties much better than human beings, releasing personnel for more interesting, more important, and more productive operations.

UPDATING COMMENTS, JUNE 20, 1960

Since December 31, 1957, savings deposits held by mutual savings banks, commercial banks, savings and loan associations, and credit unions have increased to over $156 billion. The same period witnessed an 11 percent increase in the number of accounts held by these four types of financial institutions. School savings deposits in all banks have increased 22 percent since 1957. Life insurance in force in mutual savings banks has gone up 7 percent since 1957. Mortgage loans by mutual savings banks, savings and loan associations, and commercial banks increased by 26 percent since 1957; and the number of daily mortgage transactions, including inquiries from mortgagors for information on their loans, has increased commensurately. It is estimated that there are now about 14 million mortgages held by commercial banks, mutual savings banks, and savings and loan associations. (All increases calculated as of December 31, 1959.)

The battle against inflation.—The biggest threat to our economy today is inflation. One of the best ways to fight it is to increase the savings of the Nation. In the forefront of this battle must be thrift institutions of the country. If savings are to be increased over the gains of the past decade—and to this goal every savings banker is dedicated—new and more efficient methods of operation will be required. Automation is the answer.

Electronic operations.—Electronic data processing for savings and mortgage operations is not merely a dream. Several banks have equipment on order, and many others are studying the problem.

It may be well to describe the equipment about which we are speaking. Basically, what is an electronic data processing system? First, it includes an input device which introduces the data to be worked on, and which, in the case of deposit operations, can be the window machine which posts the passbook. Then the computer has a control unit which tells the equipment what to do; an arithmetical unit which adds, subtracts, multipies, and divides; a memory to record, change, and store the data; and an output device to translate the results. Here again, this can be the window machine.

The electronic system which we are describing will release costly floor space, and permit flexibility of layout. It will undoubtedly revolutionize bank architecture of the future. It will reduce customer waiting time. Improved efficiency in teller operations has been estimated by some as high as 40 percent. The system will bring about a leveling of peak loads, and improved work flow.

Recent research indicates that the aforementioned processing equipment will be installed soon in at least two thrift institutions.

Another research study now in progress indicates that possibly a computer may be eliminated as a requirement for use with the tellers window machine. This would result in a larger savings to thrift institutions.

Several institutions having savings accounts have, since 1957, changed their internal method of operation so that the bank book which the depositor has used for many years has been eliminated. In lieu thereof, identification cards or other media of various sorts have been issued. Under this plan periodic statements are being mailed to each depositor showing all activity since last published statement together with interest added to their account during the interim. This type of operation should speed service to the depositors and reduce operating costs.

Teller operations.—Tellers will have a window machine which will post the passbook with a minimum of manual operation. In the beginning, the teller will have to pick up the balance, the account number, and the transaction manually as he does now. Ultimately, I am sure that we will get equipment which will automatically pick up the balance and read the account number, and require the teller to post only the transaction.

The window machine will be connected with the electronic center (which can be miles away from the window equipment, and thus service many banks or branches), and a determination will be made as to whether or not there is a stop payment or a hold of any kind on the account. These can be introduced into and erased from the memory at any time, against any account. If such a nonpayment condition exists, the teller will be notified immediately by one or more of several different methods—perhaps by lighted signals on the window machines, or by a tape record attached to the machine.

If the account is clear, the debit or credit will automatically be reflected in the accounting center. The balance will be determined, and recorded on the bank's records. It will be posted on the book, together with unposted interest and any previous "no book" entries not yet entered in the passbook, directly from the computer. All of this will be done automatically. The equipment will be self-checking, to insure accuracy.

The computer will figure the interest in accordance with any of the methods presently used, prove the computation, add the interest to the previous balance at the end of the dividend period, and produce a new balance for the start of the next period. Balances for check-cashing purposes, etc., can be obtained without making any entry. Accounts can be held for uncollected funds, for several varying periods of time; and the computer will automatically release the "hold" as each one expires. Proof figures will be provided for each teller, for each office, and for all offices combined. All of this will be done with complete control.

If a signature look-up device has been provided at his work area, the teller will not leave the window. Any depositor may go to any window at any office. Generally, under existing systems, the depositor must go to designated windows because of the problem of providing signatures, and information on the amount of interest to be posted in the passbook, unless multiple dividend cards or lists are furnished the tellers, or the information is transmitted by closed-circuit television or other means from a central point.

There was recently demonstrated a method of sending signatures, balance and dividend information via closed-circuit television over 48 miles of ordinary telephone line. By means of pushbuttons at the camera end, images could be directed to any or all of several receivers.

Another manufacturer has exhibited a unique method of signature communication, using television, under which a teller would merely dial an account number for which he wished the signature, and the signature would automatically appear before him in a matter of seconds. There are several other alternatives (production of directories, use of film, film strips, television, etc.).

A research study is underway to effect the very thing which Mr. Livesey anticipated in 1957 as indicated above. That is, "Ultimately, I am sure that we will get equipment which will automatically pick up the balance and read the account number, and require the teller to post only the transaction."

In addition to the signature look-up device explained by Mr. Livesey in 1957, several savings institutions have installed scanning devices which transmit images over telephone or telegraph lines; rendering printed copies of the images. There has also been a black lamp which permits the signature to be placed on a passbook or card yet not be visible to the eye without use of a lamp with a black light. However, the signature becomes clearly visible when placed beneath the black light.

Three banks have placed orders for the installation of a scrambled signature device which prohibits the reading of a signature without a descrambling device which, when used, permits the signature to be clearly visible.

These and many more to come appear to resolve the problem and delay of signature reference when paying funds to depositors. Instead of going to a designated teller's window or area, any teller may render the service desired.

Mortgage operations.—It is generally envisioned that mortgage records will be stored on magnetic tape and that the processing work in connection with mortgage accounting will be performed after regular banking hours. Under one of the systems being studied, however, some of this work can be processed by the central computer during public banking hours on a shared-time arrangement which is completely automatic. Precedence will always be given to transactions on depositors' accounts.

The tapes would contain all necessary fixed and variable data relating to each mortgage account, such as statistical information, current status, computational data, escrow or budget account information, arrears, historical detail, and the like. Tapes allow for extreme flexibility in the nature of stored data per account.

Data regarding new loans, closeouts, and changes of any nature may be introduced into the tape record through the computer by means of punched cards, punched paper tape, or directly from a keyboard on the computer console or other remote-control station. The same is true for mortgage debit and credit detail. Information introduced need not be presorted. The computer will do this automatically.

Having all of the required details, the system, when properly programed, will be able to produce bills, notices, or coupons (if used) either on paper or card stock; adjust the escrow accounts; adjust balances and arrears records upon receipt of payments; compute late charges; maintain tax and insurance ticker files; print out the details of any account or all accounts; prepare statistical reports, journals, trial balances, and so on.

No change.

Smaller banks.—The question is often asked, "Is this only for the large banks, or will smaller banks be able to avail themselves of the great possibilities which electronic data processing offers?" We see real possibilities for smaller institutions in cooperative installations, under which groups of banks would join forces, and thus be able to justify a central data processing system.

It is important to note, in determining costs, that a bank must net against the price of new equipment and installation the expense which would be displaced by it. To quote from a recent speech by the president of the Savings Banks Research Group:

> In a very large bank, this total sum in dollars is substantial and may well come close to meeting the cost of an electronic system. The total of these items when combined by a number of smaller banks may also approach the cost of an electronic system. We are encouraged along these lines by the experience of the Bank of America in California, where the consolidation of the work of many small branches justified the expense of a large and costly machine.

There is no physical reason why a group of banks cannot get together to obtain the advantages of the new equipment. Distance is not a problem. One bugaboo which has been raised is the release of "confidential information" outside of the individual bank. I can see no problem here. For example, on depositors' accounts, the installation would have only account numbers and balances, not depositors' names and addresses.

Further, there seems to be no reason from a technical or operating standpoint why banks which desire to do so cannot get together on a central installation. The president of one manufacturer was quoted in Business Week as saying, "The system is especially suited to large banks, but banks of a smaller size in one area can operate on a single system." This manufacturer feels that there are some 400 large banks which are potential customers, and several thousand smaller banks that could use equipment by banding together in groups.

As a matter of fact, an independent company has already been formed to plan, install, and operate electronic data processing systems for smaller savings banks on a cooperative basis.

Since 1957, three banks in one State are having all their mortgage transactions processed on the same punchcard tabulating equipment. In the same State, there is a committee researching the feasibility of creating one, large central processing center for a cooperative effort by many large and/or small banks for possible operating cost reduction by use of electronic data processing.

Should such a venture actually take place, it appears that it might well be more beneficial to the small bank than to the large bank because of the tremendous growth in workload requirements and activity of thrift institutions in the last decade. This seems to the author to be the only logical answer for the small thrift institution.

In still another State, there are three banks who are joining together for the processing of certain workload requirements on punchcard and tabulating equipment. There are probably many others carrying on a feasibility study for such purpose.

Personnel.—Banking is currently finding it difficult to hire enough qualified people to meet its needs. One banker has aptly said, "From where I sit, it seems to me that the only hope for solution lies in the electronic field. This is because the methods in that field tend to cope successfully with increased transaction volume, personnel turnover, and higher costs in an era of competitive manpower."

Automation has been as inevitable as night and day. We never would have left the horse and buggy age, and entered the automobile era, through hand methods of producing steel. Another case in point is telephones—automatic switching and dials. If the telephone companies tried to handle the volume of calls that they must cope with today by means of the old switchboards, there would not be enough women in the United States to do the job.

Changes in equipment are coming ever more rapidly. We in banks are looking forward to the day when machines will take over the monotonous tasks which our clerks now handle, but we also realize that the change will bring problems which we must face squarely, and which we must solve in the best interests of our people.

As recently as 150 years ago, the average man was a drudge who toiled a lifetime, only to leave behind as little as he had at birth. We have come a long way from this. We in banks keenly desire further to improve the lot of our personnel. In doing so, we will plan the transition carefully, never forget the humanities of the situation, and take care of every person who will be affected by the change.

The lack of trained personnel may well delay the introduction of mechanization which can benefit our employees and improve the Nation's standard of living. The new equipment cannot be designed or built until there are sufficient trained people to design and build it. It will not be installed until there is sufficient trained manpower to operate it and service it. No bank is going to make an expensive change in its equipment or methods without first making sure that the necessary manpower is available. Automation can occur only as rapidly as the required upgrading of skills occurs.

Banks, as well as industry in general, must face the fact that many employees who have learned particular skills over a period of years, will have to learn new ones. Many employees will be working at different jobs. Some will be considerably upset by having their status quo disturbed. Some will be too old to learn new techniques.

It is up to management to explain to every worker what is happening at every stage of the process, to reassure him sincerely and honestly about his job, and to make the training and indoctrination program as palatable and as comprehensible as possible.

We can look for an upward change in work classifications. Supervisors, maintenance men, designers, and experts in planning and programing will increase. New skills will emerge, and they in turn will require new training programs. There will be a general upgrading all along the line as machines take over the monotonous and repetitious tasks.

We in banking realize that we will have to train our personnel in the maintenance and servicing of the new equipment which we will acquire. It seems to me that we will want our own personnel to do the maintenance and servicing, because we realize that electronic data processing—which is our form of automation—will affect our business too intimately and too vitally to be left to the disposition of someone not directly associated with the company.

The conditions relative to personnel referred to previously are still realistic and current. Many of the forecasts embodied therein by Mr. Livesey are actually occurring in the year 1960.

Conclusion.—The late Philip Murray, former president of the CIO, said in 1951:

> I do not know of a single, solitary instance where a great technological gain has taken place in the United States of America that it has actually thrown people out of work. I do not know of it, I am not aware of it, because the industrial revolution that has taken place in the United States the past 25 years has brought into the employment field an additional 20 million people.

And said Marshall Munce (I think before this very committee):

> We see no problems in the offing in connection with automation except those which we may create ourselves through unwise action or foredoomed efforts to alter or distort the smooth working out of our economic destiny. If we continue to have faith in economic freedom, and affirm that faith in word and deed and national policy, we can proceed into the glorious future at the threshold of which we now stand.

Discussion following Mr. Livesey's statement:

> Chairman PATMAN. Thank you Mr. Livesey. You have presented a very interesting statement. In fact, you have presented some amazing facts. I had not realized that we had advanced so far in automation in banking. Just yesterday I was told that a person who stood right at the top of the American Bankers' Association in importance and prestige for decades, we will say, once made the statement that eventually banks will be forced to have branches and merge and integrate and be concentrated because of electronics or technology, that the smaller banks would be unable to take advantage of it. Only the larger banks would be benefited and the small banks could not compete with the larger banks. I notice your statement disputes that.
>
> Mr. LIVESEY. I hesitate to be so brash as to contradict a person with such tremendous prestige, but I decidedly disagree with that idea.
>
> Chairman PATMAN. I am glad it is like you indicated it is.
>
> Mr. LIVESEY. We believe in the unit banking system in this country, and one of the things we want to make sure of in our studies of automation as it applies to savings and mortgage operations is to take care of them.
>
> Chairman PATMAN. I want to applaud that statement. I feel we should keep the local bank locally owned and locally controlled. I feel that the franchise is granted for the purpose of serving primarily local people. I don't feel that they can perform the service that they should perform if they are owned by outside people.

> Mr. LIVESEY. I have studied this problem. I have thought about it. I have talked about it to many engineers, manufacturers, students of bank operations, anybody who would talk with me about it, and I have not yet found anybody who can advance an argument—a valid argument—why smaller banks cannot get automation.
>
> Chairman PATMAN. That is very encouraging. I am glad to hear it. I noticed you made another statement here that I feel represents the sentiment of most of the witnesses who appeared before us.
>
> "In doing so, we will plan the transition carefully, never forgetting the humanities of the situation, and take care of every person who will be affected by the change."

Very few people have been affected adversely so far, we are told, and I think management generally will make every effort to take care of the people who are displaced.

Mr. Livesey's forecasts in his conclusions are realistic, as institutions appear to be carefully planning the transition and thoughtfully studying the humanities of the situation as well as exercising extreme care to assure that every person who will be affected by the change has been properly considered.

VIEWS OF INDIVIDUALS FROM LABOR

STATEMENT OF JOSEPH A. BEIRNE, PRESIDENT OF THE COMMUNICATIONS WORKERS OF AMERICA

On October 25, 1955, I submitted to the Subcommittee on Economic Stabilization of the Joint Committee on the Economic Report, 84th Congress, 1st session, a comprehensive statement on behalf of the Communications Workers of America relating to technological and automation developments in the communications industry. I am pleased to have this opportunity to update some of the data and observations made in that original statement. You will find attached to this statement various tables, submitted originally in 1955, and now brought up to date.

At the time I wrote and spoke to the joint committee on the subject of automation back in 1955, approximately 84 percent of local telephone calls in the Bell System, dominant employer in the industry, were dialed. Approximately 50 percent of long-distance calls were dialed by the operator and no calls were dialed by the customer himself. Today, less than 5 short years later, close to 96 percent of local calls are dialed, approximately one out of every four long-distance calls are dialed directly by the customer and the remaining calls are practically all now dialed by the operator.

In addition, bookkeeping, accounting, and billing functions of most communications companies have been further mechanized.

During the same 5-year period, average daily telephone conversations in the United States increased from around 169 million to around 208 million, an increase of 39 million, or 23 percent. The number of telephones in the Bell System alone increased from 46 million to close to 58 million, an increase of 26 percent. During the same 5-year period, employment decreased some 33,000, or 5½ percent, in the operating portion of the industry alone. Employment in Western Electric, the main manufacturer of telephone equipment in the United States, rose 18,500 between 1955 and 1956 and then dropped around 4,000 between 1956 and 1959.

Here you have the anomalous situation in which telephone business, as measured by daily conversations, increased 23 percent and as measured by the number of telephones, increased about 26 percent, and yet employment in the companies providing telephone service decreased 5½ percent and in the company manufacturing the equipment you had a small increase and then a small decrease.

This is further evidence of the observation which I made back in 1955 that telephone employment could only continue to go up and, further, and perhaps more important, could only continue to be maintained at existing levels, if there were tremendous or spectacular increases in telephone service. Substantial increases are not enough, as witness the 25-percent increase in telephone business which resulted in a 5½-percent decrease in employment.

This situation underscores, once again, the recommendations which I made in 1955 and which appear to be even more pressing today. These recommendations, stated very briefly, are as follows:

1. Industries and particularly those like the communications industry where automation is having a daily effect on job opportunities must begin to think in terms of a shorter workweek and such other job spreading devices as longer vacations and lower optional retirement age.

2. In order to maintain high productivity and high employee morale, attention must be given to such things as (*a*) improved force reduction and rehiring procedures, (*b*) interdepartmental and intercompany tranfers including payment of transfer expenses, (*c*) higher pensions and lower optional retirement age, (*d*) more liberal termination payments for persons who lose their jobs as a result of technological change, (*e*) better and more extensive job retraining program, (*f*) greater weight to seniority.

3. A separate Bureau of Automation should be established in the U.S. Department of Labor to coordinate all information on automation in the United States and to develop recommended public policies in the area of automation.

It is extremely interesting to note that, at the time of my last statement to you on automation, employment was relatively high in the communications industry and forecasts were exceedingly optimistic. The picture has changed very rapidly. Employment has been going down and forecasts are now extremely cautious.

Perhaps the most important thing we have to say to this committee is that this entire problem of automation cannot be viewed, in our opinion, on an industry-by-industry or job-by-job basis. There is a need for some overall attention to this problem and some public policies in this field. Someone, it seems to us, must say, or at least have the responsibility of evaluating whether or not it should be said, that the problem is or is not serious. Someone must be constantly surveying the situation to determine whether or not, for example, Federal laws are required to handle economic dislocation caused by technology.

While we think these hearings are necessary and important, it is our opinion that some Government administrative agency must have this responsibility, ultimately.

We thank the committee, once again, for the opportunity to present our comments.

TABLE 1.—*Bell System (A.T. & T. Co. and its principal telephone subsidiaries) (excludes Cincinnati & Suburban and Southern New England Telephone Companies)*

[All figures in thousands]

	Number of—		Average daily telephone conversations			Percent, toll
	Employees (end of year)	Company telephones [1] (end of year)	Local	Toll	Total	
1920	229	8,134	31,818	1,307	33,125	3.9
1925	293	11,910	48,051	2,090	50,141	4.2
1930	318	15,187	61,150	2,884	64,034	4.5
1935	241	13,573	58,066	2,224	60,290	3.7
1940	275	17,484	76,560	2,743	79,303	3.4
1941	314	18,841	81,576	3,116	84,692	3.7
1942	327	20,013	83,466	3,427	86,893	3.9
1943	343	21,247	82,195	3,912	86,107	4.5
1944	338	21,580	81,826	4,233	86,059	4.9
1945	387	22,446	85,877	4,671	90,548	5.2
1946	496	25,709	100,401	5,361	105,762	5.1
1947	524	28,507	109,344	5,713	115,057	5.0
1948	547	31,364	119,406	5,865	125,271	4.7
1949	516	33,388	126,100	5,923	132,023	4.5
1950	523	35,343	134,870	5,912	140,782	4.2
1951	551	37,414	139,125	6,011	145,136	4.1
1952	580	39,414	143,231	6,129	149,360	4.1
1953	588	41,353	147,383	6,310	153,693	4.1
1954	578	43,322	153,041	6,554	159,595	4.1
1955	616	46,218	161,788	7,148	168,936	4.2
1956	638	49,438	170,873	7,737	178,610	4.3
1957	641	52,252	180,084	8,192	188,276	4.5
1958	592	54,684	188,160	8,528	196,688	4.5
1959	583	57,944	198,818	9,224	208,042	4.4
Increase 1920–59:						
Number	354	49,810	167,000	7,917	174,917	
Percent	154.5	612.4	524.9	605.7	528.0	

[1] Excludes private line telephones.

Source: (1) 1920–54 H. R. Maddox' letter to J. A. Beirne, Oct. 11, 1955; (2) "1955–59 A.T. & T. Annual Report to Stockholders."

TABLE 2.—*Western Electric Co. employees, 1920–59*

Year Dec. 31	Number	Index (1920=100)	Year Dec. 31	Number	Index (1920=100)
1920	39,650	100.0	1948	103,770	261.7
1925	39,460	99.5	1949	72,086	181.8
1930	64,253	162.0	1950	73,458	185.3
1935	21,033	53.0	1951	90,161	227.4
1940	42,083	106.1	1952	104,887	264.5
1941	61,271	154.5	1953	106,024	267.4
1942	73,320	184.9	1954	98,141	247.5
1943	89,016	224.5	1955	120,054	303.2
1944	94,025	237.1	1956	138,520	349.4
1945	80,029	201.8	1957	141,123	355.9
1946	114,525	288.8	1958	122,101	307.9
1947	132,927	335.2	1959	134,867	340.1

Source: Western Electric annual reports to stockholders.

TABLE 3.—*Telephone calls per operator, 1921–58*

	Number of telephone operators (experienced)	Average monthly telephone calls	Average monthly calls per experienced operator
Bell operating companies:[1]		*Thousands*	
1921	118,470	1,260,619	10,641
1922	126,080	1,384,446	10,981
1923	138,435	1,542,947	11,146
1924	139,891	1,639,785	11,722
1925	148,856	1,757,363	11,806
1926	150,753	1,886,529	12,514
1927	150,301	1,974,418	13,136
1928	153,260	2,099,104	13,696
1929	161,669	2,259,694	13,977
1930	143,979	2,270,756	15,771
Class A telephone companies:[2]			
1945	115,547	3,550,026	30,724
1946	125,290	4,181,559	33,375
1947	165,461	4,568,398	27,610
1948	170,156	5,016,126	29,480
1949	182,501	5,264,442	28,846
1950	174,650	5,619,212	32,174
1951	162,053	5,730,111	35,359
1952	165,027	5,880,298	35,632
1953	169,680	6,020,608	35,482
1954	175,209	6,275,516	35,817
1957	158,025	7,582,417	47,982
1958	159,443	7,917,072	49,654

[1] Not clear from source whether or not noncontrolled companies, Southern New England and Cincinnati & Suburban Telephone Cos., are included.
[2] Class A companies are those having annual revenues exceeding $250,000.

Source: (1) 1921–30 data: "Monthly Labor Review," February 1932, vol. 34, No. 2; U.S. Department of Labor, p. 243.

(2) 1945–54 and 1957 data: (*a*) Number of telephone operators—FCC and BLS, U.S. Department of Labor; (*b*) telephone call data—"Statistics of the Communications Industry in the United States"—FCC, 1945–54 and 1957.

(3) 1958: Statistics of class A telephone carriers, December 1958, preliminary sheets, FCC.

TABLE 4.—*Telephone calls per operator, 1921–58*

[By index number, 1921=100]

	Number of telephone operators	Average monthly telephone calls	Average monthly calls per experienced operator
Bell operating companies:			
1921	100	100	100
1922	106	110	103
1923	117	122	105
1924	118	130	110
1925	126	139	111
1926	127	150	118
1927	127	157	123
1928	129	166	129
1929	136	179	131
1930	122	180	148
Class A telephone companies:			
1945	98	282	289
1946	106	332	314
1947	140	362	260
1948	144	398	277
1949	154	418	271
1950	147	446	302
1951	137	454	332
1952	139	466	335
1953	143	478	333
1954	148	498	337
1957	133	602	451
1958	135	659	467

Source: Computed by CWA research department from data in table 3.

TABLE 5.—*Dial telephones, Bell System, 1921–59*

Dec. 31, year—	*Percent of dial telephones* [1]	Dec. 31, year—Con.	*Percent of dial telephones* [1]
1920	1. 9	1948	68. 1
1925	12. 5	1949	73. 0
1930	31. 9	1950	75. 5
1935	48. 1	1951	77. 4
1940	59. 9	1952	79. 1
1941	63. 3	1953	81. 3
1942	65. 1	1954	84. 0
1943	65. 0	1955	86. 6
1944	64. 9	1956	89. 5
1945	64. 6	1957	91. 8
1946	64. 3	1958	93. 8
1947	65. 6	1959	95. 7

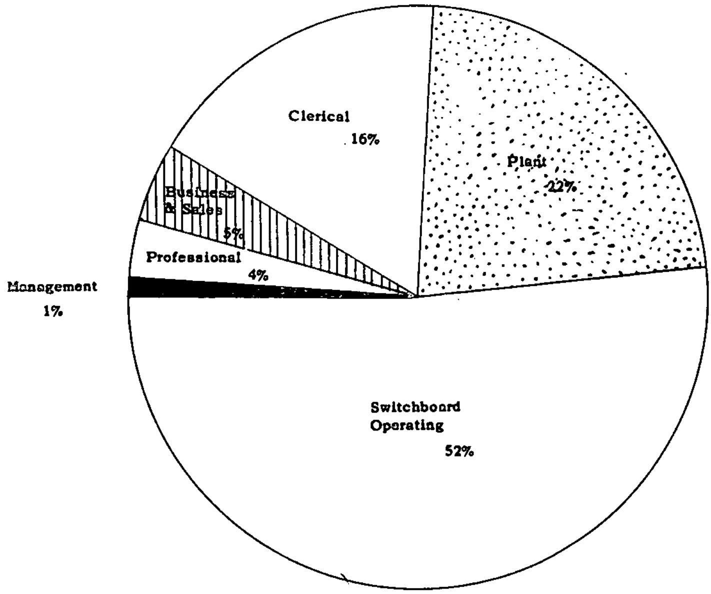
[1] "Bell System" data for 1936 and subsequent years consolidate the statistics of the A.T. & T. Co. and its principal telephone subsidiaries which differ from past practice in that it excludes the Southern New England and Cincinnati & Suburban Telephone Cos., which are noncontrolled, and includes certain controlled companies not heretofore included.

Source: (1) 1920–54, furnished by Accounting Compliance Branch, Telephone Division, FCC; (2) 1955–59, A.T. & T. annual report to stockholders.

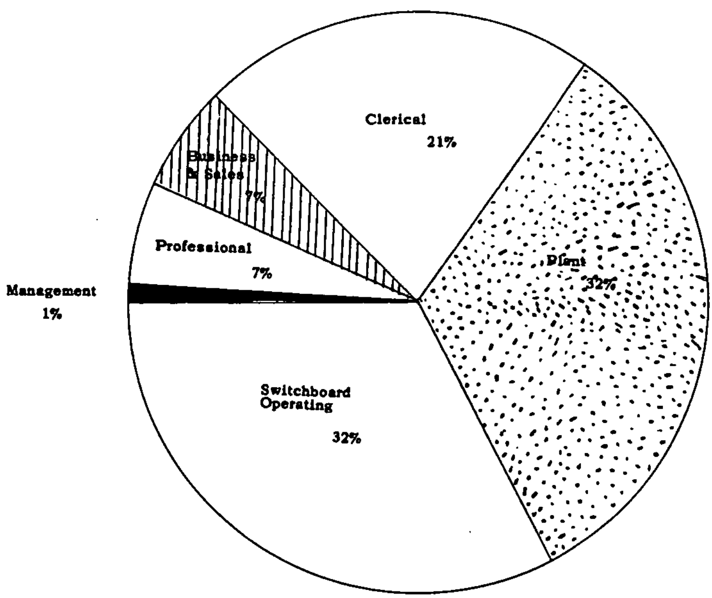
PROPORTIONAL DISTRIBUTION OF TELEPHONE EMPLOYMENT BY TYPE OF WORK, 1945 COMPARED TO 1958

TABLE 6

1945



1958



STATEMENT OF JAMES B. CAREY, PRESIDENT, INTERNATIONAL UNION OF ELECTRICAL, RADIO, AND MACHINE WORKERS, AFL-CIO

Nearly 5 years have elapsed since I had the opportunity to testify on automation and technological change before the Subcommittee on Economic Stabilization. At that time I stated that "the problem before us is not whether we are for or against automation. This new technology is already here and is growing by leaps and bounds. The problem is whether or not the American people and our free society will be subjected to vast dislocations during the coming 10 to 20 years, when the automatic operation of many industrial and clerical processes will be introduced."

We are now one-fourth to one-half of the way through this time period, and we find that, contrary to the optimistic predictions that automation would mean more jobs, tens of thousands of factory jobs have vanished because of the use of automated equipment.

In the electrical machinery industry, the number of production worker man-hours paid for dropped from 1,962,500,000 in 1953 to 1,768,500,000 in 1959, for a decline of 10 percent. But the Federal Reserve Board's index of real goods produced by our industry rose from 90 in 1953 to 108 in 1959, for a 20-percent gain over this same 6-year period.

Thus, productivity per man-hour paid for rose by 5 percent a year, compounded, between 1953 and 1959. All the evidence points to an acceleration in the rate of productivity advance, because the trend in our industry is for about 80 percent of the huge expenditures of nearly $700 million annually for plant and equipment to be devoted to automation rather than for expansion which would produce a net gain in factory employment. For example, there was a $2 billion or 100-percent increase in net plant and equipment in the electrical machinery industry between 1953 and 1959, but factory jobs dropped by 85,400.

Unless sales at stable prices expand faster than the increase in productivity, jobs will continue to be eliminated, and the chronic amputation of the factory labor force will proceed with no interruptions. Just recently, the U.S. Commissioner of Labor Statistics predicted a 40-percent increase in the number of young workers in the labor force during the 1960's together with an increase of 3 million older women (in the 45-year bracket) who will reenter the labor force after having been out of it for a number of years. He flatly concluded that "it is possible that substantial unemployment could exist side by side with labor shortages." The shortages would be mainly in professional, sales, and highly technical occupations.

What we see for the future are difficult problems made more acute unless labor, management, and the Government really come to grips now with the need for advance planning for the benefit of the workers who will bear the most severe burden of adjustment to change.

Although we welcome improved technology that can produce more with less effort, we can see that, unless this improved technology is used wisely, it will create hardships for the employees and the communities, while increased profits go to build up and further concentrate corporate power.

At the time of the previous hearing, the most severe inroads of automation on factory jobs in the electrical industry had been felt in the radio and television sector. Wiring, soldering, and component assembly had been automated.

Since then, substantial automation has taken place in appliances, electronic tubes, lamps, and even in heavy electrical equipment such as the giant generating turbines.

The lamp industry has always been very highly mechanized, with a few workers turning out 10,000 to 20,000 finished lamps per unit on daily shift. Westinghouse, however, recently announced a completely automated lampmaking machine able to turn out 32 million incandescent bulbs a year. Glass bulbs, filament mounts and other raw materials enter the machine at one end and emerge 100 feet later as complete light bulbs. The new machine, which inspects and rejects imperfect products, also packs the bulbs, inserts them into cartons, and then conveys them to trucks and boxcars for shipment.

Few people appreciate the effect which automation will have on the types of jobs available. Many think that skilled jobs will be further upgraded. However, the number of workers employed in the new skilled jobs will be considerably less than those now employed.

For example, a survey of future job opportunities at the General Electric plant in Lynn, Mass., revealed that punched tape machining methods would eventually eliminate operators on lathes, drill presses, punch presses, etc. In addition, the need for electricians would be substantially reduced, while there would be a need for electronic technicians. The company offered a training program for this new job, and 125 electricians applied for this training to fill a future need for 30 electronic technicians.

How shall the workers be selected for these new jobs which are fewer in number than the skilled jobs no longer needed?

Some companies in our industry have offered to pay employees being trained for new skills at 95 percent of previous rates, *provided they have the unilateral right to determine who should be selected for such training and who will fill the new jobs.* This is in direct conflict with longstanding seniority practices.

Overlooked also by the high priests of automation is the effect on wage rates. In many cases, companies use the reduction in brute physical labor as an excuse to cut wage rates. In General Electric plants at Providence, R.I., and Anniston, Ala., this company has introduced automated equipment which has boosted production tremendously with fewer workers than before—and has then cut the pay of the remaining workers.

Many of these problems were indicated in my previous testimony in which I indicated that the unions would resist with all their might any attempts by management to grab all the benefits of the new technology.

However, the problem of maintaining job opportunities for an expanding labor force will require action leading to the reduction in standard working hours. For example, a reduction in hours from 40 to 36 weekly would restore the 85,000 factory jobs lost in the electrical machinery industry since 1953. A progressive reduction in hours of work must be a continuing program thereafter in order to keep people fully employed.

Our union has developed a program for negotiations with the major employers, General Electric and Westinghouse, designed to provide employment security and progress in living standards during the 1960's. Part of this program deals with handling the problems of automation.

This is a serious factor in employment insecurity in General Electric because large expenditures for plant and equipment by the company, amounting to some nearly $900 million since 1954, did not produce any increase in jobs, while, according to General Electric, we should have produced 43,000 new jobs from these expenditures, and the overall result, including the increase in scientists and technicians, was some 4,000 fewer jobs.

From 1955 to 1959, while GE sales increased by $900 million and profits increased by $72 million, or about 35 percent, the number of employees actually dropped from 250,000 to 246,000.

The 246,000 employees in 1959 included the large increase in the numbers of scientists, technicians, and engineers. There was, in fact, nearly a 20-percent drop in the number of production and maintenance employees.

Another reason for the unemployment in General Electric is the great increase in productivity, which is closely related to automation.

From 1955 to 1959 there was a 34-percent increase in productivity among the production and maintenance employees. Thus, General Electric can produce a vastly greater output with a large decrease in the number of these productive employees.

In 1955, we were informed that the problem of unemployment was merely a figment in the minds of a few members of our negotiating committee. In 1958, we were told that the way to deal with the effects of unemployment was to have the employees buy GE stock. Now, in 1960, GE is suggesting that the solution lies in the localities.

Whatever the causes of unemployment, we are suffering from their effects.

A solution must be found for two problems. The first is to do everything possible to provide full employment. The second is to be prepared, to the extent that full employment is not provided, to assure that the employees do not suffer a drastic loss of income and living standards.

1. MAKING JOBS MORE SECURE

We have made a number of proposals which represent our view of how this can be accomplished. They are as follows:

(*a*) *Handling the problem of automation*

In 1954 and 1955 we raised this problem and were given promises that a study would be made, that joint meetings would be held. However, they never took place and we do not feel that we can wait longer before we begin to find answers to the dislocations caused by the effects of automation.

We cannot remain content and complacent with talk that eventually automation may make more jobs. We are dealing with a problem that exists at the present time and will become worse as the huge GE expenditures each year are devoted more and more to automation equipment. At the present rate of expenditure, in about 8 years the entire GE chain can become automated.

We must find solutions to take care of these present and future problems, with specific reference to job dislocations, hours of work, job descriptions, seniority problems, training, wages, etc.

We propose specifically that a joint committee composed of union and management or with a neutral chairman chosen by both parties, make a study of this problem. A reasonable time limit should be set for the report of this committee, such as 6 to 9 months. Following this report, negotiations should take place to determine what is to be done as a result of this study.

In the last few years, the problems created by automation have been the subject of considerable discussion and action in labor-management negotiations. As a result, a number of important agreements have been reached for a joint solution to the problem.

In the steel industry, both "Big Steel" and in Kaiser, joint committees with neutral parties have been set up to recommend how the problem should be handled and how the fruits should be distributed.

In the west coast longshore industry, a fund was established to share the benefits of automation, and in the east coast longshore industry, a joint committee is determining the savings from automation and how they are to be shared.

The current meatpacking agreement provides for a fund administered by a joint committee to make a study of the problem and what to do about it. This kind of arrangement is spreading to other industries.

(*b*) *Other needed actions*

We have proposed three additional actions urgently needed to improve job security.

The first is to provide employees with the right to move with their jobs to new plants and to carry their service credits with them for all purposes except seniority. They would have preference in hiring over new employees. Provision should be made for help in moving expenses.

This is made necessary by the great loss of jobs through the movement of operations from existing plants. There is not a single large plant in the northern part of the country where the employees and communities have not suffered greatly from these runaway operations.

We want to make it clear that we do not object but rather favor expansion of industry to new areas, whether they be rural or southern, to improve the job opportunities and living standards of the people in those areas.

What we object to is the removal of work from existing plants where it does not represent an expansion but merely a transfer, in order to get the benefit of lower wages, tax exemptions, savings on pension, insurance, vacation, and other payments.

Certainly, if efficient production requires a change in locality, it should be done at a time when there is expansion of other production into the older plants.

In any event, the affected employees on the production line should be given an opportunity to move with their jobs.

The policy of General Electric is to require the employees whose jobs have been moved out to go to the new locality at their own expense and get in line with others who have never been employed in order to compete for work.

This is callous and heartless treatment and shows contempt for employees, many of whom have given long years of service to the company.

What happened in Bloomfield was a glaring example of that kind of complete disregard for employees, many of whom had 20 or more years of service. They were thrown on the scrap heap, their entire lives were disrupted. Because of their long years of service to GE, many of them were past the age when employment opportunities would be offered elsewhere at anything approaching their skill and ability. From standpoint of efficiency, it is difficult to conceive why GE would insist upon scrapping an employee who had demonstrated in GE's words "skill, care, and effort" and hiring entire new employees.

The reasons are obviously not related to production efficiency but to the desire to have not only lower wage rates and fringe benefits and higher production quotas at the new plant, but also to have employees with no experience with unionism.

The IUE–GM agreements provide that for 18 months after production begins in a new plant, preference will be given to laid-off employees over new employees. Where there is a transfer of major operations between plants which results in a permanent release of employees, there are to be negotiations between the union and management to handle the problem. Chrysler and Ford have similar agreements.

An official of the Ford Motor Co., before a congressional committee in Detroit in November 1959, declared that policies to provide for movement to new plants had been worked out with the United Automobile Workers. When the company closed out its Buffalo, N.Y., facility in February 1958, all of the hourly employees were offered work at the company's new Lorain, Ohio, plant. According to the company, about 33 percent accepted. Another 22 percent were placed in another Ford Buffalo plant.

Similarly, when the company closed down its Memphis, Tenn., plant in June 1958, affecting 1,241 workers, all were offered employment at Lorain, Ohio, and at Cincinnati. Certain skilled employees were offered employment at Sheffield, Ala., and Nashville, Tenn. About 40 percent of the workers took employment at Lorain, and a significant number transferred to Sheffield and Nashville. The employees transferring to Cincinnati were given special training because of the job differences between the two locations.

In another situation, when the company transferred an operation from Dearborn, Mich., to a new Indianapolis plant, all of the 812 employees affected were offered transfers. Forty-five percent accepted, the remaining were placed in other Detroit area Ford plants.

The Chrysler program which the company claims is one of long standing refers laid-off employees to fill job openings at other plants of the corporation. The employees maintain recall rights to their own plant. Many thousands have been referred for placement in the last 2 years and 6,000 employees have actually been placed on new jobs under this arrangement. The employee maintains his pension, insurance, vacation, holiday, and other benefits.

GE has on its board of directors three men who are also directors of Ford.

It is difficult to understand why this enlightened policy could be good for Ford, GM, Chrysler, and so many other companies, and not good for General Electric.

Several years ago, the International Association of Machinists negotiated an agreement with Lockheed which provided a transfer of some 1,800 employees at the company expense.

As early as 1936, the railroad workers negotiated an agreement which protected them in work moves. This was provided by the Washington "job protection agreement." Briefly, the protective features of this agreement were:

(1) Advance notice to the union.
(2) Right to other jobs.
(3) Protection of compensation for 5 years.
(4) Special unemployment payments.
(5) Maintenance of fringe benefits.
(6) Severance pay.
(7) Moving expenses and losses.

The United Rubber Workers has an agreement with the Cooper Tire & Rubber Co. which states in part:

> It is understood that if the company shall move any of its present operations to a new location or should acquire a plant in some other location to perform operations that are performed at the present location, any or all employees affected shall be moved to the new location if the employee so desires.

2. PROVIDING INCOME WHERE THERE IS NOT STEADY EMPLOYMENT

To the extent that such measures to provide steady employment fail, an income must be assured to the laidoff employees so that they can live in decency and not be compelled to suffer a drastic reduction in their living standards or to exhaust their painfully stored up savings.

We propose for this the adoption of a supplemental unemployment benefit program for temporary layoffs and a separation pay for long-term layoffs.

Our SUB proposal provides that a fund be established by a company contribution of 3 percent of payroll to assure laidoff employees that, including unemployment compensation, they would have 80 percent of the aftertax pay or 65 percent of their gross pay plus $2 weekly per dependent for up to 52 weeks of layoff. Those on short work-weeks would get proportionate benefits. The maximum cost to GE is 3 percent of payroll. As steps are taken to stabilize employment the contribution can be reduced ultimately to zero. General Electric has repeatedly and in recent weeks stated its opposition to the SUB program.

It is well to deal with the arguments offered by the company.

Basically, the company argument has been twofold. The first is that the problem should be solved by unemployment compensation. The second argument which in effect is a contradiction of the first is that SUB is unworkable because, like unemployment compensation, it results in a pooling of the funds.

Let us consider first the adequacy of unemployment compensation.

The Secretary of Labor of the United States sent out to the States several years ago a recommendation of the Federal Advisory Council on Employment Security that "the maximum benefits ceiling in each State should be raised to an amount not less than three-fifths to two-thirds of the average weekly earnings in covered employment." The Federal Advisory Council is a statutory body of the Government made up of industry, labor, and the public. In 1958 it found that only 20 to 25 percent of the wage loss was compensated by unemployment compensation.

The Bureau of Employment Security of the U.S. Labor Department declared that maximum State benefits should permit 60 to 66 percent of State average weekly wages.

The chart which is attached shows the average weekly wages for key GE plants throughout the country for March 1960 based on a 40-hour week and the maximum State unemployment compensation and the percentage of wages at key GE plants met by unemployment compensation is: Philadelphia only 35 percent; in Roanoke, 40 percent; in Trenton, 33 percent; in Tyler, Tex., 35 percent; in Fort Wayne, 35 percent; in Anniston, 37 percent; in Newark, 38 percent.

The only cases in which 50 percent or more is reached is in situations where the employee has the maximum number of dependents possible.

In the great majority of cases it is impossible to even come close to getting 50 percent of average wages, which GE itself proposes is standard—not to say 60 to 66 percent.

The last two columns show that what has happened in the deterioration of unemployment compensation benefits as a percentage of average weekly State wages from 1939 to 1959. There has been a considerable drop in practically every State, showing that instead of being more adequate in terms of wages, the unemployment compensation payments are much less adequate. In only one State, Connecticut, do the unemployment compensation benefits equal 50 percent of the average State weekly wages.

Unemployment compensation benefits are set by State legislatures and are based on the economic problems of the poorest employers and the lower paid workers. Therefore, they are set to provide in effect a minimum of income.

This is verified by the statement of seven largest steel companies made to the Ohio Legislature several years ago when they declared that unemployment compensation systems "may of necessity have to be geared to the cost problems or even the marginal employer." In connection with the SUB, it declared further—

> it seemed to us that it was more appropriate to attempt to deal with this type of problem by supplementing the basic State programs on a private basis rather than interfering with the particular relationship which such State programs had to the particular industrial economy of the local State employers.

Therefore, the unemployment compensation system leaves the way open for supplementation where wages are higher and where employers are more able to pay. This is exactly the same situation with regard to Federal minimum wages and Federal social security. Both are supplemented by labor-management agreements.

Furthermore, the benefits under unemployment compensation are for a maximum of 26 weeks. In some States they are less, such as Alabama where the maximum is 20 weeks, in Tennessee 22 weeks, in Texas 24 weeks, and in Virginia 18 weeks.

In General Electric a good deal of unemployment has been of a long-term nature in which people quickly exhaust their unemployment compensation and are then left without any means of livelihood except local relief.

During the 1958 recession, the Congress of the United States recognized that at least 39 weeks of benefits were necessary. The situation which faced the country in 1958 has faced GE employees for a considerable period of time. GE opposed Federal action to make possible liberalization of these benefit periods.

A report to the Senate Special Committee on Unemployment Problems indicates that not only is another recession definitely in the making but that the unemployment compensation system is inadequate to cope with the problem. It found that—

> about 4 out of every 10 of the unemployed heads of families did not receive any unemployment insurance benefits * * * and that 2 out of 10 did not receive benefits all of the time, unemployment insurance benefits replaced only a small fraction of the wage loss incurred by unemployed persons in the recession * * *
>
> And during the 1958 recession funds available under the unemployment insurance system were utilized only to a limited extent * * *

In fact, 2.5 million jobless wage earners exhausted their benefits rights while still unemployed in the 1958 recession.

We have pressed vigorously throughout the years for improved and liberalized unemployment compensation payments and will continue to do so. But we cannot continue to wait for adequate benefits to sustain laid-off employees while the gap between wages and unemployment compensation benefits steadily increases.

GE also argues that SUB is wrong because it is a pooled fund and because its benefits go to only those who are laid off, rather than to the entire working force. SUB is a program of insurance specifically tailored for those laid off.

That is its purpose

Pension moneys are pooled and go only to those who reach the age of retirement or who are disabled.

Insurance moneys are pooled and go only to those injured or who suffer illness or death.

Vacation moneys are pooled and go to employees according to their length of service.

These programs above are mainly of aid to the older, longer service employees.

The SUB is the single program to aid the shorter service employees who may be laid off.

SUB is a specific proposal to meet a specific unmet need. Until or unless we are presented with a better way to meet the problem of loss of income during layoff we will press for the SUB as the best demonstrated method to meet the problem.

The SUB has spread widely into a number of basic industries that are closely related to the electrical industry. This includes steel, auto, nonelectrical machinery, shipping, aircraft, canning, aluminum, rubber, auto, etc. These are the industries that have moved parallel to the electrical industry in wages and benefits for quite a number of years.

It is significant that on the board of directors of General Electric are at least five men who in their own companies have the SUB agreements with their unions. For example, Messrs. Sidney Weinberg, Henry Ford, and Donald David are all members of the board of directors of the Ford Motor Co.

Other GE directors who are directors of companies that have SUB include George Love who is a director of National Steel, S. Sloan Colt, who is a director of American Can. In addition Mr. Weinberg is also director of Continental Can and B. F. Goodrich who also have negotiated SUB with their unions.

Mr. Malcolm L. Denise, vice president, labor relations, of the Ford Motor Co., in an appearance before the Special Senate Committee on Unemployment, boasted that:

> In 1955, as you know, Ford pioneered in the area of supplemental unemployment benefits. We felt that while State benefits might well be adequate in most situations, there was some basis for providing a higher level of benefits for the relatively higher paid Ford worker. As a consequence we established the Ford SUB plan which ties in very closely with State unemployment compensation systems.
>
> We believe that an individual employer should be permitted to establish such a plan for his own employees. And we are gratified that all but two States permit SUB concurrently with State system benefits * * *. During the period June 1956 (when SUB first became payable) through September 1959, the Ford SUB plan has paid out over $20 million in benefits. The bulk of these payments were made during the 1958 recession and amounted to over $13 million in that year. Payments at Ford and elsewhere, together with State system unemployment compensation * * * *unquestionably helped to maintain the relatively high level of personal income during the 1958 recession.*

It is difficult to conceive that these could consider the plan good for the management and employees of their other companies and find that it is not good for the employees of the General Electric Co.

The large number of companies which have the plan are the blue ribbons of American industry such as General Motors, Ford, Chrysler, United States Steel, Bethlehem Steel, Aluminum Co. of America, the Continental Can Co., American Can, the major rubber companies, etc.

It is difficult to conceive that management of these companies would negotiate a program which is uneconomic and unsound.

In the statement referred to of the six largest steel companies before the Ohio Legislature, they declared that the operation of a SUB plan will—

> (a) neither result in increased unemployment costs to other employers;
>
> (b) nor impair the operation of the State unemployment compensation program.
>
> If we had felt that the danger of either event was real, we would not have signed the agreements.

These companies declared that in negotiations with the Steel Workers Union their feeling was that—

> if we could negotiate a plan (a) whose benefit levels were such as would not encourage abuse (malingering), (b) which would contain eligibility and qualification provisions which should prevent abuse, and (c) which could be accomplished within a reasonable and limited cost framework (all of which we are satisfied are reflected in the SUB plan common in the steel industry), we could, in good conscience, become a party to such a plan and engage in a good faith effort to have it become workable.

Obviously, the steel companies were satisfied because they did negotiate an SUB agreement with United Steelworkers. The steel company statement declared further:

> SUB plans to date demonstrate eligibility and qualification requirements just as strict as those of the State systems. Moreover, it must be acknowledged that an SUB employer will not be less concerned with policing his unemployed than a non-SUB employer; for the plain fact is that an SUB employer will be intensely interested in keeping his payments into his SUB trust as low as possible; in other words he will have not only the incentive growing from merit rating under the State unemployment compensation systems but will have the added incentive of trying to keep his SUB costs low.

It added that:

> It seems fair to conclude, then, that since history and logic provide no basis for positively concluding that SUB will worsen unemployment experience, any contrary feeling must at this point in time be based alone on speculation, which hardly seems a fair basis for indulging in legislative restriction on an SUB employer.
>
> We cannot, of course, give positive assurance that SUB will not eventually show up some malingering abuse; we can only indicate that we think it unlikely, and follow by saying that if these problems about which some speculate actually become problems, we will be among the first to be seeking a change in our SUB agreements; and most certainly will be among the first to acknowledge that if other employers find their own unemployment costs adversely affected, they would be entitled to legislative protection.

As already indicated, the loss in wages since 1957 has amounted to about $225 million. Of this, it is estimated that not more than about $50 million was made up in unemployment compensation. It is likely if we had had an SUB program starting in 1955 that up to possibly another $50 million would have been put in the hands of unemployed people through SUB payments. This could have been a tremendous boon to not only their families but to the businesses of the affected communities.

We have yet to hear a single unfavorable reaction from either the employers, the unions or the public about SUB or its operations. Certainly in the 5 years of its existence, if it were unworkable or uneconomic, this would have been brought out. Yet, all parties seem to be satisfied. And when the original agreements signed in 1955 and 1956 came up for review in 1958 and 1959, agreements were made to improve and extend the programs.

In testimony before the Senate Special Committee on Unemployment Mr. Louis Seaton, vice president of General Motors, in charge of personnel, declared:

> A major cushion that we have had to do with unemployment compensation and payments. Currently employees laid off receive an average of about $60 per week in State unemployment compensation and company supplemental unemployment benefits combined.

The IUE is a party to this agreement.

General Motors, Ford, and Chrysler have paid out a total of nearly $100 million in SUB benefits. Well over $100 million have also been paid out in the steel industry. Yet the funds still available in the two industries alone total more than $250 million.

The fact of the matter is that in 45 States of the Union the State laws have been modified or interpretations have been made by State authorities permitting unemployment compensation to be supplemented by SUB payments. In one State, Ohio, the problem raged for a considerable period of time. The legislature last year clarified the law in order to definitely permit SUB payments.

This is an indication of the attitude of the State governments with regard to this problem. It is considered to be not only in keeping with the laws but also to be sound public policy.

Where steady work is not provided and employees suffer loss of income, the evidence is overwhelming that—

1. Unemployment compensation is and will remain for a long period of time inadequate to take care of the problem of a decent income to maintain laid-off workers.

2. Despite its inadequacies, the SUB is the best and most effective answer that has been agreed upon by both American employers and American labor to date to meet this problem.

We propose to improve upon the existing SUB programs to make our plan a more adequate one.

3. In view of this overwhelming evidence and the fact that there has not been a single negative voice raised from among those who have had experience with this program, we see no reason why the General Electric employees and the communities should not have these benefits, also. Unless or until some better pro-

posal is made at these negotiations to take care of the loss of income during layoff, we must press for adoption of an SUB program to meet the urgent needs of the General Electric employees.

Separation pay

SUB benefits are designed to take care of layoffs that normally end in the return of the employee to his job.

However, many thousands of GE employees have been finally terminated either because their jobs vanished through automation, or contracting-out, or movement to other plants, or simply because the layoff persisted beyond the period of recall rights.

Therefore, it is necessary in a sound plan for providing income to laid-off workers to take care of the situation in which he will not or is likely not to return to his job.

The need for such a plan in GE is evidenced by the fact that while there has been a drop of more than 17,000 in employment in our units since December 1955, the March 1960 record shows only about 2,000 on layoff. The rest have been terminated.

The contract negotiated in 1953 recognized the need for separation pay. But its benefits were too low, and it is paid only when an entire plant closes down.

We propose that employees with at least 2 years of service, laid off for more than 12 months, shall have the right, at their discretion, to accept a separation pay allowance equal to 1 week for each year of service. Where SUB benefits have already been paid, they will be deducted from the separation pay allowance that is due.

Thus an employee laid off for at least a year will be able to weigh the possibilities of returning to his job as against making a permanent change to other employment opportunities in or outside of his hometown. He will have some funds to help tide him over the readjustment period, and the community will have the benefit of the purchasing power.

The separation pay will also compensate the worker for job rights he has lost.

Our General Motors agreement provides for separation pay for employees with 2 years of service who have been laid off for 12 months or more. As in our proposal, the GM agreement provides that SUB payments already made are deducted from the separation pay due.

This plan is typical of the auto industry. In addition, separation pay plans have spread through the steel, rubber, petroleum, canning, aluminum, communication, airlines, apparel, textiles, fabricated metal products, and other industries.

Today, approximately 35 percent of all workers covered by collective bargaining agreements are protected by severance pay arrangements.

This is our collective bargaining approach to the problem of employment insecurity, whether it arises from automation or any other acts of commission or omission by corporate management.

The Federal Government can lend valuable assistance in this endeavor by taking two specific steps which are in addition to general programs for maintaining and sustaining full employment. These are:

1. A national system of unemployment compensation should be adopted which provides benefits at two-thirds of average wages.
2. Since nearly all of the techniques and breakthroughs leading to automation have developed out of Government-sponsored research paid for by tax moneys, no corporations should be permitted to patent anything in these circumstances. Rather, the Government should hold title to these new techniques, and the royalties from their use should be put into a fund to provide retraining, relocation expenses and assistance to areas which have become the victims of research which they financed through their own tax dollars.

STATEMENT OF HOWARD COUGHLIN, PRESIDENT, OFFICE EMPLOYEES INTERNATIONAL UNION, AFL-CIO

Since the testimony presented in October 1955, many developments have taken place in the field of automation which both substantiate the predictions and observations made at that time, but which also bring to the realm of possibility new and more far-reaching effects on the white collar class.

Due to the shortage of available office personnel, this was the area where the large-scale computer was first used. Much to the delight of business concerns, it was discovered that most office operations were of an essentially mathematical nature. Due to this fact, these operations were quickly and more easily adapted to computers. Large stores of file cabinets have disappeared and the information once stored there now resides in the form of binary numbers on magnetic tapes. Posting, billing, and the figuring of discount rates became an easy matter of addition, subtraction, and multiplication for these machines.

Although many jobs were eliminated due to the introduction of computers into the office, large scale layoffs did not take place. The positions that were eliminated were of the more simple variety and these classifications were readily adapted to the simpler operating positions on the computer. Essentially, the computers eliminated the need for additional office help at a time when shortages of such help existed and they created some positions which were filled by the people who had previously worked at jobs which were eliminated.

In some cases, the office staff actually increased but, for the most part, this was due to the reluctance of management to trust the new machine. Therefore, some processes were actually duplicated in order to check the ability of the machine to perform. Management is now convinced of the computer's reliability and we are quite certain that duplication of systems will be eliminated.

The past 5 years have essentially been a shakedown period. The computer positions have been created and filled. The slack has been taken up. The office personnel shortage is not so acute. I might paraphrase: "Those machines have just begun to fight." I believe it is important to emphasize the fact that some shortages still exist in some categories of office employment which have not been affected by electronic data processing machines. These classifications include secretary, stenographer, sales personnel, and all of those occupations which involve oral contact with other workers or the public.

Usually where an installation took place, it was to perform a specific operation. The computer was sold on this basis and was programed for this operation. It has been discovered that the computer can do many more jobs in an office than that for which it was originally purchased or planned. Many concerns have hired their own programers to get the maximum out of computer time. This is being done with little or no increase in machine investment. Here lies the greatest danger to the present jobs of most office personnel. The new machine jobs have been filled. The new operation will call for no increase in personnel. There is no longer an acute shortage in non-automated departments. What will happen to these workers? It seems evident as the programers catch up with their machines' capabilities, and the machines compute faster and faster, leaving more time for new operations, more and more jobs will be sacrificed with no increase in the operating complement.

A good example of the above took place in a New York City transit organization. A Univac had existed there for about 2 years doing more efficient equipment inventory checking and time schedules. The introduction of this system caused no loss of jobs although the clerical staff was reduced through attrition. The management hired a staff programer in the fall of 1959. By early 1960, the management was ready to put into effect a new payroll program that would have reduced the 1,300-man staff by at least 250 persons. This was without an increase in the data processing staff.

To this date, automation has only affected those offices with large staffs. Due to the expenses involved, it is not economical to install such devices if they can complete the operation in minutes and then sit idle. To overcome this and to make these machines available to smaller companies, two new developments are taking place.

First, a large computer is either purchased or rented by a company for its own purposes and for rental to others in the same or similar industry. Sometimes the work of other firms is performed on the premises of the landlord firm without the necessity of resorting to constant direct communication with the secondary firms. Thereafter, information is forwarded to the firm where the computer is housed through telephone lines or microwave signals. The use of telephone lines is quite costly at this time, and this method of communication is not widely used because of the expense involved. However, the telephone companies are constantly working on ways and means of making their facilities available to computer centers at lower rates.

The second development that will revolutionize the work of smaller offices is the advent of the small computer. With the rapid advance of the transistor, the computers' size and power requirements have been drastically reduced. International Business Machines Corp., National Cash Register, and others have announced that small computers are now available. IBM stated that these small computers can be rented for approximately $1,100 per month. These small computers are of desk size and can perform every function of the present large computers without the need of special air-conditioned quarters and expensive power requirements. The complete operation of the small computer can be performed by one operator and is well within the price range of small businesses. Actually, the information stored in the smaller computers will be retained on tiny magnetic cores or glass disks that will be more economical than punchcards or magnetic tape.

Wth these innovations not only will the computer become smaller but due to the electronic properties of transistors and magnetic cores, it will be much faster in its calculations.

Thus, it is easily seen that for the first time, computers will affect the lines of clerical workers in establishments employing only a relative few such workers. This is a development which we will have to watch very closely during the next 3 to 5 years.

The impact of electronic automative devices will also have an effect on retail clerical jobs. The R. H. Macy Co. is trying out its first electronic salesgirl. This machine is smart enough to dispense 36 different items in 10 separate styles and sizes. It accepts one- and- five-dollar bills in addition to coins and returns the correct change plus rejecting counterfeit currency. Universal Match Corp. manufactured the machine and expects to produce it in large number as soon as possible. This machine, as yet unnamed, will also be available on a rental basis.

We have often heard people say that the office computer will make new positions for the people it displaces. To a large extent this has been true, but as we pointed out, the computer has begun to encompass more and more office operations without an increase in the operating force. Now to carry out the logical development of the computer, we find that even the new jobs it created are in danger. These positions basically serve three functions in a data-processing operation. They code and prepare information for input to the computer, operate the computer, and handle the output of information. The first is by far the largest operation. It presently consists of operating such equipment as coders, key-punch, sorters, and card-to-tape converters. In the foreseeable future, the input data will automatically be inserted at the origin of this data.

Presently a payroll operation consists of personnel information and the total hours worked in a week, punched on cards. Soon this punchcard process will be eliminated. This will be accomplished by storing in the computer the time recorded on the employee's time card as he punches it. At the end of the payroll period, the computer will read out the stored information and make the necessary computations and will print the amount due on the employee's paycheck. This is jut one example of automation beginning to eliminate the jobs it once created.

We have noted the effects of the computer on the office employees working for a company, which had previously installed this electronic device.

However, the impact on blue-collar workers will even be greater. A computer will keep a close and accurate control of inventories. It will prevent overproduction and eliminate large stockpiles. Thus, when the business cycle requires accelerated production, the computer will automatically produce a speedup.

In review of the effects of office computers, I would list them as:

(1) The new automation positions have been filled. Any increase in the operation will not create new jobs.

(2) Programing techniques are just beginning to tap a computer's real capabilities.

(3) Development of smaller and more economically operated computers will begin to effect smaller office staffs.

(4) Small businesses will begin to use cooperative computers.

(5) New techniques will begin to eliminate the newly created positions.

(6) Low inventory requirements will affect business as a whole.

It is, therefore, apparent that training and retraining of clerical personnel affected by the introduction of computers and other automative equipment is imperative. State and Government funds can well be used in guidance centers and public employment bureaus toward this end.

Employers must be made to realize their tremendous responsibility in achieving a change to automation without layoffs, and with due regard to possible displacement of personnel.

We further believe that government, management, and labor should, by working together, insure the fact that workers share in the increased gains, through the greater productivity accruing through automation.

STATEMENT OF W. P. KENNEDY, PRESIDENT, BROTHERHOOD OF RAILROAD TRAINMEN

AUTOMATION AND MECHANIZATION IN THE RAILROAD INDUSTRY

I. STATEMENT OF THE PROBLEM

This report will indicate the increased use of machinery and equipment that has displaced the labor of men in the railroad industry and the extent to which it can be expected to do so in the immediate future. A program is also presented for the amelioration, if not complete solution of the great human problem of idle, trained manpower that follows in the wake of this great revolution in the methods of transportation and production now taking place.

How much true automation there is in the railroad industry in terms of fully automatic control of machinery by self-correcting electronic feedback devices or computers is not available nor, for the purpose of this report is it of particular importance. What is of great importance is that the increasing use of improved machinery and equipment including some automation has deprived hundreds of thousands of railroad workers of their jobs in the past 15 years and threatens to deprive additional thousands of railroad workers of their jobs in the years ahead. No major industry in America, unless it be the mining of bituminous coal, has seen such rapid changes in the substitution of machinery for workers and such consequent increases of productivity by individual workers as that of railroad transportation.

The capital expenditures in the 15-year period 1945–59, inclusive, provide the groundwork for understanding this phenomenal increase in output per worker. In this period the railroads invested a total of $15.5 billion in equipment and roadway and structures, an average outlay of over $1 billion per year. The following table summarizes these expenditures over the postwar 15-year period:

TABLE I.—*Capital expenditures of class I railroads, 1945-59*

	Equipment	Roadway and structures	Total
1945	$314, 779, 000	$248, 201, 000	$562, 980, 000
1946	319, 017, 000	242, 940, 000	561, 000, 000
1947	565, 901, 000	298, 788, 000	864, 689, 000
1948	917, 449, 000	356, 035, 000	1, 273, 484, 000
1949	981, 320, 000	330, 880, 000	1, 312, 200, 000
1950	779, 399, 000	286, 443, 000	1, 065, 842, 000
1951	1, 050, 849, 000	363, 146, 000	1, 413, 995, 000
1952	935, 090, 000	405, 822, 000	1, 340, 912, 000
1953	857, 893, 000	401, 904, 000	1, 259, 797, 000
1954	498, 726, 000	321, 520, 000	820, 246, 000
1955	568, 202, 000	341, 319, 000	909, 521, 000
1956	821, 357, 000	406, 500, 000	1, 227, 857, 000
1957	1, 007, 749, 000	386, 956, 000	1, 394, 705, 000
1958	479, 680, 000	258, 356, 000	738, 036, 000
1959	567, 546, 000	250, 456, 000	818, 002, 000
Total	10, 664, 957, 000	4, 899, 266, 000	15, 564, 223, 000

Source: Association of American Railroads: Yearbook of Railroad Information—1960.

The result of this unprecedented volume of capital investment in new equipment and facilities for the railroads has been a marked rise in the productivity of railroad workers. The productivity analyses of the U.S. Department of Labor show that the increase in output per man-hour in the railroad transportation industry is one of the highest for any of our major industries:

TABLE II.—*Selected industries: Indexes of output per man-hour, 1947–58*

	1947	1958	Increase over base period
Bituminous coal	100	178. 3	78. 3
Copper	100	139. 1	39. 1
Railroad transportation	100	155. 5	55. 5
Basic steel (production workers)	100	126. 6	26. 6

With the ton-miles of output staying at the approximate levels of the 1945–46 period this phenomenal increase in productivity has been a major factor in the decrease of employment from 1,420,000 in 1945 to 815,000 in 1959, a decline of 605,000 or about 42 percent of the number of workers employed in 1945. The following table shows this falling off in railroad job opportunities over the 15-year period.

TABLE III.—*Annual employment (midmonth average) class I railroads, 1940–59* [1]

	Average midmonth employment		*Average midmonth employment*
1945	1, 420, 000	1953	1, 206, 000
1946	1, 359, 000	1954	1, 065, 000
1947	1, 352, 000	1955	1, 058, 000
1948	1, 327, 000	1956	1, 043, 000
1949	1, 192, 000	1957	986, 000
1950	1, 221, 000	1958	840, 000
1951	1, 276, 000	1959	815, 000
1952	1, 227, 000		

[1] Annual reports of the Interstate Commerce Commission.

II. THE DRIVE FOR MECHANIZATION OF THE RAILROADS

The railroad industry's drive toward mechanization and automation includes almost every aspect of railroad operations. The object in all capital spending by the carriers is the more efficient and economical furnishing of mass transportation. Such improvements as the increasing mechanization of maintenace of way, and centralized traffic controls have achieved these results. Hundreds of other improvement in materials, methods, and equipment have the same objective and there is no innovation or change that does not in some measure reduce labor requirements either in operations or in maintenance. The advantages said to be derived from some of the improvements, illustrate the factors that are characteristic in modern day railroad planning.

1. *Centralized traffic control (CTC)*

Centralized traffic control is one of the great advances in railroad operations in the past 30 years. The purpose of a centralized traffic control system is to concentrate at one point under the direction of one operator the control of train movements over a long section of track and to expedite the movement of traffic in that section. This objective is achieved by placing within the view of the operator on a panel the location of trains and the position of all controls such as switches and signals which the operator can change to affect the movement of trains. As one advertisement expresses it the dispatcher "knows the location of every single train and can start it, stop it, switch it from one track to another to best meet operating conditions, and speed traffic flow." The more extensive the territory under CTC control the fewer the number of dispatchers required to direct the traffic. CTC also eliminates the reliance on the position of telegrapher or station agent in handling train movements. Not the least of the advantages is that it is possible to set up signals and routes so that maintenance forces can move or work without the delays which are characteristic of flagging requirements in territory not governed by CTC.

CTC means a reduction in maintenance of way expense because the greater efficiency makes possible the routing of traffic on less trackage. Although there are more trains using one track the cost of maintenance is below the cost of maintaining the system of double track. The abandonment of one or more tracks also results in savings from salvaged rail and switches. Approximately 30,000 miles of track are under CTC. It is claimed the expansion of CTC to cover the Nation's entire system of railroads would make completely automatic trains possible.

Railroads with CTC are said to have reported a 30 to 40 percent return on their investment, a part of which, of course, is derived from the elimination of many skilled workers such as dispatchers, telegraphers, and others.

2. *Communications: Microwave radio*

One of the fields of rapid modernization on the railroads is communications. Walkie-talkies are used on trains, by switching crews, repair gangs, and in about all railroad operations. The objectives have been, for example in repair crews, to reduce the time lost because of passing trains. Line communications are being increased to the extent possible, but some railroads are finding the demand for the rapid transmission of data so great that high frequency microwave radio transmission with its almost unlimited possibilities of expansion is being installed.

Microwave radio is a method of communication that uses a beam of extremely high frequency radio waves that can be directed toward a receiving point with great precision. With its high frequencies microwave serves as a carrier for a large number of separate and distinct messages and symbols. An enormous increase in the demands for the transmission of information from hundreds of offices in the railroads systems of the United States has resulted in the adoption of microwave transmission by more and more railroad companies. The central offices of railroads, for example, want car reports for more precise information on car movements and location in order to achieve better utilization of freight cars for shippers. Microwave transmission is a means of insuring that this information is forthcoming when wanted.

The trend to the centralization of accounting operations has created a demand for the rapid transmission of data from original documents or cards at distant points by facsimile process. The age of electronic computers has vastly increased the demand for more data flowing into a central headquarters at a more rapid rate. Only microwave systems can conveniently provide the great number of communication circuits necessary to the large scale transmission of data including facsimile, and closed circuit television enabling a dispatcher to see the passage of trains through some distant location or watch one operation of a distant classification yard.

The railroads have adopted microwave communication not only for economy in the operation and maintenance of their system of communications but also because reliable and rapid communication is indispensable to their programs of cutting cost and improving service. The use of microwave transmission eliminates much labor that was applied to the installation and maintenance of pole line communication.

3. Electronic computers

Electronic computers have been doing routine paperwork on railroads for years but now the carriers are turning to newer models with larger memory storage, sorting and data handling capacity. Railroad management, employees, and union officials are well aware that computer installations result in fewer jobs for given tasks but the gain in efficiency is great and the wages of the remaining employees are higher.

There are a number of things vital to the efficient operation of a modern railroad that are either made possible for the first time or can be done more efficiently by the computers. One or two examples illustrate these new uses.

The time required to figure tonnage ratings is cut by 80 percent. Using a digital computer, tonnage ratings require from 1 to 5 minutes per locomotive group, depending on the length of track involved and degree of accuracy required. Using an analogue train performance calculator for the same job requires a 1 man-day. For the same work with a slide rule and a desk calculator the time required would be prohibitive.

Two eastern railroads in a joint project used computer techniques in a market study of shipments from a medium sized city. The objective was to find the traffic flow by type of transportation—by rail or truck. The information was obtained from about 25 companies manufacturing diverse products. The companies reported the number of shipments, the weight of each shipment, the distance each traveled for a sample month. One of the roads is now using the information in a rate study designed to recapture as much of this traffic from trucks as possible.

One road plans to use a large electronic computer to provide information for a better distribution of boxcars. The railroad first had to find the level of loading and unloading on each division, information on empty cars on each division; receipts and deliveries to and from connections of loads and empties, time of delays involved in each division in each of the various types of moves (spotting of empty cars for example); and the combination of moves which would best meet the needs of each division while minimizing crosshaul and empty mileage.

According to the railroad the computer took all possible combinations of actions, weighed the consequences of each such combination, and eventually came up with the answer which struck the best balance between costs and services for the whole railroad.

No one could deny that to the extent this program is successful one of the elements would involve crew, fuel, and other direct costs—in other words a reduction of manpower requirements. In its other aspect, however, it increases the efficiency of the use of the freight car fleet and may be expected to provide the railroad with more traffic and possible increase in the number of workers.

One thing stands out clearly in this brief reference to the use of electronic computers is that a railroad is able to undertake jobs and digest and analyze information on a scale that was not practicable before. As a consequence, the railroad is placed in a better competitive position. Although one of the immediate results will be the reduction of job opportunities for the employees whose work is now performed by the machines the preparation of the additional materials for the computers on the many projects that heretofore were not feasible may somewhat minimize the resulting unemployment for office workers.

4. Electronic classification yards

The number of electronic classification yards is increasing and these new automated freight classification methods mean reduced manhours for these operations. The larger railroads are planning the construction of more of these automated yards but the number completed in the next few years will depend on the level of rail revenues.

The essential feature of the new method is the use of the force of gravity to classify cars into outbound trains. Once a car has been pushed past the hump—an area higher than the actual classification tracks—electronic equipment does the work of sorting cars and assembling trains. Closed circuit TV provides the yardmaster in the communications tower with a view of incoming cars. Then the magnetic memory of the electronic equipment programs the destination of all the cars in a train and sets the switches which get the cars into the correct trains. Computers make adjustments for such factors as weight, distance, and track conditions and then retarders adjust the speed of each car to enable proper coupling. Thousands of cars can be classified and sent on their way in freight trains in just a few hours.

The ability to make such a large part of the switching and assembly of freight trains a matter of pushing the right button has meant less employment for just about every category of operating railroad employee. Certainly fewer yard crews for switching are required. The savings due to increased efficiency and displacement of workers are said to be so great that the largest electronic classification yards can be paid for out of such savings in a few years.

5. Hotbox detectors

The methods of electronics have been applied to one of the most persistent and costly problems of railroad operations. The hotbox or overheated journal bearing long has been a source of waste, in the form of delayed shipments and wrecks that are due to failure to detect overheated journals in time. Roller bearings are a complete, if somewhat costly solution to the problem, but such equipment is more feasible for new cars. Out of a freight car fleet of 1,677,000 cars in the ownership of class I carriers at the end of 1959 not more than 70,000 cars were equipped with roller bearings, the remaining 1,600,000 having friction bearings. One manufacturer of roller bearings estimates that roller bearings for all freight cars would mean an annual saving of $144 per car for a potential annual saving of about $250 million for all class I carriers. The greatest savings would be in maintenance, replacement, and inspection which would mean lower manpower requirements.

Since only a small percentage of the freight car fleet is equipped with roller bearings hotboxes are still a major railroad problem. Although there has been considerable improvement in meeting the problem by better methods of lubrication one of the major advances is the use of electronic detectors to determine the existence of overheating in journal bearings before they become hotboxes and cause serious damage.

One such electronic detector uses a so-called photon (particle of energy) sensor which responds in less than one-millionth (15 microseconds) of a second. The scanner is in a weatherproof steel case which has a lens that opens automatically at the approach of a train. One such device scans the hub of the wheel instead of the journal box proper which is the method of other detectors. Separate wayside equipment includes an analyzer which translates continuing varying signals into digital form for transmission over direct wire or carrier. The analyzer reports two different degrees of heat which provide the information center with a report of "dangerously hot" and "warmer than normal" journal boxes.

The detected information is printed on a tape and when a hot bearing is noted at the office an attendant is alerted by the ringing of a bell. At this point the practice varies. In some systems (where the alarm is given at a wayside station) the train crews must call the dispatcher who has read the tape and he tells the train crew the location of the car in the train and the side of the car where the overheated bearing is located. In another system the indicator is placed at the site of the detector control signal and the train crew finds the information on the hotboxes and notifies the dispatcher on the handling of the cars with the overheated bearings. On receipt of this information the dispatcher gives a clear signal and the detector equipment is set for the next train.

Electronic methods of hotbox detection are providing substantial manpower savings by shortening the inspection time at inspection points, reducing maintenance cost of journals and bearings, holding the setoff time and the sending of cars to shops for these causes to a minimum and helping to prevent costly wrecks from overheated journals.

6. Mechanization of maintenance

Drastic manpower reductions have been achieved by the use of electronic classification yards, centralized traffic controls, microwave installations, automatic computers, and electronic hotbox detectors. Similarly, improved methods, greater mechanization, and improved materials and equipment also are effecting enormous reductions in manpower requirements in the maintenance of equipment and property. More powerful diesel engines are being built with a claimed 60-percent savings in maintenance. Such unspectacular items as better locomotive brakes, pressure-treated wood for freightcar flooring, improved brake cylinder release valves, aluminum flooring for refrigerator cars, roller bearings for freight cars, concrete self-seating tie pads all are advertised to reduce maintenance costs.

The total number of maintenance employees on class I railroads in 1946,[1] including both maintenance of way and maintenance of equipment, was 616,347, which was 45 percent of the class I employment total of 1,359,263. In 1959 the combined maintenance total had declined to 321,500, which was only 39 percent of the 815,474 class I employees. In other words, maintenance lost in relative importance to all railroad workers by the measure of the difference between 45 percent in 1946 and 39 percent in 1959, or 6 percentage points.

The following table summarizes the behavior of maintenance employment over the 14-year period:

TABLE IV.—*Class I employment compared to maintenance employment*

	Total class 1 employment	Maintenance of way	Maintenance of equipment	Total maintenance employment	Percent maintenance of all employment
1946	1,359,263	256,748	359,599	616,347	45
1959	815,474	126,999	194,500	321,500	39
Percent decline from 1946	40.0	50.6	45.6	47.8	

Where total class I employment has declined by 40 percent total maintenance employment has declined by 47.8 percent. Of the two divisions of maintenance employment, maintenance of way has been the hardest hit with a loss of 129,749 or slightly more than one-half of all maintenance of way employment. Considering the relatively more difficult job of dispensing with maintenance of equipment employees this category also has been hit hard with the loss of 45.6 percent of their number since 1946.

[1] The year 1946 is used as the postwar benchmark year instead of 1945 because in 1945 the carriers registered heavier than usual employment in a drive to reduce an accumulated backlog of deferred maintenance from the war years.

(*a*) *Maintenance of way and structures.*—The reduction in maintenance of way employees is due in large part to changes in methods of maintenance, improved materials and mechanization.[2] There is no reason to believe that the trend in any of these factors will be materially lessened in the near future. On one railroad, the Santa Fe for example, it has been said that in 10 years from 1948 through 1958 the number of track labor man-hours per million gross ton-miles decreased from 222 to 82 as a result of improved methods, materials, and modern roadway machinery and work equipment. The following table shows the trend in maintenance of way employment over the period 1946 to 1959 and its relation to all class I employment:

TABLE V.—*Total railroad and maintenance of way employment, class I railroads, 1946–59* [1]

Year	Total railroad employees	Index	Average number of maintenance of way employees	Index	Percentage maintenance of way employees to total employees
1946	1,359,263	100.0	256,748	100.0	18.9
1947	1,351,863	99.4	255,416	99.5	18.9
1948	1,326,597	98.3	256,060	99.7	19.3
1949	1,192,019	87.7	224,067	87.2	18.8
1950	1,220,401	89.8	226,994	88.4	18.6
1951	1,275,744	93.3	237,944	92.6	18.7
1952	1,226,421	90.2	228,411	88.9	18.6
1953	1,206,312	88.7	225,430	87.8	18.7
1954	1,064,705	78.3	184,893	72.0	17.4
1955	1,058,216	77.8	182,654	71.1	17.3
1956	1,042,584	76.7	170,481	66.4	16.4
1957	986,001	72.5	170,766	66.5	17.3
1958	840,575	71.8	134,122	52.2	15.9
1959	815,474	60.0	126,999	49.4	15.5
1960					

[1] Source: M–300 Reports of the Interstate Commerce Commission.

Some of the improvements directly affecting maintenance manpower requirements for road and way each with sharply reduced manpower requirements and higher output per individual worker are such as the following: Mechanical tie spacer which is said to reduce manpower requirements by 15 to 20 men; a spike setter and riveter which cuts costs, speeds rail laying and improves track and at the same time cuts out the work of a dozen men and improved tamping machines and ballast maintenance equipment. A machine has been developed that places the unloading of ties on a fully mechanized basis and it is said that a crew of 4 can unload about 6,000 ties in less than 8 hours compared to 1,000 ties a day for the same number of men before mechanization.

An unusual method said to reduce maintenance costs is the spreading of an asphalt with waterproofing and cementing qualities over the ties and ballast. The asphalt is said to create an umbrella over the ties and ballast keeping out water and dirt and to retard the corrosion of rail fittings.

[2] The railroads claim that the increasing resort to machinery and improved methods and materials was due to ever-rising costs. It is generally conceded also, that there is a large volume of deferred maintenance overhanging the industry. In other words the railroads would have higher employment if they were making strenuous efforts to reduce the deferred maintenance account and to keep their maintenance on a current satisfactory basis.

A new nuclear tie tester achieves savings by detecting hidden flaws in crossties without the necessity of removing each tie for inspection. Also, concrete ties are getting a trial on one of the southeastern railroads as a means of reducing maintenance costs. Such ties have been used on the German Federal Railroads for years and give promise of lower longrun maintenance costs.

Aside from track maintenance itself the use of welded rail is a major step that is being taken to reduce costs since rail joints require a great deal of maintenance. The cost of welded and jointed track is reported to be about the same but savings in maintenance are estimated to be about $1,000 per mile per year for the welded track. This is indicated to be part of a shift to longer lasting materials and for new designs of structures with the objective of a minimum of maintenance.

Control of weeds and brush along the railroad right-of-way furnish other examples of steps being taken to reduce costs through use of improved methods and mechanization. For example, a power brush cutter is advertised to cut right-of-way maintenance costs by enabling one man to do the work of eight men with brush hooks and scythes. Another machine is called a combination weed burner and snow remover and is advertised to clear 15 to 20 switches and retarders and hour and in this snow removal work replaces 100 men using brooms and shovels. Perhaps the greatest savings on weed and brush control comes from the use of chemicals where one application of chemicals controls weeds for an entire season or even longer. Special chemicals are used for longtime brush control. Some companies advertise the service of their specialists to examine the condition of the soil, provide modern spray cars and spreaders, supervisors, and studies to evaluate results.

At one time weed and brush removal was pretty much a manual operation with hoes, shovels, scythes, brush hooks, axes, and similar tools being used. Members of section crews even pulled weeds by hand. That the use of chemicals in weed and brush control programs has resulted in drastic reductions in manpower requirements for these persistently recurring maintenance-of-way operations is apparent.

Even in structures improved building materials have reduced maintenance to a minimum. Railroads are using prestressed concrete for such structures as car servicing shops, towers, and bridges as a means of cutting down on maintenance labor. Also, the use of different methods and materials has reduced manpower requirements in the maintenance of structures. In one trainshed painting job the use of low-pressure spray equipment the painting of seven platforms took about 4 months to finish compared with 1 month for each platform by hand brushing. The trend for lower manpower requirements is evident in bridge and car painting. One Midwestern railroad is said to have sprayed 14 bridges in 3 weeks with a 3-man crew, a very considerable reduction for the 3 months with more than 3 times the manpower required by conventional hand painting methods. One carrier reported saving the cost of two spraying machines at $12,00 each in the course of painting four bridges. One company has developed a hot spray painting system said to be particularly suited to covered hopper, refrigerator, and tank cars. Sprayed on hot and requiring but two coats instead of the usual three the system is said to effect savings on maintenance and length of service life.

(*b*) *Maintenance of equipment.*—As in maintenance of way sharp reductions in manpower requirements for maintenance of equipment have resulted from improved methods, materials, and mechanization of operations in the postwar period.[3] The following table shows the trend on the maintenance of equipment employment over the period 1946–59:

TABLE VI.—*Total railroad and maintenance of equipment employment, class I railroads, 1946–51*[1]

Year	Total railroad employees	Index	Average number of maintenance of equipment employees	Index	Percentage of maintenance of equipment employees to total employees
1946	1,359,263	100.0	359,599	100.0	27.31
1947	1,351,863	99.4	358,693	99.8	27.39
1948	1,326,597	98.3	353,638	98.3	27.52
1949	1,192,019	87.7	309,733	86.1	26.93
1950	1,220,401	89.8	337,136	93.7	28.52
1951	1,275,744	93.3	369,073	102.6	28.93
1952	1,226,421	90.2	345,531	96.0	28.17
1953	1,206,312	88.7	335,993	93.4	27.85
1954	1,064,705	78.3	275,150	73.7	25.84
1955	1,058,216	77.8	273,155	76.5	25.81
1956	1,042,584	76.7	265,684	75.9	25.48
1957	986,001	72.5	246,358	68.5	24.99
1958	840,575	71.8	196,594	54.7	23.99
1959	815,474	60.0	194,500	54.0	23.85

[1] Source M-300 Reports of the Interstate Commerce Commission.

The cleaning of equipment has been placed on an essembly line basis and one chemical company advertises that by using an automatic washer and the company's chemical the exterior of a locomotive can be cleaned in 1½ minutes at a cost of 15 cents and the interior can be cleaned for $1.35. A passenger car exterior is cleaned in a machine washer in 1 minute at a cost of 13¼ cents and in less than 8 minutes a boxcar can be stripped of paint by use of a stripping tunnel—no hand labor—for less than $7. This same chemical company advertises that the production rate for cleaning journals and unmounted axles was 30 to 35 every 8 hours. With a so-called roll-in-axle washer that requires only 1 operator, the production rate is now 90 to 100 axles every 8 hours.

There is such new equipment as mechanical refrigerator cars where no determination on the cost of maintenance of the mechanical over the iced refrigerator cars has yet been arrived at. It seems likely that the labor employed by the railroad may be less for maintenance of the mechanical "reefers" than for the iced refrigerator since the mechanical refrigerator requires special servicing. However, the servicing labor requirements of the iced refrigerator car have been sharply reduced because of the mechanization of this operation.

More complicated equipment may serve to reduce railroad equipment manpower requirements by requiring return to the plant for repair. Examples are a new car for the hauling of potatoes developed by the Bangor & Aroostook Railroad which may, in the words of the

[3] Ibid., footnote 2.

railroad, "revolutionize" the transportation of potatoes, onions, oranges, and other round vegetables and fruits. The potatoes or other fruits or vegetables will flow by gravity into unloading conveyors and the vegetables (or fruit) will be loaded the same way.

Other equipment that reduces man-hour requirements in loading and unloading which may also require special repair and maintenance are airslide hoppers where such commodities as malt, soybean meal, fish meal, salt, lime, malting grits, animal feeds, starch, powdered cake, arsenic, fertilizer, cement, and flour are loaded through pneumatic tubes.

III. THE FUTURE OF MECHANIZATION AND AUTOMATION

1. *Are automatic trains possible?*

The railroad industry appears to be suited for the rapid introduction of laborsaving machinery and perhaps partially automated train operation. With its operating schedules and fixed tracks that can be kept completely clear of all other traffic the rail carriers seem to have a potential for the introduction of more mechanized equipment and automatic controls. Any acceleration on or even continuation of the present trends means a greater displacement of railroad workers.

A recent trade publication editorial (Railway Age, Feb. 15, 1960) raised the question as to how soon the truly automated railroad would come into existence. With various electronic devices making possible such enormous improvements as the pushbutton classification yards and centralized traffic controls is it, as the editorial writer suggests, a case of how soon?

The statement is made that if all the devices necessary to operate trains without constant human attention were applied in one system the automated railroad is now possible. One company selling devices for automatic control of train movements advertises that the railroads can now consolidate control of CTC in strategic locations and "ultimately control an entire railroad from one point." Whether the use of automated devices will continue until the final step is taken to complete automation is now the question.

The economies from semiautomatic, electronically controlled classification yards are so great that more are being installed each year and it has been said (Railway Age, Oct. 27, 1958) that as many as 500 such yards will be constructed in the future. The purpose of these new installations will be to do in one place work that was done in many places—

> 8 hours at most for receipt, inspection, classification, repair, upkeep, and departure * * * Hump inspectors and pin puller will be the only men required for automatic car classification.

The prospective developments in this field hold the propect of displacement of thousands more skilled railroad workers if the descriptions of the plans of industry spokesmen are to be believed.

Is complete automation of office practices possible? The twin developments of microwave and other systems of transmission of data on a mass basis and the digital computer for summarizing and analyzing such data including car accounting, payroll calculations, rate computations, and the processing of other data appear to provide the basis for considerable developments in this field. The necessity in competitive minded railroad management for day-to-day summaries and for forward planning of their activities create the demand for increasing use of automated equipment. However, there appear to be many problems such as standardization, development of personnel to adopt electronic data processing equipment to railroad data, and many other complexities that must be further along toward solution before the automated office can become a practical possibility.

Continued mechanization of maintenance of way must be anticipated. Machines are already in use that perform more than one operation and indeed are held to be necessary if some railroads are to justify capital expenditure in such equipment. A machine that burns brush and weeds in the summer and removes snow in the winter is an example of such a multipurpose machine. Also, there are many track maintenance machines that are capable of performing more than one operation. In addition to the multipurpose machine some experts are advocating a "mother" machine carrying single-purpose machines to and from a job and which would supply each of the individual machines with power and lift them on and off the track.

An American engineer foresees machines for track maintenance that are capable of rehabilitating the surface and line of track where the lining and tamping machines move along a stretch of track preceded in the distance by a single machine equipped with an electronic brain known as a monitor or track analyzer. The idea of this engineer is that the monitor would determine with exactness any required corrections and feed the information back to the working machines.

That this is not so remote may be concluded from the earlier mention of the nuclear tie tester which is used to detect hidden flaws in the ties and, without any manual removal for examination, determine which ties would be removed. Although any large-scale application of electronics to the task of determining the condition of the roadbed is not yet a fact, the perfection of such methods in the future would further drastically curtail the manpower requirements for maintenance.

As yet there is no appreciable automation in maintenance but it is not considered impossible. Professor Dobmeir, former head of the West German Railways, is reported to have stated that someday he hoped to look out of his office window at 7 a.m. and see one operator push a single button causing all track machines to move out on line and go to work. Then at 4 p.m. the operator would press a button and the machines would move back into a siding.

We have not come this far but maintenance of way has sustained enormous reductions in employment opportunities in the past few years and undoubtedly may anticipate more from the use of machinery and perhaps automated methods. But, whether the future changes are simply mechanization or truly automated devices some future reductions of maintenance employment may be expected.[4] Part of these reductions will come from the extension of mechanization into areas and to railroads where it is not yet fully in use. Still other employ-

[4] Against this tendency must be set the undeniable fact that the railroads have accumulated a very considerable backlog of deferred maintenance which must be worked off in the near future if service standards and value of the properties are not to suffer a very great decline. And it has been said by competent railroad observers, the longer maintenance is deferred the more costly it will be for the carriers to put their properties in first-class condition.

ment opportunities may be lost through the introduction of truly automated maintenace, but this contingency appears to be a considerable distance in the future, if it ever occurs at all.

Automation already has become a fact in some phases of equipment maintenance and repair. One concern has completely automated its wheel shop with sharp reduction in man-hour requirements. One well-equipped but not automated wheel shop of an eastern railroad requires 3½ hours to machine and assemble each wheel set compared to one wheel set in one-third of a man-hour for the new automated shop. In this operation all units are connected by conveyors and transfer mechanisms and an operator at a console board only monitors the diverse operations. Such matters as the selection of axles of certain classification and selection of the lathes for such axles and delivery of the axles to the lathe are automatic. The burnishing machine operates at a speed which makes it possible for one machine to burnish the axles coming from three lathes.

2. Automation and rapid transit

Advances are being made toward partial automation in the rapid transit systems of cities. The Bay Area Rapid Transit District (BARTD) of San Francisco is planning a rapid transit system for the San Francisco Bay cities which is to be controlled by electronic computers. The computer will be programed to analyze all factors affecting transit patronage and to formulate train schedules based on these analyses. Also, a computer will initiate makeup and dispatching of trains and once in the control system the train will be regulated by trackside and station control equipment which will determine speed, halt a train at a specified position on the station platform, and cause it to leave the station after a specified interval. In the case of delays the computer equipment can even reschedule trains and thus prevent delays from disorganizing the service. For emergencies an automatic block signal system will be available to override the automatic controls. Although the new transit trains are to be almost completely automatic, it is said the BARTD trains will carry a man in the cab for psychological reasons.

In Philadelphia and New York key segments of the subway system have been modernized by the installation of an electronic train identification system which permits trains to route themselves without the need for towermen at interlockings. Another report says that the New York Transit Authority is making tests and may operate shuttle trains between Grand Central Terminal and Times Square by remote control without a motorman in the cab.

IV. LABOR'S PROGRAM TO MEET THE PROBLEMS OF MECHANIZATION AND AUTOMATION

1. The immediate problems

Whether, as some engineers suggest, a completely automatic train service from the movement of trains through the processing of data on train operations is a possibility, only the future can tell. But enough substitution of machinery for manpower is in prospect in the railroad industry to arouse the concern and anxiety of all the workers now employed on the railroads. How many railroad workers are to have jobs in the future is a question that is uppermost in the mind of all railroad workers.

Railroad workers have not resisted the introduction of machines to do the work formerly performed by less efficient methods. These advances have in the main been in the best interest of the industry and are made necessary by the competitive situation in which the industry finds itself. It would be folly to resist the modernization of equipment and machinery that is necessary to retain the position of the railroads as the most economical supplier of mass transportation. In this same movement, however, industry must meet human problems remaining as the legacy of the introduction of labor-displacing machines. The very profitability of the new equipment gives the industry the ability to meet the needs of surplus workers in the transition period.

A trend toward the use of labor-displacing machines may affect a particular industry only, or, as in the present situation, it may be characteristic of the entire economy. First, the direct human problems of the railroad industry with suggestions for their amelioration, if not solution, are considered.

When labor-displacing changes are decided on in work organization or in equipment, railroad unions believe they should participate in planning the changeover. All too frequently, however, the railroads have ignored their own workers and hired people outside the industry to operate the new equipment despite the obvious economies of retraining railroad personnel who are already familiar with railroad problems. A genuine effort should be made by management to negotiate with railroad unions in meeting such transition problems as training their employees for new positions, allowances for dismissed employees, establishment of rates of pay for employees taking new positions, allowances for necessary removal of employees to new locations, and other of the problems resulting from the displacements of workers in automation and mechanization.

As a result of the failure to include employees' participation in the solution of the problems presented in automation and mechanization, employee morale has suffered and needless and unjustified hardship has been inflicted upon the railroad employees adversely affected. The following program is suggested as a minimum requirement to meet the human needs of an industry in which mechanization and automation have displaced hundreds of thousands of employees in the past 15 years and in which the livelihood of thousands more is threatened:

1. Participation by railroad unions in all major projects of mechanization, automation, and reorganization of work.
2. Preference, according to seniority, of railroad employees for trainees in programing and operation of new machines and equipment.
3. Rates of pay for operators of new equipment be made to reflect their increased productivity, new responsibilities, and the greater physical stress and strain involved in the new operations.
4. Compensation for moving expenses, including compensation for any loss in the disposal of properties where a change in location of employment makes removal to another city necessary.

5. Severance pay equal to full pay for a period of time, the duration of the period for such compensation to be subject to negotiation with the unions.

6. A national agreement to meet the conditions arising from mechanization and automation because similarity of treatment must be accorded to similar problems arising from these causes on the different properties. A national agreement would enact the general procedure, but in each case it probably would be necessary to write out the specific terms as is provided in the Washington agreement of May 1936.

A partnership arrangement under the general direction of the Railroad Retirement Board for the placement of unemployed railroad workers has been successful in returning thousands of experienced railroad workers to their jobs on the railroads. Its success indicates the validity of the contention by the railroad unions that a cooperative arrangement to govern the introduction of new machinery would prevent the needless displacement annually of thousands of railroad workers in the first place.

The partnership was arranged in the early part of fiscal year 1957 (July 1956). Railroad unemployment insurance claims agents, railroad management, railroad unions, and the Railroad Retirement Board participate in a placement program for unemployment benefit claimants of the railroad industry. To implement this plan the Retirement Board periodically compiles inventories showing the number of claimants by railroad, location, and occupation. According to the Board, it keeps railroad officials informed on the availability of experienced railroad labor and for their part railroad management requires employing officials to give preference to furloughed rail workers, check unemployment claims agents, and contact Board placement officers before filling jobs from other sources. Railway labor officials work out agreements with the unions under which employees can be transferred from one department or railroad to another.

The Retirement Board believes that this program enables the railroads to derive the advantages of efficiency and economy in their operations by using the industry's own experienced, unemployed workers and at the same time reducing the drain on the employer-financed unemployment insurance account.

In the first year (fiscal 1957) of the partnership plan 34,000 placements of unemployment benefits claimants were reported compared to 24,000 during the preceding year. The first real test of the partnership plan was in fiscal years 1958 and 1959 because of the effect of the depression on railroad operations.

In the years (fiscal) 1958, 1959, the Railroad Retirement Board reported the placement of 33,500 and 45,700, respectively. In 1958 a total of 25,100 and in 1959 a total of 31,600 employees were returned to railroad employment. The remainder, 8,400 employees in 1958 and 14,100 in 1959, were placed in nonrailroad employment. The following table summarizes the placements of unemployed railroad workers under the partnership plan in the fiscal years 1957 and 1958:

Total placements for unemployed railroad workers in 1957, 1958, and 1959 in railroad and nonrailroad employment [1]

	1957-58	1958-59
Placements in railroad employment:		
By claims agents	8,100	20,400
By other	17,000	11,200
Total	25,100	31,600
Placements in nonrailroad employment:		
By claims agents	3,100	5,700
By other	5,300	8,400
Total	8,400	14,100
Total placements of railroad employees	33,500	45,700

[1] Annual reports of the Railroad Retirement Board 1958, 1959.

The Railroad Retirement Board considered the number of placements both in 1958 and 1959 improvements over the preceding years. Despite this advance the record is yet too uneven to give the carriers a blanket endorsement for their cooperative efforts. The performance of many of the carriers could be improved and more railroad workers who have lost their jobs through technological displacement could have been given jobs on the railroads instead of having jobs go to outsiders who have no record of employment in the industry.

In the 1957 partnership arrangement a precedent exists for a cooperative arrangement between management and labor to insure employment or satisfactory adjustments for all workers whose jobs are eliminated by new machines. The success of the partnership agreement suggests that genuine cooperation to meet the human problems involved in mechanization and automation would be successful.

The railroads have their own programs for the expansion of traffic and improvement of their competitive position. They want the right to set lower rates to regain large volumes of traffic, subsidies to maintain commutation service in the metropolitan areas, relief from the heavy taxation imposed by States and localities and a system of user taxes to equalize their competitive position with subsidized air, water, and motor carriers. The unions support the carriers in these programs but also suggest that the passenger traffic could again be made a substantial revenue producer if the railroads were also to apply the concept of low pricing-large volume to the hauling of passengers.

Railroad labor believes that the tendency to rapid abandonment of the passenger service as provided in the Transportation Act of 1958 is detrimental to the welfare both of the railroad industry and to the people of this country. The railroad unions are supporting the Passenger Train Service Act of 1960 designed to bring about a stronger passenger service. Rail labor advocates passage of this legislation providing for ICC responsibility for quality of service, mandatory hearings on all petitions for discontinuance, adequate time in which the Commission may reach a decision and the necessity that the carrier prove that such passenger service is not necessary to the public convenience and necessity.

Railroad labor believes also that wholesale consolidation of the Nation's railroads into a few giant rail systems is not in the interest of this country or of the railroads themselves. It is freely granted that the basic reason for the physical consolidation of rail properties is the declining traffic volume of the carriers. The carrier managements seem to be racing to fit the railroad plant to a shrinking traffic of what they fear is a stagnating economy. The railroad leaders are unable and unwilling to lift their thinking to include the possibility of expanding economic activity.

Railroad labor is opposed to widespread consolidation because it believes that economic growth is the only proper American policy: that economic growth is inevitable and that the future expansion of the industrial activity of this country will demand all of the railroad facilities we have today.

2. The longrun problem: A program for expansion of industrial activity

The railroad unions are not content to rest their remedies for technological unemployment on programs for the better utilization of rail workers in their industry. A program to meet the immediate human problem is indispensable to any well worked out program but it is not the basic factor. The railroad industry is but one of many industries in which the pace of automation and mechanization is increasing and more work is being done by a diminishing number of workers. The net result is that unemployment is increasing because of the modernization of many industries.

Retraining programs for displaced railroad and other displaced workers are urgently needed. If workers cannot be qualified to remain in their own industry then a training course should be available for any industrial process for which workers are needed. But this introduces the crucial matter of demand for labor. Unless there are widespread shortages of workers in other sectors of the economy it will not be possible for the railroad, automobile, steel, or other industries where the rate of mechanization, improved techniques, and automation is high to find jobs for a growing surplus of railroad workers.

An approach to this problem is made in the area redevelopment legislation under which provision was made to train local unemployed workers for jobs in the industries to be created under the act.

It is an expansion of this proposal that is needed on a national basis. As long as the economy is operating with 3 to 5 million unemployed workers the task of finding employment for displaced railroad workers and other workers is almost insuperable. The problem can be met only by a national program of full employment for all of the Nation's resources that will advance our rate of economic growth to impressive new levels.

An accelerated rate of national economic growth would contribute to the solution of this problem in two ways. In the first place the increase in industrial activity would mean more carloadings for the railroads, more maintenance with rising railroad income and greater volume of employment on the ralroads. Because of the increased demand for labor by the railroads themselves the number of railroad workers unemployed from automation and mechanization would be greatly reduced. In the second place if sufficient jobs could not be provided in the expanding railroad industry itself the possibilities for employment of such workers in other expanding industries would be so great that the small number of separations from the railroads would present no real problem.

The problem of declining employment on the railroads is only part of a larger national problem. The question becomes one of whether America wants an advancing standard of living for its own sake and for the demonstration it offers to the uncommitted peoples of the superiority of the democratic way of life. Do we want a stagnating or shrinking national economy with falling living standards and an abdication of our leadership of the democratic nations? It may seem strange that the problem of providing employment for all railroad workers displaced by technological advance is part of a larger problem of meeting our obligation to millions of underprivileged Americans and to hundreds of millions of peoples in foreign lands but such are the hard facts. The selfish interests of the owners and workers of the railroad industry demand that we take an enlightened view of the programs designed to raise the living standards of millions of human beings.

The following areas of public investment are suggested as a foundation on which to build an expanding American economy and an expansion of employment opportunities that will greatly facilitate the solution of the problems of technological displacement in the railroads and all other industries:

1. A greatly expanded program of school construction including the general improvement, at all levels, of public educational facilities.
2. Urban redevelopment of blighted areas of cities on a vast scale to raise living standards, material, social and cultural education.
3. Improvement in utilization of water supply and pollution control to meet the needs of industry, homes, and agriculture.
4. Improvement of health and hospital facilities.
5. Improvement in the transportation system with emphasis on the most economical modes of transport for particular situations. Railroads (including metropolitan rapid transit areas) and highways would be the principal beneficiaries of this program.
6. A well coordinated and comprehensive program of conservation of natural resources with emphasis on forest and soil conservation and river basin development.

An expansion in the rate of economic growth for the American economy would lead to increased carloadings of iron ore, coal, coke and manufactured products that depression conditions invariably cut down. Growth of production and manufacturing and construction means a thriving railroad industry contributing its important share to a prosperous economy. With these conditions of economic expansion and general prosperity the problems of technological unemployment would become a very minor problem of the railroad industry.

STATEMENT OF GEORGE MEANY, PRESIDENT, AMERICAN FEDERATION OF LABOR AND CONGRESS OF INDUSTRIAL ORGANIZATIONS

Automatic and semiautomatic production methods are spreading into almost every type of work. Not since the industrial revolution of the 18th and 19th centuries has radical technological change affected such a large part of the economy and so many different kinds of jobs.

New types of automatic machines and methods, symbolized by the term "automation," are being put to use rapidly and widely—in manufacturing and farming, railroads and mines, communications and clerical work, retail and wholesale trade. At the same time, older types of machines are being modernized and being made semiautomatic. The pace of technological change and its widespread application are speeding up.

Although the present extent of automation differs from one industry to another, many departments, plants and offices already have converted to automatic and semiautomatic operations. Others are making the changeover now or are planning it for the future.

In addition, new equipment and production methods are making yesterday's automation marvels out of date. Last year, the Texas Co., for example, linked automatic oil refining operations to an electronic computer and started operations of a computer-controlled refinery, described as "the first fully automatic computer-controlled industrial process." Other computer-controlled automatic plants are being built at present. The metal-working industries, which have traditionally required large numbers of skilled workers, are in the midst of the automation revolution, with automatic machine tools that perform complicated jobs.

The first industrial revolution of one hundred and more years ago replaced the muscle power of animals and human beings with steam- and electric-powered machines, operated by machine tenders. Automation replaces machine operators by supervisors of automatically controlled operating systems. In addition, the not-too-distant future will see the increased peacetime use of atomic energy and the possible use of solar energy by industry and commerce.

Rapid and radical changes in technology are creating vast changes in machines, production methods, workflow, office procedures, manpower requirements, labor skills, and industry location. They are also creating great changes in products. Printed circuits and transistors are replacing wiring and tubes in electronic equipment. New plastics are replacing metals for various purposes. Radioactive isotopes, byproducts of atomic reactors, are widely used in industry.

Such radical technological changes can result in increased productivity, improved national strength and living conditions, better public services and increased leisure. In the long run, such social and economic gains will probably be achieved, as the benefits of automation are spread to all groups in the population and as society adjusts to the new technology. But in this period of transition—in the next 10 to 20 years—the widespread and rapid introduction of radical technological change can create vast social and economic disruptions.

Radical changes in technology always create some dislocations. Old work skills are made obsolete and new skills are required. Some types of work are eliminated and entire industries or sections of industries are wiped out. Changes in materials and products cause the decline of some industries and the creation of new ones. There are changes in industry location. Entire communities and regions are affected by the decline and birth of industries.

If radical technological changes are introduced slowly, in an economy whose production and employment are increasing rapidly, social and economic dislocations can be minimized.

Even under such conditions, however, there would be numerous human and social problems that would require solutions—such as individuals and groups of workers who are displaced, others whose skills are downgraded, communities whose plants have shut down or moved to new locations and workers who require retraining for new skills. But solutions to such localized and specific dislocations are manageable in a rapidly growing economy. They can be developed through such efforts as labor-management cooperation and collective bargaining, training and retraining of workers in new skills, improved social legislation to aid displaced workers and their families, and Federal Government assistance for economically distressed communities.

Our experience in the past several years, however, has not been with localized and specific problems of dislocation. Technological change has been radical. Its speed of introduction has been rapid. At the same time, sales and production have risen slowly. As a result, there has been an insufficient number of new job opportunities to provide full-time employment for a growing labor force, as well as for those who are displaced by technological change.

Since the rapidly spreading use of automation equipment has been accompanied by a slowdown of economic expansion—the real volume of total national production has risen at an average yearly rate of only about 2½ percent since 1953—the human and social problems connected with radical technological change have been widespread and growing.

In the past 7 years of slowly rising production, sales and jobs, radical technological change has taken a great toll. The potential social benefits of technological advances have been wasted. Much of the economy's rising productivity and growing labor force has been translated, not into the expanded production of needed goods and services, but into rising unemployment and part-time work, idle plants and machines, and an increasing numbr of distressed communities.

During recent years radical technological change has eliminated hundreds of thousands of unskilled and semiskilled jobs in factories, railroads, and mines, and some skilled jobs, as well. Hundreds of thousands of farmers have also been displaced. Alternative job opportunities at good wages have been scarce for unskilled and semiskilled displaced workers and there has been an insufficient number of new jobs for the young people who are entering the job market.

Many a displaced farmer, factory worker, railroad worker, and miner is now either unemployed or working part-time, at low wages, in retail or wholesale trade or the services. Much of the burden of radical technological change in recent years has fallen on unskilled and semiskilled workers—individuals and families, with little if any financial resources.

From the first half of 1953 to the same period of 1960—

Factory production and maintenance jobs dropped 1½ million.

Farm employment declined by 1 million.

Railroad jobs fell 400,000.

Mining employment declined 200,000.

While business executives may calmly tell displaced workers to seek jobs elsewhere, the problem for displaced workers is: Where are these new jobs and at what kind of wages and salaries?

In the past 7 years—

The labor force grew by 6 million persons.

Employment increased only 3.9 mililon.

As a result, joblessness more than doubled—up from 1.9 million in 1953 to 3.9 million in 1960.

Most of the inadequate rise in employment has been in part-time work.

Total full-time employment increased merely 700,000 in the past 7 years.

This shocking trend must be halted or it will undermine our entire society and throttle the advance of technology itself.

The experience of the 1920's and 1930's should be a lesson on the results of failure to adjust to rapid technological change. The great depression of the 1930's was caused, in part, by the economy's failure to adjust to the widespread introduction of mass production methods in the 1920's. Not only were millions of workers unemployed during the 1930's, but the collapse of markets and sharply reduced profits halted the application of technological advances for many years.

The decade of the 1960's poses even greater problems of adjustment to technological change than we experienced in the past 10 years. Technological change is speeding up. Almost every AFL-CIO union reports the spread of automatic and semiautomatic machines. Newspapers and magazines also report a speeding up in the pace of technological change—particularly in clerical work, retail and wholesale trade and the services. It is in these types of employment, along with State and local governments, that jobs increased in recent years, while jobs in factories, farms, mines and railroads declined. An increased pace of radical technological change in clerical work, trade and services, however, may halt or slow down the rise of jobs in such employment in the years immediately ahead.

At the same time, the labor force is expected to increase at a much faster pace than in recent years. The increase in the birthrate since 1940 is now beginning to have effects in the job markets. The labor force in the 1960's will be increasing considerably faster than it did in the 1950's, while the introduction of radical technological change will probably be spreading and speeding up.

A more rapid rate of economic growth was needed in the 1950's to provide more full-time job opportunities. In the 1960's, the need for a much faster pace of rising sales, production and jobs is even greater.

Should the economy fail to increase its rate of growth in the years ahead, layoffs and unemployment will probably mount.

If this Nation is to continue its technological advance without depression or popular opposition and resentment, a healthy economic and social environment is required.

Adjustments to automation through collective bargaining and labor-management cooperation in the workplace can be truly successful only in growing industries or in a rapidly growing economy, with an increasing number of alternative job opportunities.

Many achievements in attempting to overcome the difficulties of radical technological change can and should be accomplished through collective bargaining and joint labor-management efforts in the workplace. The record shows much has been achieved through such efforts in recent years. More vigorous joint labor-management efforts are needed in the period ahead.

The problems connected with rapid and radical technological change, however, are beyond even the best joint efforts of labor and management in the workplace, alone. The successful adjustment to automation requires much more than adjustments in the workplace, where curtailed hiring of new employees over a planned period of years may reduce layoffs and dislocations for the existing work force.

A proper national economic and social environment is required—an environment in which new full-time job opportunities are increasing at a rapid pace and in which the Federal Government provides national programs of adequate social cushions to protect workers, their families and communities against the hazards of rapid technological change. Shorter standard working hours are required, too, as productivity rises and labor requirements are reduced. Such an environment is needed to make the achievements of collective bargaining and labor-management cooperation in the workplace truly successful.

Organized labor welcomes technological change, as providing the basis for potential benefits for the Nation and all Americans. In the past, American trade unions made technological progress possible. The present advanced stage of technology in the United States stands as testimony to the acceptance of technological advances by the American people and to the cooperative efforts of organized labor.

But organized labor insists that the burdens of rapid technological change must be cushioned, that Government and business must assume their responsibilities to minimize social dislocations and to provide adequate cushions that will protect workers, their families and communities against the hazards of radical technological advances.

In our sense of values, as Americans and as trade unionists, human beings and human welfare are more important than machines and technology. In considering the costs of technological advances, one must include more than the cost of buildings and machines alone. The costs of assisting human beings and communities to adjust to changing technology should be included as an important part of the total investment costs in the new technology.

America needs continuing technological progress. But we cannot and must not permit vast dislocations of workers and their families and disruptions of numerous communities.

An environment of rapid economic growth and rapidly increasing job opportunities is needed, in order to minimize the dislocations of rapid and radical technological change. As technological progress increases production, with less manpower, standard working hours should be reduced, without any cut of weekly earnings. In addition, labor-management cooperation and collective bargaining procedures are required, as well as Government programs, to assist displaced workers, their families and communities in the transition to the new technology.

Rising Unemployment and Part-Time Work

The effects of technological change on employment are connected with the pace of technological change and the rate of economic growth. A rapid pace of technological change and a slow rate of economic growth—as in recent years—results in rising unemployment and part-time work.

In a factory, for example, if new machines can increase production 10 percent with the same work force, a 15-percent rise of sales and production will result in hiring new employees while a 5-percent increase in sales and production will result in layoffs. To prevent layoffs, production would have to rise at least 10 percent or a compensating reduction of standard working hours would be needed.

In the national economy, the problem of adjusting to technological change is greater than in the workplace. The reason for this is that not only is output per man-hour rising, but the labor force is also growing. In the 10 years, from 1949 to 1959, for example, the civilian labor force expanded by 7.3 million persons, an average yearly increase of 730,000.

In the past several years, we have seen the spreading application of radical technological change in an economy whose labor force has been growing, but whose sales and production have been rising very slowly.

Labor force growth and rising output per manhour of work in these past 7 years of rapid technological change have made it possible for the real volume of total national production to increase by an average yearly rate of some 4 percent to 5 percent. Instead of achieving this potential, total national production since 1953 has risen at an average yearly rate of merely about 2½ percent. This suppression of the economy's potential to expand sales and production rapidly has been achieved at the cost of rising unemployment and part-time work, idle productive capacity and an increasing number of distressed communities whose industries have moved to new locations.

The civilian labor force increased 3.8 million between the first half of 1953 and the same period of 1957 and an additional 2.2 million by the same early months of 1960. Employment, however, rose only 2.7 million between 1953 and 1957 and merely 1.2 million between 1957 and 1960. As a result, unemployment moved up from 1.9 million or 2.7 percent of the labor force in 1953 to 3 million or 4 percent of the labor force in 1957 and to 4 million or 5.1 percent in 1960. (See Table I.)

The actual situation has been somewhat worse than indicated by these figures, since most of the rise in employment has been in part-time work. The number of people at full-time work increased only 600,000 between the first half of 1953 and the same period of 1957 and by an additional 100,000 between 1957 and 1960.

In the 7 years, between the first half of 1953 and the same months of 1960, the number of persons at full-time work increased only about 700,000. Farm employment dropped by a million in those 7 years of rapid technological change, while the number of persons at full-time work outside of agriculture increased only 1.7 million. (See Table I.)

It has been customary in recent years to claim that most of the increase in part-time work has been among women, who would not work full time if such jobs were available. The number of women working part time increase 1.1 million between 1953 and 1957, while the increase among men was 900,000.

Between 1957 and 1960, the increase in the number of part-time workers was evenly divided among men and women. It is clear that a significant portion of the increase in part-time work has been among persons who would work full time if there were such available employment. (See Table II.)

The alarming facts concerning unemployment and full-time work point to the economy's failure to generate a significant number of full-time job opportunities in the past 7 years. These facts are further substantiated by the U.S. Labor Department's recent report that the total number of man-hours worked in the entire private economy increased only three-tenths of 1 percent between 1953 and 1957 and declined seven-tenths of 1 percent between 1957 and 1959, so that the total number of man-hours worked in the private economy in 1959 was slightly less than in 1953.

The cause of this stagnation of employment is radical technological change in a period of slowly rising sales and production. Rapid changes in technology resulted in a farm employment decline of a million, between the first half of 1953 and the same period of 1960, while most types of nonfarm employment rose slowly or fell. Technological changes displaced many farm families, at the very same time that technological advances and slow economic growth displaced many industrial workers.

Factory production and maintenance jobs fell by 1½ million in that period, while white-collar salaried jobs in manufacturing rose almost 700,000. But only few displaced production workers were able to transfer to the rising number of manufacturing jobs as engineers, technicians, draftsmen, clerks, and supervisors. While unskilled and semiskilled jobs in factories dropped, railroad employment fell 400,000 and mining employment declined about 200,000. (See Table III.)

The number of jobs in contract construction, telephone and telegraph, gas and public utilities, however, remained relatively the same in those 7 years—they were about the same in the first half of 1960 as in the same period of 1953.

As for other types of private employment, there were significant job increases in the services which rose 1.1 million; in retail and wholesale trade which increased 1.1 million; in finance, insurance and real estate which rose 450,000. Much of the job increase in retail and wholesale trade and the services was in part-time work, usually at low wages—hardly suitable job alternatives for displaced factory workers, farmers, railroad workers, and miners. Furthermore, the job incease in finance, insurance, and real estate was essentially in clerical employment, for which most workers, displaced from factories, farms, railroads, and mines, do not qualify.

The greatest employment rise in the past 7 years has been in State and local governments, where jobs increased almost 1.9 million. While almost all of this rise in employment has been in full-time jobs, few displaced factory workers, farmers, miners, and railroad workers can qualify for jobs as teachers and clerical employees, which account for most of the increased State and local Government employment. (See table III.)

The effects of technological change can be seen more clearly by briefly examining the record of a few industries.

Neither the food nor textile industries are leaders in recent technological changes. Nevertheless, there are continuing improvements in technology in these industries. Between April 1953 and April 1960, production rose about one-fifth, while production and maintenance jobs in the food and beverage industry fell 82,000 or 8 percent. In that same period, with a similar rise in output production and maintenance jobs in textile mills dropped 246,000 or 22 percent. (See table IV.)

In the rapidly growing chemical industry, which is experiencing radical changes in technology, production rose almost 80 percent in these past 7 years, while the number of production and maintenance jobs declined slightly, by 13,000. In this industry, however, there was, at the same time, a rapid expansion of white-collar jobs. Rapid growth of this industry kept down the decline of production and maintenance jobs and provided for the rise of nonproduction employment. (See table V.)

The oil refining and coal products industry is one in which technology is already advanced and continuing to improve. Here there was a production rise of approximately one-fifth and a decline of 32,000 production and maintenance jobs, or 17 percent. (See table V.)

In the basic steel industry, technological changes, at present, are moving ahead rapidly. Steel production was declining last April and was only moderately greater than in 1953, but production and maintenance jobs were down 52,600. As compared with April 1957, 3 years ago, production last April was approximately the same, while there were 38,100 fewer production and maintenance jobs, a decline of 7 percent. (See table VI.)

The electrical machinery industry, which includes the production of automation equipment, is likewise in the midst of radical technological change. Production and maintenance jobs dropped 89,000 between April 1953 and last April, while white-collar, nonproduction jobs rose 136,000. There is no indication from this record that the production of automation equipment is providing alternative job opportunities for workers displaced from other industries. (See table VI.)

Production and maintenance jobs in the auto industry have been declining almost steadily since 1953. In the 7 years between April 1953 and April 1960, such jobs fell 201,800—reflecting the effects of both rapid technological change and sales. In the aircraft industry, technological changes and the shift from manned military aircraft production to military missiles output have resulted in a 169,600 drop of production and maintenance jobs in the past 7 years. (See table VII.)

A faster rate of economic growth since 1953—a much more rapid pace of rising sales and production—would have meant job increases in many manufacturing industries, rather than job decline. In other industries, it would have meant a much slower rate of job declines than occurred. The sharp drop of factory production and maintenance jobs, railroad and mining employment would not have occurred, had the economy's total production risen much faster than the 2½ percent average yearly rate of the past 7 years. The overall decline of jobs in those activities would have been considerably less and a much smaller number of workers would have been displaced.

In addition, a more rapid rate of economic growth would have likewise meant increasing job opportunities, rather than stagnation, in contract construction, telephone and telegraph, gas and electric public utilities. There would have been more full-time jobs for a growing labor force and more alternative job opportunities for the smaller number of workers who would have been displaced by technological changes. A faster pace of rising sales and production would have meant much more full-time employment and much less unemployment and part-time work schedules.

The lesson of the past several years clearly indicates, therefore, that a more rapid rate of economic growth is a basic necessity to provide a proper economic and social environment in which the hazards of rapid technological change can be minimized. The need for a rapid pace of economic growth is particularly great in the 1960's.

The widespread introduction of automatic and semiautomatic machines is speeding up. While the impact of radical technological change in recent years has been most severe in manufacturing, farm, mining and railroads, reports indicate that, in the next few years, the impact may be greatest in clerical work, retail and wholesale trade and the services. Most of the areas of job increases in the past several years, therefore, may become areas of stable employment, or smaller increases in the years immediately ahead. At the same time, technological advances are speeding up in manufacturing and are expected to continue to advance in other types of activities.

The labor force will be increasing at a faster pace in the 1960's than in recent years, while technological advances will probably be speeding up. In the decade between 1949 and 1959, the labor force expanded by an average of 730,000 a year, an annual rate of 1.1 percent. In 1960, the labor force will probably be about 1 million or more greater than the year before—a rise of about 1½percent. During the decade of the 1960's, the U.S. Labor Department expects the labor force to expand by 1.4 million a year, or a yearly rise of about 1.7 percent.

An increasing number of alternative full-time job opportunities will be needed for workers who are displaced by the rapid spread of technological change. In addition, an increasing number of new jobs will be needed for the growing number of young people who will be entering the job market.

The need for a much more rapid pace of economic growth is greater in the 1960's than in the past decade. Rapid and radical technological change, accompanied by a very slow rise of sales and production since

1953, resulted in a sharp increase of unemployment from 1.9 million in 1953 to 3.9 million in 1960. A contined slow rise of sales and production in the 1960's—while the introduction of radical technological change speeds up and the labor force grows at an increased pace—will result in an even greater rise of unemployment, part-time work, and economically distressed communities.

Government and private policies in the 1960's should be geared to a much faster rate of economic growth than in the years since 1953. Full employment and maximum use of the Nation's plants and machines should become the major goals of domestic economic policy. The Federal Government's commitment to promote "maximum employment, production, and purchasing power," under the Employment Act of 1946, should be achieved through national economic policies that encourage a rapid rate of economic expansion and full employment.

As radical technological change spreads, and manpower requirements are cut, standard working hours should be reduced without a reduction of weekly earnings. Legislation, as well as collective bargaining, should produce a reduction of standard working hours, with no reduction of workers' earnings.

A national economic environment of rapid economic growth and rising full-time job opportunities is a basic prerequisite for an adequate adjustment to rapid and radical technological change.

Important Role of Collective Bargaining and Labor-Management Cooperation

A faster rate of economic growth would not be, in itself, a panacea for all problems connected with radical and rapid technological change. It would narrow down these problems to more manageable size. In the workplace, however, there would remain a vast number of specific problems to be solved.

Even in periods of high and rising employment, the widespread introduction of automatic and semiautomatic machines means that some workers may be displaced and others would be affected by changes in jobs and skill requirements.

The new technology usually means the elimination of some jobs, downgrading some skill requirements and upgrading others. For many skilled and semiskilled workers, automation results is making their skills obsolete. The group of workers that has been most directly hit by rapid technological change in recent years has been semiskilled employees—the machine tenders and machine operators of the older technology, which is now passing from most parts of the economy.

Working people and their trade unions are naturally concerned with these problems and are seeking safeguards to minimize dislocations. There are a few readymade answers to the numerous problems that radical technological changes produce in the workplace. Most of these problems have to be solved on the practical basis of the special conditions that exist in the industry, company, plant, or department. Helpful precedents are developing, however, as unions and management grapple with these problems, and these precedents can be general guides toward workable solutions.

Advanced notice to the union of the company's intention to install new equipment is essential to permit joint labor-management planning to schedule the introduction of automation in periods of high employment, to permit attrition to reduce the size of the work force, and to allow time for the retraining of employees. Since expensive equipment is ordered long before its installation, advanced notice can provide the union and management with as much as 2, 3, or more years to plan jointly for the changeover. Such a period of time is of value, however, only if it is used wisely to plan the introduction of the new equipment with a minimum of dislocations and hardship.

Collective bargaining and labor-management cooperation can and should provide safeguards for employees during the transition period—such as fair and orderly procedures governing layoffs, rehiring, transfers, promotions, retraining opportunities, changes of job classifications, and wage rates.

Financial cushions can and should be provided employees who are laid off—such as supplemental unemployment benefits (SUB) and severance pay.

Adequate seniority provisions should assure workers an opportunity to qualify for higher skilled jobs. Fair procedures should be developed to permit and assist employees in retraining for new jobs with changed skill requirements.

Many workers, particularly semiskilled employees, are downgraded in the changeover period, as a result of being transferred from one department to another. Such downgrading may also occur when employees are unable to adjust to new jobs and are shifted to lower rated jobs or when the new equipment makes old skills and job classifications obsolete. Job and wage protections should be developed for employees whose job classifications and skill requirements may be downgraded.

Consideration should be given to methods for permitting and aiding workers whose plants or departments move to new locations—provisions to give workers the opportunity, on the basis of seniority, to change to the new location and financial assistance to aid their families to move to the new area.

Special procedures have to be developed to assist older workers. Many older workers are too young to retire under present pension plans but find it difficult to adjust to the new machines. Efforts to find special jobs may be required for some older workers. Pension plans may have to be changed, through the collective bargaining process, to permit early retirement.

Pension plans may also have to be changed to permit the transfer of pension rights from one plant or company to another within an industry or area, so that displaced workers may receive some protection against the loss of accrued pension rights.

The new technology requires changes in wage structures, as the new machines change production methods, job contents, and responsibilities. New job titles may have to be created. With rapidly rising production and increases in job responsibilities, rising output, and much more expensive equipment, wage rates have to be revised upward. Existing wage incentive systems and job evaluation plans require careful review for possible changes, since radical technological change usually eliminates the basis of old incentive pay systems and job evaluation plans.

Automation increases output per man-hour. Substantial improvements in wages and fringe benefits are needed to spread the gains of the new technology to the great mass of American families. Growing mass consumer markets are required in an economy whose productive ability is increasing rapidly.

As automation increases production, with reduced manpower requirements, shorter standard working hours, with no reduction of weekly earnings, and increased leisure are needed.

An orderly and fair adjustment to radical technological change in the workplace requires genuine labor-management cooperation and joint planning. One recent example of a collectively bargained procedure to develop plans for future adjustments to technological change was contained in the new contract, signed last August, by Armour & Co. with the United Packinghouse Workers and the Amalgamated Meatcutters and Butcher Workmen. The contract, which had already provided for severance pay and other provisions for technological adjustment, now provides for an automation fund committee to study and propose additional and improved methods to assist workers in the adjustment to technological change and shifts in plant location.

The fund, in the case of Armour, is to accumulate a sum up to $500,000, with the financing to be based on a contribution by the company of 1 cent per hundredweight of product shipped from the various plants represented by either of the two unions.

Behind the creation of the fund lay a recognition, which was expressed in the unions' agreement with Armour, that—

> the meatpacking industry is undergoing significant changes in methods of production, processing, marketing, and distribution. * * *
>
> Mechanization and new methods to promote operating and distributing efficiencies affect the number of employees required and the manner in which they perform their work. Technological improvement may result in the need for developing new skills and the acquiring of new knowledge by the employees. In addition, problems are created for employees affected by these changes that require the joint consideration of the company and the unions.

Prof. Robben Flemming, of the University of Illinois, in accepting the directorship of this fund, states:

> Our objective is to set up methods and procedures which will work toward security of employment as the company continues its modernization program. Automation and mechanization will be a problem for a long time and we want to establish some understandings as to what will be done in a given situation. Training programs, transfer possibilities, employer experience, and job opportunities will be studied by the committee.

In many other cases, significant agreements have already been reached on supplemental unemployment benefits, severance pay provisions, retraining procedures, transfer rights to new plants and numerous adjustments of wage structures, job titles, and wage rates. Collective bargaining reports in recent years reveal a wide variety of procedures that are being developed to provide concrete aid for workers and their families during this period of technological changeover.

While it is unfair to expect collective bargaining and labor-management cooperation in the workplace to solve all the problems of rapid and radical technological change, it is not unfair to expect unions and management jointly to develop methods for minimizing the dislocations and burdens of technological advances and for adequately sharing the benefits of such advances. Solutions to the broad national problems related to rapid and radical technology change are beyond the best possible efforts of collective bargaining, alone, or of individual companies, unions, and even industries. But a successful adjustment to rapid and radical technological change requires joint efforts by organized labor and management in the plant, company, and industry, as a necessary part of an overall program to reduce the burdens of technological advances and to aid working people and their families in this period of transition.

In a free society, there is no alternative to collective bargaining between unions and employers for developing workable solutions to the problems of technological change in the workplace. Collective bargaining should be encouraged to strengthen the only available means for voluntary and joint efforts by unions and employers to solve the many problems that arise in the workplace during this transition to the new technology.

The hazards of radical technological change can and should be minimized and cushions to protect workers and their families can and should be provided through collective bargaining procedures and labor-management cooperation.

Community Programs Are Needed

With the spreading tendency of companies to shut down old plants and to build others in new areas, a comprehensive program of Federal Government assistance for economically distressed communities is essential—to aid businesses in such localities to change their production lines, to help attract businesses into such area, and to retrain workers in new skills. Such a national effort is needed to prevent the large-scale waste of private and public investment in homes, schools, community facilities, shops, factory structures, and old family ties.

Relocation allowances, under law, as well as collective bargaining, may be necessary to assist workers and their families to move, if they wish, to locations of new job opportunities.

The new technology frequently makes it less costly for a company to build a new automated plant in a new area than to automate an old plant. In addition, changes in costs that are related to the new technology may convince many companies to move their plants closer to consumer markets or central geographical locations, rather than to remain close to raw material supplies or supplies of semiskilled manpower. Furthermore, radical and rapid changes in technology speed up the decline of some industries and the growth of others, with direct effects on one-industry towns.

These changes result in shifting plant locations and in possible plant shutdowns. For many cities and towns, the removal of several departments from the major industry or the shutdown of old plants, mines, or railroad repair shops result in distress for the entire community.

During these past several years of rapid technological change and slow economic growth, there has been a sharply increasing number of economically distressed communities. According to the U.S. Department of Labor, the number of such communities has increased sharply from 16 major industrial areas and 18 smaller communities in May 1953 to 21 major and 59 smaller areas in May 1957 and to 35 major and 113 smaller areas in May 1960. (See Table VIII.)

In its report for May 1960, the Labor Department states:

> In 20 of the 35 major labor surplus areas, and in 71 of the 113 smaller areas, high unemployment has been a relatively persistent problem over most of the past few years.

In other words, there has been chronic economic distress, according to the U.S. Department of Labor, in 91 industrial communities throughout the country.

A more rapid rate of economic growth would help to solve part of this problem by providing the basis for a slower decline of some industries and for a rapid increase of job opportunities, generally. Federal Government programs of assistance to prevent needless, chaotic declines of essential industries would also be helpful. But rapid technological change will inevitably leave some declining industries and communities.

This problem requires Federal Government action and assistance, since very few, if any, economically distressed communities can possibly revive their economies adequately, without a Federal program of grants and long-term loans at low interest rates. The communities, themselves, however, require planned local community efforts to maintain their economic health and growth.

Such needed community efforts require much more than committees to attract new industries. Joint labor-management-public community committees are needed to prevent community distress before it occurs, as well as to revive declining communities. Economic studies of the communities are needed to indicate the state of the community's economic health and to point to its future needs—which existing industries in the community are likely to decline and to which growing industries can possibly be attracted. In this effort, plant structures and private investment are important, but hardly enough.

It is essential for industrial communities to recognize that their educational, cultural, recreational, and community facilities must be maintained on an adequate level for economic growth. Such community facilities are needed in an attempt to prevent skilled manpower and managerial talent from leaving for other areas. Such facilities are needed, too, to maintain and attract skilled manpower and management and to retrain workers in new skills. This is particularly true in this age of radical and rapid technological change, with its emphasis on education and new skills, on engineers and technicians, on research and development.

Federal Government assistance for such community facilities and for economically distressed communities is needed, but the specific planned efforts must essentially be of a local, community character. Joint labor-management community planning is essential in this period of rapid changes in technology in order to maintain economic health and growth.

A comprehensive Federal Government program is needed

Many specific and localized problems, related to rapid and radical technological change can be handled through collective bargaining, labor-management cooperation, and joint community efforts, assisted by the Federal Government. But the major responsibility for providing adequate safeguards and cushions for adjustments to rapid technological change lies with the Federal Government.

It is the responsibility of the Federal Government under the Employment Act of 1946 to pursue policies "to promote maximum employment, production, and purchasing power." This responsibility should be fulfilled. Only in an economy that is growing rapidly and creating new job opportunities at a fast pace can the dislocations of automation be held to a minimum.

The benefits of the new technology should be shared widely among all groups in the population to raise living standards, strengthen national defense, increase leisure, and improve housing, education, health, community, and recreational facilities, mass transportation, and natural resources.

Substantial improvements in the unemployment insurance system are required to cushion the impact of dislocation on displaced workers and to meet the needs of those whose skills become obsolete and require retraining.

A comprehensive Federal program of financial and technical aid for the increasing number of economically distressed communities is needed.

The social security system should be improved to provide adequate retirement benefits and medical care assistance for older workers.

Federal law, as well as collective bargaining contracts, should be improved to provide a gradual reduction of standard working hours, with no reduction of weekly earnings, as the new technology raises productivity and reduces manpower requirements.

Special efforts should be made to bring an adequate share of the gains of technological advances to low-income families and to eliminate poverty—through such efforts as extension of coverage of the Fair Labor Standards Act to millions of unprotected workers, and an increase in the Federal legal minimum wage to $1.25 an hour, and the establishment of Federal legal labor standards for hired farmworkers.

The Nation's educational system must be greatly improved to provide an adequately skilled labor force to operate and maintain an economy whose technology is rapidly changing. Vocational training facilities, as well as technical skills, are needed to retrain workers in new skills and to train technicians.

A continuing review of the progress of technological change and its social and economic effects should be made by some agency of government. The Joint Economic Committee of Congress is to be commended for its frequent review of this subject. A continuing review is required, however, supported by detailed information that can be supplied by Government departments, business, and organized labor. Such a continuing review of the trends of radical technological advances should provide the basis for possible changes in Government and private policies to sustain a rapid rate of economic growth and to minimize social and economic dislocations.

Above all, the Government should encourage a rapid pace of economic growth. The Federal Government's monetary, tax, and budget policies should encourage a rapid and continuing increase of sales, production, and jobs.

Consumer buying power must rise sufficiently to provide the growing consumer markets that are needed to buy the rising volume of good and services that automated industry and commerce can produce.

Government expenditures for public investment should likewise increase to meet the vast needs for adequate national defense and public services that can be fulfilled from the potential increase in production and in Federal tax revenues, made possible by full employment and the full use of automated plants and machines.

* * * * * * *

America needs the added production that automation makes possible—to provide an adequate national defense; to improve living conditions, particularly of low-income families; to provide adequate public services; to provide financial and technical assistance for the peoples of the less developed regions of the world. Our national and international requirements could well use the additional output of an automated economy.

But the mere existence of automatic and semiautomatic machines provides no assurances that the new technology will be used fully and wisely. America needs government and private policies that will encourage full employment and the maximum use of productive equipment.

The pace of economic growth should be increased substantially above the rate of the past several years. Assistance should be provided to minimize and cushion the hazards of rapid and radical technological change on workers, their families and communities.

I am confident that the problems posed by radical and rapid technological change can be worked out. But the development of practical solutions to these problems requires continuing and vigorous joint efforts of labor, management, and Government.

TABLE I.—*Total labor force, employment and unemployment*

[Average, January-June of each year]

	1953	1957	1960
Total civilian labor force...million..	63.5	67.3	69.5
Total employed...do....	61.6	64.3	65.5
Agriculture...do....	6.3	5.9	5.3
Nonagriculture...do....	55.3	58.3	60.3
Total unemployed:			
Number...do....	1.9	3.0	4.0
Seasonally adjusted rate...percent..	2.7	4.0	5.1
Persons at work: [1]			
Full time, all industries...million..	50.2	50.8	[2] 50.9
Part time, all industries...do....	9.3	11.3	[2] 12.2
Full time, nonagriculture...do....	45.8	46.9	[2] 47.5
Part time, nonagriculture...do....	7.7	9.5	[2] 10.5

[1] Excludes employed persons not at work because of vacation, illness, etc. Part time is defined as employed 1-34 hours per week, full time as 35 hours per week or more.

[2] Includes Hawaii and Alaska. Adjusted to account for effects of Good Friday in employment survey week of April 1960, Lincoln's Birthday in survey week of February 1960, exceptionally bad weather and illness in the early months of 1960. (Adjustment by AFL-CIO.)

Source: U.S. Bureau of the Census and U.S. Department of Labor.

TABLE II.—*Increase in part-time employment by sex*

[Average, January-June of each year]

	1953-57	1957-60	1953-60
All industries:			
Men	+900,000	+500,000	+1,400,000
Women	+1,100,000	+500,000	+1,600,000
Nonagriculture:			
Men	+800,000	+400,000	+1,200,000
Women	+1,000,000	+600,000	+1,600,000

NOTE.—Same adjustments of the number of part-time workers in 1960 as in table I.

Source: U.S. Bureau of the Census and U.S. Department of Labor.

TABLE III.—*Nonfarm wage and salary jobs*

[Average, January-June of each year, in thousands]

	1953	1957	1960
All wage and salary jobs [1]	49,316	51,839	52,552
Mining	858	809	673
Contract construction	2,490	2,700	2,593
Manufacturing	17,275	16,862	16,430
Production and maintenance jobs	13,911	13,014	12,388
Nonproduction jobs	3,364	3,848	4,042
Transportation	2,884	2,740	2,572
Class I railroads [2]	1,193	993	789
Telephone and telegraph	742	807	739
Gas and electric utilities	572	595	598
Retail and wholesale trade	10,367	11,130	11,473
Finance, insurance and real estate	2,006	2,325	2,456
Services	5,457	6,283	6,595
Government	6,662	7,587	8,423
Federal	2,333	2,203	2.229
State and local	4,329	5,384	6,194
Index of weekly man-hours of production and maintenance workers in manufacturing, mining and construction (1947-49=100) [2]	113.7	106.0	99.4

[1] Excludes farm employment and nonfarm self-employed persons and unpaid family workers.
[2] January-April of each year.

Source: U.S. Bureau of the Census and U.S. Department of Labor.

TABLE IV.—*Employment*

IN FOOD, BEVERAGES AND KINDRED PRODUCTS

	Production and maintenance workers	Nonproduction workers
April 1960	953,000	444,000
April 1957	987,000	438,000
April 1953	1,035,000	414,000
1953-60	−82,000	+30,000
1957-60	−34,000	+6,000

IN TEXTILE-MILL PRODUCTS

	Production and maintenance workers	Nonproduction workers
April 1960	864,000	94,000
April 1957	920,000	93,000
April 1953	1,110,000	96,000
1953-60	−246,000	−2,000
1957-60	−56,000	+1,000

Source: U.S. Department of Labor.

TABLE V.—*Employment*

IN CHEMICALS AND ALLIED PRODUCTS

	Production and maintenance workers	Nonproduction workers
April 1960	549,000	329,000
April 1957	556,000	295,000
April 1953	562,000	250,000
1953–60	−13,000	+79,000
1957–60	−7,000	+35,000

IN OIL REFINING AND COAL PRODUCTS

	Production and maintenance workers	Nonproduction workers
April 1960	155,000	77,000
April 1957	168,000	81,000
April 1953	187,000	73,000
1953–60	−32,000	+4,000
1957–60	−13,000	−4,000

Source: U.S. Department of Labor.

TABLE VI.—*Employment*

IN BASIC STEEL

	Production and maintenance workers	Nonproduction workers
April 1960	509,800	110,500
April 1957	547,900	105,400
April 1953	562,400	94,200
1953–60	−52,600	+16,300
1957–60	−38,100	+5,100

IN ELECTRICAL MACHINERY

	Production and maintenance workers	Nonproduction workers
April 1960	862,000	426,000
April 1957	849,000	363,000
April 1953	951,000	290,000
1953–60	−89,000	+136,000
1957–60	+13,000	+63,000

Source: U.S. Department of Labor.

TABLE VII.—*Employment*

IN MOTOR VEHICLES AND EQUIPMENT

	Production and maintenance workers	Nonproduction workers
April 1960	617,000	169,500
April 1957	650,400	154,500
April 1953	818,800	160,000
1953–60	−201,800	+9,500
1957–60	−33,400	+15,000
IN AIRCRAFT		
April 1960	397,100	270,600
April 1957	589,900	302,100
April 1953	566,700	207,100
1953–60	−169,600	+63,500
1957–60	−192,800	−21,500

Source: U.S. Department of Labor.

TABLE VIII.—*Areas of substantial labor surplus*

[Unemployment of 6 percent or more of the labor force]

	January	March	May	July	September	November
1960	31 major	33 major	35 major			
	107 smaller	109 smaller	113 smaller			
1959	76 major [1]	74 major	60 major	46 major	35 major	32 major.
	183 smaller	197 smaller	177 smaller	143 smaller	124 smaller	112 smaller.
1958	45 major [1]	70 major [1]	86 major [1]	89 major [1]	89 major [1]	83 major.[1]
	72 smaller	121 smaller	161 smaller	182 smaller	195 smaller	189 smaller.
1957	19 major	19 major	21 major	24 major	24 major [1]	24 major.[1]
	59 smaller	59 smaller	59 smaller	61 smaller	62 smaller	62 smaller.
1956	19 major	19 major	23 major	23 major	24 major	20 major.
	64 smaller	65 smaller	65 smaller	60 smaller	59 smaller	57 smaller.
1955	44 major [1]	43 major [1]	35 major	31 major	26 major	19 major.
	100 smaller	113 smaller	106 smaller	101 smaller	94 smaller	74 smaller.
1954	20 major [1]	34 major [1]	44 major [1]	53 major [1]	51 major [1]	48 major.[1]
	31 smaller	46 smaller	73 smaller	68 smaller	94 smaller	97 smaller.
1953	18 major	17 major	16 major	16 major	18 major [1]	18 major.[1]
	19 smaller	18 smaller	18 smaller	23 smaller	24 smaller	24 smaller.
1952	18 major	21 major	23 major	21 major	19 major	18 major.
	5 smaller	14 smaller	27 smaller	30 smaller	26 smaller	22 smaller.
1951				14 major	16 major	15 major.
					5 smaller	5 smaller.

[1] Recession months between start of decline and return to prerecession levels of industrial production.

Source: U.S. Department of Labor.

STATEMENT OF WALTER P. REUTHER, PRESIDENT, UNITED AUTOMOBILE, AIRCRAFT & AGRICULTURAL IMPLEMENT WORKERS OF AMERICA

Almost 5 years have passed since the Subcommittee on Economic Stabilization of the Joint Economic Committee, also under the chairmanship of Congressman Wright Patman, commenced its investigations into the impact of automation on the economy of the United States.

In those 5 years, considerable advances have been made in the techniques of automation—much greater, unfortunately, than the advances that have been made in the development of programs to deal with the problems it creates.

In this testimony I intend to use the term "automation" in the same general sense as the subcommittee accepted it 5 years ago. The subcommittee's report stated:

> The subcommittee has * * * used the term broadly. It has been used to include all various new automatic and electronic processes, along with rapid technological advance and improved know-how generally.

In what follows it should be understood that the term "automation" is intended to cover the same broad ground.

At the 1955 hearings I discussed some of the problems that were already apparent in connection with automation. Most of what was said at that time could be said again today, often with increased emphasis, and some of those problems will be referred to again below. However, I do not want at this time merely to repeat what I said in 1955.

Today, we can see much more clearly the impact of automation on our economy as a whole, and I want to commence by looking at this broader aspect—the state of our economy today, the possibilities for future growth which automation now more clearly opens up to us, and the very real problems of large-scale job displacement it has also created.

In its day-to-day activities the UAW has had to face up to these questions of job displacement, not as academic issues, but as stern realities which vitally affect the lives of hundreds of thousands of its members. I should like to say something of what the union has done at the collective bargaining table and in the plants to help solve these problems, of further steps that have been planned for the future, and of those areas in which legislative action also is required.

One of the major problems closely related to automation and technological change is the increase in areas of chronic distress in our country—whole communities that have had their economies virtually destroyed by shifts of industry. These are the areas in which there has been the most serious failure to meet the problems or seize the opportunities created by automation, but as I shall endeavor to show, throughout our whole economy we have failed to use the potential benefits of automation as we could have done, to solve many of the problems which are piling up on us today. Finally, I will discuss specifically some of the policies that the UAW believes our country should adopt to meet the challenge of automation in the future.

ECONOMIC PROBLEMS STILL UNSOLVED

Since the subcommittee's hearings in 1955 the scientists and technicians have been providing us with continuing technological advances, while those already developed have been continually spreading throughout industry and business. Unfortunately, solutions to the problems of production have not been accompanied by equally effective solutions to the problems of distribution. For most of the past 5 years our economy has failed to generate the purchasing power necessary to absorb the volume of goods and services which we have the technologies and the physical and human resources to produce. As a result, we have not even come close to realizing our full potentialities for economic growth. We have not developed as we could the material basis for elimination of poverty among our own people, for the meeting of our social needs along with an adequate program of national defense, or for the provision of sufficiently generous assistance to those of other nations who are still struggling with the absolutes of national hunger and economic hardship, and with the obstacles to democratic progress which those evils create.

Instead, we have suffered our third postwar recession, sharper and more severe than either of the two which preceded it, and economists are almost unanimous in their prophesies of still a fourth decline, differing only as to whether it is likely to begin this year or next.

Even in so-called good times, the tide of unemployment washes higher and higher. When I testified on automation in October 1955 unemployment, after adjustment for seasonal factors, represented 4.4 percent of the labor force. That in itself was a substantially higher figure than is commensurate with our national goal of full employment. But for almost 3 years now the rate of unemployment has been continuously higher than it was at that time. Not in any month since August 1957 have we seen an unemployment figure below that for October 1955—which, incidentally, was the highest month in the last half of that year.

IDLE CAPACITY

Side by side with human unemployment we face the waste of unused physical productive capacity. This year, although we already have gloomy forebodings of troubled times to come, we are supposedly still in the upward moving phase of the business cycle. Yet, as this is written, steel production for the week beginning July 10, 1960, is scheduled at 53.1 percent of capacity. In the automobile industry actual current capacity is difficult to measure because it is so long since the industry has produced at anything like its peak. On the basis of earlier years, however, it would seem conservative to estimate that the industry has a capacity of at least 10 million passenger cars per year. On that basis, the industry for the first 6 months of this year operated at only 76 percent of capacity, and for the full year will probably average about 65 to 70 percent.

For manufacturing industry as a whole, production in May 1960 was less than 1 percent higher than at the end of 1959, when we were utilizing only 85 percent of our available manufacturing capacity, and there has been some expansion of capacity in the intervening 5 months.

The significance of these figures to the study of automation is, we hope, readily apparent. The ability of our economy to meet the needs of the men and women who make it up is to be measured primarily not by the degree of its technological progress—the variety of new and awe-inspiring machines it can produce to take over human functions. The major measure of an economy's success must be the extent to which it utilizes the productive resources available to it, both physical and human, to meet human needs and to fulfill human aspirations. No amount of advanced technological equipment serves its purpose if it is not used—or if its use means only that men and women are left without the employment they want and need.

MAJOR NEEDS ARE STILL UNMET

The greatest tragedy of our failure to make full use of the productive resources available to us is that so many of the needs of our people are still unmet. Millions of families still live in conditions of economic need. According to the Census Bureau, in 1959 there were still 22.7 percent of American families (not counting single persons living alone) with incomes below $3,000. In the fields of education, of health, of housing, in our lack of adequate programs for urban redevelopment, for the recovery of distressed areas, for highways, for conservation of land and water resources and for numerous community facilities, we have achieved far less than our needs dictate. And the help we have extended to other peoples far less fortunate than we, has been but a pittance in comparison with their tremendously greater needs.

PRODUCTIVITY IS ACCELERATING

Automation and technological progress generally provide the physical and technical means by which these needs can and should be met. These means to progress are increasing, not at a linear rate of advance, but at an accelerating rate.

In my testimony before the subcommittee in 1955 I indicated our conviction, supported by statements from numerous leaders of industry, that such acceleration was taking place. I said:

> This great expansion of industrial research, and the flood of routine technological innovations it produces, have been sufficient, alone, in recent years to boost the rate of rising productivity to the extent that past notions of what were normal productivity increases are already obsolete. Technological improvements of this sort, and on an increasing scale, can be expected to continue. By themselves, they would pose serious problems of adjusting our economy so as to provide sufficient purchasing power to absorb the steadily accelerating flow of goods which can be produced with every man-hour of labor.

> Beyond these routine technological improvements, however, we are now confronted with the potentially explosive impact of automation, and we can be sure that this new technology, too, will grow by leaps and bounds.

Since that time, further investigation and analysis have strikingly confirmed the fact of acceleration in the trend of productivity advance. In November 1955 Prof. Sumner H. Slichter of Harvard indicated that in the following 10 years—

> * * * we can look forward with considerable confidence to a more rapid growth in productivity mainly because of the increasing scale of industrial research and the prospective improvement in the art of management.

In 1956 John Kendrick of the National Bureau of Economic Research, a pioneer in the field of productivity measurement, wrote:

> * * * one striking fact stands out: there has been a significant acceleration of productivity advance since the end of World War I as compared with the prior two decades.

Even more specific evidence of a continuing trend to acceleration was provided by Solomon Fabricant, research director of the National Bureau of Economic Research. In the Bureau's 1959 annual report he wrote:

> Also—a fact of great importance—the long-term pace of advance in output per man-hour has been speeded up. It was 22 percent per decade during the quarter century preceding World War I. It has averaged 29 percent since. During the most recent period—after World War II—national product per man-hour has been rising at an even greater rate, 35 to 40 percent per decade. This means, in absolute terms, that a 10-year period sees added to the output of each man-hour of American labor an amount well in excess of the *total* output obtained from an hour of work in most parts of the earth. [Emphasis in original.]

In 1958, in connection with automobile industry negotiations of that year, UAW technicians made a careful statistical analysis of changes in the rate of productivity advance over the past 50 years in the U.S. private economy. The analysis showed a definite, strong trend toward acceleration which had speeded up the trend of productivity advance from 0.9 percent per year as of 1910 to 3.9 percent per year as of 1956, the last year covered by the analysis. A continuation of the trend would produce a current figure well above 4 percent.

BLS STUDY SHOWS ACCELERATION

Last year the Bureau of Labor Statistics published an analysis entitled "Trends in Output per Man-Hour in the Private Economy, 1909–58," and although the presentation was such as to obscure the significance of the findings, the Commissioner of Labor Statistics later stated that in his opinion it did show the presence of acceleration. The study produced a trend curve similar to that developed by the UAW, using data on man-hours worked, which showed a derived trend rate of productivity advance for the year 1958 of 3.9 percent. A continuation of the trend would put the figure currently at 4 percent.

Figures for 1959 which have just been released show that the actual rate of productivity increase for that year was 4.2 percent. What is more significant, in spite of the lagging advance in recent years of economic stagnation, the total productivity advance since the 1947–49 base period has been only 2 percent less than that indicated by the BLS acceleration curve.

What do these figures mean? They certainly do not provide a guarantee that in any given year the rate of productivity advance will be 4 percent or more. In 1958, for example, as a direct consequence of the recession, the rate of productivity advance was less than 1 percent. What the figures mean is simply that on the basis of past experience our economy possesses the capacity to achieve productivity advances at an accelerating rate, and that if the economic policies we adopt are such as to permit full production, we should be able to anticipate a 4-percent rate of productivity advance now, accelerating to still higher levels in the years ahead.

In addition to advances in the rate of production per man-hour, of course, we have a sustained growth in the labor force. This is particularly marked at present as the sharp rise in the birth rate which took place in the 1940's is now beginning to be reflected in a rise in the number of young people reaching working age. The labor force in the past 12 years has increased at a rate well in advance of 1 percent a year, and the demographers tell us we may expect a rate of about 1.7 percent during the coming decade.

OUR ECONOMY SHOULD GROW 5 PERCENT EACH YEAR

These two factors together—a rate of productivity advance accelerating upward from 4 percent a year, and a rate of labor force growth of 1.7 percent a year—mean that in the next decade we have only to order our economic affairs sensibly to achieve an annual growth rate of 5 percent or more in our total production, and still have an ample margin for increased leisure.

This is the picture of what automation and other forms of technological advance can mean for us and our economy.

It opens up wide new possibilities for human and social betterment.

A 5-percent annual growth rate in our national product means that the total volume of all the goods and services we produce can be doubled in just over 14 years. By 1975 we could have a total production of goods and services in the United States worth a trillion dollars—$1,000 billion—at today's prices. Taking population growth into account, this would make possible a personal income after taxes which would average almost $3,000 per year for every man, woman, and child in America, or $12,000 for an average family of four.

It could mean the absolute elimination of poverty in our land.

It could mean greatly improved standards of living, including increased leisure, for every family.

It could mean rapid progress in providing the fullest educational opportunity to every child, based on adequate facilities and a sufficient number of well-trained and well-paid teachers.

It could provide the means to make the best of health care available to all.

It could mean the elimination of slums, the regeneration of depressed areas, and the redevelopment of neglected areas in our cities.

It could give us the means to provide effective assistance to other countries which need help in building up their economies—help which may make the difference between survival or failure of freedom in those lands.

WE NEED POSITIVE POLICIES FOR GROWTH

Automation and technological advance have put all these highly desirable goals within our reach. They have done something more. They have made it not merely desirable, but absolutely essential that we reach them.

A 5-percent growth rate or better can be achieved simply by generating sufficient demand to make full use of our productive resources and provide employment for those who are able and willing to work. This is a major responsibility of government. Alvin Hansen, professor of political economy at Harvard University, wrote in 1943:

> * * * Private business can and will do the job of production. It is the responsibility of government to do its part to insure a sustained demand. We know from past experience that private enterprise has done this for limited periods only. It has not been able to insure a continuous and sustained demand. The ever-increasing gigantic powers of production of the modern industrial system, far exceeding those of any earlier experience in history, mean that an enormous output has to be reached before full employment is approached. Private industry and government together must act to maintain and increase output and income sufficiently to provide substantially full employment.

If we fail to create the necessary demand, we fail to solve the unemployment problem.

That is a very real threat, which automation greatly intensifies.

Automation makes possible a 5-percent growth rate, provided we develop economic policies which will generate sufficient private and public demand to make use of an additional 5 percent of goods and services each year.

If we fail to do so, automation will not mean growing prosperity, but growing unemployment—as it has done, for the most part, during the past 7 years.

This is the problem we must solve.

Our enemies believe we cannot solve it. When Premier Khrushchev says, "We will bury you," he means simply that he believes our economic system will fail to solve the problem of distribution. He believes that we will continue to fail, as we have in the past 7 years, to match or approach the rate of growth achieved in the Soviet Union. He believes it is only a matter of time until Soviet production surpasses ours, and the Communists are able to take world leadership away from us, not by military might but by economic power alone.

If we fail to make proper use of the opportunities which automation offers us, Premier Khrushchev's prophecy could very well come true.

It is our task to prove him wrong.

FAULTY ECONOMIC POLICIES ADD TO AUTOMATION PROBLEMS

In referring to the economic troubles which have beset our country in the past 7 years, I do not want to suggest that automation can be held responsible for them. The cause of our troubles has been that those who have been placed in positions of responsibility have been trying to live and to force our country to live by the economic theories of the 19th century. They have been obsessed with the idea that a balanced budget is more important than a balanced economy. They have clung stubbornly to the belief that the general prosperity can best be served by a system of incentives to the wealthy, by helping the rich to grow still richer so that some of their surplus riches may trickle down to those below. They have rejected entirely the alternative view of modern economists that the only way to assure a prosperous industry is to insure that the demand for goods and services keeps pace with industry's growing ability to produce. They have failed to recognize the true cause of inflation in today's economy, the abuse of the power which is held by a relatively small group of corporations to administer prices without effective competitive checks, and in consequence they have persisted in applying monetary policies which have not stopped inflation but have very seriously checked our economic growth and have been among the major causes of our economic difficulties.

It is perfectly true that automation has helped to accelerate the rate of productivity advance, and to that extent has made it more necessary than ever before that we adopt vigorous and imaginative policies designed to insure the full utilization of our growing productive capacity. But for the most part it is our failure to adopt economic policies suited to our needs that has aggravated the problems caused by automation, rather than automation's having been responsible for our economic difficulties.

The danger that by allowing ourselves to fall into economic troubles we would multiply the problems arising out of automation was foreseen by the subcommittee 5 years ago. One of its findings stated:

> The shift to automation and the accelerated pace of technological change is taking place today against the background of relatively high employment levels and of a prosperous economic situation. Under such conditions, dislocations and adjustments tend to be less painful. Any significant recession in levels of employment and economic activity might very well create new problems and greatly magnify the adjustment pains growing out of increased mechanization. After all, the challenge to the economy in the maintenance of reasonably full employment involves a great deal more than simply finding new positions for those displaced, whether by automation or other cause. Without giving any regard to changing rates of individual participation in the labor force, our work force is increasing at the rate of more than three-quarter million workers each year. If it should become apparent that automation is, on balance, lessening the job chances of these new entrants into the labor force, the appraisal of its significance would have to be greatly revised.

It requires only the most cursory comparison of today's levels of unemployment with those which existed when that finding was written to realize that something is lessening the job chances of men and women in our labor force. In my opinion, as I have said, automation is not the primary cause, but there can be no doubt that the generally higher level of unemployment has made tremendously more difficult the problems of those who are displaced by automation.

AUTOMATION PROBLEMS WERE FORESEEN

In my testimony in 1955 I pointed out that we were fortunate in being able to foresee some of the human and economic problems which automation was certain to create. I felt then, as I still feel today, that far too little was and is known as to what we can expect in the way of new problems created by automation. Our Government, which under the Employment Act of 1946 has a major responsibility for maintenance of employment opportunities, still knows far too little about what is planned by business and industry in the way of technological innovations, or even the planned application of known technologies, to be able to foresee the impact that such developments will have on employment.

We still know too little about what the consequences of automation have been, to what extent workers have been directly or indirectly displaced, what problems they have had in finding new employment, or what special help in the way of retraining or other assistance would have enabled them to find jobs more quickly. It is quite true that the Department of Labor has done a few studies of the impact of automation in specific instances, but the employers who have been willing to cooperate in making such studies possible appear to be those for whom automation has presented no serious problems of worker displacement.

It is quite true also that such groups as the Special Senate Committee on Unemployment Problems, under the chairmanship of Senator Eugene McCarthy, have taken a long and serious look at the very grave problems which have resulted when whole communities have been left without economic roots because of technological change, and have come up with excellent reports on their findings. But here again there is not, as there should be, any official body whose primary and continuing function it would be not only to analyze such situations and recommend continuing programs to remedy them, but to obtain the information as to business plans which would enable it to foresee such situations and prevent them from developing into local or regional disasters.

Nevertheless, even though we did not know in detail in 1955 what future developments in automation were going to take place, it was possible to foresee in general terms some of the kinds of problems that it was bound to create, and some of them were referred to in my testimony at that time. We knew, for example, that development of new machines and new processes was going to result in the direct displacement of many workers, and that frequently their problems would be more difficult than simply finding the same kind of work somewhere else. We knew that there would be a decreasing demand for the services of the unskilled or semiskilled worker, and that such a worker, once displaced, might find it most difficult to obtain a new job unless he were given the opportunity to learn some useful skill. We knew that there would be problems for skilled workers whose particular skills were taken over or made obsolescent by the new machines. We knew that there would be special problems for older workers, too old to learn new skills, often too old to find suitable employment on any terms. We knew that there would be distress in store for whole communities as automation and other technological changes caused industries to shift their locations.

MORE PRODUCTION—FEWER WORKERS

Some appreciation of the large numbers of workers who have been displaced from their jobs through automation and other technological change in the past 5 years can be obtained from overall statistics of industry. When I testified in 1955 I reported that there had already been a decline of 600,000 wage and salary jobs in manufacturing in the previous 2 years. That decline has continued. In 1955 there were 16,563,000 wage and salary workers in manufacturing industries. By 1959, this had fallen by 400,000 to 16,156,000—a decline of 2.4 percent. The index of manufacturing production, incidentally, rose from an average of 145 in 1955 to 158 in 1959. Thus there was a decline of 2.4 percent in employment while production rose 9 percent.

Combined wage and salary figures give a picture of the total number of jobs available in manufacturing industries, but this does not tell the whole story of workers displacement. In addition to the overall decline in jobs, there has been a sharper decline in production workers while white-collar jobs have increased. But relatively few factory production workers have either the training or the opportunity to move to a white-collar job. Thus, it is important in terms of worker displacement to note that between 1955 and 1959 production worker employment in manufacturing declined by 837,000—from 13,061,000 to 12,224,000. The fact that about 430,000 other workers had gained office employment in the industry during the same period was of no great help to those who lost their production jobs.

The same facts can be shown for many individual industries. The automobile industry, for example, in the first quarter of 1960 manufactured 2,382,000 cars and trucks, only 0.4 percent fewer than in the first quarter of 1955. Yet average production worker employment fell from 735,900 to 661,600, a decline of 10.1 percent. Average weekly hours fell from 43.7 to 42. Total wage and salary employment fell from 888,100 to 827,100, a decline of 6.9 percent, representing a loss of 61,000 jobs.

Let me make our position clear. We welcome automation as a major force for growth in our economy, holding forth the promise of increasing abundance for all if we use it wisely and well. But it is necessary to look facts in the face if we ever hope to enjoy the benefits of automation without the cost of unnecessary hardship for those whose lives it dislocates. And when the combination of national policies which hamper economic growth and new technologies which accelerate man-hour productivity results in employment declines and displacement of hundreds of thousands of workers in major industries, it is clear that there is going to be hardship and suffering unless active measures are taken to prevent it. In fact, during the past 5 years there has been a tremendous amount of hardship and suffering affecting millions of American families which could have been prevented and was not because necessary measures were not taken.

CORPORATIONS WOULD TURN BLIND EYE TO PROBLEMS

In this regard I feel it necessary to answer some of the superficial propaganda and public relations material which major employers in the automobile industry have seen fit to place before other congressional bodies investigating unemployment and associated problems, and which they may well place before this subcommittee, also. Last year, for example, representatives of General Motors and Ford appeared before the Senate Special Committee on Unemployment Problems, under the chairmanship of Senator Eugene McCarthy. They cited the increase in the number of their employees over the previous decade or so as evidence to imply that technological change was not really a problem at all and that it was only necessary to give these big corporations a free hand to carry on their business in their own way and temporary problems of unemployment would disappear.

Even as statistics concerning their own companies, the figures they presented told only half the truth. The representative of General Motors Corp., for example, cited an increase of 100,000 in GM's total U.S. employment between 1948 and the first 9 months of 1959. He conveniently neglected to say that between 1955 and 1958, largely as a result of GM's price and profit policies, U.S. production worker employment in his corporation had declined by 128,000 (we do not have equivalent figures for total U.S. employment) and for 1959 was still almost 100,000 below 1955.

This decline was primarily due, of course, to the drop in purchases of motor vehicles, which was in turn related to the 1958 economic recession. But a major cause of that recession was the imbalance in the economy caused by high-price, low-volume policies of corporations like General Motors. A corporation as large as General Motors, with sales totaling close to $10 billion even in a bad year, cannot pretend that its price and profit policies do not have a significant effect on the health of the economy as a whole.

MORE BIG THREE JOBS—FEWER TOTAL JOBS

An even more significant fact, however, which the corporation spokesmen also neglected to mention, was that the expansion of employment in their plants was in fact more than counterbalanced by displacement of the employees of other employers in the industry. We do not have total U.S. employment figures for General Motors for the whole of 1959, but it is safe to assume that it would not be too far off the figure quoted for the first 9 months, 100,000 above the employment level for 1948. The annual reports of the other 2 major automakers show that Ford's total U.S. employment in 1959 was almost 28,000 higher than in 1948, and Chrysler's U.S. employment was about 15,000 higher. Thus, the Big Three together in 1959 had about 143,000 more wage and salary employees in the United States than in 1948. Yet the motor vehicle industry as a whole had 61,000 fewer wage and salary employees in 1959 than in 1948. Thus, if there were 143,000 more job opportunities with the Big Three, there were over 200,000 fewer job opportunities with other employers in the industry, with all that that implies in terms of worker displacement and individual hardship. And as we shall show, loss of a job with one motor industry employer gives no assurance of finding a job with another.

This change has come about primarily through two developments, both of which are closely related to automation. The first is the increasing concentration of motorcar manufacture among the Big Three. The number of car producers of any significance shrank from 10 in 1948 to 5 in 1959, and the Big Three's share of new car production increased from 80.4 percent in 1948 to 90.1 percent in 1959. Automation greatly increases the economies of scale and has undoubtedly raised substantially the minimum volume below which a manufacturer can scarcely hope to produce competitively. At the same time, the increasing frequently of extensive model change and the vast sums spent on advertising and publicity by the major manufacturers make it still more impossible for the small companies to keep up.

The second development has been the increasing integration of parts and accessory manufacture into the operations of the motorcar makers, and the consequent disappearance from the industry of many long-established supplier firms. This, too, has resulted in part from the economies of scale which automation makes possible to the manufacturer who can make the necessary capital investment. Such investment is much more feasible for the motorcar companies, both because of their larger resources and because a car manufacturer can establish a parts plant with a long-range plan of production in mind, whereas the parts supplier is always subject to the buying decisions of the few firms on which he depends.

SOME EXAMPLES OF INTEGRATION

The Ford department of the UAW has listed some of the major Ford parts which Ford purchased from supplier companies prior to 1948 and which Ford now produces for the most part in its own plants.

Bodies and stampings were formerly purchased from three companies. Now all but one body is made by Ford, and that one will be taken into a Ford plant with the 1961 model.

The six-cylinder engine block used to be cast by a supplier. Ford now casts it at a Ford plant.

Automatic transmissions, formerly purchased, are now made in Ford facilities.

Ford used to purchase approximately half its gears. Now, we understand, all of them will be produced in a new Ford plant.

One firm used to supply Ford with 80 percent of its wheels. Ford now makes it own wheels.

Prior to 1950, nearly all Ford's diecasting was done by various supplier firms. Now it is done by Ford.

Smaller parts such as carburetor, shock absorbers, heater shells and motors, windshield wiper motors and instrument panels used to be purchased for the most part from suppliers. Now they are made in Ford facilities.

Similar lists could undoubtedly be prepared for other manufacturers.

We make no objections to these instances of dynamic change in the automobile industry. We have never supported the view that firms which cannot meet fair competition should somehow be kept in business anyway. To do so would be to subsidize inefficiency. It would raise costs to consumers, and in our experience it almost inevitably means that the workers in such failing plants are expected to provide a major portion of the required subsidy by accepting lower wages and less favorable working conditions than the employees of more efficient producers. Our union has on many occasions made substantial concessions to assist employers who were in temporary difficulties, but we do not accept the principle that workers should permanently subsidize management inefficiency.

On the contrary we have always maintained that managements have the responsibility, as one of the costs of doing business, to make provisions that will help to cushion the impact on their employees of technological change or other changes which may lead to unemployment.

WHAT HAPPENED TO PACKARD WORKERS

The nature and extent of that impact in the extreme case of a complete plant shutdown was illustrated by a study prepared by Harold L. Sheppard, Louis A. Ferman, and Seymour Faber of the Institute of Labor and Industrial Relations, University of Michigan and Wayne State University, and published by the Senate Special Committee on Unemployment Problems. The study was based on interviews in 1957 and 1958 with nearly 500 former employees of the Packard Motor Co., whose Detroit plant was permanently closed in 1956. These were mostly older workers, because the younger men had been laid off earlier as the company's business declined. Only about 14 percent were under 40 and over 50 percent were past the age of 55. When they were interviewed, 1 to 2 years later, 22 percent had not been able to find any kind of job at all, and 51 percent had been unemployed long enough to exhaust their unemployment compensation. Of those who did find jobs, a substantial proportion had to accept work at lower levels of skill and with lower rates of pay than they had formerly held. In general, the lower their skill and the greater their age, the longer they were unemployed.

Of particular significance as a measure of the occupational displacement which took place is the fact that out of 173 workers interviewed in 1957, only 46, or slightly more than 25 percent, had been employed by any of the Big Three auto companies, and most of those were among the younger workers. Of the sample, those hired by the Big Three included 58 percent of the men under 45 years of age, 30 percent of those 45 to 54 years, 15 percent of those 55 to 64 years and 5 percent of those 65 and over. Thus, even at age 45, some 70 percent of these experienced auto workers were unable to find jobs with the other auto makers.

This emphasizes the fact that increases in the number of workers employed by any one company, and even data about total employment in an industry, may give only a partial picture of the extent to which workers ar displaced not only from their jobs but from the industry itself.

WORKER PROTECTION HAS BEEN IMPROVED

What can be done and what has been done to protect workers against either temporary or permanent severance from their jobs, or to cushion the impact of unemployment when it does occur? As I said above, our union has long maintained the principle that protection of workers against such catastrophes should be considered one of the costs of doing business. Industry as a whole profits from technological advance and from the general dynamism of our economy, and one of the first charges against those profits should be the cost of reasonable protection for those workers to whom the change brings only loss of a job.

This is not merely a principle which we in the UAW hold, it is one which as far as possible we have put into practice through the provisions of our collective bargaining agreements. We have not yet achieved all that we would like or all that our members need, but we have made progress.

In the hearings of the Senate Committee on Unemployment Problems, referred to above, representatives of all the Big Three made a major point of the steps they have taken to prevent avoidable unemployment in their plants, to provide new job opportunities to workers displaced by automation and to provide financial assistance to those laid off. In some cases they did not attempt to disguise the fact that these measures had been negotiated with the UAW, since they are written right into our bargaining agreements. However, one employer (Ford) attempted to take full credit even for SUB, and none gave any indication of the hard battles, in many cases extending over years, which they had put up in opposition to these provisions before they were finally written into the agreements. No mention was made of the fact that many of them were won only after the Union had been forced to resort to strike action.

SUB PROTECTS WORKERS TWO WAYS

One of the major forms of protection which was pioneered by the UAW, not only against the opposition of the auto manufacturers but against all the propaganda weapons of the NAM and the U.S. Chamber of Commerce, is the supplemental unemployment benefit plan. This plan, as amended in 1958, provides our members with amounts which, when added to unemployment compensation, assure most laid-off workers of income equal to 65 percent of their take-home pay for periods up to 39 weeks. From the time benefits under these plans first became payable in June 1956, through the end of 1959, over $86 million had been paid out of SUB trust funds to UAW members laid off from Big Three auto plants alone. Tens of millions more have been paid under SUB plans negotiated with other employers. Not only have these payments averted much hardship for UAW members and their families, but by helping to maintain their buying power during the recession the payments also made a significant contribution to preventing the decline from going farther than it did, and toward speeding recovery. Similar protection is provided to workers in the steel, rubber, aluminum, and many other industries through plans of the same nature.

Perhaps the greatest benefit derived by workers from SUB plans, however, especially in the auto industry, is their effect in stimulating management to provide increased stability of employment by making unemployment costly to the employer. For many years one of the bugbears of work in the auto industry has been its uncertainty. Workers laid off for model changes might be unemployed for a few weeks, or for months. There were sharp alternations between full employment and overtime in one month and reduced workweeks and layoffs in another. The danger that whole plants might be closed as a consequence of modernization programs added to the instability. That instability has by no means disappeared, but we believe it has to some extent been curbed. A statement made by a Ford vice president before the Senate Committee on Unemployment Problems is, I think, significant. He said:

> In the course of this experience [the expansion and substantial automation of its plant between 1951 and 1957] Ford Motor Co. developed and pursued policies designed to minimize layoffs in connection with the movement of operations, and particularly the difficulties that might confront older workers seeking jobs elsewhere. *These policies had to be developed and carried out, of course, within limitations dictated by the company's need to achieve and maintain competitive costs.* [Emphasis added.]

Later the same speaker referred to improved planning designed to reduce the amount of unemployment at model changeover time.

The particular significance of the above statement, in my opinion, is the importance placed on costs, because the UAW SUB plans have stimulated company efforts to prevent avoidable unemployment, by reflecting unemployment as a cost on the companies' books. Every company policymaker knows that decisions which result in layoffs of employees will result in payments from SUB funds which must subsequently be replaced at a rate of 5 cents per man-hour in added labor costs. In companies where funds have been built up to the neighborhood of 100 percent of maximum funding requirements, this effect can be felt very rapidly, but in all cases company planners know that layoffs mean payouts of funds which will sooner or later be reflected in higher costs.

This was one of the major principles incorporated in the guaranteed employment plan which the UAW proposed in 1955 auto industry negotiations, and was carried through into the supplemental unemployment benefits plans which came out of those negotiations. A corporation's plans, such as the automation programs in the auto industry, are based for the most part on calculations of what will in the long run produce the greatest profit. If those plans also involve, as they frequently must, decisions which can mean unemployment for some of the company's workers, the social cost of that unemployment ought to be considered one of the costs of the program adopted, just as much as the cost, for example, of discarding usable machinery. Only then can we be sure that avoidable unemployment will in fact be avoided. Only then can we be sure that decisions will be influenced by at least a part of the social costs which they involve. And by such means we can best insure also that corporations make an adequate contribution toward the protection of those whose employment is sacrificed for the sake of technological progress.

PROVISIONS TO PROTECT JOB RIGHTS

Over the years we have been able to negotiate numerous provisions in our collective bargaining agreements which protect our members against dismissal in the event of job displacement. These provisions are the worker's frontline of defense against the threat which automation poses to him as an individual. Even the employers who fought most stubbornly against them when we first proposed them now point with pride to the measures they have taken under these provisions as evidence of their concern to cushion the impact of automation on their employees.

For the most part now employees who are permanently displaced from their jobs can exercise plantwide seniority in transferring to other jobs they can do. This eliminates the evil of older workers being dismissed because job requirements in one department of a plant have changed, while another department might be hiring new men off the street.

In areas such as Detroit, where one company may have several plants, our major agreements now provide that a plant which is hiring must give preference to seniority employees of the company laid off from other plants. These employees can now carry with them to the new job the rights to such benefits as insurance, pensions, and supplemental unemployment benefits which they may have built up at another plant.

When jobs are transferred to a new plant, many of our agreements protect the right of workers to transfer with the job if they wish, carrying with them their seniority rights. In addition, some agreements provide that when a new plant is hiring it will give preference to laid-off employees from any other of the company's plants.

Willingness of employers to make such arrangements has been affected by the negotiation in 1958 of amendments to our SUB plans which provide for separation payments, graduated in accordance with length of service up to 30 weeks' full pay, to workers who are permanently displaced from their jobs. Once again, by making loss of employment a cost item on the employer's books, we have been able to increase greatly the employer's concern to maintain employment.

In a period of rapidly advancing technology many problems revolve around the acquisition or updating of workers' skills. Our major agreements have been broadened to help workers meet these problems. Apprenticeship programs, for example, have traditionally provided an upper age limit, typically in the midtwenties, after which an applicant would not be accepted for skilled trades training. We have been able to negotiate the elimination or very substantial raising of this age limit for employees already on company payrolls, so that workers beyond the normal apprenticeable age have an opportunity of training themselves in new skills.

An important protection for the older worker who may find it impossible to adjust to the demands imposed by automation has been the negotiation of flexible pension programs permitting retirement before the normal age. Typical provisions permit workers to retire of their own volition at any time after age 60 with a pension which is actuarially reduced in accordance with the added years of payment, or to retire at company request or by mutual agreement with a pension which until age 65 is double the normal amount, to compensate for the fact that the retiree is not yet eligible for OASI. The latter provision, for retirement by mutual agreement, is commonly applied to meet the problems of workers over 60 in such situations as plant closing or large-scale job displacement due to automation.

In addition, the vesting of pension rights, although not yet complete, affords workers who are displaced with substantial protection of the pension rights they may have earned through many years of service.

FURTHER PROGRESS PLANNED

The substantial progress we have made in negotiating the protection workers need in the age of automation has not blinded us to the fact that many improvements in the present programs are still required. We anticipate that such improvements will be opposed by employers just as the present programs were when we first proposed them. We anticipate also that their opposition will be overcome, and that in future hearings management representatives will be claiming full credit for the advances they now oppose, just as they now claim credit for those they opposed in the past.

Among those features of our proposed collective bargaining program which relate closely to the needs created by automation, strengthening and extension of workers' transfer rights when jobs or plants are moved rank high. Workers displaced by a change in plant location should have the right to transfer to the new location whether or not the same job as they have been doing will be available, provided there is work at the new plant which they can do or can learn to do. This is now the practice under some of our agreements, but should be extended to many more.

Workers transferring to new locations because a company decision has displaced them from former jobs should be reimbursed by the employer for the costs involved in effecting such transfer, including allowances to defray the workers' unusual expenses connected with the move. Many corporations already recognize this principle as it applies to their executives. The principle behind this demand is the familiar one that the company will not make such a move unless it expects to profit by it, that the worker's moving and relocation costs are in fact part of the total cost of the company's decision, that the worker should not have to make a financial sacrifice in consequence of a decision from which his employer will profit, and that by reflecting such costs on the company's books, moves which in fact are not economically sound will be discouraged.

Workers who elect not to transfer should receive adequate separation pay without loss of seniority status. Under present agreements, a worker has to choose between forfeiting all future rights to be rehired if suitable work should become available, or forfeiting his claim to separation pay. We have proposed to the major corporations a formula by which the employee could receive separation pay and still retain his seniority status, while at the same time protecting the employer by provision for reduction of future separation payments by any amounts previously received.

In multiplant corporations, we have made a start at broadening areawide preferential hiring agreements into areawide seniority agreements. Broadening of many seniority agreements within plants is also progressing.

Areawide preferential hiring agreements should also be broadened to cover not merely plants of the same corporation, but other companies in the same industry and area. This would mean, for example, that when a plant is closed because one company cannot withstand competition, or even more importantly when a plant is closed or workers laid off because the major manufacturers have withdrawn contracts from a supplier firm, the employees in those plants would be given preference by other companies in the industry in that area when they are hiring new employees. Such agreements, generally applied, would be of benefit to employers as well as their workers, since by reducing periods of unemployment they would also reduce the drain on SUB funds.

The age of automation requires the establishment of programs under joint union-management control and direction, to train or retrain workers without loss of wages for jobs which will enable them to meet the requirements of technological change. Agreements should also protect against threatened dilution of skills and encroachments on standards of workmanship.

OTHER UNIONS FACE AUTOMATION PROBLEMS

Other unions are also facing and meeting the problems created by automation. Thus, for example, the recent steel settlement provided for establishment of a joint labor-management committee to work out such problems. Recent agreements in the meatpacking industry provide for the setting up of joint union-management committees, financed by company contributions of 1 cent for each 100 pounds of meat shipped. From the funds so established the committees will institute—

> a program of training qualified employees in the knowledge and skill required to perform new and changed jobs so that the present employees may be utilized for this purpose to the greatest extent possible.

The committees will also study other programs, such as extension of transfer rights from plant to plant, and—

> any other methods that might be employed to promote continued employment opportunities for those affected.

COLLECTIVE BARGAINING CANNOT ANSWER ALL PROBLEMS

While collective bargaining has an essential role to play in meeting the problems raised by automation, it cannot provide all the answers. Negotiated programs must function side by side with public programs. Negotiated retraining programs, for example, cannot meet the needs of all workers who require retraining, nor can negotiated relocation programs help the employees of a firm which has gone out of business. In addition, programs similar to those negotiated through collective bargaining will have to be provided for the millions of workers still unorganized. Such programs should include vocational training and retraining for workers in need of new skills; adequate unemployment compensation benefits extended over a sufficient time to enable displaced workers to prepare for and find suitable work without hardship to their families; travel and relocation allowances for those forced to move to new communities; pensions at a reduced age for displaced older workers who are unable to find suitable new jobs; and industrial development and rehabilitation of communities left stranded by the moving of plants.

DISTRESSED AREAS PRESENT SPECIAL PROBLEM

One of the most distressing features of the advance of automation is the spread of areas of chronic unemployment, where industries have either moved out or have sharply declined as a result of technological change. Communities can become blighted for reasons not closely related to technological change, and the distinction matters little if their problems are the same, but in a high proportion of cases the advance of technology can be accorded a large measure of responsibility—whether it be an automobile center such as Detroit, a Pennsylvania railroad town hit by the replacement of steam by diesel locomotives, a West Virginia mining community affected by technological advances in mining plus the change from coal to other power sources, or a New England textile town abandoned by runaway employers when the need to modernize plants gave them the excuse to relocate elsewhere.

Although the number of distressed areas is somewhat less today than it was during the recession, it is still substantially above the prerecession level. When the subcommittee was first considering problems of automation in November 1955, for example, a Bureau of Employment Security survey showed 19 major areas and 74 smaller areas which were classified as areas of substantial labor surplus. As of May 1960, there were 35 major areas and 113 smaller areas listed as areas of substantial labor surplus.

In May 1960 the Bureau made a further classification, within this group, of "areas of substantial and persistent labor surplus," consisting of those areas with 6 percent or more unemployment whose average annual unemployment rate had been at least 50 percent above the national average for 3 of the past 4 years, or at least 75 percent above the national average for 2 of the past 3 years, or at least 100 percent above the national average for 1 of the past 2 years.

The survey showed that in May 1960 there were 20 major labor surplus areas and 71 smaller labor surplus areas which met these criteria and in which, as the Bureau reported, "high unemployment has been a relatively persistent problem over most of the past few years." Thus, the number of areas with a persistent labor surplus problem today is almost the same as the number with any labor surplus problem in 1955. In fact, 14 of the major areas and 43 of the smaller areas with persistent labor surplus problems today were among the labor surplus areas listed in 1955.

AN ADMINISTRATION RESPONSIBILITY

The continuing plight of our distressed areas is a particular responsibility of the Republican administration. One congressional committee after another has investigated the problem, and has reported on the need for assistance. Congress has harkened to those reports, and has voted measures which would have afforded substantial assistance. But congressional action has been repeatedly nullified by the Presidential veto, exercised under the persuasive pressure of those who insist that it would be un-American and subversive to use Federal funds to find solutions to local problems.

The problems of the distressed areas, however, are not just local problems. These pockets of concentrated human misery are the byproducts of a technological advance from which the whole of society has profited. When the economy of a local community is disrupted and destroyed by that advance, the price of such progress should be shared by the whole of society. It should not be concentrated, as it has been through the administration's refusal to act, among the very communities and families hardest hit and therefore least able to defray the cost of recovery measures.

We are quick enough to apply the principle of mutual assistance against overwhelming misfortunes in the case of natural disasters such as tornado and flood. There was no unseemly delay in our dispatch of field hospitals and supplies to Chile in the wake of recent earthquakes and tidal waves.

The communities in our own country devastated by the decline of the industries on which they were based have waited years, however, for the American conscience to respond to their plight.

The special misfortune of the distressed areas has been that they fell victim to a manmade calamity. For according to the peculiar logic of the conservatism which rules administration economic attitudes, natural calamities are met with a vigorous human response, while the adversity caused by human failures must wait for natural remedies.

This logic flies in the face of the actual experience of the distressed areas, which have continued to be plagued by abnormally high unemployment and its bitter consequences long after the "natural" forces of recovery pulled the rest of the country out of recession.

THE HUMAN COST OF ECONOMIC BLIGHT

The testimony of witnesses before the Senate Committee on Unemployment Problems and other congressional panels is replete with evidence of the human cost which technological progress can impose through prolonged unemployment.

There has been so much study and so little remedial action that the patient endurance of the human victims of delay almost surpasses understanding. Congressional inquiry, if it seems at times to be a mere succession of echoes in the void created by the administration's negativism and immobility, at least can serve the function of reiterating the simple facts of human suffering until the national conscience demands an adequate Federal response.

Wherever the committees travel, human suffering lies just under the statistical surface: stagnant communities, broken families, undernourished children, breadwinners whose humanity is daily diminished by a sense of uselessness and futility.

School principals in West Virginia told the Senate committee how unemployment in that State meant hunger, sickness, educational loss for children. Some reports were:

> This has been our worst year as far as children not having clothes and school supplies.
>
> We are unable to operate our lunch program because of the few pupils who can buy lunches. Many of our children are not able to buy the school supplies they need.
>
> Many children have been absent until such time as the parent was able to purchase needed clothing or shoes.
>
> Many students seem to feel a sense of insecurity and the general morale of the school has been lowered. Teachers report that they can sense the feeling of unrest and unhappiness.

In one school, 120 out of 290 children came from homes in which no wage earner was employed. The principal reported:

> Quite often children come to school without breakfast because there is no food in the house. Whenever we discover a condition like this we manage to feed them. Lack of food and respectable clothing causes a bad psychological reaction among the children. Much of the teachers' time is spent in trying to supply the children with necessities.

In Raleigh County, W. Va., 17 percent of the employed heads of families were reported to have had to accept jobs which required them to live away from home. A survey made in 11 schools of the county found that 39 percent of all heads of families were unemployed. Juvenile delinquency was on the increase. A principal reported:

> Children receive little or no medical service, have frequent colds, are poorly clothed, and many are especially in need of shoes.
>
> Our lunch program is not adequate to supply a free or reduced-price lunch for all the pupils who do not have lunches or who have substandard lunches.

In 11 typical schools surveyed, 230 children were getting free lunches, but 433 others, who wanted and were entitled to them, could not be fed without overburdening the program to the point of complete breakdown.

> It is heartbreaking when children we are unable to carry on the program rush home for lunch and return before the lunch period is over at the school and ask the cook if she has any leftovers * * *.
>
> In most needy cases we provide a sandwich and milk in the morning, since many children come to school without breakfast.

In many areas of West Virginia, where mines had closed, company doctors were no longer employed and medical service was no longer available in the vicinity:

> Therefore, illnesses sometimes thought to be minor are treated at home without medical advice, and in many cases this has resulted in more serious conditions. An example of this is the rise in the number of rheumatic fever cases reported. A large percentage of these give a history of strep-throat treated at home without a doctor * * *.

These have been some of the consequences of attempting to treat West Virginia unemployment at home, without the help of a Federal program for area redevelopment.

"GET BEHIND THE STATISTICS"

An unparalleled local and State effort at industrial redevelopment in eastern Pennsylvania has not been sufficient to compensate for job losses due to technological changes in our demand for fuel. The Senate Special Committee on Unemployment Problems found that 54 percent of the unemployed in that area were skilled or semiskilled.

A district representative of the ILGWU read into the record of the committee the letters of men and women seeking work in that area; she implored the Senators to get behind the statistics and do something about the children, the women, and the men in the homes.

> Here we have strong men proud of their families, proud of their abilities to support their families, thrown out of work. A man looks for a job and finds none. His unemployment compensation expires. His wife goes to work, and he stays home and looks after the children.
>
> What happens to that man? What happens to that home? In many cases, he loses self-respect. He becomes demoralized, and the family is broken up * * *.
>
> Must a body of men who paid with their labor, many of them with their health, and too, too many of them with their lives for the industrial development of America also pay with their homes, and their self-respect, and their hopes for the industrial changes which have thrown them out of work?

Chronic unemployment undermines family human relations. The director of the Welfare Department of St. Louis County in Minnesota told the Senate committee:

> In all too many families the stress of unemployment tends to separate rather than to mold the family into a smoother functioning unit. * * * The most important reaction is that there seems to be an increase in the hostile reaction toward one another and also toward society * * * the wife blames the husband for being out of work. * * * In many instances the roles become reversed. In many of these situations, the family is never able fully to recover, to the detriment of themselves and the community.

One of the most shameful consequences of our national apathy toward the distressed areas is that even little children are made victims of our unwillingness to share the price of progress. The Senate committee reported:

> Children in one school were weighed in November and again at the start of their Christmas vacation to measure the effect of the school's hot lunch program. The net gain of between 3 and 5 pounds per pupil was completely wiped out during the Christmas vacation when the children had to eat at home.

In that Christmas story, the whole Nation is weighed and found wanting.

UNMET NEEDS AFFECT US ALL

The suffering and deprivation experienced by communities and families which have experienced concentrated chronic unemployment is perhaps the most moving impressive evidence that for tens of thousands of families automation has meant something very far from the abundance it promises. We have failed to meet even their basic needs. But failure to meet our national needs can be observed in every community.

It can be seen in the teeming slums of every large city and in pitiful areas of rural slums as well, where millions of children have never known what it means to grow up in a good home in a good neighborhood—while residential construction slumps disastrously for lack of customers who can afford the homes they need.

It can be seen in the continuing shortage of school buildings which condemns children in almost every community to the deficiencies and dangers of crowded classrooms in obsolescent buildings, many of them hazardous firetraps. The Department of Health, Education, and Welfare has revealed that it would require a building program of at least 600,000 new classrooms in the next 10 years to clean up the backlog and meet the needs of our growing population; but no program of such magnitude is in sight.

Our failure can be seen in the growing backlog of needed hospital beds. In 1955, when the subcommittee first looked into the problems and promises of automation, the Department of Health, Education, and Welfare revealed that we had a shortage of well over 800,000 hospital beds. Since that time, according to data published in the 1960 Economic Report of the President, we have added only 67,000 beds, not even enough to match the rate of population growth.

We have not met our national needs for safe highways, for modern airports, for programs to conserve our land and water resources.

Most of our cities could add to the list of our needs their requirements for modern public buildings, for recreation facilities, improved police and fire protection, civil defense, adequate roads and parking facilities, water supplies and sewer systems.

As noted earlier, some 23 percent of American families which in 1959 had incomes below $3,000 certainly lack the means to meet their individual needs.

Yet we live in a world where most of the population have far greater unmet needs than ours. We have a moral responsibility, even out of our present wealth and far more so out of our potential abundance, to give them the help which will enable them to build up their own economies to satisfactory levels.

BY REALIZING OUR GROWTH POTENTIAL WE COULD HAVE MET THESE NEEDS

Where are we to find the means to meet these needs?

A more realistic question would be: Why has the wealthiest country in the world failed to meet them with the means already to hand?

The wealth to do so could have been ours if we had simply used our available resources to create it.

As I have indicated above, the accelerating pace of automation and other technological advance and the steady increase in our population have made it perfectly feasible for us to increase our national production of goods and services by at least 5 percent per year.

Since 1953, our actual rate of increase has been at less than half that rate, a bare 2.3 percent per year.

This is the price we have paid for policies which led to rising unemployment and recurrent recession, rather than full employment, full production, and economic stability.

If we had achieved a growth rate of 5 percent per year from 1953 through the end of 1959, our total gross national product for those 6 years, expressed in dollars of 1959 buying power, would have been $292 billion greater than it actually was.

For the year 1959 alone our total production would have been $80 billion greater, $559 billion instead of the $479 billion we actually achieved.

If this extra wealth had been created, it would have meant that in 1959 we could have had $63 billion more in personal income before taxes—an average of $356 more per person, or $1,424 more for an average family of four. This would have made possible about $4 billion more in personal savings.

Corporate and personal savings combined would have made available about $12 billion more for private investment to provide the basis for continuing growth.

With a broader tax base, and without any change in tax rates, the Federal Government would probably have received about $16 billion more in revenues, which could have been used to strengthen our national defense, to meet more civilian needs, to increase generously our assistance to other countries—and to balance the budget.

SMALLER SHARE OF BUSINESS SPENDING DIRECTED TO EXPANSION

One of the ominous signs for the future is that business itself is looking at automation, not primarily as a road to growth, but as a road to cutting labor costs and so cutting employment for a given volume of production. The annual McGraw-Hill report on planned capital outlays, published in Business Week of April 30, 1960, shows that the share of business expenditures planned for modernization is increasing in proportion to the share planned for expansion of production facilities. Normally this development occurs during recessions, but not in periods of upswing.

It is expected that 65 percent—a record high—of all plant and equipment expenditures in 1960 will be for modernization.

After adjustment for price changes, 1960 outlays for expansion of manufacturing facilities will be approximately 40 percent less than in 1957, while spending on automation and other modernization will be about 25 percent greater than in 1957.

Increased emphasis on automation accompanied by a declining interest in expansion means that business has attuned its investment programs to the inevitable consequence of the present administration's economic policies—continued stagnation rather than adequate growth in levels of production, and a continuing rise in levels of unemployment.

HOW WE COULD HAVE REALIZED OUR GROWTH POTENTIAL

How could we have realized our potential 5-percent growth rate?

Chiefly by recognizing in our public and private economic policies one basic fact: that the major problem in our economy in peacetime is not how to achieve production, but how to obtain markets—in other words, how to achieve a level of effective demand for goods and services which will insure that our productive resources are used to optimum capacity, and that business is stimulated to invest in further growth.

Thus, for example, if workers during the past 7 years had obtained real wage increases sufficient to restore the imbalance of purchasing power and to match the potentialities of our economy to advance its productivity at full production levels, their increased buying power would have been a major factor in stimulating demand to full production levels.

If the policies of our administration had been directed more toward meeting the needs of our Nation and less toward efforts—which proved in vain—to balance the budget, production of the goods and services required to meet those needs would have been stimulated. For example, more adequate levels of old age pensions would have meant measured spending by senior citizens—and better markets for the producers of the consumer goods they need. An adequate unemployment compensation system would have helped the unemployed and their families to maintain their buying power; and in conjunction with other measures, might well have meant that less had to be paid out in total unemployment benefits. An effective program to maintain farm income would have helped prevent unemployment in the farm implement industry and others that serve the farmers, while higher living standards for all would have helped to absorb farm surpluses and maintain farm income. More money made available for housing programs, for hospitals, for schools and other needed facilities would also have meant more workers employed to build them and to produce and transport the building materials.

If such policies had been followed we could have achieved full production, a 5-percent rate of growth, and the balanced, prosperous economy which is the one sure means of providing a strong tax base for a balanced budget.

Policies for the Age of Automation

What policies will best help us to meet the challenge of the age of automation, not merely to deal with the problems it creates, but through positive, constructive action to derive the maximum of individual and social benefit from the great possibilities which it opens out to us?

PERMANENT COMMISSION ON TECHNOLOGICAL CHANGE

One of our primary needs, as I have suggested above, is to be much better informed on a current, continuing basis as to the developments taking place every day which may open up new vistas and create new problems. Many congressional committees do an excellent job of obtaining information from time to time on matters of public concern, and the Joint Economic Committee and its various subcommittees are to be congratulated on their outstanding record of thorough, pertinent investigations and imaginative, forward-looking recommendations. However, it would be completely unrealistic to ask a committee or subcommittee to maintain a constant survey of a field so broad and complex as that of technological change. What is needed for that task is a permanent commission on technological change, with the resources and staff required to carry such a heavy responsibility.

Because technological change will continue to have a revolutionary impact on almost every sector of our economy, such a commission should be as broadly based as possible. Its membership should include represesntatives of Government, labor, and management. The Commission would have the duty and be given the authority to gather information on, and to keep under constant scrutiny, developments in such areas of technological advance as automation, major new developments in production processes and equipment, development of atomic and solar energy for industrial use, development of important new materials, and similar innovations, and to make appropriate recommendations to Congress and the President in order to insure that the social gains and the social costs of technological progress are fairly shared, and full employment achieved and maintained.

To function effectively, the commission should be instructed and given the necessary authority to discover, for example, the present and planned extent of automation and the effect it has had and is having and may be expected to have on displacement of workers. Its field of investigation should cover not only direct displacement in plants where automated equipment has been introduced, but the equally important indirect displacement which may have occurred in consequence in competing firms or even in competing industries.

It must study the extent to which workers' skills have been made obsolete by introduction of automatic equipment, and what, if anything, has been done to enable them to learn new skills.

It should study the special problems of older workers who may find themselves prematurely relegated to the economic scrap heap.

It should find out whether sufficient new job opportunities are being created to provide jobs for the millions of young people who enter the labor market without displacing older workers.

The commission should obtain from employers the fullest information as to their plans for technological innovations which will increase productivity, and the anticipated effect of such changes on employment, as well as any plans for moving or closing plants, and should study the probable effect of such plans on the communities affected, and the necessity for programs to counteract such effects.

It should look into the price and profit policies of industry to determine whether consumers and workers are sharing in the cost savings brought about by technological progress.

IMPROVED MINIMUM WAGE

There are numerous measures which are so obviously required that they need not wait upon further investigation. Especially at a time when our economy stands perilously close to the brink of another recession, significant additions to consumer purchasing power are essential if unsold goods are not to commence piling up on the merchants' shelves and in the warehouses. About 70 percent of all consumer purchasing power is distributed through wages and salaries. For the most part, wage and salary adjustments are matters to be determined by free collective bargaining between unions and management. There is one area, however, in which only Congress can act to improve the living standards of several million Americans and their families whose need, among all workers, is greatest. That area is the determination of minimum wage standards, which apply almost entirely to workers who are unable to form effective union organizations. The responsibility of Congress is all the greater in view of legislation now on the books which places serious obstacles in the way of organization among the weak and unorganized.

As this is prepared, final action has not yet been taken on amendments proposed to the Fair Labor Standards Act. Before Congress recessed it appeared probable that once again, as in the past, minimum wage levels would be raised too slowly and coverage would remain grossly insufficient. It should be a primary objective of Congress when it returns to raise the minimum wage level immediately to at least $1.25 per hour, and to extend its provisions to the millions of workers, unable to speak or act effectively for themselves, who require its protection.

REDUCED WORKING WEEK

The Fair Labor Standards Act should also be amended to provide for appropriate reduction of the standard working week as technological advance permits us to take some of its benefits in the form of increased leisure. The previous subcommittee, recognizing the validity of this principle, had some questions as to how soon such action should be taken. It reported:

> For the most part, the industrial witnesses who appeared before the subcommittee were of the view that new and better products would so intrigue the consumer demand that we would see little near-term shortening of the workweek. Some, indeed, foresee a distinct shortage of labor supply as likely if the expected demands for new goods are to be fulfilled. Representatives of labor, on the other hand, while

recognizing that such a choice may have to be made, were rather more inclined to the view that a continued and marked shortening of the workweek is in prospect.

In the 5 years that have passed since those hearings, events have confirmed that the representatives of labor were right and those of industry were mistaken. Not only has there been a rising number of men and women with no employment at all, but for those with jobs the actual amount of work available in a week has declined. By 1958, average hours of work in manufacturing industry were 1½ hours less than in 1955, and even in 1960, for the first 5 months, they have averaged almost an hour less than in 1955.

Unfortunately, these shortened workweeks have not meant increased leisure to enjoy the good things of life, but merely a decreasing opportunity to earn them, and in consequence a decrease in the potential market for industry.

A reduction in the standard workweek without reduction in weekly pay would have meant an increase in genuine leisure along with maintenance of earning power.

It may be argued that the evidence of all our unmet needs refutes the argument for a shorter standard workweek. Historically, however, we have always taken part of the benefits of advancing technology in the form of increased leisure, yet at the same time we have been able to make dramatic increases in our production of goods and services. Prof. William Haber of the department of economics, University of Michigan, has estimated that "in the past, about 60 percent of the increase in productivity has gone into higher real wages and about 40 percent into more leisure."

Certainly, it is impossible to argue that our economy cannot afford a shorter workweek when there are still 5 percent of the labor force for whom no jobs are available at all.

If we had reestablished, or were even moving toward a full employment, full production economy, then it would be realistic to say that we must choose between more goods and services or more leisure, although the abundance of goods that we could produce at full production would make it obvious that we could afford more leisure. In our circumstances today it is not really a matter of making that choice. A shortened standard workweek without reduction in weekly pay would increase employment, increase the total income of workers, increase purchasing power and so stimulate an actual increase in production.

AREA REDEVELOPMENT

With the presidential veto twice applied to measures for assistance to distressed communities, it becomes painfully apparent that this issue can be satisfactorily determined only by another Congress and a new and different administration. But the absolute necessity for such legislation should be taken before the forum of the whole American people and there made plain. Ample reports have been made to convince any reasonable person that there is no possible answer to the plight of these sick and wasting communities but generous Federal assistance. With the shriveling away of their economic roots, most of them have lost the means of restoring economic health by their own efforts. In large part the most distressed areas are found concentrated in States whose total economies have been so undermined that adequate aid from the State level is no longer possible. No source of help is left except the Federal Government.

Morally and economically these communities are the responsibility of all of us. Whether their decline results directly from technological causes, or from other forms of that dynamic change which is an essential feature of our free economy, it is a consequence of the forces which lead ultimately to economic advance and improved living standards for the people as a whole. We cannot turn our backs on the victims of those forces from which we ourselves benefit.

Legislation is necessary which will provide practical assistance, in adequate amounts, to help rehabilitate idle plants and facilities, or to create new productive facilities where necessary, to purchase machinery, to provide loans and grants for needed facilities of a community nature, and to provide for the retraining of workers and proper maintenance for themselves and their families while they are in training.

As a further measure, policies for the placing of defense and other Government contracts and for the location of defense plants financed in whole or part by Government funds should be directed, wherever feasible, toward assisting areas suffering from chronic unemployment. As evidence given before the Senate Committee on Unemployment Problems made very clear, only an infinitestimal fraction—less than one-half 1 percent in fiscal 1958—of defense procurement contracts have been placed under the policy of aiding distressed areas. In fact, it was revealed that a provision of the Defense Appropriation Act actually prohibits the payment of any price differential on such contracts for the purposes of relieving economic dislocations. The fact that total gains to the national economy and even to the Federal budget resulting from the relief of economic dislocations might far outweigh the cost of such a price differential is given no weight whatever. In that regard I would repeat to this subcommittee the recommendation that I made to the Committee on Unemployment Problems:

> I would urge your committee to consider seriously a recommendation for amendment of the Defense Appropriation Act to provide that within a strictly limited margin, and with ample safeguards against profiteering by any contractor, the Defense Department be permitted to pay a reasonable differential in price specifically for the purpose of placing contracts in areas where they will help to relieve economic dislocations.

In the same way, where a contract is such as to require the building of a new plant, procurement policies should provide that if an area of continued heavy unemployment is otherwise suitable, it should be given first choice as a location for such plant.

INDUSTRIAL REDEVELOPMENT

One of the problems arising out of automation is that industrial sites which were formerly satisfactory may no longer meet the needs of more modern industries. For example, automated plants very frequently function most efficiently when built on a single level, and therefore require a much greater area of land than the old-style multistory plant. In consequence, a firm which has decided to automate may change location and leave behind it a site which no longer meets present industrial requirements even with the old buildings removed, and an area of industrial blight is created in what may be an otherwise healthy community. Loans and grants to such communities which would enable them to put together such areas in parcels of useful size and otherwise develop them for modern industrial use would be well repaid in the economic benefits thus created.

HIGHER FEDERAL STANDARDS FOR UNEMPLOYMENT INSURANCE

Even if we solve problems of chronic unemployment in our economy, technological change is always going to mean that some workers will be displaced from their jobs for a shorter or longer time and will require unemployment insurance protection. To the extent that we fail to solve our chronic unemployment problems, that need is so much the greater. Here again, we believe that the overriding principle should be that unemployed men and women are the innocent victims of a process from which most of us benefit, and that we have no moral right to turn our backs upon them. The experience of the last recession proved the gross deficiencies of many of our existing State unemployment compensation systems as to duratiton of benefits, amount of benefits, eligibility requirements, and disqualification provisions. A particularly vicious form of interstate competition to keep unemployment insurance costs down, regardless of the inadequacy of the laws, is fostered by large sections of industry. In consequence, only one of the States has established a program which meets even the inadequate criteria that have for many years now been urged upon them all by the administration.

We call once more, therefore, for the enactment of additional Federal standards which will extend duration, raise benefit levels to an adequate proportion of earnings, and remove present restrictive eligibility requirements and harsh disqualification provisions.

STRENGTHEN EMPLOYMENT SERVICES

Even in an economy of general full employment, automation will frequently involve large-scale displacement of workers from their jobs. In order to reduce both the loss to the individual and the loss to the economy of any unnecessary prolongation of his unemployment, our employment services should be strengthened in every way possible.

One of the obstacles to an adequate employment service program is the antisocial employer who refuses to cooperate with the State employment service by listing with the service job vacancies he may have. Public employment services have been organized as a means of bringing order and efficiency into the labor market, by matching available workers to suitable vacant jobs and thus minimizing their periods of unemployment. The effect of refusal by employers to list job openings with the employment service, coupled with requirements under State unemployment insurance laws that workers must be "actively seeking work," means that workers are put to unnecessary sacrifice of time and money visiting plants where there may be no openings, that their periods of unemployment are unnecessarily prolonged, that the employment service is hindered in placing applicants, and so the cost of unemployment compensation to all employers is increased. A suitable method of discouraging such practices would be an amendment to the existing Federal law which would require every employer to list job openings with the public employment service or else pay the full amount of unemployment compensation tax provided for in the Federal law, without any so-called merit rating tax reduction to which he would otherwise be entitled.

SPECIAL NEEDS OF DISPLACED WORKERS

Because of changes in the kinds and levels of skill that it requires, automation frequently presents special problems for the worker who is displaced from his job and finds that no other employer requires his particular abilities. To help meet these problems and avoid the waste of idleness, we recommend Federal assistance for programs of vocational training and rehabilitation, including adequate payments for support of workers and their families during training. Where displaced workers are too old to learn new jobs or to find suitable employment, early retirement should be possible. The Social Security Act should be amended so as to provide, with suitable safeguards, for early retirement of workers for whom there is clearly no opportunity of further employment on account of their age. Such amendment might provide, for example, that after a given age any person who has been unemployed and registered for employment for a given period of time, and who is certified by the State employment service as unlikely to be reemployed because of age, would be permitted to retire with full pension rights payable immediately. It would not be unduly costly. In most cases it would probably relieve some other agency of the cost of maintenance, and it would give such older workers a measure of economic security to which they are morally entitled.

ASSISTANCE TO WORKERS IN RELOCATION

Where local job opportunities are insufficient, especially in chronically distressed areas, assistance in relocation should be provided for workers and their families. In many cases assistance of this kind would be most helpful, both to the workers affected and as a partial solution to a local problem.

I would warn, however, that it must be handled with the greatest of care, to avoid even the appearance of any undue persuasion. For many workers, moving is no solution at all. It is no easy matter to sever family ties and roots in the community formed over long years of residence and participation in community and church activities. Those who own their own homes will be forced to sell those homes in a depressed market, and if they are moving to an expanding community will probably have to buy in an inflated market. If they have children of school age, those children face additional problems of adjustment.

In most cases, any attempt at wholesale removal of workers and their families from a community would also involve a tragic waste of community investment in public facilities of all kinds. It could involve creation of new serious economic problems for local retail and service business and professional men and women if the local population is drastically reduced.

For many workers, however, particularly younger persons who have not yet struck deep roots in the community, moving to an area of greater opportunity may represent the easiest and most satisfactory solution to their individual problems, while at the same time it relieves some of the pressure on the local labor market. I would urge, however, that any program of financial assistance to those who wish to move must contain adequate safeguards to insure that no worker is induced to move against his will and, where alternatives are feasible, that no community is endangered by the loss of an undue proportion of its working force.

STRENGTHEN COLLECTIVE BARGAINING

As has been indicated above, effective trade unions have been able to work out solutions to many of the problems of automation at the collective bargaining table, and we shall continue to do so. We believe in the principle of settling questions of this kind at the bargaining table whenever possible.

Trade unionism is an essential element and instrument of democracy. It carries the democratic process into the workshop, and insures that when problems arise both management and workers will have a voice in finding the answer to them.

However, if trade unions are to play a fully effective role in helping to work out democratic solutions to the problems raised by automation, it is time for Congress to take another look at some of the labor legislation it has enacted. The right of workers to organize and to bargain collectively through representatives of their own choosing is now greatly hampered, and too often effectively nullified.

We must return to the basic principles originally embodied in the Wagner Act, which recognized the role of trade unions as part of the essential machinery of a democratic society, to be actively encouraged, rather than as an annoyance to employers, to be merely tolerated, grudgingly conceded, or effectively frustrated.

Congress must be alert to resist further encroachments on collective bargaining rights which would restrict the right of unions to bargain on some of the most important questions raised by automation. Senator Dirksen has introduced a bill, for example, which would remove from the area of required collective bargaining "the creation or discontinuance of positions." Its passage would deny to unions the right to bargain on practically all the vital issues raised by adjustment to automation.

IMPROVE EDUCATIONAL OPPORTUNITIES AND FACILITIES

The spread of automation underlines the need for improvement of our educational facilities, both through school construction and through grants to help raise teachers' salaries to levels consonant with the skills and responsibilities demanded of them, and for extension of educational opportunity through a Federal scholarship program.

One of the effects of automation is to eliminate many of the unskilled jobs for which no extensive educational background was required, and to increase demand for both blue-collar and white-collar skills. Beyond that, reduced manpower requirements for production of goods should give us the opportunity to educate more students to provide the professional and technical services of which there is an undoubted shortage in many fields.

Nor should our educational program stop short at consideration of practical needs. The age of automation will be an age of increasing leisure, and it should be an age of increasing cultural opportunity. Facilities for increased study of the humanities should be considered just as important as facilities for technical, vocational, and scientific education.

Increased facilities for the constructive use of leisure time will also need to be provided or expanded. Facilities for adult education, for study groups, hobby classes, art and music appreciation, improved libraries, as well as more national parks and other facilities for relaxation will help many men and women to live fuller and richer lives in the age of automation.

Meeting these needs will require more schools, more and better paid teachers, and more financial aid to young people whose own families do not have the resources to finance extended education. In devising programs to provide these necessities, one factor which should be taken into account is the special need of some minority groups in our country, and particularly the Negroes. Not only in the South but in many parts of the North also, large numbers of colored children are crowded into obsolescent, understaffed schools where in practice the educational opportunities offered them are far inferior to those available to other parts of the community. At the same time, a high proportion of them come from families whose low income makes any thought of higher education virtually impossible. It is high time we recognize the disadvantages to which a large proportion of Americans are subjected, and developed programs specifically devised to assure them full equality of educational opportunity.

POLICIES FOR FULL PRODUCTION AND FULL EMPLOYMENT

The above recommendations are intended for the most part to deal with the immediate problems arising out of automation. But if we are to meet its real challenge we must adopt policies which will make full use of the possibilities of automation to achieve an optimum rate of economic growth under conditions of full production and full employment.

The essential quality of such policies is that they must be designed to meet the needs which are still unmet today. In meeting those needs we shall make demands upon our productive capacity which will provide jobs for the unemployed and stimulate new investment. Programs to raise the incomes and protect the health of our senior citizens, to increase educational opportunities for our young people, to clear away the slums and build the decent homes we need, to build more schools and more hospitals, to improve our highway system, to conserve our natural resources, and to meet more fully our responsibilities abroad, all can contribute to economic growth while at the same time helping to meet needs that should be met.

Automation intensifies the need for such programs, because the same machines which hold within themselves the possibilities of creating abundance if we plan wisely how to use abundance, can also create increasing unemployment if we plan badly or fail to plan our course at all.

The American economy has always been a dynamic one, constantly changing. In economic life those who have been able to foresee the trends of the future and change their thinking with changing times have been those who have become leaders. In the areas of public responsibility we require today more than ever the same flexibility, the same vision, the same imagination. The challenge of automation cannot be faced by looking to the past.

The passage of events makes it increasingly clear that automation will present us with increasing problems. The solutions to those problems will not always be easy to find. They will require courage, determination, and above all a willingness to blaze new trails where the old roads have led us to obvious dead ends. These are the qualities we have a right to expect in our leaders. These are the qualities we must find if we are to meet the challenge, if automation is not to become an unguided monster leaving hardship and suffering where it passes by, but a tool which we can use to create abundance for all.

STATEMENT OF JAMES A. SUFFRIDGE, PRESIDENT, RETAIL CLERKS INTERNATIONAL ASSOCIATION

AUTOMATION IN RETAILING AND DISTRIBUTION

The significant role that automation can and does play in retailing was underscored recently when the authoritative Journal of Retailing published a special number (Spring 1959) devoted entirely to developments in automation in retail distribution. Throughout the issue the advantages of automated installations were highlighted and its possibilities were carefully emphasized. Yet the editors seemed to decry the fact that retailers were not moving as fast as they might in this area.

Electronic equipment, said the writers, could replace large pools of clerical help; customer billing could be speeded up; sales forecasting improved; compilation of financial data advanced; inventory control put on a sounder basis; credit analysis made more scientific; and the timeliness and accuracy of merchandising data enhanced.

SELLING FLOOR AUTOMATION

Naturally enough, these devices are intended to improve the conduct of business management. What of the selling floor? Presumably there was less opportunity for automation here. Yet it was admitted that demonstration equipment and vending machines could simplify selling and that electronic devices could be employed to transmit data on transactions from the point of sale to a central office. Somewhat euphemistically, management authorities explained that these devices were intended to lighten the work burden for salespeople.

Unfortunately, things have not worked out quite that way. The work force in retailing has been reduced and evidence is available to show that the remaining work force, especially full-time employees, now must bear a heavier burden of work. Cash register wrapping and stock duties are assigned to sales persons as fast as devices can be introduced to shorten the time of other nonselling operations. The salesperson becomes a combination worker giving a substantial part of his time to nonselling duties.

As the Journal of Retailing stated, it is the objective of technical advances to encourage simplified selling, a process which includes preselection of prepackaged items in departments converted as much as possible to self-service. That automatic devices are employed mainly to reduce personnel was admitted by one writer in the Journal of Retailing:

> The main attraction * * * is that they [automatic devices] provide a further retreat for the retailer from the expense and problem of personnel. The salaries, uniforms [for elevator operators] and fringe benefits are eliminated * * * (p. 19).

This indeed is a candid statement of the ultimate objective of introducing advanced equipment into retail operations.

The same writer predicted for a department store of 1965:

> The customer walks through an invisible curtain of air and passes from the 95° temperature outside into the 75° temperature inside. She takes an automatic elevator to the sixth floor, where she goes to the housewares department which operates on a self-service basis with checkout counters. She selects a coffeemaker from a merchandise gondola and takes it to the checkout counter, deciding to charge it and have it delivered. Unknown to her, the sales register receives authorization for the charge (as a result of the cashier putting her charge plate in a special slot in the register) and sends complete information about the transaction back to a computer which updates her account and includes her purchase in all sales and stock control reports being currently compiled of the day's business * * *.
>
> Our customer of 1965 boards another operator-less elevator and goes to the first floor. She stops at the men's furnishing department on her way out of the store and buys a shirt for her husband from one of the vending machines which sell the fastest moving sizes, colors, and brands of men's shirts. She charges her transaction by placing her charge plate in the special slot in the machine. This action on her part causes all information concerning the transaction to be electronically relayed to the sales audit, accounts receivable, and stock control departments * * *.
>
> On the way to the garage where her car is parked, she stops in the lobby of the entrance to the store and purchases a pair of hosiery from a vending machine which takes her currency and returns the proper change.

Developments in selling floor automation suggest that this may well be the picture for department stores in 1965 and perhaps even earlier. Whether or not the full benefits of selling floor automation, continued our writer, are enjoyed by retailers in the immediate future depends upon their ability to visualize the possibilities for cost savings and their willingness to act decisively to exploit the benefits of selling floor automation.

There was not a word in this prediction concerning those human beings who may have spent two or three decades of their creative, active lives in the retail business. Surely, there must be something callous in this seizure of opportunity without concern for human beings.

Automated devices may very well flood retailing, materials handling, and distribution within the immediate future. While there are many areas in which the engineers have not yet found practical ways to apply automation and electronics to merchandise management, and progress toward that goal may have been somewhat slower than anticipated, the evidence that we shall present indicates that it is steady and increasing.

COMPUTER CONTROL SYSTEMS IN RETAILING

In the past 2 or 3 years progress in retail automation has been limited mainly to the application of electronic data processing and automated devices to accounting and control operations. Tangible savings of 10 percent or more in these operations have been attained. Moreover, as retailers become aware of the possibilities of these techniques, engineers will come forth with devices that can be used directly in merchandising. In fact, in the food sector this has been manifested to a marked degree.

Naturally enough, it is to be expected that the introduction of automated devices will first reveal themselves in the larger enterprises. At the moment large stores and chains make considerable use of automated techniques in warehousing and materials handling. Elaborate systems of conveyors, pallet lifts, and monorails are being installed in department stores and supermarkets, indicating that retailing is catching up to industry in the techniques for the handling of goods.

One of the problems that retailers need to overcome is the lack of sufficient flexibility in some of the mechanical systems. Department stores, particularly, stock thousands of items in containers of varying size, shape, and weight. Yet goods handling has been perfected in a number of department stores and specialty operations so that merchandise can be moved through conveyor belts and monorail tracks from the delivery platform to the selling floor. One such case is the well known Alexander Department Store operation in White Plains, N.Y., which we described in our testimony before this committee in November 1957.

Another concern, Joseph Magnin Co., of San Francisco, installed mechanization in its department store operation as far back as 1952 and has reported that this allowed for expansion of its operations with only a fraction of the clerical manpower that would be needed under a manual setup. Merchandising information was obtained which the company did not previously possess and the drudgery of routine work was eliminated with tasks done faster and more accurately.

The company started its mechanization program in the accounts-payable department, then added sales audit functions to the operation, and as a third step began to integrate merchandising aspects into its mechanized system.

The operation begins at the order level with the use of an order form designed by the head buyer. Copies of the form are made in quadruplicate: The original is used as a unit control form while single copies go to the vendor, marking department and the New York office. The next step is to make a key punchcard from the order and run the card through the electronic computer for extending and calculating markups. The card then goes to a tabulating operator for preparation of a daily list of orders. When the incoming merchandise is received, a four-part punch price ticket is made from the vendor's invoice after the latter has been checked against the order. One part of the ticket is retained for the store's receipt records and the other three are left on the garment until sold. At the time of sale one part is removed to record the transaction and the other two are left on the garment in the event it must be returned. From the sales cards listings are made up which summarize statistics for buyers. Listing sheets are posted to unit control records for retail extension and invoices. Thus, effective control is maintained of the merchandising aspects of the operation through the use of punchcards and tape systems.

Now, this may seem to be nothing more than a mechanical application of ordinary merchandising methods. Yet it is encompassed in the broad meaning of the term "automation." John Diebold, the acknowledged father of automation in this country, has defined automation as follows:

> "Automation" is a new word denoting both automatic operation and the process of making things automatic. In the latter sense it includes several areas of industrial activity such as product and process redesign, the theory of communication and control and the design of machinery ("Automation: The Advent of the Automatic Factory," New York, 1952).

In its broadest sense, therefore, automation can be defined as mechanization or rationalization plus electronic controls including variety of sensory apparatuses, feedbacks, computers, memory drums, closed loop or surveillance systems and the like.

ECONOMICS OF RETAIL AUTOMATION

In this sense the advances now being made in materials handling and retail operations can be described as automation, for these fall into the category of process redesign and control of operations. The underlying conditions of mass purchasing power, relative labor scarcity and high operating costs are well known. In retailing, these factors are supplemented by the existence of suburbia, mass transportation, refrigeration, and an industry which has exhibited a steady growth pattern since 1950.

We would agree that advances in the field of automation are limited in any area by certain factors. These would include the level of progress, adaptability of devices to a given process, cost factors, and the kind of services or materials handled. But given the kind of progress now being made in the development of sensory apparatuses and electric response equipment, automation has proven feasible in certain key areas of distribution, especially materials handling, prepackaging and the like. The human response in retailing is being eliminated and for it, electronic connections are being substituted.

For example, Certified Grocers of California has successfully adapted two complete Datatron computing systems and allied equipment which have proven valuable cost savers. Certified Grocers was the first large wholesaler to purchase electronic equipment for use in its materials handling operation. Nonfood ordering, accounting, and billing is handled on a completely automatic basis. With the computer system over 1 million file cards were relegated to the bonfire. Inventory records are maintained on magnetic tape, thus ending the need for more than 2¼ million cards. By relying on the machine for routine computations, buyers are released from engaging in detail work and can give attention to policy decisions.

In addition, Certified Grocers is providing its retailer members with additional services so that analyses of purchases can be made to provide members with turnover figures. Certified envisions a completely automatic order-filling system in its warehouse operations controlled by computer equipment. The computer processes retailers' orders through the use of photoelectric cell scanning devices that read the orders and electronically relay the information to the computer. About 1,200 order per day, involving from 175,000 to 200,000 cases of merchandise, are handled for the 1,450 retail member markets. The entire inventory of Certified is impressed on a 2,500-foot roll of tape.

The system requires an operator at each of the two control consoles. One service engineer is on hand in case of breakdowns. The machine keeps running all night on routine operations without a console operator.

The Safeway Co., one of the Nation's largest retail food chains, has streamlined its operations with the installation of a medium-sized electronic computer at its national headquarters in Oakland, Calif. The installed equipment is used to keep a running record of the 300,000 to 500,000 pieces of equipment installed in stores, warehouses, and plants throughout the country. Equipment at each location is updated by changes on a perpetual basis. A unit and dollar sales analysis of private brands as compared with other brands is maintained. In addition, a 4-week profit-and-loss statement for each division covering sales, tonnage, gross profits, expenses, as well as comparison figures for the same period a year ago, is obtained quickly by virtue of this installation. Sales of meat and produce by pounds are analyzed without difficulty.

None of these installations is costly. In fact, in retailing and distribution it would be impracticable to install the really large computer systems. But the medium-sized and smaller operations nevertheless work quite effectively. For example, last year R. H. Macy arranged with the National Cash Register Co. for the first major installation of automated equipment in department stores. This is currently being developed and is due to start in 1961. Initially, the system will speed Macy's customer account recordkeeping. By punching a few buttons on keyboards, operators will be able to register each of Macy's 40,000 daily charge sales on tape which will be later fed to the computer. This will sort bills, total them, and prepare the bills for customers, registering return payments. It is expected that the National Cash Register system will be extended to include inventory control, providing daily reports on everything in the stock, and ultimately increase the company's return on investment by 10 to 15 percent.

This operation is to be built around an all-transistor NCR–304 computer fed by 40 other machines. Installation will be used mainly for statements and billings. It is said that this system will solve one of the major problems of present-day cycle billing systems, namely, the difficulty of balancing billed and unbilled accounts to the control total on the general ledger. When the customer makes the purchase or payment, the information will be recorded on punched paper tape. The data-processing system will automatically enter the transaction from the tape and produce the customer's statement. The system will be able to handle in 1 hour punched tape containing information on

300,000 sales checks with a single manual operation. Computer and feed machines will maintain daily totals for the accounts, enabling the store to balance individual accounts with control totals. Macy's expects to program operations for accounts payable, payroll, merchandise statistics, sales, and the like. The company says that it is going into this automated process because of a "tight clerical labor market."

AUTOMATION FOR SMALLER RETAILERS

More and more we find that medium-sized computer operations are being adopted in the distribution field. Roundey's Inc., of Milwaukee, Wis., employs 205 employees and has $30 million in sales. The firm supplies a full line of grocery store merchandise to some 350 stores in Wisconsin. Over 4,000 items are maintained on inventory in a large warehouse. Previously, to keep track of inventory and customers, Roundey's used the so-called tub filing system, which is a large open storage bin of punched cards. When a customer phoned in an order, his old card, with an itemized list of accounts receivable to date, was withdrawn from the tub and replaced with an updated card. A similar change was made in an inventory card.

With the installation of a computer system, the new order and customer's name are simply punched on a fresh single card which is fed into machine. The computer then updates the customer's account and inventory status and stores both in a magnetic memory drum. The company realized savings not only by reducing the size of its inventory and reducing the number of out-of-stock items but in staff as well.

Factory Motor Parts, Inc., of San Francisco with $3½ million in sales and 64 employees switched from ordinary punched card system to a computer device in 1958. While the computer installation costs $5,200 a month rental as against the $3,700 for the punched card equipment it replaced, the additional cost has been offset by a reduction of six persons in the clerical staff.

The fact is that computer systems of various sizes are available to firms in the retail and distribution field which do not require heavy investment and expensive equipment. Allen Harvey of the Dasol Corp. has remarked that small firms can reap the benefits of automatic data processing. He states that virtually any concern can install a system involving computer equipment that will satisfy its specific needs and at the same time be economically feasible. Of course, this means careful investigation of whether a retail chain can afford to move into the area of electronics. A choice needs to be made among a rather bewildering variety of available equipment.

One authoritative economist, Wassily Leontief of Harvard, has estimated that on the average the cost of automation is only about 6 percent of the total cost of a plant. Moreover, with present knowledge and the relatively smaller capital investment, as compared to past years, automation can be introduced more rapidly. Even if the cost of automation goes up to 20 percent, this does not present too great a burden on the giant firms now found in retailing.

Thus, continued advances are being made. For example, shoe chains are adopting point-of-sales data input devices whereby cash registers create a punched tape with details of every transaction: variety chains are working on ordering systems based on a universal code which identifies each item, involving print-punch tickets; drug chains are installing computers for merchandising purposes; department stores continue to experiment with point-of-sale devices; apparel chains are using computers in merchandising and inventory control and in preparing documents relating to charge accounts; mail order concerns utilize computers to control warehouse inventories and to produce order-picking sheets and store invoices; food chains are experimenting with installations which produce punched paper tapes representing the daily order of perishables so that the data can be transmitted by wire to the company's regional distribution center; and a number of retail concerns are putting into operation merchandise control and reordering systems based upon the use of a three-part, full-sized punchcard.

The General Shoe Corp. which has a large number of retail outlets, places perforated standard punchcards in shoe boxes as a first step in applying electronics to merchandise control and reordering. General Shoe began to investigate electronic methods as early as 1951 and by 1956 had worked out its automated merchandising methods. The objective on the retail end is to capture the data on what is sold. The use of three-part punched card systems makes it relatively easy for the company to obtain the necessary information, since a large part of the retail outlets' purchases are made from its own plant. One part of the card is used to control manufacturing, the second to create an invoice for the store, and the third shipped with the shoes and removed at the time the shoes are sold. The third part is then returned to headquarters where it is used to provide for reorders.

The Grayson-Robinson apparel chain, which has more than 100 stores throughout the country, receives print-punch tags daily from its stories and converts them to full-size punchcards. The complete merchandise and inventory control function is then handled on a computer. What styles are to be processed first are determined at the computer center. During any given week about 60 percent of the sales data are received and summarized. On the following Monday morning the remaining 40 percent of the sales data are received. The computer can then begin running style reports immediately after the tickets have been converted to cards. By this time the company can run up style reports by departments and price lines in order to obtain the necessary merchandising information. The entire reporting job is completed by Wednesday afternoon of each week, including reports on all inactive stockpiles.

The Abner A. Wolf Co., a leading Midwest wholesaler, has recently adapted a system of electronic handling of frozen food at its warehouse in filling orders for retailer customers. The company is a wholly owned subsidiary of the ACF-Wrigley store chain and does an annual volume of about $100 million. The system consists of punchcard and tabulator operations and a battery of automatic materials handling equipment. For each case of frozen foods in the warehouse there is a prepunched computer card, carrying a description of the case, the unit price, how packed, and a price extension.

Cards for a given order are placed in a tabulator and an electronic impulse is sent from the tabulator to a console unit from which a signal is sent to the special equipment at the warehouse point of selection. The signal determines if the item is available and can be

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selected. Another signal is returned to the console and to the tabulator indicating the status. If the item can be shipped the tabulator will print data from the card and if the item is not available no extension will be made.

The materials handling equipment consists of a series of slides, some 1,800 in all, set on a 15° angle to a series of conveyor belts which travel 250 feet per minute. Three of these slides are located, one above the other, leading to the three belts. The frozen food products are loaded on these slides and sent to the belts upon the signal sent by the console.

In 1959 the Lerner Stores Corp., a 283-unit ladies' apparel chain, installed electronic equipment based on transistors and magnetic cores which provide information through magnetic tapes. Each machine has four parts, a high-speed card reader, a repunch unit, a high-speed printer, and a central processing unit. Two people can operate the machine which processes data received on sales from store managers. The cards received from the individual stores are transformed into punchcards by tabulating machines. The card reader then senses the data at the rate of 450 cards per minute. This is then verified and repunched as new cards are needed for different parts of the computing program.

The central processing unit contains all the memory, logic and computing circuits in the system. It can store 50,000 digits for future repeated use. Since extensive air conditioning is not needed for a transistor system, a single four-part unit requires only 575 square feet of space, including working area. The Lerner equipment represented a forward step in the practical processing of retail data. Moreover, these computers which are known as solid state construction offer the advantages of low cost and good reliability while taking up minimal space.

These automatic computer systems, particularly the automatic reorder techniques, have decided advantages for the retail chain in that they save many labor-hours in addition to providing more balanced stocks and enabling more business to be done on less inventory. Of course, these techniques can be applied much more easily to small staple lines that include a wide range of sizes, styles, and colors and that have a high turnover rate. It is rather difficult to apply the automatic computer system to bulky goods, high fashion lines that change rapidly, seasonal goods, and slow turnover departments.

Yet even management recognizes that there is a certain cost in the effect that these systems have on human beings which must be taken into account in installing automatic systems. Said one management expert, quoted in Chain Store Age, January 1958:

> The danger of pushbutton merchandising lies in the fact that the chains can lose their merchandising talent at the store level. * * * Automatic reordering takes the fun out of work for the salesgirls. People like to feel they are in control of an operation and even making mistakes is beneficial because it gives them a sense of importance. When you get too automatic, you get restless, or listless help * * *. The salesgirl's planning instincts become dulled from disuse. She becomes so accustomed to ordering automatically, that she

loses the ability to * * * plan for future seasonal and fashion peaks. Personnel today spend more and more time in selling big ticket merchandise and ignoring small wares.

MATERIALS HANDLING AND BACK-OF-STORE AUTOMATION

It is, of course, in the area of materials handling that some remarkable developments have been made in automatic techniques. Last year the Jewel Tea Co. unveiled an automatic carryout system which takes shopping carts underground from the store to a parking lot pickup station. The system was installed at a new 18,700-square-foot market in Joliet, Ill., where the nearest parking space was 200 feet away from the store. The shopping cart is carried on a belt to an underground carryout system. It takes 2½ minutes for the belt system to move from the market to the pickup station where stock boys load the groceries into the customer's car. The belt speed can be varied from 25 to 75 feet per minute. Pegs rising from a three-quarter-inch channel are attached to special lugs put on conventional gliders. The moving belt of pegs carries the gliders to the pickup area. Pegs are spaced 4 feet apart allowing 50 carts to be carried on the entire system at one time.

Even more significant is the creation of what has been called an automatic warehouse. This has been set up by the Diana Stores Corp. in a $3 million plant constructed in New York. The central feature of the installation is an electronically controlled ferris wheel conveyor housed in a shaft running from the first to the fifth floor. Through a system of dial controls cartons are directed from the receiving platform to their destinations on upper floors. Similar electronic controls direct the distribution of hanging garments from the first floor receiving area to upper floors over a motorized monorail system. The monorail also conveys garments to the packing area. Small wares are sorted into trays which are conveyed automatically to the packing area. These innovations give a multifloored warehouse the advantages of continuous flow of materials usually associated with single floor operations. The mechanical devices receive merchandise from more than 2,000 suppliers, direct the flow through the warehouse and out to 208 stores across the country. The engineers who installed it said that the machine could ship an average of 150,000 units a day with almost absolute accuracy.

Retailer enthusiasm was captured at a recent exhibition of store equipment by labor-saving devices that could be used in supermarket backroom operations. As reported in the trade journals only this past month, there were devices which weighed, labeled, and computed the price of merchandise by electronic methods; cellophane wrapping machinery for prepackaging eggs; tracking equipment to enable the upright stocking of items such as detergents, beer, soda, and other heavy and bulky merchandise; power adjusted wrapping machinery for prepackaging meat, fish, poultry, and produce; a double-grind chopper featuring a double-grind process which in a single operation can reduce the number of man-hours required by 60 percent; automatic wrapping machinery and automatic labeling machinery to wrap and label meats in a single operation; industrial sweepers for warehouse and parking lot use, as well as a variety of other devices.

In the supermarket sector, the most important area for improved materials handling is, of course, the backroom. On the basis of 43 chains' answers to a survey made by the National Association of Food Chains in 1957, it is generally felt that the backroom facilities of a supermarket should represent about one-third of the total square footage of a modern supermarket. It is generally agreed in the industry that "what the boys in the backroom will have" is more mechanized equipment. The trend to mechanization is most evident in the handling of nonperishable items. Equipment to speed the flow of stock from truck to shelf has been gaining widespread acceptance among food chains. While conveyor systems of both the gravity and power type have been used in single-level and two-level stores for many years, the trend is for more complete installations. Full conveyor systems are now in use in which the line of flow of merchandise is along the most direct line from the truck to the shelf. Alternate lines of flow are built into the system so that the stock may go to a holding area until needed and to the price marking station. Supermarkets are also using the pallet loading system more extensively. Full loads of stock of one item or of items for one section are loaded on wooden pallets in the warehouse and placed aboard a trailer by forklift trucks. At the store they are unloaded by another forklift and the stock is then trundled to its holding bin in the backroom. Sometimes the pallet is taken from the truck directly out to the sales area for price marking and stocking. Supermarkets are installing overhead rail systems for unloading and transporting sides of beef, more power equipment for cutting, grinding, and shaping, more powered automatic and semiautomatic wrapping machinery, and more automatic ticket printing pricing scales. Linked up to these devices are both power and gravity conveyor systems. Wrapping machinery accelerates the mechanization of the various departments and such machines tend to require a linkedin materials flow system to keep up with their wrapping capacity.

Produce backrooms in supermarkets are also being automated. At work stations, trimmings fall into automatic disposals. Cases of produce are fit securely into given positions reducing handling to a minimum. The produce workrooms are being styled in the manner of meat department work stations, with wrapping materials, trays, heating irons, and hotplates carefully arranged for maximum efficiency. Movable racks are used which will hold a dozen or more trays of produce, while in other systems conveyors carry packages behind the produce racks. In some stores, sliding windows have been introduced into refrigerated produce racks, enabling the merchandise to be stocked from the backroom in the same manner as meat is stocked from the wrapping rooms.

Dairy department backrooms frequently have to be provided because of the new equipment being introduced. Actually, a dairy backroom is part of the display itself, since the new reachin cases and air screens are made so that the backroom stock is directly behind the sales display. As customers remove merchandise from the display, the stock clerk merely slides new products into position from behind. In order to mechanize the operation, mechanical belts are being introduced so that a new facing is brought forward when one has been removed from the front.

These mechanized devices feed on each other. The trend toward more prepackaging in produce, for example, leads to more mechanization in the steps both preceding and following the packaging operations. This is turn leads to larger departments with a relative increase in storage and preparation areas. And, in turn, this creates a need for more materials flow equipment. This, perhaps more than anything else, is the most significant thing in retail automation. One step produces another, and in the end human beings are disposed of as unnecessary to the conduct of business.

Has all this streamlining and mechanization paid off? One Red Owl installation in Minneapolis makes the fullest possible use of laborsaving machinery. It is air conditioned at 65° and employs a staff of seven men and four girls. While the company has not provided any figures on the extent of laborsaving resulting from mechanization, this particular store uses the same size work force as a market with approximately two-thirds of its volume. Trade-journal commentators, while stressing the gains in efficiency secured from automation, are not averse to pointing to the laborsaving that stems from installing new equipment. Several recent articles in Super Market Merchandising pointed to the advantages of quality control as well as increased sales. Also mentioned were the benefits of reduced labor costs. Said T. S. Melvin of the Publix Super Markets of Lakeland, Fla.:

> Under this centralized system we have realized many tremendous advantages such as (1) quality control, probably the most important one; (2) labor costs, a substantial and important item. It costs less to prepackage produce commodities on an "assembly line" basis than it does to prepackage in individual stores. Thirty-five people in the warehouse have replaced approximately 150 in the stores. This represents a huge dollar saving * * *.

STORES WITHOUT WORKERS

When we submitted testimony on this problem to this committee in November 1957, we suggested that it was entirely within the realm of possibility for a completely automated retail supermarket to be established such that the customer would be able, with a minimum of effort, to place her order, have the merchandise delivered to the front of the store, and pay her automatically computed bill. Within a month the newspapers and trade journals announced that a device had been patented which would permit precisely this sort of mechanized technique to be adopted by the modern supermarket. Developed by the International Telephone & Telegraph Co., and intended primarily for chains of 150 stores or more, all of which would draw merchandise from a central warehouse, the system can transmit orders for 37 cases of eggs, 96 bunches of bananas, and one-half ton of instant coffee, all of which is delivered automatically to the store. The orders are transmitted from the store end into a photoelectric machine which then translates the markings into audible tones, speaking them into a telephone. While the sounds are not intelligible to the ear, they are automatically decoded and fed into a printer and card-punching machine or calculator which then goes to work gathering the order.

The system can be linked to a data-processing machine so that orders coming from all stores may be totaled.

One year later, in November 1959, General Telephone & Electronics developed a machine that can be placed at supermarket checkout counters where it reads fluorescent stickers on each grocery item as it passes on a traveling belt. This information is passed to a computer which totals the customer's purchases. This automatic checkout operation takes about two-thirds the time now required for manual handling by checkout clerks. The device provides automatic checking to speed customer flow; more accuracy in totaling orders; and an automatic reorder system for the warehouse. The flow may be increased by having the punched, coded tickets placed on the checkout belt uppermost so that the electric eye or scanner above the conveyor belt at the checkout counter can read the punched, coded tickets on each item as it passes through. The scanner is connected to the cashbox where a similar device enables the electronic reader to automatically record prices of the individual items at the checkout. Problems of handling items selling for prices in combination, such as 3 for 29 cents, are solved by having the device "remember" the first 2 items at 10 cents each and ring the third at 9 cents. Going one step further, Samuel S. Otis of Winnetka, Ill., received a patent in January 1960 for an automatic checkout machine that would replace human checkers entirely. According to Mr. Otis, his machine would "almost instantly" tabulate the cost of a group of articles and present the shopper with an itemized bill. Two types of equipment were available based on the basic concept involved in his patent—an entirely mechanical device or one of the "trans-space" variety which would include an X-ray unit. With either type of machine it would be necessary for the merchandise items to be tagged according to a code used by the machine. The tags would indicate the price and the machine would use as basic information other characteristics such as shape or weight. The complete automatic checker comprises a printing register, an index sensing mechanism, an impulse-activated electrical apparatus to operate the register, and a scale and computing register interconnected with each other and to the printing register. A cross-checking section of the device prevents "jimmying" of the machine. The shopper would place a box of selected grocery items on the platform scale of the machine, push a button and, in a fraction of the time it takes by conventional methods, receive her bill. The rebagging operation would also be eliminated with this procedure.

The engineers are quite certain that the automated supermarket will be a reality within the very near future. D. G. Gumpertz of Industrial Electronics Engineers in California has already designed and installed an automated system for the Brunswig Drug Co. By adding certain electronic and computer devices to his system, Mr. Gumpertz insists that he can automate a market completely. All that would be necessary is to control the size of packages which go in and out of the system so that a greater degree of standardization becomes possible.

The timing for introducing an automated supermarket to the public appears better today than when Clarence Saunders suggested his Keedoozle idea. While Mr. Saunders had made some interesting advances in mechanizing supermarket operations, the Keedoozle system did not have the support of electronic computers or other devices which are currently available.

Starting with a central warehouse that services individual supermarkets of the chain, Mr. Gumpertz indicated that his system would be somewhat as follows:

A centralized data-processing machine would be installed in the warehouse. This computer would be tied in with the individual supermarkets that are serviced. Orders from the stores would be sent in code over normal telephone systems into the computer, thus requiring no special line of communications. By installing a system of endless belts on loading and unloading docks of the warehouse, better transportation of merchandise from the warehouse to the store is provided. The cases or pallets of merchandise would be placed on these dockside belts moving toward the trucks. Not only would the cases handled in the warehouse be standardized but the retail packages themselves would also be uniform. Once this was done, then the apparatus could automatically pick out a grocery order in the smaller standardized shapes, which Mr. Gumpertz calls cartridges.

The automated supermarket itself would be divided into two major sections. One would be a showroom in which merchandise, sometimes only dummy containers, would be displayed on shelves. The customer would move down the aisle looking at the merchandise holding a special card. To order the merchandise she would insert the card in the slot immediately under the display and automatically the item and price would be printed on the card. Since the printing would cover only one unit, the purchase of two or more items of the same unit would require reinsertion of the card each time. The machine could make corrections in cases of error. Once the customer has made up her order on the card she would then take it to the cashier. The card then would be inserted into a reading machine which would total the order and redesignate it with a coded number. After paying the cashier the customer moves out of the store, drives to a loading area, and the boxboy puts the order into her car.

Actually the customer never touches any groceries. When the card is inserted into the reading machine it passes the information to a computer associated with the cartridge-loading machine. These devices would be in the second half of the automated supermarket. The loading machine would drop the customer's order automatically on a moving belt in one second. If two units of an item are ordered the machine would merely take another second to repeat its job. The moving belt, loaded with the customer's order would travel to the assembly line, where it would be prepared for the customer.

Thus the completely automated system would eliminate many of the cash registers, shopping carts, expensive fixtures, reduce the size of supermarkets, reduce the size of inventories in the store, end the need to price mark individual items, and drastically reduce the number of workers required.

All that seems necessary at this time is for one of the giant supermarket chains to undertake such an installation and to accustom the public to its use. This does not seem to be too difficult a public relations task. When supermarkets were first started, customers were unwilling to purchase prepackaged meat and insisted upon seeing the butcher at his work. This problem was solved by the late Lansing Shields of Grand Union by moving the butcher workmen out from the back room closer to the selling area to do his job behind a glass window. Gradually the housewife became accustomed to prepackaged meat and today one seldom sees the butcher workman. Prepackaged meats are placed in attractive displays and counters and the housewife is quite content to make her purchases without observing a butcher at his trade. Personal relationships, once thought so necessary to the successfulness of a retail operation, are being reduced to a minimum, if not entirely eliminated.

AUTOMATED VENDING EQUIPMENT

Even changemaking, so important to the completion of a transaction, is being mechanized. Last August reports were received of a conveyor belt, dial system, vending machine installed in a Swiss supermarket which automatically registered, checked, and added coins and returned change. Shoppers selected items from the front panel and then dialed the particular selection they wished. Items were delivered to the customer via a conveyor belt. The unit consisted of a selector, coin, and delivery assemblies which were built separately and enabled the entire apparatus to be adapted to various conditions. Over 100 different items could be accommodated by the machine and units can be built to accommodate up to 1,000 different articles.

The customer designates the merchandise desired by dialing its class number on a telephone-type dial. Coins are then inserted which the machine explores, sorts, and adds. If the sales price is reached or exceeded the delivery assembly receives an electric impulse and the automatic computer determines the sum in excess of the selling price and then returns the correct change. Tests demonstrated that a maximum of 30 seconds was required for a sale if a customer inserted a large number of small coins.

Additional devices can be installed to issue trading stamps, vouchers, gift bonuses, or publicity articles. A remote control and indicator panel can provide data on total receipts, expenditures, turnover, and out-of-stock items.

Clearly, with the development of automatic vending machines the possibility of completely automatic retail stores is virtually upon us. The most serious problem in vending equipment was the development of devices for rejecting slugs and other foreign matter. However, John Gottfried of National Rejectors, Inc., of St. Louis (a subsidiary of the Universal Match Corp.) developed a magnetic device that measured, weighed, and analyzed the metallic content of a coin, instantly rejecting anything that did not meet specifications. A similar device was invented by the Atwood Vacuum Machine Co. of Chicago.

With the advent of effective false coin rejectors, automatic vending has grown apace, starting with cigarette machines, and spreading rapidly into the selling of candy, soft drinks, popsicles, sandwiches, hot soup, coffee, milk, and other small consumer items. The business has reached into the billions of dollars services by almost 6,000 small operators. Vending machine sales have risen from $600 million in 1946 to $2.3 billion last year. The industry is confident that it will reach $4 billion in sales by 1965.

For a long time growth in automatic vending has been limited by the lack of a reliable machine to handle paper money. After years of work, the Atwood Co. has developed a machine which, when presented with a dollar bill, delivers two quarters, three dimes and four nickels in change. Mr. Gottfried has worked up several vending machines: one that sells telegrams, a ticket vending machine with up to 30 selections for commuter trips, and a multiproduct machine which when presented with a $1 bill can deliver any one of eight grocery items plus change. The Atwood device is understood to operate by holding a bill in a perforated screen under a photoflood lamp and then electronically reading the amount of light passing through the perforations. It can be adjusted to accept other denominations than $1 and deliver any combination of change. The Gottfried device works on the principle of electronic scanning, directly reading the face of the bill and is able to accept $1 and $5 bills with any combination of these with coins. It promptly rejects foreign bills or counterfeits "without comment."

While the biggest area today for these new devices is in office and in plant feeding and plant cafeterias, the vending machine industry is quite optimistic about its future in retail selling of various staple items in department stores and supermarkets. Beginnings have already been made in machine sales of nylon stockings. A bill-changing device would enable extension of such operations to such high turnover staple items as ties, socks, underwear, and the like.

A completely automatic supermarket in mild climates might comprise nothing more than a roofed labyrinth of vending machines services by mobile grocery chain units and selling goods to shoppers sitting in their automobiles who would never see a clerk or checkout counter. One vendor, quoted in the Architectural Forum of December 1958, suggests that every large apartment house could have an automatic canteen and sundries dispenser selling anything from light meals to baby diapers. Small shopping units could be dotted around the suburbs dispensing a line of household staples. Automatic roadside stands for turnpike travelers could be established quite easily. Store-front units operating on a 24-hour, 7-day-a-week basis are now entirely feasible.

Says the Architectural Forum in discussing this problem:

> It is too early to say what all this will do to the ranks of service workers, currently the most sharply rising sector of U.S. employment, thus far almost untouched by automation. *It may someday pose a social problem of no mean dimensions.* [Italic ours.]

SOLVING THE PROBLEM OF AUTOMATION

The major question facing us is: Can technological unemployment and underemployment which may stem from automation be solved? Most authorities are agreed that retailing is the one area in which jobs can be simplified and made routine to such a degree that electronic computers can replace the worker entirely or permit one worker to do the jobs of several. Now we agree that industries differ with regard to the extent to which automation can be applied. But in materials handling and in retailing, the range of application is indeed a broad one.

We are told that job retraining, unemployment insurance, and diversification can help the workers to adjust to the new situation. Skills must be directed toward repair and maintenance, instrument reading, and the like. Abilities will have to be of a higher level. But the question still remains whether room will be made in the retail industry for the development of semiskilled technicians or whether these jobs would not be attached elsewhere. Certainly the impact of automation would be lessened if there would actually be an upgrading of jobs in retailing and distribution. It is certainly desirable that the "humanization of work" which many predict will stem from automation not be impeded. Yet retail executives concede that there has been a loss of employees because of the installation of electronic equipment. Some of this has resulted because of a failure to reassure workers about their positions in the company. They have found that employee morale has been damaged by rumors and the security of old-time employees seriously shaken. This reaction is quite understandable when people learn that the introduction of electronic computers has eliminated perhaps as much as 25 percent of old jobs. This was the finding of a Labor Department survey of 20 major concerns which switched to automation in varying degrees in 1957. Admittedly the decline took place through attrition and job shifts rather than outright firings, but whatever the method, the shifts involved considerable hardship, particularly among older employees, while many other workers required extensive retraining in order to keep them at work. As one authority commented, the displaced worker is not fired; he is rather the one who is not hired. Once business expansion slows down, as it threatens to do at present, the real effects of automation will be revealed.

Productivity figures for retailing demonstrate quite conclusively that more work is being done now with fewer employees today than was the case a decade ago. Our studies of man-hour input, retail output and productivity in the retail industry for the period 1950–59 reveal that man-hour input is down 5 percent, while retail output, as measured by value added, has increased almost 31 percent. This suggests an increase in productivity in retailing of 4 percent per annum since 1950. These productivity increases have come about despite the fall in man-hours in retailing. Although the total number of employees has increased, man-hours have declined because of the precipitate drop in average weekly hours per employee, reflecting the increased utilization of part-time personnel.

For the supermarket sector alone, sales per man-hour between 1954 and 1959, computed on a constant dollar basis, increased 5.5 percent per annum and this despite the decline in man-hour input. A similar trend seems to be evident in department stores. According to the Controllers' Congress of the National Retail Merchants Association, payroll expenses in department stores declined last year from 18.4 percent of the sales dollar to 18.2 percent while transactions per sales person increased from 7,503 to 7,642. The average gross sale per transaction rose from $4.76 to $4.84. Thus, even the fragmentary evidence currently available demonstrates that greater output has been flowing out of retailing with a smaller man-hour input. With a substantial part of this attributable to increasing rationalization and automation in distribution, the continued thrust toward further technological advance will further accelerate the process.

We recognize that many progressive managements are aware of this problem and are urging that industry assume the responsibility, through education and training programs, to help employees develop different kinds of skills. In addition, many concerns, usually at the urging of the labor unions, are developing or increasing severance pay schemes. Other concerns provide assistance to employees to move to other company plants or find jobs elsewhere.

But too often these measures are uncoordinated, hit-or-miss approaches. We agree with the thought that the introduction of automated equipment ought to be carefully planned and the proper time selected to take advantage of normal attrition in the work force. However, as a labor union, we feel it is important that labor sit down with management to arrive at effective solutions of this problem. Joint consultation has worked exceedingly well in the meatpacking industry where there are union-management committees, notably in Armour & Co., to study the problems of automation. Under the present union contract, Armour contributes to an automation fund 1 cent for each 100 pounds shipped from the meatpacking plant up to a maximum of $500,000. The union and management plan to work out jointly helpful recommendations for the application of this special fund to the solution of the problems stemming from continued automation in that industry.

We in the trade unions recognize that there may be longrun gains stemming from automation. We know that progress in improving standards of living has been possible because of increasing knowledge and increasing productivity. But at the same time we must call attention to the fact that this is a longrun process and the immediate impact of automation does raise serious social problems. The immediate welfare of individual workers can be threatened by the haste to automate every process, every technique, every method of getting things done in industry and distribution.

We cannot agree that automation moves slowly. In the retail field recent developments have turned it into a veritable flood of change. We agree most wholeheartedly with the statement of the National Planning Association that the effects of automation are important enough to require national attention. Automation was unknown in retailing not too many years ago, but now it is increasing in application and intensity. We cannot afford to allow automation to become an uncontrollable force which would turn not only industrial and business processes topsy-turvy but create a severe strain on human relationships. Rapid technological change can disrupt the lives of individuals and we must urge that thought be given to programs for reducing the harmful effects of this new technology. Certainly more study is required. Perhaps automated devices ought to be introduced carefully in accordance with some schedule so that the individual worker in retailing and distribution will be protected against adverse effects.

Perhaps one of the most effective ways of mitigating the impact of automation would be the reduction of the workweek. Aside from other benefits that would flow from this measure, it provides a sensible approach to the distribution of the fruits of automation.

One of the chief objectives of the labor movement has always been to reduce the burden of work and to bring greater leisure to millions of workers. Over the decades, the labor movement has successfully moved toward this humane goal. Not very many years ago, American salesworkers, as well as other workers, were required to work from sunup to sundown. Of course, the advances made in reducing working hours were not gained without opposition from unenlightened employers. Throughout the 19th and 20th centuries, unions have had to undertake strong and militant courses of action in order to win through to the goal of a shorter workweek. Prior to the Civil War, employers countered the demands of workers with the contention that a 12-hour day was ordained as a means of strengthening workers' morals. These specious arguments were overcome as the unions pressed for improvements in working conditions.

The movement toward a shorter workweek in the retail industry must be viewed against a background of ever-increasing output and productivity, the data on which we have already cited. These increases stem not only from rationalization, self-service and automated devices, but from a greater intensification of the work process itself. Those workers who are not displaced by technological advances are required to expend more nervous energy and more physical labor per unit of sales than ever before. Studies show, for example, that in produce departments, the intensity of work rises more rapidly and in higher proportion than the increase in sales. This is true also of many other retail operations.

Yet the fact is that a reduction in the workweek does not impede a greater output. In 1910, about 34 million people working an average of 55 hours a week produced a gross national product of about $37 billion. In 1955, 63 million people, working an average of 42 hours a week, including paid vacations and holidays, produced a gross national product of $391 billion.

Certainly, the present is a period of rapid technological change in all industries, and retailing is no exception. We have witnessed the introduction of self-service operations in areas where it was once thought improbable and more and more automatic devices are being utilized to displace human thought and labor. It is clear that a reduction of the standard workweek would help minimize the serious impact that rapid mechanization is having in our industry. Moreover, it is also clear that increased time for one's self and one's family is a necessary condition for a rounded, useful, and satisfying life. The fuller development of individual capacity, better care of children, greater attention to community obligations, better education, and a general improvement in the quality of life makes for higher productivity. To achieve this, leisure time beyond the period of work in the store is required to give our people an opportunity for growth and development.

Numerous sociological and economic studies, as well as experience itself, have demonstrated again and again that a shorter workweek in an advanced society such as ours enhances rather than detracts from productivity. During the black days of the great depression it was argued that a shorter workweek would spread the available job opportunities. While we recognize that in an advanced economy such as exists in the United States, full employment is a derivative of sound measures to sustain consumer demand, including proper monetary and fiscal policies, we nevertheless affirm that the shorter workweek will make a substantial contribution to such full employment. Greater leisure would lead to an increased demand for goods and services utilized during leisure hours and would mean ultimately a net addition to total demand, particularly if there is no reduction in weekly earnings. There would be no diversion of demand, but actually a relative increase, particularly for the products of consumer goods industries.

In fact, it seems clear that such effects would markedly stimulate the rate of investment, particularly in consumer goods industries. Shorter hours could have a favorable effect on employment, enabling the existing stock of capital to be utilized more efficiently and to provide more jobs.

The general executive board of the RCIA in its last session, held in January 1960, weighed the foregoing considerations and urged the need for meeting the challenge of automation and rationalization in retailing today. It recognized that new job opportunities must be created in the retail industry, and went on record as supporting the extension of the 35-hour week with unreduced weekly pay as a major instrumentality for moving the American economy in the present context of increasing automation to new heights of prosperity.

One problem stemming from a reduced workweek is the tendency for many workers to take multiple jobs, to engage in "moonlighting," and almost always at straight-time rates for both jobs. This can create serious social problems and would in the long run defeat the objectives of the shorter workweek. One possibility of dealing with this would be to apply overtime rates to the individual worker rather than in terms of the job or jobs held. This may pose some difficult administrative problems, but it does suggest a way of overcoming an unwitting circumvention of the shorter workweek principle.

One of the methods utilized in retailing to adjust the work force to changing technology is via the simple process of attrition—retirement, quits, and the like. But the peculiarities of retailing highlight certain special problems in this situation which we feel require attention. With the general level of wages as low as it is in the retail industry, especially in the unorganized areas (may we point out that retailing is as yet uncovered by the Fair Labor Standards Act, so that wage rates are often below $1 an hour), we find older workers desperately hanging on to their jobs because the social security retirement they can look forward to would hardly suffice to sustain them. Perhaps a more adequate pension system, either through improvements in the Federal program or through combinations of the latter with private schemes, would help these older employees to face the future with a greater sense of peace and hopefulness and at the same time directly lessen the strain of trying to hang on painfully as members of a work force undergoing sharp and radical change.

It is our feeling that unions, management, and the Government must shoulder responsibility for developing solutions to this problem. A new industrial revolution is upon us and yet we are helpless to deal with the human costs that inevitably stem from it. Only the other day, on June 2, Dr. Eli Ginzberg, one of the Nation's leading experts on manpower problems, urged before a New York State Conference on Automation that government take a more active role in meeting this problem. Not only did he advocate the usual programs of extended unemployment insurance and retraining programs, but advocated also improved education and a more careful coordinated approach to the problem generally. It is good to note that not only are the authorities in New York State addressing themselves to this problem but that in Massachusetts, Gov. Foster Furcolo also convened a special conference on automation.

And it is heartening to see that this committee is continuing to take forthright steps to develop a coordinated program for dealing with the problem of automation so that all sectors of society—unions, management, and government—will face up to their human responsibilities.

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