AUTOMATION AND RECENT TRENDS

HEARINGS

BEFORE THE

SUBCOMMITTEE ON ECONOMIC STABILIZATION

OF THE

JOINT ECONOMIC COMMITTEE

CONGRESS OF THE UNITED STATES

EIGHTY-FIFTH CONGRESS

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AUTOMATION AND RECENT TRENDS

THURSDAY, NOVEMBER 14, 1957

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON ECONOMIC STABILIZATION OF THE
JOINT COMMITTEE ON THE ECONOMIC REPORT,
Washington, D. C.

The subcommittee met at 10 a. m., pursuant to call, in room 1301, New House Office Building, Hon. Wright Patman (chairman of the joint committee) presiding.

Present: Representative Wright Patman and Senator Ralph E. Flanders.

Also present: John W. Lehman, acting executive director, and James K. Knowles, staff economist.

Chairman PATMAN. The subcommittee will please come to order.

Senator O'Mahoney expected to be here this morning, but he is ill. Other members who expected to be here are unable to come to Washington. These hearings, as in the past, will be printed and will be made available not only to the members of the Joint Economic Committee, but to every Member of Congress. The printed hearings also go to the principal libraries throughout the Nation and to interested people. They have very wide distribution.

Three or four years ago, we all began to hear, through the magazines, newspapers, and the Sunday supplements, an increasing amount of discussion about possible effects upon the economy of the rapid progress being made since the war in automation and technology. In the United States we are, of course, proud of the advancing technology and the increasing productivity of our labor which together have combined over the years to give us the world's highest standard of living.

Along with these stories about automation, there seemed to be overtones of concern that the speed of technological change taking place in the postwar period might be carrying us toward a situation in which we would come up against the problem of lost jobs and large-scale unemployment.

There was the fear also that, as a result of automation, small business was being hurt at a further disadvantage against the larger well-financed companies which produce for the mass markets.

Now, anything that concerns overall level of employment or threatens economic stability is of the utmost immediate concern to the Joint Economic Committee, created and acting under the Employment Act of 1946. The committee, under the act, is directed to make continuing studies of matters concerning economic development and trends, current and prospective, for the purpose of determining whether such trends are interfering or likely to interfere with the achievement of the stated policy objectives of the act.

Those objectives are to promote, within the framework of the free competitive enterprise system, maximum employment production and purchasing power. For these reasons, the Joint Economic Committee, through its Subcommittee on Economic Stabilization, held hearings in the fall of 1955 and again in 1956 designed to throw light upon the role of automation broadly defined, and to advise the Congress as to any problems which might seem to be developing from this rapid progress of technology.

Under no circumstances should or can the committee's interest be interpreted as opposed to automation or seeking to inhibit or direct the activities of private enterprise in this field. Our concern, as I have just stated, is to reassure ourselves and the Congress that the benefits of mechanization and automation are being achieved without serious threat to the stability of the economy as a whole or to the general levels of employment.

In the report which this subcommittee filed with the full committee a little over 2 years ago, we made a number of findings, several of which I think it is worthwhile again to refer to specifically. One of these was that so long as we have a prosperous economic situation throughout the country, the conditions and dislocations resulting from the accelerated shift to automation tend to be less painful. For this reason, it is urgent that everything be done through fiscal, monetary policy and every other practicable means to maintain the high employment levels which we have managed to achieve during recent years.

At the same time, as the committee pointed out at that time, we dare not overlook or deny the fact that many individuals do suffer personal, mental, and physical hardships as the technological adjustments go forward.

There was some evidence that, in a few businesses, management was so busy on the side of advancing labor-saving and cost-reducing machines as to be unaware, apparently, of the responsibility for helping to solve the problems of the individual who is displaced or who finds his skills rendered obsolete overnight.

Happily, this indifference to personal hardships was not widespread. This is, however, an aspect of automation which enlightened business, planning labor-saving machinery, would do well to keep in mind.

It seems particularly proper at this time also, to comment upon another of the findings which the subcommittee made, which I think is still relevant and, I think all will agree, extremely important. I will quote only the key sentence of the report on that point, and ask that the remainder of the finding be inserted in full in the record of these opening remarks.

The report of our subcommittee, on page 7, had this to say on a matter of urgent concern to the Nation. I quote:

> The most disturbing thing which came to the subcommittee's attention during the hearings was the near unanimous conclusion of the witnesses that the Nation is faced with a threatened shortage of scientists, technicians, and skilled labor.

The statement of the committee follows:

> One may be willing to pass over lightly the expert testimony that there are plants in Western Europe that are "more highly automatic than anything we have got in this country" (hearings p. 66), even in the automotive business. But we can certainly not dismiss lightly the generally accepted evidence that professional engineers are currently being graduated at a rate nearly twice as fast

in Russia as in this country, and that technicians are currently being turned out at 30 or 40 times our rate.

This evidence is not to be taken as necessarily indicating that our science and capacity for technological advancement have been surpassed elsewhere. It must, however, be taken as a plain warning that others can catch up with us and, indeed, at current rates, are doing so. The president of the Carnegie Institution of Washington, Dr. Vannevar Bush, summed up the problem of the subcommittee:

"We already have a shortage in this country of skilled men of various sorts. We also have a shortage of engineers and scientists. And not enough men are entering these fields. It has been brought out in these hearings that Russia is in some ways doing a better job in this regard than we are; they are certainly training more scientists and engineers" (hearings, p. 616).

It is, of course, generally accepted that the short-run retraining and salvaging of the skills of those whose livelihood is threatened by automatic machinery should be a first cost upon industry and the particular company itself. Technological change cannot be regarded as progress at all if it is not able to pay its own way, not merely in the junking of old machinery, but by giving due recognition to the human costs of retraining and readjustment.

But the longer and larger run problem is that the Nation recognizes the need for keeping up and advancing its resources in the form of trained experts in every field. The training problem exists at all levels. Dr. A. V. Astin, Director of the National Bureau of Standards, in expressing grave concern over this situation, said:

"I think that the critical area is the high-school level and it is primarily high-school teachers. I don't think we can get teachers who will inspire people to take up science and engineering as a career unless these people themselves are sold on it, and, 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" (hearings, p. 587).

Under our traditional system of education, the first responsibility for this must fall upon the local communities and the individuals and business directly interested in specific kinds of skills and expertness. Many companies are already demonstrating their awareness of this problem by providing in-training technical courses and by endowing and supporting company fellowships and advanced education.

There are important reasons why this need for increased attention to the training of experts should be underscored and recognized as a real problem. The fact is that much of the knowledge and personnel upon which we are drawing so heavily today comes as a byproduct of the military background of the past decade. Under the necessity of war and defense expenditures, the Federal Government has contributed immeasurably to the building up of a comfortable present supply of trained personnel.

This is all well and good, but none of us want a situation to arise in which we must depend upon the war or defense expenditures as the means to securing such beneficent byproducts. Industry and the colleges themselves must take over and give adequate civilian support to technical education.

In many ways the question is not simply one of Federal support or no Federal support. It is a question of finding and accepting a peacetime program to take the place of in-service training of technicians, the war-accelerated and militarily sponsored college programs, and the later support and encouragement of education afforded by the so-called GI bill of rights.

Some 20 million persons now in civilian life have been in the Armed Forces and a large part of these were given specific forced draft training of some kind. A far larger number, by the use of or the sheer closeness and rubbing elbows with highly developed modern instruments, became familiar with technologies which, under other circumstances, would have been reserved for specialists.

As Dr. Vannevar Bush pointed out to the subcommittee there are in this country today thousands of young men to whom the design of what would once have been fabulous devices is not only possible but a pleasure. They can simply take off the shelf a combination of cheap, reliable gadgets with which are already familiar and whose "queer ways" are already fully understood by them (hearings, p. 613).

This great pool of knowledge cannot be regarded as inexhaustible or self-replenishing. The dangers of its depletion deserve the fullest attention of all in making sure that high school and college training are made possible for

young people with demonstrated ability and aptitude so that the Nation and the economy as a whole can continue to profit by the fruits of knowledge.

At these present limited hearings, we will not be able to go extensively into this subject again, but I do want to underscore this earlier finding for the present record.

At the two earlier hearings, we directed our attention primarily to a selected group of industrial situations in which the progress of automation and technological change seemed particularly noteworthy. We went into the problems in the metal-working, chemical, electronic, transportation and communication industries as illustrative of the kinds of problems which may be found in the trend toward automation.

The committee observed at that time that other fields, for example the processing of commercial bank paper, the basic steel industry, and various aspects of the service industries might equally well be studied with great interest and profit if time permitted.

On the occasion of the present 2 days of hearings, we are going to confine our attention to the processing of commercial bank paper work, the impact of automation upon retail trade, and to hear from representatives of the scientific and research profession, and the labor movement, something of the general overall aspects of recent developments as viewed from their respective strategic positions.

The committee release giving the schedule of hearings should be incorporated in the record at this point.

(The schedule of hearings is as follows:)

CONGRESS OF THE UNITED STATES, JOINT ECONOMIC COMMITTEE, SUBCOMMITTEE ON ECONOMIC STABILIZATION

Hearings on Automation and Recent Trends

November 4, 1957.

Representative Wright Patman (Democrat, Texas), chairman of the Joint Economic Committee, today announced further hearings on automation and technological development by the Subcommittee on Economic Stabilization. At the same time, Mr. Patman released a list of the participants at the hearings scheduled for November 14–15, 1957. The hearings will be held in room 1301, New House Office Building.

In pursuit of its responsibilities under the Employment Act of 1946, the Joint Economic Committee believes it desirable to review periodically the trend toward automation in industry in order to keep aware of any problems which may be developing. The hearings now planned are designed to extend the knowledge gained through hearings held in the fall of 1955 and again in 1956, at which time the subcommittee considered a number of industrial situations in which automation and technological change seemed particularly noteworthy.

Industries previously covered include metalworking, electronics, transportation, chemicals, communication, and instrumentation and automatic controls. In its study of automation, and in its report, Automation and Technological Change (S. Rept. No. 1308, 84th Cong.) the committee has directed its attention to (1) the extent of possible displacement of personnel, together with the problem of resultant need for personnel, together with the problem of resultant need for personal readjustments and retraining, (2) the possible shifts which may arise in the distribution of mass purchasing power, (3) the effect upon our business structure, (4) the distribution of the expected gains in productivity, and (5) the effect upon the volume and regularity of private investment.

The current hearings will continue this inquiry, focusing upon recent developments and areas previously unstudied, to bring the record up to date on current trends and the outlook.

The schedule of the hearings is attached.

Members of the Subcommittee on Economic Stabilization are as follows:

Representative Wright Patman, Texas, *Chairman*

Senator Joseph C. O'Mahoney, Wyoming
Senator Barry Goldwater, Arizona
Representative A. B. Kelley, Pennsylvania
Representative C. E. Kilburn, New York

WILLIAM H. MOORE, *Economist for the Subcommittee*

CONGRESS OF THE UNITED STATES
JOINT ECONOMIC COMMITTEE

SUBCOMMITTEE ON ECONOMIC STABILIZATION
SCHEDULE OF HEARINGS ON AUTOMATION AND RECENT TRENDS

Thursday, November 14, 1957

10 a. m.—Trends and outlook for technological progress from the standpoint of the research scientist: B. D. Thomas, vice president and director, Battelle Memorial Institute, Columbus, Ohio.
2 p. m.—Automation—the growing need: Roger W. Bolz, Editor, Automation, the magazine of automatic operations, Cleveland, Ohio.

Friday, November 15, 1957

10 a. m.—Economic reasons for automation in banks and the development of mechanization of check handling: John A. Kley, executive vice president, the County Trust Co., White Plains, N. Y.; and chairman, technical committee on mechanization of check handling, bank management commission, American Bankers Association.
Automation in banking other than check processing: A. R. Zipf, vice president, Bank of America, NTSA, San Francisco, Calif., and member, technical committee on mechanization of check handling, bank management commission, American Bankers Association.
Electronic handling of savings and mortgage accounts: Everett J. Livesey, vice president and secretary Dime Savings Bank, Brooklyn, N. Y., and chairman, savings management and operations committee, savings and mortgage division, American Bankers Association.
2 p. m.—Automation and prepackaging in the retail trade: James A. Suffridge, president, Retail Clerks International Association, Washington, D. C.

Chairman PATMAN. Dr. Thomas, we are delighted to have you this morning. You may proceed in your own way and we will listen to you with interest and appreciation.

STATEMENT OF DR. D. B. THOMAS, VICE PRESIDENT AND DIRECTOR OF THE BATELLE MEMORIAL INSTITUTE, COLUMBUS, OHIO

Dr. THOMAS. Thank you, Mr. Chairman.

In preparing this statement for the Subcommittee on Economic Stabilization, I have had occasion to read and study the previous work of the committee. I have been impressed by the significance of the material that has been covered, and I welcome an opportunity to express a view before such a forum.

I have been impressed in reading the record to find how prophetic your remarks of 2 years ago actually were.

A statement of the trends and outlook for technological progress is particularly timely at the present because of what we have experienced over the past several weeks in connection with the series of events that are identified in the public mind by the Russian word "Sputnik," which has entered the American language as "sputnik." Sometimes dra-

matic events of this kind are needed to focus attention on a matter that should be of more concern to the public than it is.

One of the great lessons to be learned by us from the Russian satellite is that there is a need for a better understanding by the public of the relations between our industrial society and science and technology. Some of the almost hysterical reactions at the time were symptomatic of a lack of such understanding.

A survey in one of our Midwestern States conducted a few weeks ago showed that 10 percent of first- and second-year college students did not know that Russia had launched a satellite. This survey indicates that even this presumably well-educated group does not have an up-to-date knowledge of current events nor a very profound understanding of the place of science in our economic world today. Yet it is almost self-evident that the success of a democracy depends on the consciousness that the people who compose that democracy have of the elements that sustain it.

We are not like an authoritarian state which may be maintained by force. We must not only believe in our institutions; we must understand them and still believe in them, which is another matter.

In studying the previous work of this committee, I am sure that it has been made clear that the applications of science are essential to a continuing economy of abundance. The situation was summarized very clearly by Mr. Patman when he said, during his preliminary statement at the 1955 hearings:

> Increasing productivity has provided a self-generating force for economic good in the past. In the interests of economic stability and growth, we must be alert to long-run trends and make sure that it continues that way, with its good features maximized and the resulting personal and short-run hardships, if any, kept at a minimum.

There is a branch of mathematics that deals with maximums and minimums. While I do not know whether Mr. Patman is a mathematician, a mathematician could not have stated this particular problem any better.

Your subcommittee, at the 1955 hearings, was concerned specifically with the impact of automation on industry and the possible attendant unemployment caused by replacing men with machines. Every one of the witnesses agreed, however, that technological progress was in itself a good thing. And if I analyze the opinions correctly, there was unanimous agreement that the increased economic income gained by automation was fully capable of carrying the relatively minor costs of readjustment.

Mr. Reuther, speaking for the labor movement which he so ably represents, stated it well when he said:

> For centuries they have struggled with the economics of scarcity; now we are entering that period of human history when the tools of abundance made possible by developing science and technology make it possible for mankind to meet basic economic and material needs.

Speaking as a scientist, let me say that it is very reassuring to find such evidences of appreciation for science and technology in the Congress of the United States and among the many witnesses who have appeared before this committee.

It is very easy for research men to despair of obtaining public understanding of science. Science seems to suffer from extremes of affection or dislike in the public mind and corresponding variations

in public support. The period of the last several months, during which there was a feeling that research was currently out of favor, was very happily terminated by the assurances of support which President Eisenhower gave in his speech last week on science and security.

In your letter of invitation to appear before the committee, Mr. Chairman, you requested that I speak on trends and outlook for technological progress from the standpoint of the research scientist. You were very kind to suggest a subject of such general scope that it gives me an opportunity to make a statement that is concerned more with policy than technology. You are to hear later from experts in automation, and so I am not going to discuss that subject.

Science and technology seems to be dominated in the public mind today by considerations of satellites and rockets and missiles, but I can assure you that, fortunately for us, there is also some other research work going on of more immediate value to human beings. The research laboratories of this country are going to continue to pour out the ideas that make living easier for more people. The devices that spare human effort, the drugs that save human lives, the agricultural developments that insure our bountiful food supply, the miracles of transportation and communication, and, of course, the thought-saving contrivances of automation will continue to increase our standard of living for the foreseeable future.

Perhaps this is a good place for me to state that if the Russians would direct their research effort a little more toward raising their standard of living as we have and less toward the creation of a threat to the peace of the world, they, and we, and the world, would be better off.

Each country must make a choice as to what it does with its scientific facilities. We have no way of estimating what the satellite development may have cost the Russians, either in rubles or manpower or in the proportion of their total scientific effort, which was diverted from the peaceful objectives they profess to believe in. But we do know that they still live in a climate of economic scarcity and that one cannot eat or wear or live in a satellite.

The things that are said to this committee, unfortunately, are not likely to affect the doings of the Russians. But there is a lesson in this for us, too. The supply of scientific facilities in the form of trained men and laboratories is not unlimited in any country in the world.

The question of what we do with our scientific effort is one that we must answer. We must decide what course we shall follow, and the decisions we make may well be of surpassing importance in determining the future of this country. Against the regimented and calculated scientific effort of a dictatorship, we must marshal the ideas of men who enjoy a greater freedom in their scientific research. Freedom is a perilous thing to hold to in the face of such a threat. but there is no other course open to us.

The decisions about our scientific effort must be made on the basis of an understanding of the real place of science and technology in our industrial complex.

I would like to introduce to the committee a concept that I call the technological potential. We hear a great deal about technology and

industry research and development, basic science and applied science. All these things are of importance in the production of wealth. All must be supported, but it is well that we understand their interrelationships.

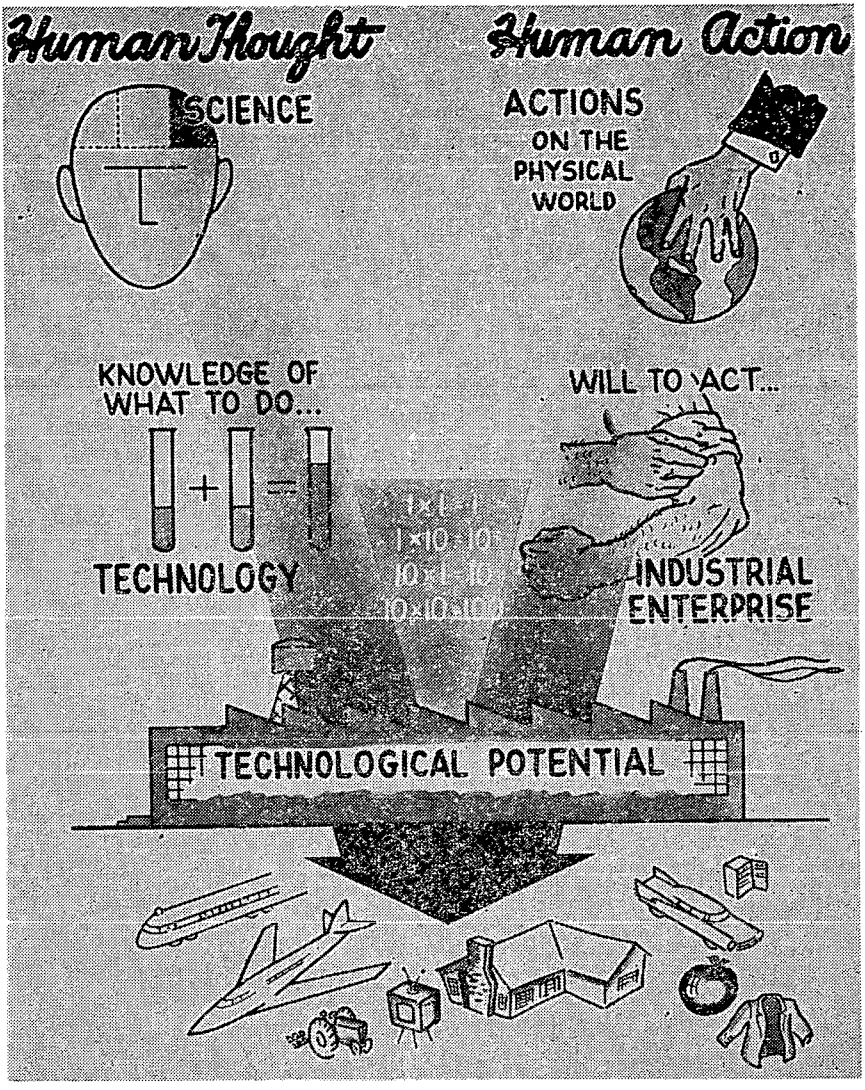
Science does not in itself produce wealth, nor is it directly related to industry. An intermediary is required, and the intermediary is technology.

The Einstein equation $E=mc^2$ sums up the science of the relationship between mass and energy. This is science. But between this equation and the generation of useful electric power by a nuclear reaction stands an enormous amount of extremely complicated engineering. This is technology. This is the way that the knowledge of science is transformed into a physical reality.

Our modern industry is a product of two factors: knowledge of what to do and the will do it. The first factor is supplied in our industrial complex by the technologist, and the second by industrial enterprise; the one by the engineer and the other by the businessman.

I would like to illustrate this by a diagram.

(The diagram referred to follows:)


Human Thought
Human Action
SCIENCE
ACTIONS
ON THE
PHYSICAL
WORLD
KNOWLEDGE OF
WHAT TO DO...
WILL TO ACT...
TECHNOLOGY
INDUSTRIAL
ENTERPRISE
TECHNOLOGICAL POTENTIAL

Dr. THOMAS. This diagram is not as complicated as it appears. It shows how the knowledge of what to do derives from that part of human thought which we may designate as science, and how it combines with the part of human action which operates on the physical world to produce wealth. This interaction is what I have termed the "technological potential." It exists even in the classical example of the man with a hoe. His knowledge of what he can do with a hoe is technological, and it derives from a knowledge—even though it may be primitive—of the science of agriculture.

In our modern world this interaction has become much more highly developed, and in an industrial society the technological potential results in industry. Each of the separate parts of the potential is tremendously complex.

Science is so complex and specialized that it is impossible to keep informed except in a narrow field. Scientific literature appears at a rate greater than a thousand pages per day. This is greater even than the Congressional Record. No man can read even a small part of it.

I am sure I do not need to tell the committee that human action is also complex. Industrial enterprise, for example, includes all the involved economic, social, and human relations that are well known to you. One of the most important segments of industrial enterprise, for instance, is labor. Of all the forms of human action we are talking about here, labor is certainly the most immediate and direct.

The success of an industrial economy depends on how the two factors of technology and industrial enterprise are brought together. When I said previously that industry was a product of these two factors. I mean that in a certain sense their interaction is like multiplication.

I want to introduce you to a multiplication table which I have included on this chart, which shows this. When both factors are large, then there will be a large output from industry, and the standard of living of a country will be high. If either of the factors is low, it will inevitably reduce the nation income, and if both are low, a country will have a mere subsistence economy.

We can see that 1 times 1 equals 1. If the knowledge of what to do is multiplied by a will to act, evaluated at 10, we still only get 10. On the other hand, if technical knowledge is evaluated as 10, but the industrial enterprise is only 1, we still get 10.

On the other hand, if both the knowledge of what to do and the will to act can be evaluated, each of them, as 10, then the product becomes 100, and we get an industrial production, a technological potential which may be 100 times that of a more primitive society.

Some examples, I think, will make this clear. Here is a list of some representative countries of the world, placed in order of their per capita income: United States, Switzerland, Great Britain, Sweden, Netherlands, France, U. S. S. R., Brazil, India, China.

It is apparent that countries at the top of the list are those that have both high technological competence and a large industrial enterprice. Those in the middle will have at least 1 of the 2 factors lower. Those countries for which both factors are low will fall at the bottom of the list.

It is interesting to note that the possession of abundant natural resources is apparently of secondary importance. Switzerland, with no resources except its natural beauty, and Great Britain are near the top, while India and China, with very considerable natural resources, are near the bottom. But we know that Switzerland has an extraordinary technological competence and a high measure of industrial enterprise.

The countries of Western Europe are in general high, but it is significant that France, with great natural resources, is comparatively low. The level of technological competence in France is high, but technology is not brought together with business enterprise in an effective way. I would hazard a guess that French industry, particularly labor, would resist automation, for example, much more strenuously than would our more enlightened labor in this country.

The lower per capita income and standards of living which prevail in Eastern Europe among the Iron Curtain countries may be attributed to low industrial enterprise. In some of them, technological competence may be very high, as we have just had demonstrated to us by Russia, but individual initiative in human action is officially frowned upon and the technological potential is reduced to correspondingly low levels.

In Asia both factors are low and the countries of Asia exist at mere subsistence levels as a consequence.

The name of this committee indicates that it is interested in economic stabilization. High industrial production is important if we wish to maintain our high standard of living.

Since I am speaking as a research scientist, I will simply point out that industrial production can be increased by anything that stimulates that part of human thought concerned with science and technology, provided it is coupled with a corresponding stimulus to human action as expressed in industrial enterprise, whether it be business enterprise or a better educated and more sophisticated labor force. To me, these factors appear of overwhelming significance in the structure of our industrial society.

I stated earlier, Mr. Chairman, our country must make a choice in the way it wishes to support and utilize technology. It must decide the way in which technology is brought into our industrial enterprise. These decisions are basic, not only to our military security but to our economic welfare, and, in a very real sense, our military security is founded on and depends on our economic power.

If we acept this idea, then I would like to point out factors that should be considered in making these decisions:

1. Our supply of technological manpower is limited. It is important that it should be used to best advantage.

2. Our research facilities are limited. It is important that they be used to advantage.

These factors are almost self-evident to discerning observers. It is also apparent that there is a need to expand technical manpower and facilities.

There have been numerous reports by governmental agencies, technical societies, and educational groups on the technical manpower situation. Comparisons have been drawn between our production of technically trained men and Russia's. It can hardly be said that we have

yet come to grips with the problem. We have not put into our social and economic system the incentives that will attract talented young men and women into science.

The need for expansion of research facilities may be less apparent than the need for a solution of the manpower problem. But modern research requires elaborate equipment and facilities. This need must be recognized.

Up to this point, Mr. Chairman, I have been trying to present a research man's view of the way science and technology fit into our economy and to show the existence of certain problems.

My understanding is that the main purpose of the investigations of a congressional committee is to obtain information that may be of value to the Congress in its consideration of legislation. I hope that the recommendations that I would like to make will be useful to the committee. But I would like to take advantage of the opportunity to address an appeal to others as well. Industry, labor, the press, and educators have a need to understand these problems that confront us.

I hope the committee will sympathize with the difficulty of making authoritative statements when the President of the United States is currently speaking on the same subject. I trust it is not to become the custom of this committee to confront its witnesses with such competition. It is hardly fair to the witness—or to the President.

I am sure that most scientists in the country will be pleased with the President's decision to give greater support to basic research. This is certainly a forward step. It will help satisfy a primary need of our country, which is to create and maintain an atmosphere in which science and technology will grow and continue to contribute intellectual and material benefits to our national life. This can be effected in various ways, but undoubtedly the largest single factor is the Federal Government. It is the largest spender in the field and its research policies are of fundamental importance in the scientific effort of the country.

These policies should be better established and understood. There is a need for more stability in the Federal research programs. The recent curtailment is a case in point. The damage to research morale was certainly greater than the value of the dollars saved. Stability and continuity of effort are of as great importance as the actual magnitude of expenditures for research.

The policies of the Federal Government should encourage research in private industry. In England this is done by Government subsidy, which I do not recommend. But the same result may be accomplished by having our tax legislation encourage research and industrial progress. The country would gain if our tax laws contained provisions which made it advantageous to industry, particularly small industry, to do scientific research.

I spoke earlier of our failure to build into our social and economic system the incentives that will attract talented young men and women into science. I am not speaking about financial incentives entirely; although it may be remarked in passing that in the Soviet Union scientists and engineers enjoy the highest paid positions. The highest salary in the entire country is paid to the president of the Soviet Academy of Sciences.

But here I think our failure to attract young people into science and engineering stems more from a public attitude than from considerations of income. And this attitude is engendered more by some of our basic educational policies than any other factor.

The salaries paid our public-school teachers are a national disgrace and evidence of public indifference toward learning. The tendency to designate scientists as "longhairs," "eggheads," and other derogatory expressions that I am sure will occur to you, is further evidence that public sympathy for and understanding of science do run very deep. We can ill afford such extravagant byplay in a competition with a hostile power that places science on a pedestal. The press, radio, and television have some responsibility in this matter.

To me, one of the most reassuring aspects of the inquiry conducted by your committee has been to note that several of the labor leaders that have appeared before you have been accompanied by research assistants. This is evidence that the responsible leadership in our labor movement is alive to the realities of our modern life. Even though the research activity of a labor union may be concerned with economics and social science rather than the physical sciences, it nevertheless indicates an awareness of the problem that is reassuring. Such an effort cannot fail to disclose the importance of science and technology to the rank and file and to educate them in its more significant phases. I am speaking as a research man when I say that an educated, enlightened, and sophisticated labor movement is essential to sound industrial enterprise.

To summarize, Mr. Chairman, I would like to repeat and emphasize that—

1. The science and research facilities of this country are not unlimited, and they should be utilized in ways that will do the most good. The policies of the Federal Government in this utilization will be of paramount importance, and great wisdom will be necessary in the direction of its scientific effort.

2. Our industrial enterprise and our economic stability are still dependent on scientific research and development. This must not be lost sight of in any reorganization of our research.

3. There is a pressing need for more public appreciation of the role of science and technology in our economy. This appreciation must be built up through education and sympathetic support from all parts of our society—labor, the press, radio, and television.

I would like to make one further observation.

The place of science in the daily life of every one of us has changed completely in the past 20 years. And I am not speaking of just the scientists. There is no one in this country whose life has not been made quite different from the one his father lived by the revolutionary changes effected by science. Perhaps it will take a new generation to recognize the full significance of this fact, and several generations to make the economic, social, and moral readjustments which are required as a consequence. But the sooner we set about it, the better.

Chairman PATMAN. It is a wonderful statement, Dr. Thomas. I personally appreciate it and I know the other members of the subcommittee will be grateful for this contribution.

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I just want to reread, for the purpose of reemphasizing, the review of the full statement you made on page 10:

> The salaries paid our public-school teachers are a national disgrace and evidence of public indifference toward learning. The tendency to designate scientists as "longhairs," "eggheads," and other derogatory expressions that I am sure will occur to you, is further evidence that public sympathy for and understanding of science do not run very deep.
>
> We can ill afford such extravagant byplay in a competition with a hostile power that places science on a pedestal. The press, radio, and television have some responsibility in this matter.

I wonder if you would tell us, Dr. Thomas, a little more about the work of your own organization in the several fields of scientific development in which you are operating.

Dr. THOMAS. Battelle Memorial Institute is an American research foundation. It was established by a bequest left by Gordon Battelle in 1923. The Battelle family were Ohio pioneers. They were associated with the Ohio steel industry, and at the time that Gordon Battelle died, without children, he left the family estate to establish a foundation, as he said, for research and education for industry.

The purpose of the foundation is essentially to advance science and its applications. The funds were left with a board of trustees, and a laboratory was built in Columbus, Ohio, in 1929.

The board also decided to make the facilities of this laboratory available on a nonprofit basis. The work of the foundation has grown very substantially over the years. It has a record of helping during the war in many phases of our military research. At present it has a total staff of around 2,600 people, about 1,500 being scientists and engineers.

We work in the following fields: Metallurgy, physics, chemistry, chemical engineering, engineering physics, mechanical engineering, and economics.

Our largest effort is in the field of metallurgy. We conduct many very interesting studies on materials. These are of current interest, of course, in connection with the present missile program, which is very much concerned with the properties of materials subjected to extreme conditions of temperature and stress.

Chairman PATMAN. In connection with the needs for training scientific personnel, I have seen little publicity given to the inservice training program which many of our industries have developed for adding to the academic education of their new employees. Would you consider this an important source for meeting some of our needs for increased scientific training?

Dr. THOMAS. I am very glad you mentioned that, Mr. Chairman, because I feel very strongly on this subject.

Battelle has a program of continuing education for the members of our staff. As you may know, we are situated close to Ohio State University, and we encourage the men on our staff to go on for graduate work and to add to their own skills and education by providing financial assistance.

In considering this whole problem of educating engineers and scientists, it has seemed to me that since we have over a million people in this country who already have a sound technological training, the best thing the country could do would be to build upon this existing broad base.

In practically every case where a man has a degree in engineering he should be receptive to going on and getting additional training. Since even if we are able to make changes in our elementary education and in the high schools, it would be still a period of 10 years before we could reap any benefits from this; the most immediate thing is to encourage on a wide national scale the continued training of the people we already have.

Chairman PATMAN. What more can be done, Dr. Thomas, to train what might be designated as intermediate grade technicians?

What more can be done to train what might be designated as intermediate grade technicians?

It is my understanding that the increased use of automation will call for a much higher quality of operating personnel. How can we best get this type of technician?

Dr. THOMAS. In Russia they have a large number of technological schools for which there is no counterpart in this country. These schools train just the sort of people, I think, that you are talking about, Mr. Chairman, and I think it is something that we in this country should consider: Whether we should not set up schools that are specifically designed to give an intermediate sort of technical training for people of this kind.

Certainly we can see that if our country continues to grow within the technological framework that I described, we are going to need more people of this kind. The points that I made in my remarks about the need for a more sophisticated labor movement in this country are along the same lines.

I think that one of the things that we could do that would greatly strengthen our country technologically is to see that our workers know more and understand more about what they are doing. Certainly many of them work in factories that, if they are automated, involve highly complex technical operations. If they know about these things, they are better workers, and they, in my opinion, would be better American citizens because of it.

Chairman PATMAN. Would you give us any measures which could be used to determine how our educational resources should be divided to meet the several types of personalities to which you refer in your paper?

How will we know when we have enough scientists for basic research or enough scientists for operational research, and so forth, Dr. Thomas?

Dr. THOMAS. I think that the essential problem is to upgrade the entire country in this respect.

I was impressed with a paragraph from President Eisenhower's speech last night that I think deserves quoting. In talking to the school board, he said this:

> Remember that when a Russian graduates from high school, he has had 5 years of physics, 4 years of chemistry, 1 year of astronomy, 5 years of biology, 10 years of mathematics through trigonometry, and 5 years of a foreign language.

I think that the essential aim here is to see that a large part of our citizenry has a rather complete education in science, not with the idea that they are going to function as scientists or engineers, but just simply so that they will understand the society in which they live.

I think that the problem of the education of scientists, per se, is a little different. In this problem, we are concerned with educating individuals. One of the big problems of our educational system is to single out the individuals who are capable of advancing to a very high degree, who can go up to the very frontiers of science, so to speak, and this is quite a different problem from educating a large mass of scientists and engineers.

I think that we have to do three things:

First is to see that the public generally is more highly educated in science.

Second, to educate a class of technicians, as you referred to it a few minutes ago, and, third, to see that our leading scientists, our geniuses, if we can call them that, are given full scope for the personal development at which they are capable.

Chairman PATMAN. I have heard it said—though I don't know who said it, though some said—"Nothing is so powerful as an idea whose time has come."

It is possible that the invitation we have been making to get public attention to this matter has caught hold, and we are now getting the attention that the subject has deserved for some time, particularly the last 2 years.

Two years ago, this committee held the first hearing of this kind on automation. We held a hearing which continued for 2 weeks. I will quote here what I released in a newsletter after that time. I think it is important now. I am quoting from that newsletter that I issued at the time.

> The most disturbing thing which came to our attention during these hearings was the evidence presented by the witnesses that our country is faced with a threatened shortage of scientists and technicians which could cost us our technological superiority. We find that professional engineers are being graduated at a rate of nearly twice as fast in Russia as in this country, and that technicians are currently being turned out there at 30 to 40 times our rate.
>
> Shortly after the close of our hearings, the chairman of the Atomic Energy Commission, Adm. Louis Strauss, in a major speech, acknowledged this threat and called upon the Nation's citizens to take it seriously.
>
> The National Science Foundation also published a statistical study after our hearings which gave substantiation to the evidence we had received. Our subcommittee report, which was approved unanimously, recommends that all groups get together to formulate a specific and broad program, for both secondary and higher education to the largest extent possible.

Possibly the members of our staff would like to ask questions.

Mr. Lehman, the acting executive director of our committee, will be recognized.

Mr. LEHMAN. Thank you, Mr. Chairman.

I have one rather general question which I would like to ask as we return to the overall topic to which you have addressed yourself, Dr. Thomas. It concerns the broad trends and outlook for technological progress.

What are the frontiers at which we might expect the next breakthroughs, particularly the frontiers that will be of economic as well as scientific significance?

I know your own field is chemistry. Where are we going in chemistry that will be of particular economic significance?

Dr. THOMAS. The most important work, I think, from the standpoint of its economic significance in the field of chemistry, is probably that

now going on in plastics. There is some very remarkable work going on in studying cross linkages in synthetic resins and plastics that is going to produce some materials with rather astonishing properties.

I think that this will undoubtedly be of great significance in an industrial way.

To many the most fascinating things that are going on in chemistry are those studies which are concerned with the chemistry of living processes. We seem to be up to a frontier where, by studying the reactions of some highly complex protein molecules, we can arrive at some conclusions with regard to the character of the living processes themselves. This, of course, is of very great philosophical interest.

We cannot be sure of ultimate applications, although undoubtedly it will be possible, if we understand these living processes better, to make greater progress in the study of disease and to arrive at new ways of combating disease.

In the field of physics we are still greatly preoccupied with the character of the atomic nucleus and the nature of the ultimate particles of physics. The application of this, of course, is still in a state of what we might call technological development, because, while it is easy enough for the physicist to say that we can get a tremendous amount of energy from the atomic nucleus, it is a much greater technical and engineering problem actually to generate electric power, which, of course, is the immediate objective of all the development work that is going on in the country in this field of electric power generation from nuclear energy.

In the field of mathematics, there is a great deal of highly theoretical work going on in studies of topology, groups, and so on.

Some of these studies are important in a practical way in a subject that you are going to be discussing in the rest of these hearings; that is, automation. Automation is proceeding in many factories and in industrial processing. The greatest interest today seems to be in the processing of data. Here we seem to encounter limitations of the computers themselves. Good as these computers are, they have certain inadequacies when compared with human minds. Their memory systems, great as they are—perhaps greater than many human minds—still don't seem to have the necessary flexibility in their searching mechanism. There is a need for computers not only with a higher volume of memory, but a greater speed in searching that memory for required data.

All these developments are going to have an immediate effect upon the technological growth of this country.

Mr. LEHMAN. You mentioned the work that the institute is doing in high temperature metal research. I read an article in your October bulletin that I think may be of considerable interest to the subject today.

Could you give us an example of some of the applications of this temperature metal research in the missile field?

Dr. THOMAS. In the speech that the President gave a week ago on science and security, you will recall that he displayed a rocket nose cone that he said had been outside the atmosphere, and which had successfully reentered and had been recovered.

I am fairly sure that most of his listeners missed the point. Actually, the fact that he had this nose cone there in his office to show, in

my mind represents an achievement that is comparable to the satellite achievement of the Russians.

Actually, to get a missile or any part of it back through the atmosphere is a very difficult thing, and the materials from which this nose cone is made must be able to withstand some rather extreme conditions of temperature and stress. So the means by which this cone that he had in his office got back down to earth and was recovered, as I say, indicates that some very substantial progress has been made.

This matter of space flight and so on is inherently fascinating to people and accounts for much of the public excitement in connection with the satellite. I think it is unfortunate that the public has apparently gotten the idea that because the Russians have put up a satellite, that they have beat us in a scientific way.

This is not a failure of science. We certainly have the capabilities of putting a satellite into an orbit. The fact that we didn't do so was just simply a reflection of the fact that this was not made a primary objective of our research work.

Your question was directed to Battelle's role in the development of high temperature metals.

Battelle, from the time it started, was concerned very much with the high temperature properties of metals. Dr. Gillett, who was the first director, formerly with the Bureau of Standards, had as one of his fields of interest high temperature materials. So this work has been going on at Battelle for 30 years, and, consequently, it is not surprising that we have some role in the development of these materials.

Chairman PATMAN. Mr. Knowles, would you like to ask a question?

Mr. KNOWLES. Thank you, Mr. Chairman.

Your statement, Dr. Thomas, raises some questions in my mind, perhaps because they present analogies between the problems with which physical scientists and economists are concerned.

On page 4 of your statement, you speak of Einstein's comment of $E=MC^2$, and of the fact that there is a long gap between that concept and getting energy out of a switchbox somewhere when you flip a switch.

I am wondering if the scientist has some sort of rough rule of thumb that he thinks of as the most probable time lapse between the time the pure scientist comes up with some such concept and the time at which you can bring a practical reality out of it.

Dr. THOMAS. If you are speaking specifically of nuclear power, this is hardly a fair question. There have been a great many opinions given by experts on the length of time that it is going to take, ranging from 10 years to "never."

My own opinion is that the time is going to be shorter than many think, because this is not altogether a matter of economics. People will expect electric power from nuclear energy.

I take it that you are an economist?

Mr. KNOWLES. That is correct.

Dr. THOMAS. Let me point out that if you try to defend the automobile entirely on economic grounds, you will find that it is quite indefensible. If you are a two-car family, and if you have ever tried to convince your wife that it is cheaper to use public transportation or to ride taxis than to own a second car, you will know what I mean.

Actually, there is a lot more to owning an automobile than mere economics. There are some similarities in the case of atomic power.

I think one of the most important factors in this is the demand of people that some use be made of this new force. It is perhaps a psychological demand, but I think it is very real, and I think it is going to be a factor that will shorten the time when this use is made rather than have it go its natural economic course.

Mr. KNOWLES. Could you point out any example in the past in which there has been a fundamental discovery of this sort, such as the nuclear breakthrough, where we have already made some application of the principle, such as the one we are looking for here in atomic power? Can you point out something that would give an example of, let us say, how many decades it was, or years, whatever is the relevant magnitude, between the time of the first publication of theory and the time we finally got a practical application?

Dr. THOMAS. A classical example of this, of course, may be found in the so-called electromagnetic field equations of Maxwell.

I think that Maxwell published these equations in 1870, or thereabouts. These are the equations on which are based all our modern developments of radio, television, and communication. Radio was developed during a period beginning about 1900 and one might say that a period of 50 years elapsed between the time when these equations were written, and their widespread practical application. But I think that the whole trend of modern times would indicate that this period is going to be greatly shortened—that there is going to be a much shorter time elapse between what we might call a breakthrough in basic science and its expression in some physical applications.

Mr. KNOWLES. I take it from what you say that this time period is not something which has some sort of fixed physical law about it that depends on the nature of the universe and the scientific processes, but is something in which this time lapse can be shortened or lengthened, according to how much resource you put into it, and how much drive you put into carrying out the technology between the theory and the application.

Dr. THOMAS. That is correct. It depends to a very great degree on how much, how badly, people want it.

Mr. KNOWLES. Thank you, sir. Those are all the questions I have.

Chairman PATMAN. Thank you, Dr. Thomas. We appreciate your testimony. Thank you very kindly, sir.

We have with us this morning a member of our own group of the Joint Economic Committee. We are expecting him to testify. I do not believe we have a more highly respected man in Congress than Senator Flanders of Vermont.

Senator Flanders has been on the Joint Economic Committee for 10 years. During that time, I have listened to him with interest and appreciation, because I have always learned something from what he said. He was a businessman in the machine-tool-making field, one of the most important businesses, of course, in our country, because it makes the tools to make the products. He was chairman of the Federal Reserve Bank of Boston and he has a number of patents, I think over 30, in his own name.

He is a very versatile Member of Congress, and a very versatile, patriotic American citizen.

Senator Flanders, I want you to know that we appreciate the fact that you are willing to take time off from your important duties and responsibilities in your home State during this vacation period to come to Washington for the purpose of appearing before our committee on a subject that I feel like is of great importance today.

STATEMENT OF HON. RALPH E. FLANDERS, UNITED STATES SENATOR FROM THE STATE OF VERMONT

Senator FLANDERS. Thank you, Mr. Chairman.

Mr. Chairman, when first initiated a few years ago, it seemed a real advance when the automatic wage increase tied to the cost of living was introduced as a feature of labor agreements. We now know that this was a disastrous condition, since it does more than compensate for increases in the cost of living. It stimulates increases in the cost of living, and is, therefore, self-defeating so far as the wage earner is concerned.

It seems more logical and less dangerous to base wage increases on the increase in productivity. This certainly is safer than basing them on the cost of living, because there is not necessarily involved the automatic inflation which results from dependence on the Consumer Price Index for labor policy. Even increase in productivity has, however, to be carefully considered if it is not to feed inflation.

The subject of these hearings is automation and recent trends. Since automation is the greatest prospective means of increasing productivity, it seems to me very important in these hearings that the effect on inflation should be considered. It is for that reason that I have asked to appear before you.

I propose, very briefly, to suggest a constructive principle to use in the distribution in the various groups involved of the profits arising from automation or any other increase in productivity. The suggestion is this:

When an increase in productivity has been achieved, and not before then, the profits from this increase should be divided 3 ways between the 3 groups whose interests are involved. I would propose that one-third of the profits be assigned to increasing wages, one-third be assigned to the business itself, and one-third go toward the lowering of prices.

That distribution of some part of the profits from increased productivity should go into wages will, I believe, be generally accepted, not merely by the wage earners and their bargaining organizations, but also by management and the general public.

Experience has shown that it is dangerous to grant full distribution since it leads to inflation and a consequent nullification of an increased standard of living for the workers. It is extremely important that a proper share of the increased profits should go into the business. The increased productivity in modern conditions is not obtained by harder work or longer hours on the part of the workmen. It is obtained by managerial efficiency and particularly by heavy capital expenditures for the most proficient productive equipment.

Since the whole plan here proposed is directed toward raising the standard of living of the wage earner, and everyone else, it is important to leave enough of the improved profits in the hands of the management to encourage them to go further still in the purchase and installation of expensive and more efficient equipment. It might, in fact, be suggested that for the sake of workers and the consumer, the proportion to management should be higher than one-third. But I am suggesting a three-way division.

One-third of the improvement in profits should go to cutting down the cost of the product. If this principle is accepted, it immediately puts an end to the present effect on rising wages raising the cost of living.

Furthermore, the wage earner gains two ways if prices are reduced. He gets an increased wage, and he gets a decreased cost of living. The wage earner really gains three ways, since a reduction in prices will tend to expand the market for the product, it will thus minimize any decrease in unemployment resulting from the more efficient production.

I offer these proposals as principles. They cannot be worked out simply so that any achieved increase in productivity is automatically divided.

If, however, the principles are accepted, then for the future, labor negotiations can be carried on rationally and to the benefit of all, instead of being a scramble to see whether management or labor is to get the biggest piece in the newly baked pie.

I would also like to express at this point my fear that Federal Reserve action, including the maintenance of higher interest rates, can only bring the wage cost-profit-price spiral to an end by producing unemployment. We must find some other way to end inflation, and I do not see how it can be done, except by a better understanding of the situation on the part of labor and management, with labor negotiations based on a broad and long-range comprehension of the self-interest of the parties involved.

Chairman PATMAN. Have you completed your statement, Senator Flanders?

Senator FLANDERS. That is all there is to it, sir. I run out of words rather quickly.

Chairman PATMAN. That is a very interesting statement, Senator Flanders. I would like to clarify it in my own mind, if I may.

I wonder if this is comparable, the proposal you are objecting to, automatic wage increases, I wonder if that is comparable to what has been proposed in this country in the past and what has been adopted in some of the European countries, I believe, where a bond is issued and sold with a guaranty that it will have the same purchasing power at the time of maturity.

Does it strike you that the proposed automatic wage increase is comparable to that theory, Senator Flanders?

Senator FLANDERS. It would seem to me disastrous to the Government to accept that principle under the present situation of more or less automatic inflation. We would then have to borrow more money to pay off the money we last borrowed. But it seems to me that that proposal becomes possible, provided we bring this wage-cost-profit-price spiral to an end.

I wonder whether, in the event of deflation the proposal would work the other way. Whether the bondholder in retiring the bond should be willing to accept a less sum in dollars than put up when he bought the bond. Do you think that could be a two-way proposition or only a one-way?

Chairman PATMAN. I was only mentioning that to possibly determine whether or not there is a similarity between the two proposals.

In other words, if we are going to have an automatic wage increase to take care of the increased cost of living, have an escalator for one class or one group, should we use that same argument in telling the people who bought the bonds from the Government that "We are going to give you an escalator, so as to guarantee to you that the dollars that will be paid to you when the bond matures will be equal in purchasing power to what the dollars were at the time the bond was purchased?

Senator FLANDERS. It seems to me, Mr. Chairman, that a good case in equity could be made for treating the Federal bond purchaser in the same way as the wage earner. I would only say that if we are going to establish equity by that means, we had better be pretty careful that our equity doesn't cost us too much.

Chairman PATMAN. Well, you see, if we establish it in one, and if we extend it to bond purchasers, of course, we would have a number of other problems to solve. We would dig up a lot of snakes to kill; wouldn't we?

There would be problems all over the place.

Senator FLANDERS. Yes.

Chairman PATMAN. If we are going to try to administer exact justice between people on the purchasing power of the dollar, we would have a lot of problems to solve.

Senator FLANDERS. Yes; we would have. We would have a lot of problems to solve.

Chairman PATMAN. When would you say there is a profit in an industry or business that should be divided?

Would you say after it has earned enough to pay interest on all of its bonded indebtedness, or all expenses, business expenses, cost of materials and supplies, and then the stockholders a reasonable return on their money?

Where would you arrive at your point of division between the three groups?

Senator FLANDERS. Mr. Chairman, we are now entering into the area of negotiation, and I was trying to establish principles which will be differently interpreted by the two parties to the negotiations.

But, in general, it would seem to me that the profits should be reckoned only after the amortization costs of the new equipment are taken care of, just speaking broadly, and that what has been a customary rate of dividends should be considered. After those things are considered, then the division, the increased returns to the wage earner, the company, and the lowered prices, should take place.

I may say—and I am now going to just speak of some of the difficulties in applying the principles, I think the principles are all right—it is easier to apply it to a manufacturing product than it is to a merchandising product or a service industry.

For instance, if we take the bargaining between the clerks and the managements in the supermarkets, the history of the supermarkets is

not one of reducing costs; it is one of wrapping things in cellophane and increasing costs. It might have the effect, if sufficiently advertised, of selling the customer on the notion that the costs of distribution could be reduced if it were not quite so fancy, and that they thereby might get cheaper food in the supermarket. I don't know. But I recognize that that is one of the instances of an industry in which it would be difficult to apply the principle.

Nevertheless, I want to state and maintain the principle.

Chairman PATMAN. The principle, I think, has a lot to recommend it.

I wonder, however, about an industry that had certain profits last year, which you are going to divide according to your formula. One part of the formula calls for a reduction in the cost of the product. Now, if you reduce the cost of the product, you will make it probably impossible for the wage earner to get any increase the next year, wouldn't you?

Senator FLANDERS. In the first place we don't divide the profits. We divide the increase in profits.

Chairman PATMAN. The increase in profits?

Senator FLANDERS. Yes, the increase in profits.

In the second place, the reduction in price might very well bring an increase in volume which again increases profits.

So I do not believe that it is a self-terminating principle.

It also stimulates the manufacturer, and allows him to retain the means for introducing new cost-reducing machinery.

I think the element of the increased sale, the increased market, resulting from a lower price, is an important possibility in reducing the resulting unemployment.

Chairman PATMAN. We want to thank you, Senator Flanders, for a very interesting statement. We will certainly give it consideration.

Senator FLANDERS. Thank you.

Chairman PATMAN. This afternoon, at 2 o'clock, we have Mr. Roger W. Bolz, editor of Automation, the magazine of automatic operations, of Cleveland, Ohio, as our witness.

Without objection, the committee will stand in recess until 2 p. m., to reconvene here in this room.

(Thereupon, at 11:30 a. m., the subcommittee recessed, to reconvene at 2 p. m., same day.)

AFTERNOON SESSION

Chairman PATMAN. The committee will be in order.

This morning we heard from Dr. Thomas of the Battelle Memorial Institute on Trends and Outlook for Technological Progress from the standpoint of the research scientist.

This afternoon we will continue to look at automation from the overall standpoint. Roger W. Bolz, editor of Automation, the magazine of automatic operations, will discuss the future of industrial applications of automation and the growing need for automation in our economy.

Mr. Bolz is not only a distinguished editor, but has been the organizer and director of a number of significant conferences dealing with the problems of automation which have been held at some of our major universities.

Mr. Bolz, we are delighted to have you, and shall look forward to hearing your testimony. Although some of the members cannot be here that expected to be here, the testimony, as you know, is printed, and it is distributed to every member of the committee and to every Member of the House and Senate. It goes also to all the principal libraries in the country and to the press.

We are delighted to hear from you, Mr. Bolz. You may proceed in your own way.

STATEMENT OF ROGER W. BOLZ, EDITOR, AUTOMATION MAGAZINE, PENTON PUBLISHING CO., CLEVELAND, OHIO

Mr. BOLZ. Mr. Chairman and members of the committee, since August 1954 I have been editor of the magazine, Automation, published by the Penton Publishing Co. of Cleveland, Ohio. Automation, I might add, is edited by a staff of experienced engineers and is the only journal devoted solely to the basic technology that is now described by the generic word "automation."

As editor, I was indeed pleased when Chairman Patman asked me to talk to you today on some of the pertinent facts concerning this important topic of concern to all of us in the United States.

Most discussions of automation to date have been concerned with its impact on the economy. In a way, to speak of automation's impact brings to mind a collision—a dynamic reaction to a tremendous force. Perhaps this term is a bit too emphatic, perhaps even misleading. In fact, if we look only at the 1956 advance in productivity level. we might conclude it has little.

Nevertheless, automation will continue to have a gathering influence and effect. Its influence, however, will be evolutionary, a slow and gradually spreading effect of tremendous benefit. Because it depends greatly upon engineering, research, development and plain ingenuity, fostered by economic pressures, its advance will be geared to a large extent to business economics.

It seems to me that, in presenting this subject, the assumption is always made that automation is a known technology relentlessly infiltrating the industry. There is evidence to question this point.

Today, the big problem appears to be otherwise. Without a positive approach and careful study of the possibilities, the benefits of automation may never be realized in many cases, or not realized in time to be of help. Few business managements are prone to change or invest money without good reason. Basically, automation is stimulated by economics.

Advance into successful automation must always have as its goal a positive aim and purpose. From a business standpoint, certain important factors as a rule, force a move toward, into, or to greater automation. Among the many, a few significant factors are:

(1) Loss of market due to overpricing.
(2) Limited market due to cost of product.
(3) Failure of product due to low quality.
(4) High service costs due to low quality.
(5) Need for rigid purity or sanitary conditions.
(6) Product quantity demand beyond manual capacity to produce.
(7) Strong competitive conditions.

(8) Delicate, violent, or unsafe materials handled.
(9) Lack of adequate labor.
(10) Job or production conditions unsuitable for human endurance.
(11) Available workmen refuse to labor under prevailing job conditions.
(12) Desire to bring badly needed goods within the reach of all pocketbooks, et cetera.

These and many equally important fundamentals, among which may be the strong urge to remain in business, can and should spur the businessman toward seeking automation as an economic solution to his problem. However, he will not necessarily obtain success, as everyone seems to take for granted. More often he may fail without considerable help because the technical and business aspects are complicated, more so than any in the past.

It seems to me we should be working to learn how to apply these principles and fundamentals to better advantage in a positive way rather than using the negative approach of trying to make tremendous conclusions as to the social effects of a development which is little understood by the layman but which has resulted from his own demand for a higher social order.

One development breeds another. Each upward step in our social order and standard of living must be made from the one below.

Automatic flour milling became a necessity to bring sacked flour to the population at an acceptable cost barely over growers' cost. In the United States of America the industry has probably been as automatic as it will get for some 30 to 40 years already. No one would dispute the need or necessity.

The same is true of volumes of items we consider a vital part of our everyday life, such items include things like cigarettes, toothpicks, candy, pop, matches, food products, and on and on. Today's effort continues the long, arduous path to successful manufacture of more and more products and items at lowest unit costs, highest quality, and necessary quantity while creating jobs, both direct and indirect, with greater and greater pay and skills along with continued return to investors and stockholders.

The greatest contribution which this committee can make will be to promote factual and specific understanding of this important industrial technology as we move into a new age. The question is not so much how can we cope with the social effects of automation as it is how can we use automation to advance our position and insure a better future. Where there is no vision or enterprise, there is no accomplishment.

Alfred North Whitehead, the great scholar, has perhaps summarized most effectively the conditions under which advances such as automation can flower and bear fruit. In his book, Adventures of Ideas, he says:

> Every epoch has its character determined by the way its population react to the material events which they encounter. * * * They may rise to the greatness of an opportunity, seizing its drama, perfecting its art, exploiting its adventure, mastering intellectually and physically the network of relations that constitutes the very being of the epoch. On the other hand, they may collapse before the perplexities confronting them. How they act depends partly on their courage, partly on their intellectual grasp.

Definitions and origins: We have been distressed greatly by the widespread concern over a precise definition for the word "automation." Volumes have been recorded in recent years, but unfortunately the interest has been largely academic without real desire for understanding the field of activity for which the word was coined and for which it is broadly used today. Concentration on definition has caused many to lose sight of reality.

Seeking a definition for the word "recently," one company recorded over 40 separate and different definitions. The complaint is made that it is a bad word because it has no precise definition accepted by all.

Our approach to this problem accepts the fact that few words have precise definitions. The dictionary always shows alternative and varied interpretations for words normally thought to be precise. Definitions for the word "automation" today vary with the experience and background of the definer, reminding us of the well-known fable of the blind men and the elephant.

Based on the understanding and usage of the term throughout industry, our overall general definition would be something like this:

Automation encompasses the basic technology of manufacturing, processing, or performing services automatically to the extent or degree dictated by business economics, market demands, and product characteristics.

For industry it is simply continuous and automatic manufacturing ranging anywhere from a few operations all the way to the whole plant—from the office to the warehouse.

The important part is that as many as possible of a series of production operations needed to produce a product be integrated into a continuous line. The specific varieties of techniques needed to achieve this aim, with competitive advantage, are not of key importance. The practical production results, however, are.

We can trace the origin of the word "automation" itself back at least 10 years to its first regular use at Ford by Del Harder, executive vice president. Within the few years of usage it has grown to assume the full meaning of continuous automatic production throughout all industries. But, more interesting yet is the fact that we can trace the origin of this idea of continuous manufacture to Britain early in this century. Recorded in a paper, Mr. Frank G. Woolard outlined his working theory of continuous production embracing the major factors now sought by industry through automation efforts.

Thus, today, automation engineering has evolved piecemeal out of many industries to fulfill a basic principle of manufacture conceived years ago. Fundamentally, the principles of continuous production had been tried with varying success much earlier without benefit of a formal name.

To recognize the development today as part of this evolution is an engineering necessity, there is no value in definitions except pride of authorship. The only thing that makes the principle of continuous automatic production significant is its value in terms of economics and people, both as workers and consumers.

The important job, therefore, is to learn the fundamentals of automation, to learn how to direct and use its powers wisely.

Technology. In the development of automatic operations, three key phases are involved. These can be reduced to—

(1) The processing steps or equipment;
(2) The handling system or devices; and
(3) The automatic control arrangement.

Suitable results are obtainable only through careful integration of all three phases into a complete working system.

Once it is recognized that automation is basically a new approach and not a precise state, condition or device, then several important conclusions can be drawn—

(1) Automation is a horizontal engineering technology;
(2) It requires horizontal integration industrially and,
(3) It creates a broad new job function.

Automation requires the coordination of many specialized vertical engineering fields. Such areas of knowledge as process design, production equipment, handling devices, instrumentation, measurement and sensing, hydraulics, pneumatics, mechanisms, et cetera, must be drawn upon to attain satisfactory engineering results. This constitutes a difficult and complex problem for men ordinarily accustomed to working in one field only.

Secondly, automation creates a horizontal technology from an industrial standpoint. Complete automatic systems today may require the integration of many specialized areas of industrial experience and know-how. Chemical, food, packaging, paper, metalworking, primary metal, petroleum or warehousing operations may be brought into complete systems in any and all combinations. Few companies have developed engineering departments with experience in all fields to make successful automation sure.

Thirdly, automation has brought about the development of a new engineering job function. Today we find automation engineering throughout all industries. Documenting this new requirement in the engineering area is a statement in the new catalog of the automation division of Patterson-Emerson-Comstock, Inc., Pittsburgh, I quote:

THE AUTOMATION ENGINEER

Examination of the growth of most mechanized plants will show that the present state of development was reached through sporadic improvement in one or more facilities at a time, to meet the needs and conditions of production as they arose. This will have led to a pattern of thinking on the part of those in authority—including the plant's own engineers—that is directly opposed to the thinking necessary for the successful conversion to automated production. Actually, an entirely new perspective—a new philosophy of production—is called for. Where, in the past, a plant's facilities were departmentalized, now, with the prospect of automation, each facility must lose much of its individuality and develop a closer relationship to the system as a whole. All functions must become one function. Integration must become complete.

This need for a new perspective has stimulated the formation of groups known as automation engineers. Such groups should have sufficient combined range of productive experience to thoroughly analyze the present plant operation in the light of future automated production. Qualifications should include the ability to design, procure and install new mechanical and electrical equipment to be integrated with existing facilities where possible.

Basically, automation engineering is a new high-level approach to manufacturing and services engineering. Its demands create before-the-fact engineering of facilities for productivity, and as such there

is a growing need for educational facilities to train engineers in the fundamental aspects of automation engineering.

Problems in accomplishment: Thus you can see, there are many factors that militate against easy achievement in automation. I am sure that others before me have brought many of these factors to your attention. I would like to emphasize but a few that appear to be important. One is the need for improved management technique.

Because effective management of automated facilities calls for factual up-to-the-minute statistical data for long-range planning, more specific and timely information is needed today. An important part of this data is the kind that can be gathered only by such groups as the Commerce Department and the Census Bureau. Most of this data today is really past history and of little use in planning for tomorrow's operations.

Development of up-to-date methods for obtaining pertinent and necessary business statistics, facts on automation developments, and basic knowledge of business activities beyond hearsay, would aid tremendously in tomorrow's planning. It would also create increased business confidence and confidence in America's future.

One of the greatest deterrents to effective employment of automation is the almost complete lack of knowledge in the area of forecasting costs.

As you know, automation has cosponsored two conferences on manufacturing automation with Purdue University to date. It has been revealed at these conferences that there is a great area of disagreement and a need for basic facts on costs. There often appears to be no effective means for determining equipment costs or production profitability beforehand in order to plan properly. To enter into an automation program without some close approximation of costs can be disastrous and result in loss of the business.

An example of such a circumstance is the new A. O. Smith frame plant at Granite City, Ill. In the twenties, the well-known original mechanized frame line in Milwaukee was built at a cost of some $200,000. The new line to replace it was to cost $1¼ million. Now some 5 to 10 million dollars and several years of intense work will be abandoned as a loss. (Business Week, August 10, 1957.)

Time needed for development of the equipment and a difficult labor situation posed some knotty problems that, when resolved, revealed the situation that the market has changed. With the new market conditions, it is no longer profitable to use the automatic plant.

Because there is no really good way to forecast accurately the cost of special automatic lines, many small-equipment builders have gone into bankruptcy under a fixed-price policy. Without hard facts on costs, potential buyers of such equipment may be unable to justify purchase on the basis of effect on operating costs.

Surely there is need for assistance in this area, and we are endeavoring to develop sufficient information to assist both buyer and builder of automation equipment.

Tied in closely with the production and management problems are those of product distribution. It has been emphasized many times that production is not the whole problem; distribution is also important.

There is no value in solving the automatic production problem unless we also solve the distribution problem. The better standard of living made possible through automation of production operations can be realized only through more effective means of product distribution.

Many excellent worthwhile products never do reach the consumer owing to our cumbersome outmoded distribution channels. This is especially a problem for the small-business man.

Another area of concern is that of product design where engineered products are manufactured. The design engineer strives to design, and the production or manufacturing engineer to produce, products that will perform their function economically and well. But it is imperative to realize that design and production are intimately related.

Just as in warfare, where offense and defense stimulate each other, design and production can prod one another ahead. Some new product designs force the manufacturing engineer to develop or invent new methods of manufacture, and every advance in the art of manufacture must be exploited for lower costs. There is no plateau of full attainment. Every day brings new and fuller knowledge.

Mutual understanding and exchange of knowledge between the two groups can be highly beneficial generally, but in the field of automation, success and fundamental economics dictate equal recognition of these two functions, with manufacturing engineering for automation commanding the key position in many instances.

Colleges and universities as yet offer little or no formal education in the broad principles of manufacturing engineering and design for production. There is great need for educators' recognition of these important areas of engineering.

For worthwhile results today, the basic functions of product design and manufacturing engineering must be directly coordinated to effect a realistic move into either partial or fully automated production. Two factors are present:

(1) A design for conventional manufacture may make automation and lowest manufacturing cost impossible; or

(2) A minor design change of little market significance may obsolete an effective installation of automated equipment.

Economics possible with effective automation cannot always be achieved merely through simple purchase of machinery or controls. Complex combinations of equipment and devices, owing to particular product features, may be necessary to attain the most desirable production line integration. However, products carefully engineered for automatic production, regardless of the level of automation attained, will always result in lower cost in production. Products so designed can be produced on a gradually increasing level of automation to suit customer demand and acceptable pricing.

There is need for careful consideration of the growing importance of manufacturing engineering. Know-how in manufacturing engineering offers the smaller producer the most effective weapon to keep his position in the competitive race of free enterprise.

Effects of automation: What effects, if any, can be traced to automation and its gradual development in the past?

What of the future?

I say effects are good on both counts.

There has been altogether too much emphasis placed on the social and business impact of automation. In an evolutionary force there is no impact, only slow change.

Development of automation can only occur as fast as man can dream and devise the processes, machinery, and controls needed. And, as most businessmen must be conservative, investment in ungraded plant equipment occurs only under the continued pressure of economics, competition, and market demand.

In addition, equipment replacement policies based on depreciation allowances under present tax laws create a severe barrier to fast equipment replacement. A new flexible policy of fast writeoff is needed.

There is a growing need with automation to consider entire production lines, or plants, as expendable tooling, useful only for the short duration of effective product sales life. Automation equipment, unlike machinery in past years, is often of no value for producing economically products other than those for which it was designed.

That more intensive study and application of automation techniques is needed is plainly underscored by a recent statement by General Electric accompanying a rise in lamp prices:

Although General Electric's lamp plants have long been recognized as leaders in mechanization, it is virtually impossible to develop, build, and install new types of machinery fast enough to effect manufacturing economies which would offset increasing costs of labor and materials.

Nevertheless, while compensation of industrial employees rose some $60 billion, 60 per cent, between 1948 and 1956, with corporate net profits taking little or no increase, prices of manufactured goods rose only 30 percent. This is a notable record, but it can be bettered.

Automation does not grow of itself. Meticulous care and feeding is necessary. We cannot expect to reap a harvest unless the seed is sown. Industry has a responsibility to understand and employ automation the fullest practical extent if we are to realize our aims of increased living standards and job levels in the years to come.

Recognition that automation development offers much for workers was evidenced at the recent meeting of the Amalgamated Lithographers of America in Chicago. Reported in Time, the delegates adopted a proposal to set up a fund of $1 million to promote technological advances in lithography provided employers matched the sum.

Edward Swayduck, president of ALA, believes:

Automation is a boon to workers, not a menace. If it helps get products to the consumer more cheaply, it's going to broaden activity in the industry and provide more jobs.

Productivity and automation are intimately related. With such serious study and cooperation, they will continue to advance for all to benefit.

It is worthwhile to note that in manufacturing alone, some 2.5 million people per year must be hired merely to replace voluntary "quits." Of the 75 million persons employed in 1955, 11.5 million changed jobs during the year. The most generous estimates of possible job displacement per year through automated installations, based on investment of $20 billion in equipment, have been placed between 300,000 and 600,000 (Yale Brozen, professor of economics, North-

western University, in a paper presented to the Minnesota Economics Association, November 1955).

Obviously, this problem of overall job displacement is of insignificant proportion. Actually, major job losses in industry during the past decade can largely be traced to other causes, one of which is failure to automate.

Another important aspect concerns the rising level of education today. As a result of a careful study, Professors Baldwin and Shultz of MIT came to this conclusion:

> We are entitled to a cautious hope that automation may afford a partial answer to those who look at the rising education levels in this country and ask, "What are people going to do with all that education when they find themselves on the dull and routine jobs of American industry?" Mechanization may indeed have created many dull and routine jobs, but automation is not an extension but a reversal of this trend; it promises to cut out just that kind of job and to create others of higher skill.

Automation creates a greatly increased demand for engineers, scientists, and other skilled personnel.

A look at the facts bears this out. Statistics of the chemical industry, for instance, show a percentage increase in professional and management jobs greater than the rise in output in the past 10 years. Production workers, however, remained virtually stable during the same period. The steel industry shows the same characteristic as do all gradually automating industries. This trend is indicated in the booklet, Our Manpower Future—1955–65, United States Department of Labor.

Probably most potent in the way of statistics are those concerning population. Automation can be most effective in serving an expanding market.

By 1975, the latest Department of Labor figures forecast a population increase of 55 million and a gross national product doubled to $858 billion. A 100-percent increase in output will be demanded from a total labor force roughly 28 percent over today's level.

To serve the needs of this growing and vastly expanding country, automation has a job to do. We are committed to a rising standard of living and a program of world leadership. Business management must understand the potentials of automation and strive to bring it to full fruition. The time is past for random academic dissertation. We must begin to actively build for the fascinating and challenging future.

Chairman PATMAN. Thank you, sir.

I believe that this next to the last sentence in your statement is worth reemphasizing. In this next to the last paragraph you say:

> Probably most potent in the way of statistics are those concerning population. Automation can be most effective in serving an expanding market.
>
> In 1975, the latest Department of Labor figures forecast a population increase of 55 million and a gross national product doubled to $858 billion. A 100-percent increase in output will be demanded from a total labor force roughly 28 percent over today's level.

That is a point that I have never seen brought out just that way before.

You produce a fine magazine, Automation. You have pioneered that field, have you not, Mr. Bolz?

Mr. BOLZ. Yes, we have.

Chairman PATMAN. It is the only magazine of its kind, I believe, that is published.

Mr. BOLZ. I brought along the latest issue, in case the committee would like to take a look at it.

Chairman PATMAN. Thank you.

Mr. BOLZ. Publication was started in August 1954. The conclusion was arrived at by the company, after a study of development of automated operations throughout the country. While automation was not a brandnew idea or brandnew development, we found it had reached a point where there was a tremendous need for cross-breeding ideas and developments between industries. Thus, industries that had over many years developed high-level automated operations, could share their secrets of success with other industries having parallel problems, and thus enable them to up-date much more rapidly.

This, of course, is the whole point and purpose of our magazine—to assist industry in stepping from the knowledge of the past and present into the future at a much more rapid rate than would be possible if every problem had to be solved by the same procedure of basic development.

Chairman PATMAN. You mentioned about how difficult it was to define the word "automation." We ran into that same problem when we first started these hearings 2 years ago. The subcommittee finally concluded the economic significance of the automation movement is not to be judged or limited by the precision of its definition.

We had the same trouble over finding a real definition that you have found, and we have discovered that there are a lot of definitions, and many good definitions, but the actual definition is not the important part.

What are the prospects for the extension of automation in the service industry, Mr. Bolz?

Mr. BOLZ. It looks like the big development in service industries is for the future. It is beginning today in such areas as banking and warehousing. They are now moving into automation and actually developing working systems for rapid handling and distribution of goods in warehousing. There has been a tremendous bottleneck in the past in the distribution of goods. In the future there will be some tremendous savings made in this area. Goods will be moved faster and at less cost to the consumer.

Chairman PATMAN. This morning, Senator Flanders, of Vermont, who is a member of the Joint Economics Committee, testified and advanced a new idea. He said that the gains of automation or other gains in productivity should be divided three ways, between labor and the management or owners, and the consumer; in other words, let labor have a third, the owners of the business have a third, and use a third of it to reduce prices.

Would you like to comment on that, Mr. Bolz?

Mr. BOLZ. I think that is a nice ideal approach. If we arrive at the state where we can effectively attain our aim of reduced costs, and not just hold the cost line, certainly some such plan of sharing would be excellent.

The three-way share is good. I am all for it, but I think it has to come after the problem of real cost reduction has been attained.

Chairman PATMAN. That is right. Your statement here that we will have to have a 100 percent increase in output with a total labor force increased 28 percent, is very convincing that automation is not going to cause unemployment. It is very convincing in that respect. I do not think anyone is afraid of automation. I think people generally are in favor of automation.

Your statemnet here to the effect that in the next 18 years we will have this 100 percent increase in output, and we will only have 28 percent more workers, I think, is a rather convincing statement to the effect that automation is not likely to cause any serious dislocation or unemployment.

Would you like to ask any questions, Mr. Lehman?

Mr. LEHMAN. Thank you, Mr. Chairman.

Mr. BOLZ. where do you think the next breakthrough will be in terms of a new independent industry which may grow out of the development of automation, such as the electronics industry, which was an industry which we virtually did not know at all before 10 years ago?

Are there areas of that kind that are still open to development?

Mr. BOLZ. I do not know whether you would call it an industry or not but the one area that appears to have had great growth in the past 10 years is a group of companies specializing in developing automated lines, automated production facilities of all kinds. This has been largely a development of smaller companies having a well-knit group of ingenious designers and engineers with imagination and ingenuity for seeing the possibilities in automation.

This group of companies, and there are quite a large number of them, constitute, I think, a new business area with a great deal of potential. In this area of the smaller businesses, and the smaller machine builders, lies a great deal of the genius for production development that we have in this country. I think past history has shown this to be true, also.

Mr. LEHMAN. Is this perhaps a means by which small business will be able to obtain the help it needs to achieve the maximum benefits of automation?

Mr. BOLZ. It is a combination.

On the one hand, these machine builders create equipment for others to use. Small business can obtain benefits from such equipment equally well as does big business.

The bulk of our businesses are in the medium and small areas, and the bulk of the builders of productive facilities is in the small-plant area also. As a result, most of this activity is taking place largely in the small-plant category.

Mr. LEHMAN. Is it not also possible that even in those cases, a large part of the components are developed by smaller, separate companies who are simply concentrating on that part of the business?

Mr. BOLZ. That is true. The electronics group has been a little bit out of proportion as to its importance in this development. I like to refer to it as the electrical group, of which electronics is a part. There is a great deal of development in electrical controls that is, I think, as fascinating and as important to the future as developments strictly in electronics.

In the combined electronics and electrics area there lies a tremendous development for the future. We can look forward to some very

interesting developments. Forecasts indicate that 50 percent of the electrical products that will be produced 10 years from now are unknown today.

Chairman PATMAN. Since your testimony will be considered not only by the Joint Economic Committee, but by other members, by other committees of the House and Senate and individual Members, would you like to comment on sputnik, and give the members the benefit of your opinions about sputnik?

Mr. BOLZ. From what standpoint?

Chairman PATMAN. From the standpoint of the challenge to American science.

Mr. BOLZ. I think this is a tremendous challenge for American scientists. A firm believer in American ingenuity myself, I cannot help but think that had anyone decided we were going to put one of these into the sky a year ago, it could have been done.

Chairman PATMAN. You think we could have?

Mr. BOLZ. I see no reason why we couldn't. I have considerable faith in the ability of American engineers and scientists. With the required demand, research, and backing, the job could have been done.

Chairman PATMAN. In other words, you don't feel that it is a defeat for us, the fact that Russia went into space first?

Mr. BOLZ. No, for this reason: I like to think of scientific development as benefiting mankind first. In this regard, I think America is unparalleled in that we have put into the hands of the people of our country the wherewithal of the highest level of living standard the world has ever known. Just putting a sputnik into the sky still will not benefit the average Russian one iota.

Chairman PATMAN. Would you like to comment on the shortage of engineers and scientists?

Mr. BOLZ. I think this is one of the big problems in automation, as I pointed out in my comments. There are just not enough engineers trained who know how to design the automatic equipment required.

Chairman PATMAN. Well, I think you covered that pretty well in your statement. The real point I am getting to, and I would like to have your comments on it, is as to what we should do about overcoming the shortage of science graduates in our country in comparison with the larger number in Russia being graduated each year.

Mr. BOLZ. Of course, there have been a great many plans already presented. Fundamentally, I think it is necessary to stimulate the youth of this country in the direction of following scientific studies. There is a crying need to reinstitute in all of the high schools a requirement that every youth study the sciences, starting in high school. We are living in a scientific age. I think we all can agree on that. I think it is a sad commentary indeed that any of our youth can graduate from high school without the rudiments of science or scientific understanding.

For our own benefit, and for the benefit of these children who will be our future citizens, I think they should study the sciences. With such study as a requirement in high school, I think we can expect automatically to obtain a much greater influx of students into the scientific areas, through colleges and universities. I think it has to start that far back. Our school systems have, in the past 20 years,

moved in the direction of eliminating the sciences from the required curriculum in high schools. I think that is the opposite direction from where we should be going.

Chairman PATMAN. I think the President made a very interesting observation last night in comparing our education for science with Russia. Of course, he made a lot of good statements, but that was one that I thought was particularly good. It shows we are behind, and that the high school is really the bottleneck.

Mr. BOLZ. That is the focal point.

Chairman PATMAN. In the investigation we made during our study 2 years ago, it was indicated that high schools were the bottlenecks, that high-school teachers were not getting enough money. The witness this morning pointed out that he felt that the salaries received by high-school teachers was really a disgrace.

Mr. Knowles, would you like to ask any questions?

Mr. KNOWLES. Thank you, I do have a question, Mr. Chairman.

On page 6 of your statement, Mr. Bolz, you state that a new flexible policy of fast writeoff is needed because there is a growing need for automation to consider entire production lines or plants as expendable tooling, useful only for the short duration of effective product-sales life.

This implies, as you say in the next sentence, that automation equipment, unlike machinery in past years, is often of no value for economically producing products other than those for which it was designed.

Is this a necessary characteristic of automation designed production lines themselves? Is this a necessary characteristic of automation-engineering projects, as such, or is this just a characteristic of the present kinds of production lines as they are presently engineered for automation purposes?

I see, for example, in your definition that you set up three elements, that is, a process, a handling system between the processes, and a control system. I am wondering what phase of that combination of elements necessitates that the equipment just have the life of this particular special model and nothing else.

Mr. BOLZ. This refers to entirely special production facilities, designed to produce a single product at the most economic level possible. This is usually the case:

For instance, if you design a plant to produce paper matches, it is entirely a special setup. Such plant wouldn't be capable of producing anything else. This is the case with certain production lines. The product can be produced most rapidly and at the very, very lowest cost, by designing entirely special facilities for that operation. Then, should the product be dropped or changed radically, the production equipment may be useless.

There is the graduating possibility all the way down to completely standard production facilities that are common in all job shops. You can pick a level in between. But the economics of the situation, and the market requirements, and so on, dictate the level at which you will have to start in order to make it practical. Job-shop operations result in maximum unit cost and automatic operations in minimum unit cost.

This A. O. Smith frame plant is a good example. They can only make frames on that machine. There are a lot of standard compo-

nents on the equipment, but to remove those and attempt to use them on other equipment usually is just uneconomic.

Mr. KNOWLES. Suppose you designed a plant, let us say, such as the Ford engine plant. Here you have a plant that is not good for anything, obviously, except producing engines. It is true that you couldn't design that production line so that you could use it for producing some other model than the particular V–8 engine now produced on that line. Suppose you switched to a V–6, or something else. Isn't it possible as far as the engineers are concerned, that he could still design it so it could be readapted to something else?

I am thinking that if this type of plant is so highly specialized each plant must be scrapped whenever we change to different models, then with rapidly changing styles, it might turn out that changing of the equipment itself that frequently might, in itself, make this uneconomic.

Mr. BOLZ. The whole thing boils down to a matter of producing the maximum output of product at minimum cost within a prescribed period of product-design life. Certain products are of that nature. An engine, especially, is a problem because the possibility of design changes a few years later usually create considerable difficulty in adapting the line for the new design. The competitive market can be ruthless, and to hold your share design changes become a necessity. In addition, we need to stimulate improvements. We will always be able to improve design as we learn. There should be no heavy bar to improved products and services such as stagnant production-equipment policies.

People like Ford, Chrysler, and the other companies are attempting to find if there is an answer to this. So far no one has been ingenious enough to really solve the problem, since it involves continuous improvement in equipment design.

In certain instances you can make a line adaptable to other products, but these have not been too numerous. In the case of engines, Ford has stated that the Cleveland engine plan has a line which is now obsolete, and it has only been there a few years. This is a basic problem. We don't have an answer yet. Work is proceeding in the direction of standardized segments for lines which could be pulled apart and reassembled in another way.

Overriding all is a combination problem of product design and equipment design. There is need to forecast product design and possibly product changes for a reasonable period of years.

Mr. KNOWLES. This leads me to the other question that I had in mind: In your definition you have three elements—the equipment that actually does the processing, the handling system that moves things from one process to the next, and then a control system.

I am wondering from your description are you, in effect, saying that the key to the automation production is the engineering of the control system?

Mr. BOLZ. No. None of those takes precedence over the other. They are three equally balanced phases. You can have the best control system possible today and without a properly conceived cycle of production operations the whole thing will be a failure; and the reverse is true.

It becomes, apparently, a packaging up of these three together in the proper form to make a line successful. Then you have this problem. How long will the product life be? In many cases, the man that tools up can't always forecast this.

Mr. KNOWLES. I understand then, that really, perhaps, you ought to add a fourth element here to the automation engineering process and that is the design of the product. It is the design of the product, really, that determines whether or not you can put these three elements together in some economic fashion.

Mr. BOLZ. Yes. That can be the case with certain products. The product design and the manufacturing engineering phase go together. They have to be integrated properly and balanced with each other or you will lose out one way or the other.

Mr. KNOWLES. If we were determining a tax policy on the idea of, let us say, a fast writeoff, one of the implications is that you would have to have some way of forecasting the length of life and the characteristics of the product, rather than of the equipment.

Mr. BOLZ. This, of course, is something you have to ask the public. When sales drop to a point where it is uneconomical to produce, the production line may be worthless.

Mr. KNOWLES. I was wondering how we could write a tax law to provide a writeoff for a product whose period you don't know, and where you don't know how long the product will last. It seems to me that the staff of the Ways and Means Committee would have a tough problem.

Mr. BOLZ. It is a tough problem, but it seems we are trying to stimulate the wider distribution of products at lower cost. I think one of the things in the picture is the production facilities, which are very much like an expendable tool or a means to an end.

Rather than being considered a permanent fixture, they are really a means to an end for getting to this result that we are shooting for, at the least investment overall to the consumer.

There is a basic problem today as to just how to consider the status of production facilities. In other words, it could be decided, since it is necessary to keep certain equipment for 20 years, there is no need to upgrade operations. Such a policy has made plants obsolete and closed them down. There is a place in here, I think, where production facilities may have to be considered as an expendable item for our own benefit.

Chairman PATMAN. Why could it not be arranged this way: The depreciation to be taken each year, say, for 5 years, and then if it is obsolete, it could be thrown away and the remaining depreciation allowed immediately. Is that what you have in mind?

Mr. BOLZ. Yes, something like that would be good. It would make the move into new facilities easier, and also to stimulate businessmen to make such moves, which are all to the good.

Chairman PATMAN. I agree with Mr. Knowles. It would be very hard to anticipate in advance. But there is no reason, or I do not see any reason as to why it could not be taken at the time it is declared of no further use.

Mr. KNOWLES. I was stimulated to think along these lines at the start by a statement by Mr. Bolz that you have to know something

about forecasting costs to know whether you are going to use one way of producing an item or another.

If you have to forecast costs, and an operation has a large amount of capital compared to the actual direct labor, you have to forecast in part how much depreciation you are going to charge off for each unit produced. This means, in effect, that at the start of the process, as I am trying to visualize what you are stating, it seems you have to forecast how long the product is going to last in order to arrive at your original estimate of costs, including costs of capital and hence the original depreciation cost for tax purposes.

Of course, we realize that you have to have some way out in case a company makes a mistake.

Sometimes this is via the tax law and sometimes via the bankruptcy court. But I wonder if no one ever makes a mistake, whether the problem would still be there. Somebody would have to figure out a way to forecast the length of market life of these products, and how long, for example, the Chevrolet style is going to be acceptable.

Mr. BOLZ. It is difficult to say whether it will be possible to actually forecast something like that. The consumers and their reaction to the products must be considered. Much is yet to be learned in the way of market forecasting. The other side of the picture is the one Chairman Patman pointed out, that a period could be established under which businessmen could operate. They would then have a stable system for planning at least part-way to their goal.

Chairman PATMAN. Well, thank you very much, Mr. Bolz. We appreciate your testimony, sir.

Mr. BOLZ. Thank you. I have some exhibits here, if you would like you may distribute them to the committee.

Chairman PATMAN. Thank you.

You will receive a transcript to go over to make sure it is satisfactory before it is printed.

Mr. BOLZ. Thank you. We will do that.

Chairman PATMAN. Tomorrow we have a very interesting day. First we have the subject of economic reasons for automation in banks and the development of mechanization of check handling, by Mr. A. Kley, executive vice president, the County Trust Co., White Plains, N. Y., to be the witness.

Next is automation in banking other than check processing, by Mr. A. F. Zipf, vice president, Bank of America, San Francisco, Calif., and then electronic handling of savings and mortgage accounts by Everett J. Livesey, vice president and secretary, Dime Savings Bank, Brooklyn.

In the afternoon we have automation and prepackaging in the retail trades by James A. Suffridge, president, Retail Clerks International Association, Washington.

Without objection, the committee will stand in recess until 10 o'clock in the morning.

(Whereupon, at 3 : 10 p. m., the hearing in the above-entitled matter was recessed, to reconvene at 10 a. m., of the following day.)

AUTOMATION AND RECENT TRENDS

FRIDAY, NOVEMBER 15, 1957

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON ECONOMIC STABILIZATION OF THE
JOINT COMMITTEE ON THE ECONOMIC REPORT,
Washington, D. C.

The subcommittee met at 10 a. m., pursuant to recess, in room 1301, New House Office Building, Hon. Wright Patman, chairman, presiding.

Present: Representative Wright Patman, Senator Ralph E. Flanders.

Also present: John W. Lehman, acting executive director, James K. Knowles, staff economist.

Chairman PATMAN. The committee will please come to order.

Yesterday the hearings were devoted to some of the recent developments in the general aspects of automation. Today we turn to automation in specific business situations. This morning we have a presentation by a three-man panel who will discuss the use of automation in banking. Each member of the panel is a practicing banker, and has particular competence in the phase of the subject which he has been asked to cover. As most of you know, this subcommittee and the Joint Economic Committee have long been interested in the policy problems of banks and banking. Today we welcome this opportunity to learn more about the operations side of the banking industry.

We now will hear from Mr. John A. Kley, executive vice president of the County Trust Co. in White Plains, N. Y.; Mr. A. R. Zipf, vice president of the Bank of America in San Francisco; and Mr. Everett J. Livesey, vice president and secretary of the Dime Savings Bank in Brooklyn, N. Y.

I understand that Mr. Livesey must leave early in order to catch a plane and meet an important appointment. We will hear from him first.

STATEMENT OF EVERETT J. LIVESEY, VICE PRESIDENT AND SECRETARY, DIME SAVINGS BANK, BROOKLYN, N. Y., AND CHAIRMAN, SAVINGS MANAGEMENT AND OPERATIONS COMMITTEE, SAVINGS AND MORTGAGE DIVISION, AMERICAN BANKERS ASSOCIATION

Mr. LIVESEY. Thank you very much. I am representing this morning the savings and mortgage division of the American Bankers Association, and my remarks will be directed to the savings and mortgage operations of banking institutions.

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.

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 the 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, multiplies, and divides; a memory to record, change, and store the data; and an output device to translate the results. Here again this can be a 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.

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 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 poduce a new balance for the start of the next period. Balance 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.

For example, the depositor may deposit checks drawn on Washington, Chicago, and Los Angeles. The period of time during which the balance must be held to insure that the checks will be collected will vary. For the east coast, a few days; for the west coast, a longer time. Accounts can be held for these 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.

This is an important point, I might add, because presently since depositors must go to designated windows, there are occasions, more often than one might think, when there are lines at some windows and no lines at others. Yet the customer has to stand at the designated

spot, and he may not be served at a window where a teller may be waiting to serve him. Under the proposed system, a depositor may go to any window.

There was recently demonstrated a method of sending signatures, balances, 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.)

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.

When the computer is not handling a transaction on a depositor's account, it will begin to process mortgage data. It may process 10 transactions; it may process 100. But as soon as some teller has a customer at the window who wants to be served, automatically the computer will stop posting the mortgage transactions, and will pick up the deposit transaction, so that there is no waste of processing time during the day.

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 tickler files; print out the details of any account or all accounts; prepare statistical reports, journals, trial balances, and so on.

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 Bank 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.

The American Airlines has an electronic system to control plane reservations which is very similar to a banking operation. They start with the total number of seats on a plane, and begin to sell them. The sales are debits against the account, and the number of seats is reduced. Cancellations become credits, and the space is reinstated. So they have credits, debits, and balances just as in banks. The American Airlines has been operating this system for several years in LaGuardia Airport in New York, serving Idlewild, Newark, and points as far away as the Buffalo ticket office. So you see 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. Next week in New York we are having a meeting of small savings bankers from one area in New York State who are interested in this matter, and who are coming together to discuss it. We are going to see what we can do for them. The matter is definitely current.

PERSONNEL

Banking is currently finding it difficult to hire enough qualified people to meet its need. 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 and methods without first making sure that the necessary manpower is available. Automation can occur only as rapidly as the required upgrading of skills occurs.

Sometimes I think we get the cart before the horse. We talk about the equipment and how soon we can get it. It seems to me one of the delimiting factors is the question of whether or not we are ready for it. That may well be longer than the manufacturers will take to manufacture the equipment for us.

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.

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 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.

Thank you very much for listening to me.

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.

The next witness is Mr. Kley, the executive vice president of the County Trust Company of White Plains, N. Y., and chairman of the technical committee on mechanization of check handling, bank management commission, American Bankers Association.

Mr. Kley, we are glad to have you.

STATEMENT OF JOHN A. KLEY, EXECUTIVE VICE PRESIDENT, THE COUNTY TRUST CO., WHITE PLAINS, N. Y., AND CHAIRMAN, TECHNICAL COMMITTEE ON MECHANIZATION OF CHECK HANDLING, BANK MANAGEMENT COMMISSION, AMERICAN BANKERS ASSOCIATION

Mr. KLEY. Thank you, Mr. Chairman. My remarks will be directed primarily in the area of the commercial bank industry.

In considering the economic reasons for the automation of bank operating processes, bank managements have three fundamental factors to consider:

1. Service to the general public.
2. The maintenance of enlightened personnel policies in the handling of their employees.
3. The establishment of a fair return to the stockholders of the bank.

In the face of increasing demands for service, the greatly increased competition for personnel and the rising costs of doing business, automatic mechanization seems to hold a great deal of promise. Certainly no one is naive enough to believe that it represents a panacea or a substitute for aggressive and well administered management technique. However, by its very nature and from experience gained to date, automation, when properly implemented, can:

1. Have a stabilizing effect on unit costs.
2. Relieve personnel of the monotonous, ever-burdening clerical load and free them for more creative and constructive service.
3. Speed up recordkeeping and improve service.

COSTS

The margin of unit profit contained in most normal banking transactions is extremely small. It is the aggregate of a large volume of small unit profits on service transactions which make up the major portion of a bank's income, other than that derived from loans and investments.

In this connection, it is interesting to note that in the 10 years preceding 1956, the average net profit after income taxes for all insured commercial banks was slightly more than 8 percent of the average total capital accounts of all of the banks involved. This is considerably lower than the years earlier.

PERSONNEL

Expansion of existing bank services and the creation of new ones has resulted in the banking population almost doubling from 1941 to 1956. In fact, during the postwar period alone (1945–56) it has in-

creased by 70 percent. Of particular significance is the fact that this tremendous growth in numbers of personnel employed by banks in the country rose in spite of the introduction of a great number of mechanical and laborsaving devices during the same period of time.

I would like to introduce at this time exhibit No. 1, which is information supplied by the bank personnel administration department of the American Bankers Association, indicating the content of the banking population from 1941–45 to 1956.

Chairman PATMAN. It may be inserted in connection with your remarks.

Mr. KLEY. Thank you.

(The information follows:)

EXHIBIT 1

Banking population[1]

	1941	1945	1956
Officers:			
Male	57,900	59,400	87,750
Female	3,110	5,600	9,750
Total	61,110	65,000	97,500
Employees:			
Male	62,600	95,000	167,000
Female	185,290	190,000	333,000
Total	247,890	285,000	500,000
Total, officers and employees	309,000	350,000	597,500

[1]Information supplied by bank personnel administration department, American Bankers Association.

Mr. KLEY. Exhibit 1 shows that two-thirds of the nonofficer personnel are female, a large proportion of whom are employed from high school and trained at bank expense for work in the bookkeeping and other administrative service departments of the banks. Their period of service is relatively short as most of them leave to become housewives and mothers. For this reason the turnover in these departments is generally higher than the overall average for banks which is currently estimated at about 25 percent per year.

It would appear that the normal growth of bank services and the attrition created by normal turnover and retirement would more than adequately absorb any personnel temporarily displaced in a specific job by a mechanical device.

THE TREND OF BANK SERVICES

Let us look at what is happening to both the volume and the velocity of bank service requirements, using figures immediately before World War II, the year following its end, and at the present time. Because the figures for these various activities had to be drawn from a number of sources, all of the dates for the varying services do not necessarily coincide. For this purpose, however, they are close enough to depict the trend.

First, in the field of installment credit activity, here, Mr. Chairman, I would like to introduce exhibit No. 2, which indicates the

activity of installment loans held by the commercial banks of the country. The dollar totals were derived from the Federal Reserve Bulletin, and with the application of average loan amounts supplied by the American Bankers Association, I have indicated the actual number of units for the various years.

Chairman PATMAN. It may be a part of the record at this point.

(The information follows:)

EXHIBIT 2

Activity in installment loans held by commercial banks

[In thousands

	Total dollar amount outstanding	Total number of units	Auto paper		Other goods		Repairs and improvements		Personal loans	
			Dollars	Units	Dollars	Units	Dollars	Units	Dollars	Units
1941	1,726,000	2,056	785,000	500	309,000	180	161,000	36	471,000	1,340
1945	745,000	1,182	209,000	190	114,000	67	110,000	25	312,000	900
August 1957	12,588,000	22,200	6,402,000	5,300	2,427,000	9,700	1,462,000	2,100	2,297,000	5,100

Dollar totals obtained from Federal Reserve Bulletin.
Number of units calculated by installment credit commission, American Bankers Association, derived by approximating average loan amounts for each category.

Mr. KLEY. Because of the inability to obtain durable consumer goods during the war, the figures for 1945 naturally reflect a drop from the aggregate of the last preceding nonwar year. It is interesting to note, however, that the 1957 dollar volume exceeded that of 1941 by more than 7 times and, compared to the number of individual units, by slightly more than 10 times.

The annual reports of the Comptroller of the Currency show the figures in the trust field for national banks alone to be as set forth in schedule No. 3.

I would like to introduce exhibit 3 into the record, Mr. Chairman.

Chairman PATMAN. It may be made a part of the record.

(The information follows:)

EXHIBIT 3

	1941	1946	1956
National banks exercising trust powers	1,856	1,507	1,486
Living trusts	73,361	87,938	123,278
Court trusts	66,258	75,928	108,713
Corporate trusts	15,904	18,379	43,484

Figures obtained from the annual reports of the Comptroller of the Currency.

Mr. KLEY. These indicate that, while the actual number of banks exercising trust powers was reduced in the 15-year period, the number of living and court trusts alone almost doubled during that time and the number of corporate trusts almost tripled. There are no similar figures available for all State commercial banks, but it is believed that their proportion of increase would be substantially the same.

In the field of savings accounts for all commercial banks, the following increase has occurred:

Date	Amount [1]	Number of accounts [2]
1941	$19,884,000,000	37,318,000
1945	30,135,000,000	40,955,000
1957	54,700,000,000	[3] 60,000,000

[1] Dollar amounts obtained from Federal Reserve Bulletin, October 1957.
[2] Number of accounts obtained from Annual Report of the Federal Deposit Insurance Corporation (1957 figure an estimate; study for 1955—52,799,718 accounts).
[3] Approximate.

Mr. KLEY. It is significant to note that in the last survey conducted by the savings and mortgage division of the American Bankers Association, the withdrawal ratio of time deposits for commercial banks (that is, the money withdrawn during the year as a percentage of deposits received during the year) was 94.02 percent. This is only indicative of the vast amount of administrative activity involved.

A look at the numbers and amounts of mortgages held by the commercial banks indicates that in 1941 they held $4,906 million, in 1945 they held $4,772 million, and in 1957 they held $22,740 million.

It is quite obvious from individual samplings that other bank services, such as commercial loans, bank money orders, registered check sales and safe deposit rentals, have also enjoyed a phenomenal increase in volume. But here, again, no specific figures indicating the aggregate of such increases are available.

THE INCREASE IN USAGE OF CHECKING ACCOUNTS IN COMMERCIAL BANKS

The growth of demand deposits of all commercial banks is depicted in schedule No. 4. I would like to introduce that into the record, Mr. Chairman.

Chairman PATMAN. It may be made a part of the record at this point.

(The information follows:)

EXHIBIT 4

	1941	1945	1952	1956
Number of banks	[1] 14,877	[1] 14,621	[1] 14,617	[1] 14,208
Demand deposits of individuals, partnerships, corporations	[2] $37,425,750,000	[1] $73,876,141,000	[1] $100,141,329,000	[1] $111,489,082,000
Bank debits	[3] $537,398,000,000	[3] $974,087,000,000	[3] $1,642,853,000,000	[3] $2,200,643,000,000
Number of checking accounts (52,129,072 in 1955) [1]	[1] 26,291,000	[1] 35,610,000	[4] 47,000,000	[5]
Estimated check circulation volume (3,500,000,000 estimated in 1939) [4]	[5]	[5]	[4] 8,000,000,000	[6] 10,000,000,000

[1] Annual report of the Federal Deposit Insurance Corporation.
[2] Condition and operation of State banks, State bank division, A. B. A. (not available from FDIC in 1941).
[3] Federal Reserve Bulletin.
[4] Joint committee on check collection system (confidential report—Study of Check Collection System).
[5] Not available.
[6] Estimate based on forecast of joint committee on check collection system.

Mr. KLEY. There is, perhaps, no more accurate indicator of the rise in business activity than that represented by these particular statistics.

FORMATION OF TECHNICAL COMMITTEE AND ITS ACTIVITIES

Because this increase in checking account activity represents the most significant and cumbersome clerical detail facing the commercial banks of the country today, the technical committee on mechanization of check handling was created in 1954.

It is well, I think, to define the dimensions of the check-handling problem in order to view its ramifications in perspective. The estimated 10 billion checks written in 1956 were handled by an average of 2⅓ banks in the process of collection. Extending this mathematically, it would result in approximately 23 billion check handlings. This, of course, does not allow for the multiple handlings within a given bank. One billion checks (placed front to back) represent a tsack of 500,000 feet, or the equivalent of slightly less than 100 miles. The 10 billion items written in 1956, if stacked in such a way, would reach from New York to Chicago.

The problem of accounting for checks in the various stages of processing is unique in data processing. Its uniqueness derives from the fact that the data must be accompanied by the source document in the process.

The general areas of administration in check processing fall into two categories: (1) the transit operation; (2) the "on us" operation.

The transit phase involves the proper processing and transmittal of the item between various banks and/or the Federal Reserve System so that the item is directed to the bank on which it is drawn.

The "on us" operation involves solely the intrabank operation which must be performed by the bank on which a check is drawn and includes the balancing, sorting, and posting to the proper account; as well as the ultimate submission of the entry with the canceled check to the individual bank customer.

In considering the problems of both large and small banks and the various steps in the process, the committee was founded to present the overall problem from an industry standpoint to machine manufacturers.

One of the very serious problems confronting the mechanical handling of checks is the great variety of sizes prevalent today. It was felt that any practical solution to the difficulty must incorporate procedures to meet this obstacle as it exists.

Aside from the electronic devices required to read material encoded on a check, there is the additional problem which is at least as difficult—the physical movement of checks through various pieces of equipment. The mechanical ingenuity required to move checks of varying width, length, and thickness in transport through equipment is indeed remarkable.

It is estimated that there are over 400 varying sizes of checks in use throughout the country today. Rather than embark on a program of attempting to standardize the sizes of all checks, it was determined that such standardization could be achieved if all checks bore certain uniform markings to be located at a specific distance from a fixed reference point. Information representing the pertinent data contained on a check such as (1) amount, (2) bank on which it is drawn, and (3) individual account number would appear in such a manner as to be a common language for all future mechanical and electronic devices to read and interpret.

It became obvious early in the program that the greatest single contribution to be made by an industry committee would be the study and selection of such a common language. This language would be common not only to human interpretation, but to understanding by all types of equipment, regardless of manufacture. It was felt that it would be desirable for the various equipment manufacturers to retain their individual proprietary rights and competitive interests, but that any equipment developed should be able to read and process checks from any source.

This has been likened by many people as being comparable to the universal thread on electrical fixtures or the single gage railroad track used by all of the major American railroads.

Over 2 years of evaluation was devoted to the ingenious concepts advanced by machine manufacturers. The possibility of various codes, inks, and slave attachments to checks were all considered.

After this exhaustive study, magnetic ink character recognition was determined to be the medium most suitable for the common machine language. The facts of this recommendation, including the various avenues explored, are outlined in a report prepared by the technical committee, entitled, "Magnetic Ink Character Recognition, the Common Machine Language for Check Handling," dated July 21, 1956.

Sir, I would like to enter a copy of that report in the record.

Chairman PATMAN. It may be inserted in the record.

(The report follows:)

[Bank Management Publication 138—Automation of Bank Operating Procedure]

MAGNETIC INK CHARACTER RECOGNITION—THE COMMON MACHINE LANGUAGE FOR CHECK HANDLING

Bank Management Commission, American Bankers Association, New York, N. Y., July 21, 1956

FOREWORD

The recommendation for a common machine language described herein for mechanization of check handling was submitted by the technical subcommittee on mechanization of check handling and unanimously approved by the committee on mechnization of check handling and the bank-management commission of the American Bankers Association on July 20 and 21, 1956, respectively, in Chicago, Ill. The selection of a common machine language will probably have a greater impact on bank operations than perhaps any other project that has been sponsored by the bank-management commission. The recommendation comes at a particularly appropriate time in that developments in the field are presently more or less in the experimental stage and, hence, will enable machine manufacturers and banks to direct their study and activity toward a single objective.

The technical subcommittee is listed on page 4.

This subcommittee has been most thoroughgoing and logical in the studies it has made as a basis for evaluating the various machine languages which were studied and in reaching a conclusion as to the one language which should be recommended. During the past 2 years, as indicated by the report, there has been an intensive amount of research and consultation with engineers and research specialists in the field.

The bank-management commission, on behalf of the banks of the country, takes this opportunity to express deepest thanks and appreciation to the subcommittee for the extensive amount of work, study, and intelligent thinking which it has devoted to the project. Undoubtedly, the developments in the field of bank automation in future years will bear eloquent testimony to the work of this subcommittee.

BANK MANAGEMENT COMMISSION, AMERICAN BANKERS ASSOCIATION,
WILLIAM W. COTTLE, *Chairman.*

Technical Subcommittee on Mechanization of Check Handling

John A. Kley, vice president, the County Trust Co., White Plains, N. Y., Chairman
Herbert R. Corey, vice president, First National Bank of Boston, Boston, Mass.
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, Ill.
Raymond C. Kolb, assistant vice president, Mellon National Bank & Trust Co., Pittsburgh, Pa.
A. R. Zipf, assistant vice president, controllers department, equipment research, Bank of America National Trust & Savings Association, San Francisco, Calif.
Melvin C. Miller, deputy manager, American Bankers Association, 12 East 36th Street, New York, N. Y., Secretary

Committee on Mechanization of Check Handling

William W. Cottle, vice president and cashier, Security-First National Bank of Los Angeles, Los Angeles, Calif.
W. Dale Critser, general vice president and cashier, Fourth National Bank in Wichita, Wichita, Kans.
Oliver L. Dalrymple, vice president and cashier, Seattle-First National Bank, Seattle, Wash.
John A. Kley, vice president, the County Trust Co., White Plains, N. Y.
J. Lewis Nungesser, assistant cashier, Philadelphia National Bank, Philadelphia, Pa.
Harry C. Schaefer, vice president, National Bank of Detroit, Detroit, Mich.
Frank W. Sherman, president, American National Bank, Jacksonville, Fla.
Edward T. Shipley, auditor, Wachovia Bank & Trust Co., Winston-Salem, N. C.
J. C. Welman, president, Bank of Kennett, Kennett, Mo.

Liaison representatives from the Federal Reserve System

Herbert H. Kimball, vice president, Federal Reserve Bank of New York, New York, N. Y.
John H. Wurts, vice president, Federal Reserve Bank of New York, New York, N. Y.

Bank Management Commission, American Bankers Association, 1955–56

William W. Cottle, vice president and cashier, Security-First National Bank of Los Angeles, Los Angeles, Calif., Chairman
Melvin C. Miller, deputy manager, American Bankers Association, 12 East 36th Street, New York, N. Y., Secretary
G. Edward Cooper, vice president and cashier, Philadelphia National Bank, Philadelphia, Pa.
Philip H. Cordes, assistant comptroller, Continental Illinois National Bank & Trust Co., Chicago, Ill.
W. Dale Critser, general vice president and cashier, Fourth National Bank in Wichita, Wichita, Kans.
George A. Guerdan, vice president and cashier, First National City Bank of New York, New York, N. Y.
Orval U. Habberstad, president, Northwestern National Bank, Rochester, Minn.
Owen T. Jones, vice president and controller, American Trust Co., San Francisco, Calif.
John A. Kley, vice president, the County Trust Co., White Plains, N. Y.
Charles A. Kramer, president, Farmers & Merchants State Bank, Fredericksburg, Va.
Arthur McCormack, assistant vice president, the First National Bank of Miami, Miami, Fla.
Harold E. Randall, vice president and comptroller, First National Bank of Boston, Boston, Mass.
Harry C. Schaefer, vice president, National Bank of Detroit, Detroit, Mich.
John A. Wallace, executive vice president, Willard United Bank, Willard, Ohio
Fred H. Waterhouse, vice president, First National Bank of Minneapolis, Minneapolis, Minn.

Magnetic Ink Character Recognition—The Common Machine Language for Check Handling

The bank-management commission of the American Bankers Association on July 21, 1956, approved a recommendation for the adoption of magnetic ink character recognition as the common machine language most suitable for check handling. This recommendation was made by the technical subcommittee on mechanization of check handling.

The subcommittee's report, published herewith, is regarded as one of the most important banking developments of recent years.

After considering all of the factors which were presented, the commission approved the recommendation and authorized its dissemination to the membership of the American Bankers Association and to the machine manufacturers and check printers which were interested in this project.

The following is the report of the technical subcommittee which was presented to the bank-management commission.

Part I. Introduction

Since the formation of the technical subcommittee, we have attempted to study all phases of the problem of check mechanization. While we have been extremely active in the study of specific hardware and systems analysis, it became obvious, very early, that the basic matter for consideration was that of a common machine language.

Regardless of the size of the bank involved, or the magnitude of equipment required, one fundamental source from which machines of all manufacture could derive the pertinent data contained on a check is a common machine language.

It is in this area that an objective and impartial body, away from the interests of specific manufacturers, could provide the greatest amount of assistance. This subcommittee has tried to be just such an instrumentality in the solution of this problem. Today, after many man-hours and considered thought, we are ready to recommend to you the one which, in our opinion, is the best common machine language.

Part II. Activity of the Technical Subcommittee

The subcommittee on mechanization of check handling was appointed on April 5, 1954, and its first meeting was held in New York on May 4, 1954, at which time the subcommittee was briefed on the problems, the objectives, and the program. It was agreed that two presentations should be made up, one to go to the manufacturers and another to operating men in banks. A letter dated May 21, 1954, and statement of the problem, objectives, and program, as outlined by the committee on mechanization of check handling of the bank-management commission, was sent to key operating men, asking for suggestions and their general reaction to the program. A questionnaire was also enclosed, requesting various statistics in connection with the check-handling problem.

On May 27, 1954, a letter and supplementary questionnaire were sent to key operating men of the bank-management commission. This questionnaire was in clarification of the original questionnaire of May 21, 1954.

Over a period of several months, a brochure called Automation of Bank Operating Procedure was prepared, to be released to manufacturers and to others who might wish to become manufacturers of mechanical, electromechanical, or electronic bank and office equipment. This brochure was released with a letter from Homer J. Livingston, then president of the American Bankers Association, on January 7, 1955, to 75 companies who, the subcommittee felt, might be interested in the project.

A letter dated January 19, 1955, and a copy of the brochure were sent to all banks with assets over $50 million.

On April 25, 1955, a followup letter was sent out to 60 organizations that had not sent in an acknowledgment to confirm their interest in the project. This followup letter, signed by the commission secretary, elicited a few more replies. Of the 75 organizations to which the original brochure was sent, 13 indicated a desire to participate in the project.

The subcommittee received an invitation from Burroughs Corp., the Todd Co., and Addressograph-Multigraph Corp. to see the equipment they had developed and discuss their thoughts on the problem. The meeting was held in Rochester, N. Y., on May 10, 11, 12, 1955. In addition to the meeting with Burroughs, Todd, Addressograph, and the Standard Register Co., the subcommittee had discussions

on a common language. It was decided to send a letter, dated June 13, 1955, and questionnaire, covering a common machine language to the 13 companies which had evidenced interest in the work of the subcommittee. This questionnaire attempted to ascertain the preference of each company and their reason for the selection.

During the summer, C. M. Weaver, then assistant vice president, First National Bank of Chicago, who had made a major contribution to the original brochure and subsequent questionnaire on common language, retired from his bank and from the subcommittee. At this time David H. Hinkel, assistant secretary of the First National Bank of Chicago, and Raymond C. Kolb, assistant vice president, Mellon National Bank & Trust Co., of Pittsburgh, were added to the subcommittee.

A meeting was held in New York on November 16, 17, 18, 1955. At this time visits were made to the International Business Machines Corp. plant at Poughkeepsie, N. Y., and the Pitney-Bowes research laboratory at Stamford, Conn. On these plant visits, existing equipment as well as projected equipment and procedures were discussed with these organizations.

The next meeting of the subcommittee was held in Los Angeles, Calif., on December 4, 5, 1955, where they reviewed the Telemeter project of the International Telemeter Corp. They moved to San Francisco on the 6th and reviewed ERMA and the character reader for travelers checks and other equipment and procedure developed by the Stanford Research Institute at Menlo Park. At this meeting it was decided that sufficient information had been developed about common language to justify a meeting with printers to see how they would fit into the program.

On January 16, 1956, the first progress report of the subcommittee, signed by John A. Kley, chairman, was submitted to the bank management commission. This report appeared in the February 1956 issue of Banking magazine.

A meeting with the Lithographers National Association was arranged in New York. The subcommittee presented the problem of check handling and the need for a common machine language with technical aspects and impact on check design and printing. A part of 1 day was devoted to an outline of check-handling routine as developed by the International Standard Trading Corp. A meeting was held with John H. Wurts and Herbert H. Kimball, vice presidents of the Federal Reserve Bank of New York, and liaison representatives of the Federal Reserve System. Another part of the day was spent with representatives of Intelligent Machines Research Corp., which company has developed a number of character readers. These meetings were held on January 25, 26, 27, 1956.

John A. Kley, chairman, and A. R. Zipf met with representatives of the Federal Reserve System in Dallas, Tex., on February 20, 1956. At this time the philosophy of common language was covered. All of the Federal Reserve banks and the Board of Governors of the Federal Reserve System had representatives attending this meeting.

Another meeting was held in New York on March 8, 9, 10, 1956. With the background and knowledge gained from talking to the lithographers and the visits made to various manufacturers during 1955, it was decided to review the progress, present status, and future plans of the manufacturers, with particular reference to common language. At this meeting discussions were held with engineers and other representatives of Burroughs Corp., the Todd Co., and the Addressograph-Multigraph Corp., International Business Machines Corp., the National Cash Register Co., Pitney-Bowes, Inc., Sperry Rand Corp., and the Stanford Research Institute. As a result of this meeting, the subcommittee decided to attempt to set up some criteria for evaluating common languages. A research survey by the Battelle Memorial Institute, covering Evaluation of the Burroughs-Todd Fluorescent Check-Coding System, to the Todd Co., was also reviewed by the subcommittee.

On May 11, 1956, a letter and progress report of the subcommittee was sent out to member banks of the American Bankers Association over the signature of William W. Cottle, chairman of the Bank Management Commission.

Another meeting was held at Philadelphia and Paoli, Pa., with the Burroughs and Todd representatives on May 13, 14, 1956. They reviewed the latest equipment and procedures developed at Paoli, as well as the newest developments in fluorescent coding. The subcommittee then moved on to Dayton. A part of the day on the 15th was devoted to the International Business Machines Corp. representatives and some of their most recent findings on coding. On May 16 and 17, meetings were held with the National Cash Register Co. and Pitney-Bowes, Inc., representatives to bring the subcommittee up to date on

their progress and projected equipment as well as the latest developments on fluorescent coding.

On June 28, 29, 30, 1956, the subcommittee met at Palo Alto, Calif. A visit was made to the Stanford Research Institute to see the latest developments in magnetic character reading and check processing. Meetings were held with the representatives of Stanford Research Institute and the General Electric Co., the latter having purchased ERMA and its component units.

In addition to the meetings outlined briefly above, there has been a large exchange of correspondence with manufacturers about various phases of the problem. Also, each member of the subcommittee has met with individual manufacturers and others who could contribute to the general fund of knowledge relative to the work of the subcommittee.

PART III. DESCRIPTION OF MACHINE LANGUAGES

A study was made of all of the existing language mediums available. A description of them follows:

SLAVE OR CARRIER

In the booklet entitled "Automation of Bank Operating Procedure," the opinion was expressed that a slave or carrier was less desirable than a language printed on the check itself. Nevertheless, these possibilities were fully considered.

These systems contemplate the coding of information into the slave or carrier during an early, if not the first, bank processing operation. The slave or carrier systems include:

1. The attachment of a punched card to each check.
2. The wraparound—in which information is coded in a punched card and the check is wrapped around the card for sorting and processing.
3. The envelope system—in which each check is placed in an envelope of uniform size.
4. The punch tape tab—in which a coded tab is attached to each check.

Of these 4, development is proceeding on only the last 2. It is appropriate, therefore, to elaborate upon these two systems.

The envelope system

Contemplates the automatic enclosure of the check into a plastic or mylar envelope of uniform size, which contains a small strip of magnetic tape upon which information is coded in a fashion analogous to conventional magnetic tape recording. Once the information is recorded during an early bank operation, all subsequent operations become automatic, including the removal of the check from the envelope following processing. This system which is under prototype development has not been demonstrated but has been described to the subcommittee.

The punch tape tab system

Requires the automatic attachment, by a thermal adhesive of a piece of punch tape of uniform length to each check as a byproduct of a now necessary proof operation. In addition to the amount, other information such as American Bankers Association number or account number may be encoded into a tab containing guide rod holes for automatically positioning checks in cartridges for subsequent handling. The tab may be automatically removed during the last operation. This system is now in laboratory operation running with very limited numbers of "live" checks. The subcommittee has witnessed some components in actual operation.

NONCARRIER SYSTEMS

All of the noncarrier language systems involve some form of printing of machine readable language onto the check itself. These systems may be classified as follows:

1. Codes or patterns, printed with—
   - (*a*) Fluorescent ink (invisible):
     - (1) Binary or bar code.
     - (2) Spot code (decimal system).
   - (*b*) Magnetic ink (visible):
     - (1) Miniature bar code on face of check.
     - (2) Large bar code on back of check.
2. Arabic characters:
   - (*a*) Conventional printer's ink.
   - (*b*) Magnetic ink.

All of these systems contemplate printing (in machine language) the customer account number, American Bankers Association number, routing symbol, and in some cases check serial number on the checks prior to original delivery to the customer. This we refer to as preprinting. They also contemplate printing on each check the amount and other information as a byproduct of the proof operation. The possibility of having information encoded on some checks as part of the writing process is also conceivable. This we call postprinting.

CODES OR PATTERNS

Fluorescent inks

For machine reading of fluorescent ink codes, the check is irradiated with black light (ultraviolet) as it passes through the reading head, and the printed inkspots fluoresce so that a signal is induced in the reading head. Our studies show that excessive ink from tellers or endorsement stamps, as well as other extraneous substances placed over the spots tend to cause wide fluctuations in signal strength.

To mitigate this problem it is common to print relatively large spots and to design the system to operate at signal levels generated from as little as one-tenth of the printed spot. The distance between spots or bits of information decreases as a function of the size of the printed spots and the amount of information required to be coded on an individual item. The tolerance in printing, cutting, perforating, reading, and the angular displacement or skew of each of them becomes largely a function of the distance between spots.

Binary or bar code

This system employs one variation of the binary code common in computer design. It employs uniform fields in which to code the necessary information. The coding system provides for a total printing, cutting, and perforation tolerance of one-tenth of an inch, plus or minus.

It is stated that an additional tolerance of 0.075 is available in machine reading but that angular displacement or skew will dissipate some of this tolerance. Reading is accomplished in serial fashion, or one digit at a time. The subcommittee has witnessed a laboratory demonstration of these reading techniques.

Spot code (decimal system)

In this system spots one-eighth of an inch square are printed in a decimal pattern. The presence of a spot in a given area indicates the presence of a digit and the position of the spot within the area identifies the value of the digit. There are 13 areas on the check for different classes of information. In 11 of the areas the identity of the digit is established from 1 edge; in 2 of the areas it is established from 1 side. Total printing, cutting, and perforating tolerances given for this system are one sixty-fourth of an inch. Reading may be either serial or parallel.

The subcommittee has witnessed a laboratory demonstration of the reading system.

Magnetic ink

In machine reading of magnetic ink code, the code bits are magnetized before they pass through the read head so that signals are induced in a manner somewhat similar to normal magnetic-tape devices. To the naked eye the printing quality cannot be distinguished from conventional printer's inks. Ink colors are presently somewhat limited and drying qualities are slightly slower than for conventional inks.

However, little effort has yet been expended in these areas and there is virtually a unanimity of opinion that neither problem is unsolvable. The subcommittee has witnessed demonstrations of accurate reading by a variety of processes even when the printing was totally invisible to the naked eye. These systems also make provision for obtaining the required signal from only a portion of the individual code bits.

Miniature bar code on face of check

This system requires the presence of some combination of six miniature bars to represent each digit. The Arabic equivalent is printed above the code. The codes are printed eight to the inch with the overall vertical height of the code, including its Arabic equivalent, being approximately eleven-sixteenths of an inch. The distance between the miniature bars is about 12 one-thousandths or one-eightieth of an inch.

The subcommittee witnessed a laboratory demonstration of this reading technique.

Large bar code on back of check

This system employs a binary code requiring the presence of 2 bits of information, from a total of 5, to represent each character. Printed 7 to the inch, each code, with its Arabic equivalent, requires 2 inches in the vertical direction. The bars are spaced one-eighth of an inch apart to achieve the widest tolerances of any of the pattern systems. Its size precludes printing any place but on the back of the check, thus requiring a two-side printing operation.

This system has been in successful but limited productive operation for more than 6 months, with various size checks passed through the usual banking channels that were first printed by some 53 different printers. The subcommittee has witnessed a demonstration of this technique.

ARABIC CHARACTERS

Conventional printer's ink

Character recognition of information printed in conventional printer's ink employs the use of optical reading techniques. While there are a variety of such techniques, in principle they employ some form of scanning device which differentiates between light and dark to optically determine the shape of a character. Thus a blot of ink, a pen stroke, or a teller's stamp impression on any character will very frequently cause a reject. While it may be possible to virtually "design out" errors, it appears that such design may be prohibitively expensive.

The light absorption qualities of paper and the contrast of printing to background are also factors which present design and operating problems in this technique. While this is the most classical system, there is reason to believe that the degree of mutilation and defacement to which checks are subjected in the normal collection channels makes it impractical, from a standpoint of reject and possible errors, for some time in the future. Its dimensional tolerances are greater than any of the code systems.

Individual members of the subcommittee have witnessed variations of this technique in operation.

Magnetic ink

This technique in principle employs the salient features of both character and pattern recognition. Data are printed in Arabic characters in almost conventional style except that magnetic inks are used. Printing in magnetic ink overcomes problems of obliteration and mutilation which belabor optical character recognition systems and the close-tolerance requirements of pattern systems. Hence, the system offers all of the advantages of both systems.

The subcommittee has witnessed a laboratory demonstration of these techniques.

PART IV. PRINCIPAL FACTORS CONSIDERED IN THE EVALUATION OF A COMMON MACHINE LANGUAGE

There are many factors to be considered in establishing the basis for evaluating the various machine languages which have been suggested for encoding information on checks. Before proceeding with the selection of a common langauge, it would perhaps be well to consider a bit more in detail the more important of these factors.

Accuracy

The accuracy with which data may be encoded on checks and subsequently read by both machines and humans is of paramount importance. Accuracy, in this instance at least, can be best measured by two factors: (1) the error rate—the number of items which the machine will read incorrectly, and (2) the rejection rate—the number of items which the machine will discard as not readable. From the beginning the subcommittee has pointed out that every check must be rejected where there is a failure of accurate reading. A fractional percentage of rejection is to be anticipated but we must insist upon accuracy once the check has been accepted by the machine. Were it otherwise, the expense of isolating and correcting errors could substantially reduce the savings to be found in automation.

The rejection rate varies somewhat among the various machine languages which have been suggested. We had hoped that this rate would not exceed

one-half of 1 percent, or 1 item in every 200 processed. Happily, it now appears conceivable that this rate may be improved, perhaps by a factor of as much as 10—at least with respect to 1 language.

Tolerances

Tolerances—that is, the variations in the distance from one or more edges of the finished check to the encoded information which is to be read mechanically—must be reasonable. Quite extensive studies of checks presently used throughout our banking system have been made ,and meetings with check printers to discuss this problem have been held. These studies and discussions with the check printers covered the three major factors in check printing which affect tolerances—printing itself, perforating, and cutting the paper.

The preciseness with which the check imprinter must place the encoded information upon the checks, and cut or perforate them, will determine to a considerable extent whether he can economically imprint them upon his present equipment, or whether he must obtain and install new and more expensive equipment. Some codes require a far greater degree of accuracy on the part of the check printer than others. While many of the printers agree that this higher degree of accuracy can be attained, they have indicated that it will substantially increase the cost of check imprinting.

To the preciseness of placing the encoded information on the check is added the problem of the accuracy of cutting and perforating the check once it has been printed. Since either cutting or perforating the check defines the edge, variations in these operations have a cumulative effect on the distance from the edge, or edges, of the check to the encoded data. Inaccuracies in printing, cutting, and perforating, as they are done today, add to greater tolerances than those permitted by some suggested languages.

In addition to the above tolerance factors, post-printing of the amount, and any other related information, in a fixed location on the check within the tolerances required by the language, present a problem to the banks and manufacturers of their equipment. The preciseness with which the checks must be positioned in such equipment, in sorting equipment which will be used to sort them, and reading equipment used to read them, will have a material effect upon the cost of the equipment, as well as upon the dependability and accuracy which may be realized in its use.

Our studies have convinced us that tolerances should not be less than plus or minus one-eighth inch.

Printing

Automatic check handling, in any of its forms, will require each bank to encode all checks used by its customers. Since machine manufacturers are developing a variety of systems designed to accommodate the smaller banks, as well as the larger ones, any code or language selected must not only fulfill the requirements of the entire banking industry, its customers, and the machine manufacturers, but it must also be one that check imprinters can handle on a practical and economical basis. The cost of such imprinting will be a major factor in determining the feasibility of adopting any automatic or semiautomatic procedure. Presumably a substantial number of the banks will feel that they are obligated to assume the major portion, if not all, of the cost of imprinting the prequalified data. This cost may be substantialy influenced by not only printing tolerances, but also the use of special inks or a code that requires double runs or two different printing heads—one to imprint Arabic data on the check, and the second to imprint the check with the coded information. And there are other factors to be considered—such as the durability of the printing, whether the accuracy of the printing is readily determinable, whether special equipment may be required for verification procedures, and whether the coded information is susceptible to obliteration or mutilation during the processing of the checks. It may be noted here that both check printers and banks are much more familiar with handling checks where such data as the transit numbers, routing symbols, check number, and customers' account number (particularly with respect to special checking accounts) are encoded on them in the form of Arabic characters, than they are with any other form of coding.

Customer acceptance

Customer acceptance of the encoded check will depend considerably upon the appearance of the check itself, the ease with which it may be prepared on present office equipment, and the ease and convenience with which it may be read and verified by the customer. In respect to the latter point, it may be well to note

that if the coded data are readily understandable by the customer, it may well serve to eliminate or at least reduce problems inherent in reconciliation procedures. If public acceptance were the only consideration in evaluating the various languages, then perhaps we would lean most heavily upon that manner of encoding which would in no way affcet the present appearance of the check. Since this is not the case, however, we must carefully evaluate all of the advantages and disadvantages of each of the proposed languages and select that which will best enable us to render the most accurate and most economical service to our customers.

Verification

Verification procedures must be given due consideration. The language selected should be one which will permit the check printer, in the first instance, to readily verify his accuracy. Similarly, it should permit each processing bank to readily verify the accuracy of the validation of amount and other data subsequently added in the automatic system. The transition to mechanization will take place over an extended period of time, during which a language compatible with human recognition will be of inestimable value in manual procedures. Last, but not least, the language should be susceptible to ready interpretation by customers of the bank, and by personnel of the bank who are not necessarily trained in the automatic processing itself. Thus, since it is essential that any encoded information be humanly understandable, it must be written in Arabic as well as in a pattern, unless the Arabic characters themselves are to be read by machines.

Costs

Costs must be carefully considered, not only in connection with the paper stock to be used, and the printing of the checks themselves—to which we have already referred—but also in connection with the processing equipment which banks will need to handle the checks. The cost of printing, encoding, and processing equipment will be based upon the following factors:

1. Permissible tolerances in positioning the paper.
2. Types of inks required.
3. Number of printing runs required.
4. Whether decoding equipment is required for verification purposes.
5. Variations in thickness of paper stocks and check sizes.
6. Nature and extent of the circuitry required to read and to interpret the encoded data.

Format

The format of the check must be such as to accommodate the information which must be encoded, regardless of the language selected. This information is of two types—that which may be prequalified, or preprinted, before the checks are given to the customer, such as the account number, the bank transit number, the routing symbol, and possibly the check number (if similar automatic equipment is to be used to reconcile checks), and that which may be imprinted by the banks during processing, such as the amount, a transaction code to differentiate between debits and credits, etc., and a date or block identification number. An area must be reserved in the same location on all checks, regardless of size, for each of these items, if they are to be processed automatically throughout the banking system. The size of each field—that is, the maximum number of characters of information to be accommodated—may have to be fixed, as well as the location. Certainly this is true of such data as the amount, etc., if various banks are to validate each other's checks.

Careful thought has been given to the possibility of placing encoded data upon the reverse side of the check. Because of the additional costs of printing in this manner, and the difficulties inherent in turning cecks over to read or verify data so printed, this plan has been rejected. It follows then, that it will be necessary to make some alterations in the present format of our checks. Space requirements of some of the language patterns have a material effect on the degree of such changes, and actually limit the minimum sizes of checks that may be used.

Mutilation and obliteration

The susceptibility to mutilation and obliteration will have a material effect upon the error and rejection rates in procesing checks. This can be a most important point, since, as we have experienced with punchcard accounting systems, a high mutilation or rejection rate can defeat the objectives which we hope to gain through the introduction of automatic equipment. It can lead to a stream

of exceptions which must be handled manually. Therefore, the language that is selected must be one where the inks used are durable, where the reading accuracy of the equipment will not be influenced by foreign markings or substances which are subsequently placed upon the check by the customer or banks during processing, or to which checks are exposed when they are in the hands of the public. The ideal language is one which, as far as the reading equipment is concerned, cannot be altered by pencil or ink markings, adhesive stamps, mending tapes, and exposure to such foreign substances as oils, greases, etc.

It is hardly practical to attempt, in this report, to enumerate all of the factors serving as a basis for the evaluation of a common machine language for the electronic processing of checks. The subcommittee, for more than 2 years, has been studying all of the ramifications and technicalities involved in such an evaluation. Since to itemize all the points that were considered would materially increase the size of this report, we have, in the interest of brevity, confined ourselves to merely outlining briefly the more important factors which were given the most careful attention.

Part V. Evaluation of Factors and Reasons for Selection of Magnetic Ink Character Recognition

After very careful consideration of all of the factors involved, the subcommittee respectfully recommends the adoption of magnetc ink character recognition as the common language most suitable for check handling. Following are the subcommittee's findings with respect to the principal factors which were considered in the evaluation of the common machine languages.

Accuracy

The subcommittee has attended laboratory demonstrations sufficient to convince it that magnetic ink characters of approximately typewriter size are capable of being read at least as accurately, both as to error rate and rejection rate, and as fast as any other language which has been suggested. Experiments to date have indicated an error rate of 1 in 100,000, and it is reasonable to expect that this rate will be further improved.

Tolerances

Printing tolerance requirements—including those for the actual printing processes, and for cutting and for perforating—are not as stringent using magnetic ink character recognition as they are wth the other languages studied. In fact, the present state of the character recognition art, as demonstrated to the subcommittee indicates that permissible tolerances of perhaps as much as plus or minus one-half inch will be acceptable to the readink equipment.

Another serious printing tolerance—that of obtaining uniform ink coverage—hav been demonstrated as solved by the development of reading equipment that will accept and recognize both lightly and darkly inked characters. This will prove to be a marked advantage in that it will permit a latitude in postprinting equipment needed to encode the cecks with the amount and related data.

Printing

With the wide tolerances allowable under the magnetic ink character recognition system, both large and small equipment now used in the printing trade can be utilized for preprinting or prequalification purposes. Though a special ink is required, it is relatively inexpensive, and it permits printing the code in a single run. As the use of magnetic ink is not necessarily restricted to the printing of the coded information, this language may permit an entire stock check to be prepared with one inking.

As to postprinting, or the affixing of additional information—such as dollar amounts—to checks after their receipt at a bank, it has been demonstrated that present office machines—including the common typewriter—can be used to print magnetic ink characters with excellent reading results. This fact, combined with the wide tolerances in locating the encoded data and in the density of the inks used, minimizes the very serious problem of being able to inexpensively postprint information that will register correctly in the reading operation, and also be compatible with preprinted information.

It should be noted that the accuracy of both preprinting and postprinting is readily determinable by orthodox methods, no special verification equipment being required as in the case of some of the other languages studied.

Customer acceptance

Magnetic ink character recognition will require some changes in check format which will result in a change in appearance of the checks. In the opinion of the subcommittee, changes in appearance which will result from the use of magnetic ink character recognition will not prove to be as objectionable as some of the languages studied. If due consideration is given to the ease with which checks may be prepared on present office equipment, particularly by customers who may wish to use new automatic equipment in processing and reconciling checks, and the ease and convience with which the code may be read and verified by all, the subcommittee believes that this language will prove to be the most acceptable of those studied.

Verification

The fact that the recommended language utilizes common Arabic numerals eliminates the need for correlating a code with printed characters. Verification of preprinted information is, for printers, exactly the same as any proofreading or other similar checking operation now performed. As to postprinted data, verification procedures will consist of reading or calling back as they do at the present time. Although the other languages studied provided for the printing of the code in Arabic numerals for human recognition, as well as in the pattern required for machine reading, we have no assurance that variations will not occur between the Arabic character and its representation in the code, which will result in errors that may be extremely difficult to locate.

Costs

Considering costs, proper emphasis must be placed upon operating expenses, as well as the capital investment for equipment. The subcommittee has found that:

1. The much wider tolerances permitted by magnetic character recognition will enable large and small printing concerns to continue to use their current equipment for the production of checks, thus eliminating the need for new and more expensive equipment and a high degree of preciseness in cutting and perforating checks. This will serve to minimize printing costs.
2. Magnetic inks will be no more costly than other types of special inks.
3. Checks may be imprinted in a single run and with one inking.
4. No special decoding equipment is required for verification purposes.
5. Variations in thickness of paper stocks and check sizes will be limited only by the mechanical devices required to handle the paper itself. The language used will have little or no effect upon them.
6. While the nature and extent of the circuitry required to read Arabic numerals may be, in the first instance, somewhat more expensive than that used to read some of the other languages suggested, this additional expense will be more than offset by a reduction in the cost of the mechanical equipment which would be otherwise required to more precisely position the paper for both preprinting and postprinting operations, as well as by substantial reductions in continuing expenses for imprinting, processing, and verification operations.

Format

As we have already indicated, the use of magnetic ink character recognition will require some changes in check format. These changes will not be as radical as that required by some of the languages studied. There are but three ways to avoid these:

1. The use of an invisible code.
2. The use of a "carrier" which could be detached after processing the check.
3. Placement of the language on the back of the check.

Again, as we have already pointed out, the use of an invisible code will require special equipment for reading and verification processes. Since it will not be susceptible to human recognition, it will serve to complicate preprinting, postprinting, and proving operations. To meet this objection, coded data can also be imprinted on the check in Arabic numerals for the use of humans, but the advantage of invisible inks is then lost, since changes in format will be required to accommodate these numerals. Furthermore, 2 separate runs, or a double run, must be made to imprint such data with 2 different inks.

If a "carrier" is used to carry the coded data through the various processing steps, then additional equipment must be used which will attach this carrier to the check or enclose it, as the case may be, and subsequently detach the check or remove it from the enclosure. Because of the cost of such

equipment and the additional operating steps that its use necessitates, the subcommittee has not deviated from its originally announced requirement that the check should be its own carrier.

As stated earlier, the subcommittee rejected the suggestion that the language be placed upon the back of the check because of the additional costs for both printing and postprinting data in this manner, and the difficulties that it would present to printers, bank personnel, and bank customers in reading and verifying the encoded data.

As a part of the concentrated effort to study and evaluate all of the proposed languages and their effect on check formats, the subcommittee analyzed the type and style of check imprinting for 138,162 accounts. It was found that 45,747 accounts, or 33 percent, used checks individualized in some way. Of this number, 21,298, or 15.4 percent, were held by businesses, while the remaining 24,449, or 17.7 percent, were held by individuals.

Of the total of 138,162 accounts observed, 1,125, or 0.81 percent of the total, or 2.4 percent of the imprinted checks, used "cuts" on the imprinted checks. The remainder of the checks were either set in type or were printed by multilith. Also included in this study was the amount of space by area on the check, available for printing a visible common machine language.

Mutilation and obliteration

Of the media studied, the subcommittee found that magnetic inks were least subject to mutilation and obliteration through the ordinary handling and exposure which checks might be expected to receive. Magnetic inks can be read mechanically through overstamping, pencil and ink marks, oils, greases, carbon smudges, scotch and opaque tapes, as well as other foreign substances. The inks used are as durable as any presently used in printing and typing operations. In fact, magnetic inks may be obliterated as far as the human eye is concerned and yet be readable accurately by mechanical equipment.

Conclusion

In this report we have mentioned briefly only the principal criteria upon which the selection of a common language for automatic processing of checks must be based. These, plus many others of perhaps less importance, were all very carefully weighed in reaching our conclusion to recommend, as the common machine language, magnetic ink character recognition.

PART VI. SUMMARY

We have covered the activity of our subcommittee, the basic factors considered in this selection, a description of the technical aspects of the languages existing today and the reasons for the selection of the language we are recommending.

It is our intention to seek cordinated agreement on designated field lengths and locations, as well as specific character type font, as soon as possible. A specifications manual will be published for the guidance of all concerned immediately thereafter.

Respectfully submitted.

JOHN A. KLEY, *Chairman.*

TECHNICAL SUBCOMMITTEE ON MECHANIZATION OF CHECK HANDLING

John A. Kley, vice president, the County Trust Co., White Plains, N. Y., chairman.
Herbert R. Corey, vice president, First National Bank of Boston, Boston, Mass.
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, Ill.
Raymond C. Kolb, assistant vice president, Mellon National Bank & Trust Company, Pittsburgh, Pa.
A. R. Zipf, assistant vice president, Bank of America National Trust & Savings Association, San Francisco, Calif.
Melvin C. Miller, deputy manager, American Bankers Association, New York, N. Y., secretary.

In addition to the foregoing formal report, the following statement of acknowledgment and appreciation was made by Chairman Kley.

ACKNOWLEDGMENT AND APPRECIATION

The action taken by the Bank Management Commission in endorsing the recommendation of our subcommittee is, of course, a source of great satisfaction to us. At this point I would like to take your time to express the pride that I have in being chairman of such a group of individuals. Their earnestness and conscientious attention to duty, I think, is somewhat unique for a volunteer type of committee. A great deal of time spent in the last 2 years has been on their own, during nights and weekends, in order to minimize their absence from their regular bank duties. The banks for whom they work are to be commended for allowing such men to participate to the degree that they have done so.

The selection of a common language in the total scheme of check mechanization is, of course, just a first step. However, for us who have served on the subcommittee, we now feel that we have left the paths of frustration and have now entered upon the road to fruition.

It has not been an easy task to consider all factors involved and arrive at a single language. A great deal of effort, financial support, and technical know-how has been put into the various approaches to languages by many people. The manufacturers with whom we have worked have been most cooperative, and it is a thrill to observe the results of their individual ingenuity.

Some people will tell you that the selection of a language by such a committee is foolhardy, in that a single common language will never be attained. We have been told in some quarters that the selection of a language will be a calculated risk. Our considered opinion at this time is that this is not so, and that this is, in fact, a calculated selection. While it is true that perhaps a media entirely unknown at the present will emerge as a better answer in the future, we feel that we have selected the best existing medium.

The time for selection is most opportune. Although large sums have been invested toward the perfection of various language concepts, still none of the systems has reached the state of production tooling where extremely large amounts of capital are required.

We hope to immediately implement this recommendation by asking the various machine manufacturers and the check-printing industry to join with us in the cooperative selection of specific details, such as field location and designated places on a check to be reserved for this language. In this endeavor we hope to be successful and feel that now the primary designation has been made; that the cooperative action of all manufacturers concerned will tend to accelerate the day when common language is a reality.

Today might very well go down as a day during which men sat together and made a decision that had absolutely no effect on the check-mechanization problem whatsoever. On the other hand, it could represent a day in which an historical landmark was created in the field of bank operations. We submit to you that, in our opinion, there is no question but that it is the latter.

Only time will tell how important a part the concept of a single mechanical check-reading medium will play in the field of bank operations and customer service.

MR. KLEY. The recommendations contained in this report were subsequently received and approved by all of the major machine manufacturers in the country.

Magnetic ink character recognition is a procedure whereby characters in almost normal Arabic form are printed on checks with an ink containing ferrous oxide. With the use of a scanning head a machine may be motivated by the signals induced by the ink after it has been magnetized. At the same time, the scanning device can differentiate between light and dark to determine the shape of the character.

Following the first major decision, the next determination to be made was that of the vertical location of the language to be contained on the checks. This recommendation was contained in a report entitled "Placement for the Common Machine Language on Checks," dated April 10, 1957.

I would like to insert a copy of this in the record, Mr. Chairman.
Chairman PATMAN. It may be inserted.
Mr. KLEY. Thank you, sir.
(The report follows:)

[Bank Management Publication 141—Automation of Bank Operating Procedure]

PLACEMENT FOR THE COMMON MACHINE LANGUAGE CHECKS

Recommended by Technical Committee on Mechanization of Check Handling, Bank Management Commission, American Bankers Association, New York, N. Y., April 10, 1957.

FOREWORD

Automation in bank-operating procedures becomes closer to reality with the recommendation described herein for the placement of the common machine language on checks. The need for automation was recognized some years ago and the necessity for cooperative action and tentative suggestions for language and placement were covered in the American Bankers Association booklet issued in 1955 on the subject Automation of Bank Operating Procedure. The big step toward automation was achieved in July 1956 when the common machine language was recommended in the bank management commission of the American Bankers Association's booklet entitled "Magnetic Ink Character Recognition," which recommendation received the unanimous support of machine-equipment manufacturers and the check-printing industry. Further progress can now be recorded as a result of the recommendation of the best location for the common machine language as outlined in this booklet.

The immediate problems remaining to be solved relate primarily to the type of information to be coded, the location of each part of the information with relation to each other part, and the number of digits of information needed.

The specificatins for the type font for the common machine language are being established by the machine-equipment manufacturers. Considerable progress toward solving these problems has already been made, and we anticipate a final solution will be forthcoming within the next few months.

Electronic and semielectronic equipment of various sizes and types is even now available for the processing of data relative to the handling af checking accounts. The design and development of check-handling equipment capable of reading, sorting, and listing checks from magnetic ink character coding is proceeding at a fast pace. The establishment of the location of the coding on checkes will permit the design and development of encoding machines, and it is reasonable to believe, therefore, that a high degree of automation can be expected to be achieved within the next few years.

Credit for the remarkable progress being made toward automation of bank operating procedures is due to the cooperative effort of the members of the bank management commission's technical committee on mechanization of check handling and the representatives of machine equipment and printing industries, all of whom have freely given of their time and talents. The bank management commission specifically commends the members of the technical committee who have worked so diligently on this project. To all these individuals and to the concerns they represent the bank management commisison on behalf of the banks of the country expresses sincere thanks and appreciation.

BANK MANAGEMENT COMMISSION, AMERICAN BANKERS ASSOCIATION,
HAROLD E. RANDALL, *Chairman.*

PART I. INTRODUCTION

Magnetic ink character recognition was adopted in July 1956 as the common machine language most suitable for mechanized check handling by the bank management commission of the American Bankers Association. Subsequent to the publication of the report of the technical committee on mechanization of check handling on July 21, 1956, the following machine manufacturers which had actively participated with the committee in the common machine language phase of the project have added their support to the recommendation: Addressograph-Multigraph Corp.; Burroughs Corp.; General Electric Co.; International Business Machines Corp.; Lithographers National Association, Inc. (representing the

check-printing industry); National Cash Register Co.; Pitney-Bowes, Inc.; Sperry Rand Corp.; the Todd Co., Inc.

Since the date of adoption, the above organizations, together with additional representatives of the check-printing industry, have been meeting, both by themselves under the auspices of the Office Equipment Manufacturers Institute and with the committee, to coordinate technical details concerning the placement on the check of the common machine language, the sequence and amount of information to be coded, and the final specifications of the type font.

At a meeting on September 22–23, 1956, the committee submitted the problem of common machine language placement to the manufacturers with the idea that they would resolve this phase themselves. Because of some basic and unreconcilable differences of opinion, this problem was turned back to the committee for study and decision at a joint meeting held on December 13, 1956.

Since it is essential to the concept of common machine language that a uniform placement location for the characters be established, the committee has attempted to be especially diligent in evaluating all of the considerations presented. It has also developed additional material not presented by the various manufacturers. Meetings of the committee on this particular problem were held on January 14–15, 24–25, and on March 21–23, 1957. In addition, statistical data were compiled by the individual banks with whom the members of the committee are associated. Assistance and cooperation have been provided by the Federal Reserve System. A nationally recognized independent consulting organization was utilized for an independent determination of certain of the committee's findings related to the probable economic factors involved.

Originally, it was considered that the selection of the common machine language placement would require considerably less study than did the primary designation of the common machine language itself. It soon became apparent, however, that placement of the language involved some serious differences of opinion. Unless these could be resolved, they would present a formidable obstacle to the philosophy of common machine language.

Briefly stated, such a code could conceivably be located adjacent and parallel to either the top or the bottom edge of a check. The preference, ultimately reached by all the manufacturers except one, was for the bottom edge. The reasons advanced in favor of the bottom edge were fewer mutilations, economy in equipment and operation, and greater customer acceptance. The one reason advanced in favor of the top edge was the apparent difficulty of adapting bottom-edge encoding to punchcard checks. It was pointed out that the bottom row of holes in punchcard checks would negate magnetic-ink character coding if the two were located in same area. Bottom-edge encoding seemed to offer a number of very important advantages if the reasons advanced for its preference were valid. However, on the other hand, the proponent for top-edge encoding contended that punchcard checks were in existence and were, therefore, a problem that had to be considered in the ultimate decision.

The question was also raised as to whether or not the common machine language should be concerned with the problem of compatibility with another language.

There follows a detailed report of the findings of the committee, together with its recommendations and conclusion.

Part II. Principal Factors Advanced for Consideration

The committee recognized early in the study of the common machine language for check handling that the location of the language on the check was an integral part of the language itself. To reserve a fixed area for encoding the common machine language on any section of a check presented problems. In its studies of literally millions of checks and in its discussions with machine manufacturers and check printers, many factors were considered. The principal factors to which the committee devoted considerable time follow.

Incidence of Mutilation

Early observations indicated that the mutilation of checks is greater at the top than at the bottom. When one visualizes the handling of checks in the proof departments of our banks, this becomes easily understandable. As checks are processed through the various stages of the sorting and proving operation, they are repeatedly jogged to the bottom edge and bundled. Rubber bands are universally used for wrapping, and have a great tendency to tear or fold those checks that protrude from the top of the bundle. Another significant factor in the

mutilation of checks is staples placed in checks by depositors. An extremely high percentage of these staples appear in the top of the check.

A check mutilation is of concern in the automatic sorting and proving operation and in the automatic document-processing system. A mutilated check has some probability of rejection by the machines, and, while rejections are much more desirable than errors in reading, it is, of course, extremely important that rejections be kept at an absolute minimum. Of even greater significance, however, is the effect that mutilation has on the ability of the machines to read the coding correctly. Errors in reading the encoded information can result in many man-hours of checking to effect corrections.

ECONOMICS

In any systems consideration of the problem, economics must be carefully considered.

The cost of equipment is a factor of importance in determining the extent to which the mechanical check-processing system is adopted by the various banks throughout the country. The cost of the major equipment, such as the electronic computer system, will not be dependent upon the position of the magnetic ink characters on the check, and, therefore, is not a factor in our considerations. However, the postprinting equipment used for amount encoding and postencoding of normally precoded information is dependent upon the location and must receive careful consideration.

Most of the manufacturers feel that the design philosophy—the "rising print segment" used in virtually all numeric accounting machines and printers—provides far greater adaptability to effective encoding at the bottom than at the top of checks. According to most of the machine manufacturers, this should result in less costly equipment for performing this function.

In any system envisioned, there will, necessarily, be a limited amount of manual handling. The nature of this manual operation is affected by the location of the coding. Opinions were expressed that bottom encoding would result in some laborsaving in the manual operation.

CUSTOMER ACCEPTABILITY

There is little doubt that coded information printed on checks in any position will be disturbing to some customers. The degree, in all probability, will be directly related to the extent of change required in their check format. In having checks printed, many companies desire to have their name printed in a predominant position at the top of the check. Advertising cuts at the top are also used to a considerable extent. In the case of individual depositors, most personalized checks are imprinted in the upper left corner with the name and address. Encoding at the top would, in many cases, seriously contract the customer's "personalized area"—a factor of concern when customer acceptability is considered. The check-printing industry indicated that, in its opinion, bottom encoding would permit far better check design and result in much greater acceptability by the public.

PUNCHCARD COMPATIBILITY

It was submitted that 14 percent of the checks handled by the banks of the country are on punchcard stock. Of this 14 percent, approximately 50 percent are drawn on the Treasurer of the United States. The use of punchcard checks has grown considerably in the last decade, and the growth is continuing. Despite the distinct possibility that many checks presently issued on punchcards may one day be issued on paper stock, the change will come about only when and if it becomes economical. Therefore, it was contended that, in order to obtain complete automation in the check-collection system, compatibility between punchcard checks and paper checks was essential.

PART III. FINDINGS

INCIDENCE OF MUTILATION

Paper checks of varying sizes and paper weights are subjected to a variety of mutilations when processed through the normal check collection system. The degree to which such mutilations inhibit or complicate the accurate reading of the common machine language is, therefore, of prime consideration.

The incidence of mutilation in various areas of the check should, consequently, be a subject for exhaustive study if we are to preclude the imposition of unnecessary burdens upon the reading system.

While it appears reasonable to postulate that a reduction in the variety of check sizes, coupled with a continuing customer educational program, may mitigate the mutilation problem, it will never be eliminated.

Page 13 shows a tabulation of 3 studies concerning the relative frequency of mutilation at the top and bottom areas of checks. These 3 studies were made independently, and concerned check-handling operations in 3 cities—Chicago, Philadelphia, and San Francisco. All types of checks (clearings, transit, and "on us") were included in representative proportions.

The studies of mutilation concerned areas which are designated as top or bottom. The critical area of mutilation evaluated was a band one-quarter inch wide and one-quarter inch in from the top or bottom edge of the check. (Punchcards were evaluated similarly at the top, but the bottom was evaluated in a band one-quarter inch wide along and adjacent to the bottom edge.)

The average of the 3 studies shows that top mutilations occur on 6.6 percent of the checks, while bottom mutilations occur on only 1.5 percent of the checks. The consistency among the three independent studies indicated a high reliability of the samples. Also, a relatively equal mutilation rate occurred among clearings, transit, and "on us" checks, indicating uniformity in the data.

Mutilation must, of course, be divided into two categories: That which will preclude transport of the check itself, and that which will not affect the transport but will affect the "reading" reject rate. Since it has been demonstrated to the committee that various transport mechanisms (sorters) now existing in prototype form have the ability to transport checks with serious mutilations, the mutilations with which we are concerned are, therefore, those which will become "reading rejects" because of the mutilation of one or more of the common machine language characters.

Relative mutilation frequency at top and bottom check area

	San Francisco study	Philadelphia study	Chicago study	Total, 3 studies
Number of checks examined	101,000	18,771	8,413	128,184
Top mutilations:				
Tears	495	171	29	
Torn out		88	27	
Staples	967	290	72	
Staple holes	3,925	655	499	
Dog ears	441	116	26	
Key sort	3	119		
Pinholes			40	
Other	451		9	
Total top mutilations	6,282	1,439	702	8,423
Percent of checks examined	6.2	7.7	8.3	6.6
Bottom mutilations:				
Tears	205	69	10	
Torn out		38	11	
Staples	23	12	10	
Staple holes	158	17	35	
Dog ears	320	102	15	
Key sort	8	48		
Pinholes			3	
Other	822		3	
Total bottom mutilations	1,536	286	87	1,909
Percent of checks examined	1.5	1.5	1.0	1.5

The problem of determining the probability of rejects due to the mutilation of individual characters lends itself readily to statistical analysis.

Consider the following calculations:

Given: 1. The mutilation area has the dimensions 6 inches (minimum proposed check length) by one-fourth inch (although the characters themselves are only one-eighth inch, the additional one-eighth inch is the normal printing tolerance)

2. Each character is one-eighth inch in height with a density of 8 characters horizontally to the inch

3. There are 41 characters (tentatively agreed minimum number)
4. A mutilation is random with respect to position.

Problem: What is the probability of a mutilation affecting at least one character?

Solution: 1. Mutilation area 6 inches$\times$¼ inch=1.5 square inches.
2. Character area 41$\times$⅛ inch$\times$⅛ inch=0.64 square inch
3. Probability that a mutilation affects at least one character equals

$$\frac{0.64 \text{ square inch}}{1.5 \text{ square inches}} = 43 \text{ percent}$$

Thus, if a mutilation occurs in this designated area, the probability is that 43 out of 100 items so mutilated will be "reading rejects."

A precise calculation of mutilation cost is difficult to make at this time. Systems planning for the magnetic document processing system has not progressed to a point where precise determination can be made of the action that would be taken at the time a reject occurs. However, a substantial cost savings appears possible through bottom encoding. This opinion is substantiated by a study made by a nationally recognized consulting organization.

ECONOMICS

One of the most important factors for evaluation in any decision of this kind must, without question, be costs.

The committee has consistently made a diligent effort to evaluate these considerations in light of the smallest bank which may participate in this automatic check-handling venture. By constantly striving to bring costs down to the point where the utilization of such systems is feasible for smaller and smaller banks, the interests of everyone—manufacturers and banks alike—will best be served.

Cost considerations logically divide themselves into the following two principal categories: Equipment costs; continuing labor costs.

Equipment costs

The cost of equipment is a factor of considerable importance in determining the extent to which the common machine language is adopted by various banks throughout the country.

Equipment cost, at first glance, would be of lesser importance to a large single-unit bank than it would be to a small bank or to a branch system. A large single unit bank would have sufficient volume to justify expensive equipment in the one location. A small bank, or system including several small branches, would have difficulty justifying expensive equipment to handle small volumes at individual locations.

However, the equipment cost should be of major interest to all banks. The large, single-unit bank should be concerned that equipment cost permits the smaller banks or units to employ the common machine language. Many benefits would be lost if only a large bank could afford to employ the system.

Although the over-all cost aspect of the system is not within the scope of this report, the effect of top and bottom encoding on equipment is considered here.

Equipment for the common machine language system is still in the development stage. For this reason, precise determination of the cost effect of top or bottom encoding is difficult. However, some specific conclusions can be reached based on the general concepts involved.

It is doubtful that the cost of the equipment to be used for the bookkeeping function, particularly in the larger installations using electronic computers, will be materially affected by the choice of top or bottom encoding. The data encoded on checks will be read by sundry types of transporting devices capable of moving the checks under a reading head and transmitting the information to some magnetic recording device or to the central processing unit. Common machine language sorters are a type of transporting device. The feeling and scanning mechanisms will be essentially the same in either case. It has been indicated to the committee that the common machine language sorter could probably be designed to sort either top or bottom encoded checks with negligible difference in cost.

On the other hand, the cost of the postprinting devices which will be required may be affected substantially by the location of the code. These machines will be used early in proof operations to encode the amount and transaction codes (as well as other data on items received which have not been precoded). They may take the form of relatively simple document inscribers, or more sophisticated proof machines. Their cost will be significant to both the small bank, and the large bank which may require a multitude of such manually operated devices.

The position of the magnetic ink character common machine language must be placed in a consistent location on each check. Because of varying check widths, encoding at the top requires the top edge as a reference point while encoding at the bottom requires the bottom edge as a reference point. In either case, it will be desirable that the check be so positioned that the operator can have an unobstructed view of the face of it during any encoding operation.

Many business machines in use today employ the principle of rising type bars or print wheels for imprinting. This principle appears to offer the greatest promise for adaptation to bottom encoding of amounts on checks during a proof operation, using the bottom edge as a reference point and leaving the face of the check visible to the operator. Top encoding, using the top edge as a reference point, could be accomplished with rising type, but this would require inversion and relocation of the type, and the face of the check would be obscured from the operator during the printing operation. Such machines would be special and, hence, probably more expensive.

The wide use of "rising print segments" in existing equipment suggests that this mode of operation is predicated upon a considerable amount of engineering and experience on the part of many manufacturers. It appears reasonable to believe that the conversion of existing numeric devices (adding machines, printers, accounting machines, etc.), or the use of some components of existing conventional machines, or the principles involved in their design, will tend to reduce the cost of postprinting devices.

The logic of this reasoning lies in recognition of the substantial costs involved in the research, design, and engineering inherent in the development of any new product. Following this stage comes the cost of prototype design and "debugging" and, subsequently, production engineering and tooling.

With the tooling being an extremely significant part of the cost of any mechanical product, the extent to which existing machines or components may be used will have a significant effect upon tooling costs.

It has been demonstrated to the committee that a standard electric typewriter may successfully be employed to magnetically imprint the common machine language along the bottom edge of a check.

The typewriter demonstrated to the committee was modified to the common machine language system by replacing the platen (roller) with a simple fixture and changing the space bar to provide 8 characters per inch instead of 10. Naturally, the type was also changed.

A typewriter could also be used to top encode. However, when typing on the top, the body of the check would be hidden (by the platen) from view and the operator could not see the information to be encoded. Since up to 41 characters could be involved, a clear view of the check is required.

Thus, a simple and inexpensive device is difficult to visualize for top encoding, while a standard electric typewriter can be converted for bottom encoding. This advantage is particularly important for small-volume operations.

The employment of known and proven techniques of machine and component design is a possible means of reducing postprinting equipment costs—with bottom line encoding of the common machine language.

Continuing labor costs

The committee, recognizing its technical inadequacy to evaluate the necessary facets of human engineering, which will have an effect upon continuing labor costs, employed a nationally recognized consulting organization to study and evaluate the differences (if any) which would accrue through top or bottom line encoding. The liberty of quoting from this report will now be taken.

"This study concerned the differences in performing manual operations with a top-encoded check as opposed to a bottom-encoded check.

"Two manual clerical operations are anticipated with a magnetic document-processing system. These are: (1) The initial sort, proof, and encoding operation when the check is first received; and (2) the filing operation subsequent to the automatic bookkeeping process.

"Most checks should have preencoded characters on them when first received by the bank on which they are drawn. It is anticipated that only the amount would be encoded during the first sorting and proofing operation which would be manual. The nature of this manual operation is affected by the location of the magnetic ink characters.

"The magnetic ink characters must be precisely located on the check. A fixed reference edge is required to accomplish this location.

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"Bottom encoding would use the bottom edge of the check. Top encoding must use the top edge of the check as a reference point because of the varying widths of checks.

"Therefore, bottom encoding can be accomplished in a vertical position with the bottom edge of the check facing down. This position permits the use of standard rising type mechanisms in which the check can be positioned by a vertical drop on the part of the operator.

"Top encoding would require a special mechanism of a new design to accomplish the encoding with a vertical positioning movement. A more economical device for top encoding would use a horizontal movement, positioning the top locating edge of the check against a stop prior to actuating the printer.

"Thus, a comparison of the alternate encoding positions should measure the relative ease of a vertical drop (for bottom encoding) and a horizontal position movement (for top encoding).

"A work station was set up to measure the time to perform the horizontal position and the vertical drop movements. * * * The test station provided for equidistant spacing for both horizontal and vertical drop movements. The operator was timed for over 200 cycles of each positioning movement.

"The time per 1,000 checks for the vertical drop (bottom encoding) was 28 minutes as opposed to 32 minutes for the horizontal movement. * * * Thus, a 4-minute savings per 1,000 checks (12 percent) can be claimed for bottom encoding versus top encoding in the amount encoding operation. This savings was substantiated by a work-factor analysis as well as the actual time study.

"The other manual operation subject to human engineering study is the filing operation subsequent to automatic bookkeeping. This filing operation would include a signature verification (currently done by bookkeepers) under the magnetic document-processing system, as the bookkeeping work would be performed automatically.

"The filing and signature verification operation was simulated with both top-encoded and bottom-encoded checks.

"The operator was timed when filing and verifying the signatures on 150 bottom encoded checks and 150 top encoded checks. The difference between the two methods was negligible, amounting to only 0.02 minute per 100 checks. A difference of this magnitude is within the range of time-study error.

"Two other factors might be considered in regard to the filing operation. First, although filing time is equivalent for top or bottom positions, searching for a misfiled check would be faster with top encoding. However, this factor can be disregarded as filing errors are corrected periodically when statements and checks are mailed to customers. Searches for misfiled checks seldom occur between statement mailing dates.

"The other additional consideration deals with verifying the signature. It might be argued that signature verification is less likely to be omitted by the file clerk when filing by a number located next to the signature (bottom of check). However, this is a somewhat elusive point, difficult to evaluate precisely, and will receive only passing mention in this report.

"Although filing operations are unaffected by the coding position, a 12-percent manual proofing, sorting, and amount encoding cost savings would be experienced with bottom encoding."

* * * * * * *

"Thus, human engineering factors favor bottom encoding."

CUSTOMER ACCEPTABILITY

In general, check forms are fairly well standardized as to the information on the check. Unfortunately, in some cases the check itself has become a means of carrying other information pertaining to the transaction or, in some instances, it is considered a medium for advertising. Over the years many banks and customers, as well as check printers, have spent considerable time and money in designing their checks not only from a utilitarian standpoint, but from the esthetic standpoint as well. The committee is in complete sympathy with the trend to improve the appearance of checks, and consequently it feels that the fewer the changes in check format that need to be made to accommodate the common machine language coding, the greater the customer acceptability will be and the lower the printing costs.

Various surveys have established that individualized imprinting generally is confined to the area at the top of the check and that less serious changes in check format would be required if the encoding were at the bottom.

PUNCHCARD COMPATIBILITY

Because the volume of punchcard checks is relatively small when compared with the total check volume, there were a few who questioned the necessity for compatibility of punchcard checks with paper checks. Therefore, the committee felt it advisable to have more detailed studies made to assist it in arriving at an objective solution.

Extent of use of punchcard checks

Information submitted to the committee indicated that approximately 14 percent of all the checks issued in the country were in punchcard form. Of this 14 percent, about one-half are drawn on the Treasurer of the United States. Some time ago, the Treasury Department embarked upon a program of converting the remaining paper checks it issues to punchcard checks, and it was pointed out that this would have a tendency to increase slightly the percentage of such checks in use. It was felt initially that Treasury checks could be eliminated from the problem of compatibility with paper checks as it was contended that they are handled separately in the check-collection system. However, it was brought out that a substantial volume of Treasury checks received by Federal Reserve banks are commingled with paper checks in a single sending. In studies made in a number of large correspondent banks, this commingling of Treasury checks with paper checks received in cash letters from their bank depositors was of even greater magnitude.

While onely 14 percent of the total checks handled by the banks of the country are on punchcards, it was recognized by the committee that this was a national average and that it could vary substantially in various areas. Several studies were conducted which showed that there is a concentration of punchcard checks in large money centers where the percentage of these checks to the total number of checks handled runs substantially higher. In one bank surveyed, the percentage of punchcard "on us" checks was as high as 36 percent, and the New York City Clearinghouse banks averaged 27 percent. It was unanimously agreed that a volume of this magnitude and concentration could not be ignored.

Area presently used for punching

The committee next explored designating an area on the punchcard check for encoding the common machine language. To determine the extent to which various columns are punched, and to ascertain the area that would be available for common machine language characters, three independent surveys were made. In these three surveys the total number of punchcard checks drawn on the banks, the total number of customers involved, the issuer (customer or bank), the number of fields punched, and the location of these fields were all obtained. A brief summary of each survey follows:

1. The bank involved in this survey had an annual volume of 37,497,000 checks. The study showed that, of this volume, 8,720,600 items were drawn on punchcards. This represents 23.2 percent of the total volume. Of these 8,720,600 checks, 4,707,000, or 54 percent, were drawn by 54 customers; the remainder were drawn by the bank itself. The locations of punchings vary between customer and bank, as well as between customers. However, of the 8,720,600 punchcard checks, 99 percent contained punchings in 21 columns or less, in various locations on the check. About two-thirds of the remaining 1 percent had the punchings in 26 columns, or less, and in no case did the punchings exceed 47 columns.

2. This survey covered a group of 12 clearinghouse banks with an annual volume of 359,978,570 checks. The study showed that, of this volume, 95,910,200 items were drawn on punchcards, representing 26.6 percent of the total volume. Of these 95,910,200 checks, 42,282,780, or 44.1 percent, were drawn by 385 customers, the remainder being drawn under the control of the banks. In this study of 95,910,200 punchcard checks, 65.4 percent contained punchings in 21 columns or less. However, of the 34.6 percent with punching in over 21 columns, 17,587,641, or 18.3 percent, are under the control of the banks with a maximum of 34 columns being used. In respect to the checks under the control of the customers, 15,613,400, or 16.3 percent, are punched in over 21 columns, but this involves only 23 accounts out of the 385 using punchcard checks, and in no case did the use exceed 34 columns.

3. This survey covered 11,546,440 punchcard checks, of which 6,585,628 were 51-column checks. In preliminary discussions between the check printers, the machine manufacturers, and the committee, it was agreed that the minimum length of a check must be 6 inches if we were to place on the check all the necessary coded information and, therefore, these 51-column checks (which are 4⅝ inches in length) were removed from further evaluations. After excluding these 51-column checks, there remain 2,916,612 punchcard checks drawn by 100 customers and 2,044,200 drawn under the control of the bank. In the latter case, the check had no more than 26 columns of punching and in no case did the punching in checks drawn by customers exceed 40 columns.

The Treasury Department has advised the committee that checks drawn on the Treasurer of the United States are punched in 22 columns, as a rule, with a small number of issuers authorized to use a limited number of additional columns.

From the above surveys it can readily be seen that the majority of punchcard checks do not contain more than 22 columns of punching. These surveys also point out that this large volume of checks is concentrated in relatively few accounts. On the basis of these findings, it would appear possible to confine punching on punchcard checks to one area and encoding the common machine language characters in another, thus eliminating the problem of overpunching. For example, columns 1 through 50 might be reserved for punched information, leaving the balance of the card for postprinting data in magnetic ink character codes.

It is known that a great deal of effort has been expended in the past in an attempt to standardize specific punchcard fields. Because of limitations in operating requirements, such effort met with either little or no success where no latitude was afforded.

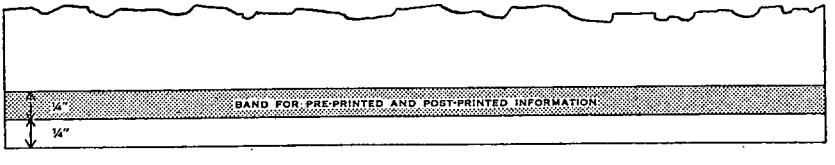
There is no thought whatever on the part of the committee to standardize on the specific columns which may be assigned for punching account number, amount, or like information. Under its proposal, the punching may be arranged in any fashion desired within the reserved area. The committee feels that this area, covering a field of approximately 50 columns, permits wide latitude in the selection of columns to be punched, since all of the checks surveyed indicated a need for considerably less than 50 columns.

While the committee recognizes that this approach will require both banks and their customers to shift their fields of punching in many cases, this does not seem to be an insurmountable obstacle. Practically one-half of the punchcard checks are issued by the drawee banks. They have much to gain, ultimately, if they shift the fields of punching in order to handle punchcard and paper checks intermixed in their check processing and bookkeeping operations. Greater difficulty may be encountered in asking depositors who use punchcard checks to shift their punching. However, experience over the years in the use of punchcard checks has indicated that drawee banks have been quite successful in securing the cooperation of their customers in locating punching so as to permit them to handle a large proportion of such checks on punchcard machines.

Part IV. Recommendation

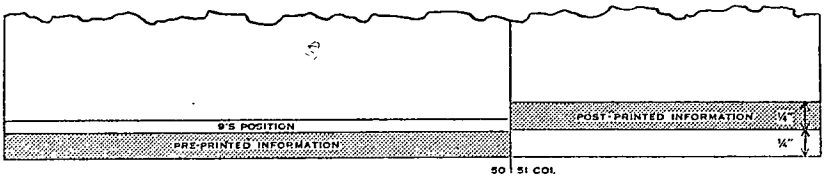
After studied consideration of the findings detailed above, the committee respectfully recommends that: The magnetic ink character common machine language be positioned parallel and adjacent to the bottom edge of all checks.

For all checks, except 80-column punchcard checks, both preprinting and postprinting should be confined in a band one-fourth inch wide; located one-fourth inch from the bottom edge.



Paper check coding area.

It is further recommended that magnetic ink characters preprinted on 80-column punchcard checks be positioned parallel and adjacent to the bottom edge, and below the 9's punched-hole position. Postprinting for these checks should be at the same location designated for all other types of checks.



Punchcard check coding area.

With this location, incidence of mutilation and resultant reading reliability, equipment and labor economies, and customer acceptability all provide basic advantages which require no further elaboration. In fact, if it were not for the one major factor of consideration—compatibility of punchcard checks with paper checks—bottom location recommendation would doubtless have been made by the equipment manufacturers and printing industry representatives themselves, without need for referral to this committee.

PUNCHCARD CHECK COMPATIBILITY

As indicated by the findings, the committee considers the matter of punchcard check compatibility as not only a factor of major importance, but also as an absolute essential to the proper functioning of any check-handling system utilizing the accepted common machine language. Not to so consider it would either give recognition to a two-language concept (magnetic ink characters and punched holes) or ignore a very important and practical problem.

This being so, the committee examined all avenues which gave promise of solving the problem. One possibility included printing checks upside down on punchcards so that the characters could be ostensibly on the bottom of the check, but actually on the top of the card. It was felt this approach would create a tremendous amount of operating problems, difficult orientation, and add an abnormal amount of customer resistance. A second approach suggested the use of both top and bottom locations with two reading heads. This required switching gear, which the committee considered too costly and complicated.

Because of these reasons, these possibilities were discarded in favor of the final recommendation.

The following salient factors were considered in concluding that the final recommendation was the most satisfactory solution to the problem of punchcard compatibility.

Postprinting

It should be noted that the modification regarding punchcard checks covers only preprinted characters. It is proposed that postprinted characters on these checks be positioned not below the 9 punched-hole position, but at the same distance from the bottom edge as all magnetic ink characters will be positioned on paper checks. This will result in the preprinted characters on punchcard checks being somewhat closer to the bottom edge than the postprinted characters. It is universally agreed that this spread in itself will cause no difficulty.

Placing postprinted characters on punchcard checks in the same position as paper checks will eliminate a requirement for separate postprinting devices (or a device with an adjustable printing position) for paper versus punchcard checks. The only disadvantage is that it will require that card columns reserved for postprinted characters not be punched. Analysis of the statistics on card column usage presented in part III reveals that on virtually all punchcard checks ample columns are available in other areas of the check to accomplish all necessary punching. Correspondence with the Fiscal Service of the Treasury Department indicates that this is also true of Treasury Department punchcard checks.

While some punching may nevertheless occur at present in the columns finally selected to contain this postprinted information, so many of the checks are wholly or partially under bank control (dividend disbursement and account reconciliation) that the problem is minimized. Further, Treasury Department punchcard checks are not punched in the columns expected to be selected for postprinted characters. Admittedly, the problem of moving some columns of punching will exist in some cases, but, physically, column usage will permit this. Further, the great latitude afforded for such a move should tend to simplify this action.

Tolerances in printing

The height of the common machine-language character that has been generally approved by the machine manufacturers, check printers, and the committee is one-eight inch. Accordingly, sufficient printing area is available between the bottom of the 9's punching and the lower edge of the card for printing the common machine-language characters.

Discussion with representatives of the printing industry satisfied the committee that the printing tolerances required to place the characters between the 9 punched-hole position and the bottom edge of the card would not be unreasonable for commercial printers to maintain.

Further, it was the opinion of some representatives of the printing industry that it is, in fact, easier to maintain tolerances when printing is closer to an edge of a card which can be used for registration.

Reading

While there was some difference of professional opinion among the equipment manufacturers as to the feasibility of reading characters so close to the edge of a punchcard check, the majority considered it feasible on the basis of their experience and their tests. In addition, the committee conducted tests to satisfy itself on this point. These tests were admittedly based on a sampling, but the results—utilizing both paper and punchcard checks that had passed through the banking system—were such as to satisfactorily resolve the question.

Mutilation

While the possibility of mutilation normally becomes greater closer to the edge of a paper check, tests conducted for the committee of punchcards, encoded at the bottom below the 9's position and passed through the check-collection system, indicated an insignificant incidence of mutilation.

From these tests and the mutilation studies previously referred to, the committee concluded that because of the texture of punchcard stock and normal handling techniques little or no difficulty could be expected from mutilation at the bottom of punchcard checks with the preprinting located at the recommended position.

Wear on reading heads

A problem presented as vital with respect to reading feasibility involved excessive wear on reading heads due to necessity for the bottom edge of punchcard checks to pass over the head when characters are so close to the bottom. Neither formalized statistical evidence nor tangible physical evidence were presented to the committee to support this contention. On the other hand, the majority of manufacturers (in one case, based on experience that ran into hundreds of thousands of items) did not consider this a problem and presented several possible technical solutions if, in fact, the problem did develop. Further, it is an admitted fact that a wear problem exists in any case—first, because of irregularities in paper surfaces discernible under a microscope, and, second, due to the passing of punched-hole edges over the head. Based on these considerations, the committee was satisfied.

* * * * * * *

With this recommendation, the committee feels that it has arrived at an objective and analytic solution to the location problem and one that permits compatibility of punchcard and paper checks.

Part V. Summary

This solution permits the philosophy of common machine language to be extended by taking the maximum advantage of all the benefits advanced for

bottom-line coding, while still permitting compatibility with punchcard checks.

The committee acknowledges with gratitude all of the assistance and cooperation of those persons and organizations that made this recommendation possible.

The determination of the sequence and amount of information to be coded is under continuing study by the committee. Some aspects of this study will include consideration of the number of digits to be used to encode the necessary transit information in magnetic ink along the bottom of the check. The fractional transit number-routing symbol, which is now used to indicate such information, will continue to be printed in the upper right corner of all checks.

Simultaneously, a committee, established by the manufacturers themselves, is working to finalize the specifications of the type font.

It is obviously difficult to forecast when these last two studies will be completed, but every effort will be made by the ABA committee, and, we are sure, by the manufacturers' committee to resolve the remaining problems as expeditiously as possible. In the meantime, the very fact that the problem of placement of the code has reached a logical solution will permit manufacturers interested in producing check-handling equipment (sorters, listers, coders) to proceed with the development of equipment that is dependent upon the position of the code.

The committee sincerely hopes that its recommendation for placement of the code along the bottom of the check will receive the same enthusiastic and unanimous support given to its earlier recommendation for magnetic ink character recognition as the common machine language. The continued wholehearted support of the machine-equipment manufacturers, the check printers, and the banks of the Nation is earnestly solicited.

Respectfully submitted.

JOHN A. KLEY, *Chairman.*

FUTURE CONSIDERATIONS

Mr. KLEY. 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.

Chairman PATMAN. Thank you very much, sir. I am sure we will be greatly aided by the information you have given us along with the statements inserted in the record. Although the other members of the committee were not able to be here, they are following these hearings closely, as they always do. The proceedings of this committee are printed and made available not only to the members of the Joint

Economic Committee composed of 7 Members of the Senate and 7 Members of the House, but the proceedings go to all Members of Congress, House and Senate. The published hearings go to many libraries throughout the country and to interested persons in many places. The legislative committees of the House and Senate, of course, also consider the information we receive.

Our next witness is Mr. A. R. Zipf, vice president of the Bank of America, San Francisco, Calif., and member of the technical committee on mechanization of check handling, bank management commission, American Bankers Association.

I want you to know, Mr. Zipf, when I was speaking about unit banks I was not reflecting on you or your associations. (See p. 45.)

I realize that your bank is the leading bank in the United States of America. There is a lot to be said on the side you represent. We want to be absolutely fair with every person that comes before us. We are grateful that you are here. We know you are here on an entirely different subject than policy matters, but if you want to insert something in connection with your remarks to reply to what I said and what the first witness said, it will be all right for you to do so.

Mr. ZIPF. Thank you, sir.

Chairman PATMAN. We are glad to have you, and we are glad to hear your testimony.

(Mr. Zipf subsequently submitted the following for the record:)

BANK OF AMERICA,
San Francisco, Calif., November 29, 1957.

HON. WRIGHT PATMAN,
Chairman, Joint Economic Committee,
New House of Representatives Building, Washington, D. C.

DEAR CHAIRMAN PATMAN: This letter may be incorporated into the record of my testimony before your subcommittee on November 15, 1957. It will supply the additional information I was requested to obtain from the Bank of America.

At page 132 of the daily transcript, you provided me an opportunity to offer my views on a subject which you had discussed earlier with Mr. Livesey. Your statement was, quoting:

"I feel we should keep the local banks 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."

Local ownership and control might appear to permit the ultimate in service to local people. However, local ownership and control by a small group of key businessmen in the community who may be engaged primarily in pursuits other than banking is no guaranty of a general desire to render service to a representative cross-section of the entire community. However, professional management of branch-banking systems virtually insures that services will be offered to depositors and borrowers representing all aspects of the community's needs. Branch systems can ill afford to alienate any single group by restrictions upon the service, identity of customers, or the way the service is offered.

Moreover, there are many misconceptions as to what constitutes local ownership and management. The record shows the Bank of America has over 150,000 stockholders residing throughout California who hold over $630 million of market value of the bank's capital stock. In many communities there is more local ownership and distribution of Bank of America shares than there is of the shares of the local bank. Further, Bank of America's practice of recruiting staff members of all grades wherever possible from the areas served by the local branches

coupled with the policy of giving substantial lending authority and management autonomy to branch managers results in actual local management and operation of Bank of America branches to a very large extent.

To give further assurance that local branch policies will conform to the trends and the requirements of their respective communities, over 150 of our country branches have advisory boards comprised of leaders of local business and industry. The board members' intimate understanding of the community's economy is combined and tempered with the experience of the branch officers and their knowledge of sound banking practices.

The branch bank has the ability to furnish credit to new and rapidly expanding communities where there might otherwise be a dearth of loanable funds which, of course, forces borrowers to travel to metropolitan areas to establish banking relationships. A small local unit bank cannot meet these credit requirements at the early critical stage. The necessity of obtaining credit elsewhere is a serious impediment to the growth of small business and industry and often places banking services beyond the grasp of individuals with modest incomes.

Probably the most important single benefit of branch banking is the contribution which it makes to growth in new areas. Branch banking makes the services, resources, and experience of a large and firmly established banking organization available to even the smallest community. Branch banking brings banking services to the communities where they are required—everyone benefits, not just a few.

In response to Mr. Lehman's question, at page 159 of the transcript, the Bank of America does not anticipate any new problems of bank financing in connection with the utilization of electronic or automatic equipment. As to smaller banks, the promise of stabilized, if not reduced costs, might well make it easier for them to obtain bank financing.

At page 156 of the transcript, the following question was asked:

"Why is it that large city banks generally have higher service charges by way of direct charges and minimum balances than the country banks, when one would expect that the larger volume would result in a lower unit cost in a large bank? Since you have the largest bank in the United States, possibly you should be asked that question."

The available data are inconclusive as to whether large city banks do, in fact, levy higher service charges than do country banks. Also many variable factors—such as collateral services, compensating balances, historical relationships, etc., make any comparison difficult. Many country banks levy a direct "exchange charge" on each item presented for payment and this charge is passed on to the payee of the item. This kind of charge by country banks is, in most cases, substantially higher than the direct-item type of charge made to a depositor of a large bank on a "metered charge" basis. Such a country bank may charge less to its own depositors because its own depositors do not pay all of the charges.

Smaller banks have been slow to adopt cost-analysis techniques and, therefore, frequently do not have accurate cost information upon which to predicate the determination of a fair and profitable metered charge. However, current surveys have revealed a growing interest among smaller banks in service charges and cost analysis, and within the next few years bases of comparison should be available. In any event, the larger city banks make every effort to adopt reasonable charges which reflect the most efficient mode of operation and yet yield a reasonable profit.

I trust the foregoing provides the information desired, but, if not, I shall endeavor to obtain any appropriate additions. For myself, one of the most satisfying rewards for all of the many hours devoted to the sessions of the committee on mechanization of the American Bankers Association was the privilege of having been able to appear before your subcommittee. On behalf of the Bank of America, I would like to express our appreciation for that privilege and opportunity.

Sincerely yours,

A. R. ZIPF, *Vice President.*

STATEMENT OF A. R. ZIPF, VICE PRESIDENT, BANK OF AMERICA, NTSA, SAN FRANCISCO, CALIF., AND MEMBER, TECHNICAL COMMITTEE ON MECHANIZATION OF CHECK HANDLING, BANK MANAGEMENT COMMISSION, AMERICAN BANKERS ASSOCIATION

Mr. ZIPF. I am A. R. Zipf, vice president of Bank of America National Trust and Savings Association, in charge of its systems and equipment research department. My department is, in general, responsible for the design and development of methods and the study, evaluation, and installation of equipment to perform the bank's daily work most efficiently. In short, it is our responsibility to find or develop the best way to do the job.

It is a privilege and a pleasure to respond to the invitation of this committee, which I received through the American Bankers Association, and I am hopeful that my statement will assist you in discharging your responsibilities. My portion of the American Bankers Association presentation will be devoted to the consideration of automation in banks, both large and small—the type of equipment and program that may be involved, the ultimate consequences of the utilization of such techniques, and something about my own experience with automation in the Bank of America.

Through my committee work with the American Bankers Association, I have had the opportunity to substantially increase my knowledge of the scope and complexity of operations in banks of all sizes.

Fortunately, my appreciation of the problems of small banks is enhanced by actual experience, for the Bank of America is confronted with similar problems in many of its smaller isolated branches. Because of their remote geographic locations, the work of many of the branches cannot be centralized but must be performed in a manner analogous to, if not identical with, the manner in which it is performed in many unit banks.

Although my responsibilities now lie in a rather specialized technical area, I started my career as a messenger with Bank of America in 1935 and learned banking operations in the traditional manner by progressing through a wide variety of positions. To better equip me to discharge my present duties, the bank has provided me with the opportunity to do advanced work, both academic and practical, in electronics and engineering.

If in this presentation I inadvertently slip into the jargon of computers and banking and use words or phrases whose meanings are not immediately clear, I hope you will stop me for an explanation.

Seldom in the history of the banking industry have new concepts received attention so rapidly, or new terms been accepted so readily, as automation and electronic data processing. The interest in these subjects is not casual; it is generated by a very genuine need for improvement in recordkeeping and accounting methods. The constant spiral of operating costs, if permitted to continue, can only result in an increase in the schedule of our charges, if we are to continue to improve our service to the public, or even to render the identical type and quality of service offered in the past.

I question that anyone seriously believes he can significantly reduce current operating expenses. However, I am sure there is a common

desire to stabilize them at their present level and to improve the quality and scope of service.

Most will agree that higher personnel costs have contributed largely to our overall increase in operating expense. Personnel costs are greater, not merely because of the general increase in salary patterns, but because of lower productivity resulting from staff turnover and consequent lower levels of experience. It is increasingly difficult to obtain, and retain, competent employees to handle routine clerical tasks. A large segment of banking's labor force in the past has been committed to the performance of repetitive clerical tasks, tasks which are neither stimulating nor self-satisfying. The scarcity and turnover of labor in this field have been, in my opinion, closely related to this lack of stimulation and personal satisfaction.

By eliminating clerical drudgery, the people formerly occupied with routine detail become available for the more rewarding work of selling and serving upon which any business thrives. The success of automation in stabilizing operating costs will, in general, be accompanied by the upgrading of employees into more challenging areas of endeavor which will encourage permanency and, hence, staff stability, and yield greater financial rewards to the individuals and to the institution to which they contribute their efforts, as well as better service to the public. It follows that an institution, whose success depends primarily upon service rather than upon the sale of a tangible commodity, must place the most emphasis on serving the customer. The greater the volume of clerical detail, the more restricted is the organization's position in regard to improving the quality of existing services and offering new services.

Technological advancements during the latter part of World War II made the electronic computer a potential accounting tool. Developing was slow and expensive and was delayed during the Korean conflict while attention was turned to production of equipment designed to meet the requirements of the scientist and the engineer. There emerged from this research, however, electronic business computers capable of performing all of the steps of a complex accounting problem without human intervention. The equipment is reliable and the results accurate.

Electronic computing machinery and the concept of automatic accounting systems have a great deal of popular appeal. Unfortunately, much of the publicity and fanfare that accompanied the development of electronic computers had little regard for accuracy or fact and was generated solely because it was a popular topic. Many of the speakers and writers who contributed to this clamor had only a slightly better understanding of the subject than their audiences or readers.

The impact of this publicity was so great that even today otherwise well-informed people envision a computer as a device which magically produces any desired result when the right button is pressed. It is not difficult to understand why many view the advent of computing devices with suspicion and even alarm.

It has been popularized as the panacea for all ills. Actually, when seen in proper perspective, it assumes its rightful proportions as an advanced accounting tool. Considered as such, this tool offers a potential solution to problems associated with the volume of routine, repeti-

tive clerical functions with which we are burdened, and provides the facilities to rapidly compile and analyze report information for management.

It is my considered opinion that the greatest potential rewards to be achieved through the use of a general-purpose computing system will accrue through intelligent employment as a scientific aid to the increasingly complex problems of management.

Management must frequently wade through a virtual sea of material to evaluate historical information and to forecast future trends upon which business success depends; and all too often the basic information on which to predicate a decision is missing, incomplete, or obsolete and the decision must be made entirely upon intuition and instinct.

Today, the degree to which intuition must be relied upon is neither reasonable nor desirable. If we can accelerate the accumulation and consolidation of more categories of useful historic information, digest it and present it to management in concise form, together with forecasts based upon statistical and mathematical laws of probability, we can provide much more accurate bases for management decisions.

The most promising areas of mechanization in banking are reasonably apparent: Reporting functions, loan accounting, deposit accounting, and check distribution which, in general, require speed, exhibit repetitive characteristics, and involve the volume required to justify mechanization.

Contrary to popular misconceptions concerning the leisure hours of bankers, the relatively short public-banking day is necessitated by the tremendous volume of clerical work that must be completed before and after the bank is open to the public. A very substantial part of this clerical work is performed by tellers and other public-contact personnel before and after public-banking hours. The extent to which other full-time personnel are required for this work depends on several factors. Among these:

1. Banking hours;
2. Volume;
3. Distribution of this volume between major accounting functions; and
4. Complexity of accounting detail.

Electronic performance of work that was formerly handled before and after banking hours by tellers will yield little or no savings in costs.

The experience of my bank in evaluating a large-scale, general-purpose computing system for savings-account bookkeeping may serve as an interesting illustration of the effect this element has on potential staff economies.

A computer program was developed on paper to assume all daily-bookkeeping and record-maintenance functions for 250,000 savings accounts. This hypothetical program also provided for proof balances, periodic listings of account numbers available for reassignment, and for the calculation of interest, using any formula desired. The equivalent of 25 people is required for the internal recordkeeping of this savings-account volume. (The computer program did not affect the window transactions and, therefore, the same number of tellers was required with either accounting system.)

Of the people required to handle this task, only three are assigned full time to the bookkeeping and accounting activity. Therefore, even though we were to transfer all routine accounting for this job to an automatic system, at best we could save only these three people because the remainder of the work is performed by tellers before and after public-banking hours, and the requirement for tellers, and other public-contact personnel, will not decrease. Indeed, if we are to improve and expand our services, the number of people engaged in this work must increase.

There is a benefit, however, in that peak activity such as semiannual calculations of interest, audits, and certifications, statement preparations, et cetera, can be accomplished without pressure, and, more important, accurately, despite the volume or complexity involved. Also, as a byproduct of mechanization, the complexity of certain jobs will be decreased. We may, therefore, expect an increase in the effectiveness of the individual staff members and a proportional reduction in training requirements. These benefits are attractive, even though they may cost something in the way of equipment.

Bank of America's two data-processing centers offer a reasonably good example of the actual results of mechanization in banking. The first large-scale, general-purpose computer to be installed in any bank in the world was placed in operation in San Francisco in October 1955. In July 1957, a similar system was installed in Los Angeles, and conversion to that system is currently in progress. The San Francisco installation has now been in productive operation slightly over 2 years and, therefore, factual data, rather than theory and conjecture, are available.

Although the motivating factor in installing a system of the size and speed of the IMB–702 was to establish the facilities to eventually handle the rapid accumulation, consolidation and analysis of management-report information, the initial application of the system was loan accounting. The installation handles all routine real-estate and installment-load recordkeeping functions for 119 of our San Francisco Bay area branches. This currently represents a volume of approximately 100,000 real-estate loans and 200,000 time plan (installment) loans. As an indication of the processing speed, approximately 4½ hours of computer time daily are required to service 100,000 real-estate loans.

In operation, the data-processing center performs entirely a service function. Public-contact personnel within the branches continue to make all decisions regarding the manner in which entries are to be applied to the loans. Loan payments are received at branch offices in the normal manner and, at the close of business each day, forwarded by automobile messenger to the data-processing center. There they are entered into the master loan records and the necessary reports and registers are produced. These registers and reports are returned to the branches the following morning together with the original loan entries. In addition to daily registers and statements, the data-processing center prepares past-due notices, certifications by loan class and interest rate, delinquency listings, insurance-expiration listings and notices, and consolidated monthly activity and condition reports.

Lest I be accused of contributing to the further irrational glamorization of computing equipment, I would like to list for you some of

the items of human time and expense required to make such equipment perform. These data were developed by us in planning and installing our own system, but it is a Bank of America tradition to make our know-how on banking methods freely available to the entire banking fraternity, and I am glad of this opportunity to disclose these figures for the benefit of others who might profit by them.

1. Approximately 40 man-years of effort were devoted to systems and equipment analysis, programing, location engineering, and the direct work of conversion to the system.

2. One hundred and eighty-five thousand dollars was expended for air conditioning, electrical facilities, and special construction, all required for the proper functioning of the equipment, and an additional $40,000 was expended for magnetic tape, the basic computer storage medium.

3. An operating staff of 32 had to be organized and trained for the actual loan accounting work. Six of the most senior positions are occupied by men selected from within the bank, upgraded and retrained over periods as long as 18 months. Several of the other positions were filled by transfers after retraining and upgrading over shorter periods of time. All of these positions could have been filled internally through retraining, which the bank was able and willing to provide, if a sufficient number of people had become available from existing jobs who were interested in the new positions.

4. The maintenance of the equipment requires 6 competent technicians and 4 members of a research and programing staff for continual revision and maintenance of the computer programs.

On a cost analysis basis, the original investment in programing, quarters, and conversion, together with the operating loss sustained during the conversion when the system operated at less than capacity, will not be recovered until December 1958.

Although our studies indicated that the equipment would do the routine work previously performed by the equivalent of 130 full-time clerks, in actual practice only 92 people became available for reassignment, because the remainder were engaged only part time on the work automated. Of the 92 people, 43 were reassigned at their same grade level, 25 were upgraded one or more grades and 24 resigned for normal reasons before reassignment. Most important, however, as a direct result of the computer installation, 32 more challenging new positions were created which, because of the greater requirements of skill and responsibility, are more rewarding both in terms of salary and personal satisfaction. This reduces turnover, and should ultimately stabilize operating costs.

In evaluating a mechanized system after it has been installed several months, it is not unusual to find that many of the most significant benefits have accrued as indirect byproducts of the operation. Loan accounting is not an exception. The increase revenue realized through improvement in the accuracy of interest calculations and consistent collection of scheduled charges frequently overlooked in manual bookkeeping has contributed in large measure to the economic feasibility of this system. In fact, this additional revenue alone pays more than one-half of the total equipment rental.

In addition, the loan records will yield a vast array of valuable, and otherwise unobtainable, statistics for management. The type of

information of value to management can, perhaps, best be illustrated by a report we supplied in August 1956 to the National Bureau of Economic Research, Inc., indirectly for the President's Council of Economic Advisers. The information was requested to assist in a broad investigation of the conditions in the field of consumer credit. The report requested statistics and experience on installment loans for the purchase of automobiles, both new and used. It requested a sampling of loans delinquent 60 days and over, and a sample of a similar number of nondelinquent loans to obtain 35 classifications of data in 6 various combinations as to amount, delinquency, term of loan, amount of downpayment, income group of borrower, occupation of borrower, and one or two other categories.

With only one exception, we were able to supply the information requested from our basic computer records. Although 4 man-days were required to prepare the program to withdraw the information, the running time was less than 30 minutes. This program may now be used at any time.

In lieu of the relatively small sampling that would have been possible with manual accounting methods, with questionable accuracy, we were able to supply information on all 47,991 loans.

It will immediately be seen that from the information contained in this file, we can more accurately forecast the rate at which loans will retire, and, consequently, the rate at which funds will become available for new loans.

The single largest area of common interest in mechanization among banks both large and small, is check handling and checking account bookkeeping. Transit check distribution and bookkeeping are volume routine accounting operations and a large segment of the bank's labor force in the past has been committed to the performance of these repetitive, clerical tasks. The tasks are complicated by wide fluctuations in activity, resulting in the necessity to gear production to the extremes of very light or heavy activity.

The people who occupy these positions are, in general, young women employed during the transitory period between graduation from high school and their permanent occupation as housewives and mothers. In the Bank of America, we now have more than 2,300 bookkeepers. Of this number, over 90 percent are young women. Our staff turnover in this category, for the year 1956, was 78.1 percent, most of which was caused by marriage and other family reasons.

Another problem arises from the continuous growth in the volume of checking account activity, which is increasing at a far greater rate than is the number of people available to handle it manually. Thus, as our population relies more and more on checking accounts, banking has no alternative to mechanization.

While we talk loosely about electronic bookkeeping, an economical systems application is very largely dependent upon automatic reading and paper handling techniques. In checking account bookkeeping, the problems are indeed more mechanical than electronic. Not only must the information from checks and deposit slips be introduced into the bookkeeping system and appropriate balances extended, but the paper checks themselves must be sorted. The development of automatic reading and paper-handling equipment is unquestionably the most significant and enduring contribution that has been made toward automation in the banking industry.

Pilot testing will soon commence on production check sorters capable of sorting paper checks of varying sizes and paper weights at speeds in the vicinity of 600 to 750 per minute. By adding electronic equipment to the automatic sorters, it is possible to achieve any degree of automation that economic reason will warrant.

While it is popularly believed that the advantages of such equipment will be available to only the largest organizations, this is not necessarily true. Any organization may select and attain a level of mechanization consistent with its particular volume and objectives. This means that all banks, whatever their size, can adapt their operations to this type of mechanization, and that automation as such does not necessarily favor one group of banks as against another group of banks. We, and I mean banks in general, all maintain the same relative positions.

There is in production or development a variety of intermediate equipment as well as large-scale fully automatic systems, and, therefore, one has many choices in the manner in which components may be assembled to do part or all of the bookkeeping job. With the great emphasis on modular construction in systems design, meaning the step-by-step assembly of interchangeable components in piecemeal fashion, there is every reason to believe that the favorable effect of stabilizing operating expenses is available to banks of all sizes.

It is obvious that the economics of the large fully automatic systems demand volume. However, the fact of volume does not in itself preclude the possibility of smaller banking organizations enjoying the benefits of large-scale equipment. It is reasonable to believe that arrangements for the collective ownership or rental of equipment will be made for the mutual benefit of a number of participating banks. This situation, in many respects, is not dissimilar to what has been done in the past by bankers' associations and local clearinghouses in devising and utilizing common services.

Automatic check-handling equipment may vary in design and operating characteristics just as machines used by different organizations to perform similar functions differ today. The sole restriction imposed on the design of any such equipment is one of compatibility in reading the common language. The adoption of magnetic ink character recognition as the common language for nationwide use in check handling is regarded as one of the most important banking developments in recent years. We may expect such equipment to be available in a variety of sizes, operating speeds, and prices.

The adoption of this common language benefits both banks and manufacturers. By enabling banks to utilize the coding of bank identification number and dollar amount, both supplied through previous handlings, manual handling will be reduced. Some systems components may be utilized for more than one function and the cost of equipment can be spread over more functions and therefore be justified in smaller banks. This will tend to increase production and thus reduce costs.

With 613 branches serving over 350 California communities, Bank of America is confronted not only with the problems of a large metropolitan bank, but also those of a small unit bank. We are, therefore, interested in intermediate size bookkeeping systems as well as large-scale fully automatic systems. In fact, it is our intention to install our

first intermediate equipment late this year for pilot testing. Initially, manually operated bookkeeping machines that perform certain functions automatically will be installed, and it is our hope that ultimately this equipment can be supplemented with automatic sorters to further reduce the manual effort required by the bookkeeping job. Equipment of this general nature appears to offer the greatest promise for banks and branches that are excluded from centralized accounting because of their geographic isolation.

In the light of the distribution of checking account volume statewide in the Bank of America system, it appears that approximately 2 million accounts may be handled on a centralized basis with ERMA, our large-scale automatic equipment, within the next 5 years. Upon the basis of this forecast, we are planning 17 ERMA centers in populous areas throughout California.

As with the general purpose computer installations for loan accounting, the ERMA centers will perform entirely a service function. At the close of business each day, branches will forward checks, deposits, and other entries by messenger to the ERMA center. There the entries will be processed, the balances and the historical records updated, and the necessary journals, reports, and statements produced. The printed results, together with the sorted checks and deposit slips, will be returned to the branches the following morning. Branch personnel will verify the signatures on checks as they are filed and refer to the registers and journals for information in handling window transactions and inquiries from depositors.

You may be interested in a few highlights of the planning considerations that go into a project of this magnitude and the implications they have upon the general economy outside of banking.

1. As a direct result of the installation of this equipment, approximately 200 people will be required in the printing industry to code the checks and deposit slips used by our customers.

2. In order to provide the more comprehensive messenger service which will be required for this centralized operation, approximately 50 additional messengers (and automobiles) will be required.

3. Approximately 200 thoroughly trained technicians will be required to service and maintain these units on 2 shifts.

4. The systems will require special quarters with custom construction providing special air conditioning, refrigeration, and power.

5. Then there is, of course, the additional labor force employed in manufacturing the equipment, replacement parts, and the research and development necessary to improve upon the technology.

To return to banking, the conversion of our records to the new system will require an estimated 150 man-years of effort over a conversion period of several years.

Although the first installation may be at least a year away, this month we began the training of the first 12 men who will become computer programers and senior operating and conversion personnel. This is in addition to the 9 men already employed on the project. Without exception, the men were selected from within the bank for promotion to these new, challenging, and rewarding positions which heretofore did not exist.

What will happen to the bookkeepers as their work is assumed by ERMA? As I pointed out earlier, we lose 78 percent of our book-

keepers every year—about 1,800 people at current figures—largely because of marriage and other family reasons. For these same reasons, 2,000 tellers—50 percent of the employees in this category—resign each year. If ERMA in full-scale operation eventually were to replace 2,000 bookkeepers—and this is pure conjecture—the fact would still remain that we need more than 2,000 tellers each year for replacement alone, and this need disregards growth entirely. The ERMA transition will be gradual, extending over a period of several years. The personnel who will become available will follow the normal progression pattern to tellers' positions—two salary grades higher than bookkeeping.

In addition, new positions will be created by the installation of the ERMA systems. There is sometimes a tendency to overlook the staff requirements for operating automatic equipment. According to our best current estimates, a minimum of 525 people will be engaged in various phases of ERMA operations when all installations have been completed. We estimate that 54 percent of this staff will occupy positions at least 4 salary grades above bookkeepers and 24 percent at least 8 salary grades above the bookkeeping level. And where will these people come from? From within the bank through training and promotion.

I view the future with more than hope; I believe that automation in banking will upgrade job opportunities and create new employment. The electronic computer is one of the most dynamic banking tools of our age, opening new horizons for our staff and offering new banking services to the public.

Chairman PATMAN. Thank you very kindly, sir.

Mr. ZIPF. Thank you.

Chairman PATMAN. You have all been so thorough and comprehensive that many of our questions have already been answered. There are some we would like to ask. I notice you state that there is no reason why the small banks should not benefit the same as the large banks from automation. You feel that there is no disadvantage to the smaller banks; is that correct?

Mr. ZIPF. That is quite correct.

Chairman PATMAN. Do you agree with that, Mr. Kley?

Mr. KLEY. Essentially; yes, sir.

Chairman PATMAN. How do the banks arrive at the appropriate service charge for handling an account and checks?

Mr. KLEY. The proper method, Mr. Chairman, is to gain the highest degree of efficiency and cost reduction, and then allow for a normal profit on top of that.

Chairman PATMAN. You agree with that?

Mr. ZIPF. Yes, I think that is a fair answer. Actually I am just a little bit out of my league on this particular question.

Chairman PATMAN. Why is it that large city banks generally have higher service charges by way of direct charges and minimum balances than the country banks when one would expect that the larger volume would result in a lower unit cost in a large bank? Since you, Mr. Zipf, came from the largest bank in the United States, possibly you should be asked that question, first.

Mr. ZIPF. I shall attempt to answer, although the establishment of service-charge schedules is a function of our controller and my spe-

cialty is systems and equipment. I would be happy to supply any information the chairman would like.

Chairman PATMAN. If you will for the record, please.

Mr. ZIPF. I would be happy to do so.

(See letter, p. 76.)

Chairman PATMAN. Mr. Kley, would you like to comment on that?

Mr. KLEY. If your statement is essentially true, I think one plausible suggestion by way of an answer to that, Mr. Chairman, is the fact that the technique of determining costs varies in banks. In the case of a number of so-called large banks, it could be the result of having the facilities to more adequately evaluate the entire cost factor than is possible in the smaller banks. That is, I think, all I can suggest.

Chairman PATMAN. Will the installation of electronic processes in the long run cause service charges to be increased or decreased?

Mr. KLEY. Speaking for ourselves, sir, we hope to be able to stabilize the costs at their existing level. Using the method of establishing service charges, as I have already indicated, we would hope to hold them to at least the level they are at the present time.

Chairman PATMAN. Mr. Lehman, would you like to ask some questions?

Mr. LEHMAN. Thank you, Mr. Chairman, I have 2 or 3 questions which I think might be helpful.

Do either of you have any suggestions to make to the committee as to how our educational systems might develop the more highly trained personnel required by this new age of automation? You all mentioned the need for it and I realize you have your own programs of training within the banks. What do we need to do by way of public education to anticipate that training?

Mr. ZIPF. There is now a good deal of effort being directed to this. A good deal of the emphasis is coming from machine manufacturers and from users themselves. The organizations who employ or contemplate employing equipment of this kind, I am certain all feel a responsibility to train some people in advance of actually utilizing the equipment. We have a long-range training program in which we are taking a small group of students beginning at the high-school level and employing them during summer vacations. We have also sponsored in the local high school an educational program, evenings and on Saturdays, in which we provide the instructor.

As far as sponsoring it, from within this committee, is concerned, I think, yes, there is a possibility for educational programs offered on a voluntary basis outside of regular school hours. Because of the dynamic trend in this area, such programs would be received well by at least modest groups of students at the high-school level. This is really where we should begin looking for and training people, encouraging them to take really difficult electives, rather than easy ones, to better qualify for the more senior positions in the field.

Mr. LEHMAN. We all know about the fine training programs and the graduate seminars which the American Banking Association has helped to develop which deal largely with bank management policy problems. Is the American Bankers Association planning anything similar in connection with the introduction of automative devices? Is this part of your committee's work, Mr. Kiley?

Mr. KLEY. No, it is not, sir. Part of our activity will undoubtedly involve dissemination of information to provide a better understanding of the program. But, so far as I know, we would not undertake any specific formal educational program.

Mr. LEHMAN. I have one other question which may have to be left to the comptrollers, too. Has the investment requirement which must be considerable in the light of the kind of expensive and large-scale machinery we have been talking about here, posed any new problems of bank financing?

Mr. ZIPF. That, I am sorry, I am not qualified to answer. I shall be happy to attempt to supply some information.

(See letter, p. 76.)

Mr. LEHMAN. Do you have a reaction to that, Mr. Kley?

Mr. KLEY. I have no comment.

Chairman PATMAN. Mr. Knowles, do you have any questions?

Mr. KNOWLES. Yes; I have some that the witnesses' statements have raised. I notice that in both cases these systems are being designed, apparently, to handle the existing flow of checks as far as physical size and quality of paper are concerned. This means a variety of sizes and weights of items going through the machine. I can appreciate what this means as an economist because we use statistical computing devices. It seems to me that it would increase the potential productivity and consequent cost savings of these new systems if you could standardize the paper going through the system.

I am wondering what is the key consideration dictating that you don't standardize the check and solve many engineering problems as well as cost problems in the process.

Mr. KLEY. I will attempt to answer that, sir. A check is used in many instances as an esthetic advertising device, as well as a medium of exchange. Also, various internal bookkeeping systems used by bank customers themselves dictate the size and numbers of copies and location of material, and so forth. There has been a concerted effort for almost 30 years to reduce the numbers of sizes of checks from the standpoint of sheer printing economy alone. However, individual preferences and the other reasons outlined above pretty much dictate a philosophy that standardized size is not a practical approach.

It is commonly known that despite the the past effort to reduce the number of sizes, the number has increased. I think it is also the feeling of a number of people that a step toward standardization through a common language will automatically tend to reduce the number of sizes. In other words, it has not been a significant problem up to now. There has been no real motivation for people to tend to standardize. But now there will be, and we think that the number of sizes will automatically be reduced. We thought that if we were to wait until we reduce the sizes of checks to, say, 1 or 2 sizes the program conceivably would never be consummated.

Mr. ZIPF. I might comment on that, too. If I remember correctly, there has been on several occasions a committee of the American Bankers Association appointed to do exactly this. To the best of my knowledge also the efforts have been largely unsuccessful.

There is a mitigating influence in considering cost. In designing paper-handling equipment of kind to take care of the mechanical problem of various sizes of checks, one automatically has then accomplished a very substantial amount of work toward handling other

kinds of paper for other people. The horizon will eventually be much wider than simply check handling.

Mr. KNOWLES. Am I correct in assuming that if these paper items, particularly the checking items—but perhaps some other items—could be reduced to a single size or 1 of 2 sizes as you do with punchcard equipment, that this in itself would result in an appreciable increase in the potential speed and efficiency of the apparatus compared to handling a variety of sizes?

Mr. ZIPF. I think one might theorize that might be true. There can be no question that the design of such a device is more complicated. It therefore means that you put more research and engineering dollars into it. After having done so, I don't think one can assume that there would be a substantial difference in production cost of the machine. That cost would be little, if any, greater. There should be little, if any, difference in speed and efficiency.

Mr. KNOWLES. I am wondering whether any thought has been given to the possibility of working out through automation in banks in a whole city or country, a process similar to the Bank of America's handling between branches for the handling of interbank transactions? If you are going to automate this procedure of check handling, to what extent is this extendable ultimately to interbank operations, between one bank and another, and between the bank and the clearinghouse?

Mr. ZIPF. By this do you mean the transfer of information as distinct from the transfer of paper? This is a question that has come up frequently. It has been advocated that rather than transfer the paper, one should transfer only the information between points and in effect destroy the check at the originating point. The growth of commercial-deposit-accounting activity in this country, in addition to convenience, can be attributed to the fact that the customer always wants and receives the check as a receipt. I think it would be looked upon most unfavorably if we took away that receipt. I for one, and this I must admit is a personal opinion, do not at any time in the foreseeable future look for the transfer of only information as far as customer accounts are concerned. As to the transfer of other information between banks, we are now doing this between banks within the Federal Reserve System where we transfer funds by wire without actually passing pieces of paper. This is not an uncommon procedure. I don't look for it as far as individual customers are concerned, however.

Mr. KNOWLES. This would mean that you are in effect not very hopeful that something can be done in the way of photostating or televising the document at one end and reproduce it at the other end photographically as a substitute for transferring the actual document?

Mr. ZIPF. I think that process is possible now, as indeed are many others. I really mean I do not expect that process to be economical for a long time in the future. I seriously question whether it would receive a great deal of approbation from our customers. I don't think it is salable.

Mr. KNOWLES. The next question I raise is whether or not in introducing automation, some of it controlled from a remote central processing point, you envisage any security problem? In the ordinary bookkeeping or handling operation you have various forms of

checking by which you know who made the entry, who handled the piece of paper, what the identity of the individual was handling the transaction through the bank—you have handwriting checks, fingerprinting. Conceivably if there is any problem of shortage or improper handling of accounts there are various ways of tracing who was guilty, so to speak. What kind of problem do you get into if you mechanize this and automate the process? Does that create for you some security problems?

Mr. ZIPF. I think either one of us could attempt to answer that question. Actually, no. I think that any automatic system will still be predicated upon determination of the validity of the signature. I think this is really the question. I do not look forward to any early time when one will verify signatures automatically. This, however, I think is technically feasible or virtually so. But the cost will be so high that I do not think anyone will be able to afford it. I am sure in the final analysis that at some point in time a human must exercise judgment to determine the validity of the signature in any system.

Mr. KLEY. Sir, I would like to submit by way of clarification of my original statement and that of Mr. Livesey that because of the nature of his operation, he was referring more to internal types of operation, rather than to the check-handling problem. For instance, there would be no reason why payments on a mortgage or the record of a payment of a mortgage could not be conveyed to a purely internal type of record. But as we pointed out, the check-handling process in itself is unique in that the source document we feel must accompany the entry. So we have a 2-pronged problem in the check handling and conceivably a 1-prong problem in the other type where the source document might subsequently follow the entry as an audit trail. This I believe is highly likely but not in the check-processing field.

Chairman PATMAN. Thank you, gentlemen, very much. You will receive the transcript from the reporter for your approval, and if necessary, correction. You have made a great contribution to our hearing. We appreciate it. Thank you very much for your attendance.

Mr. KLEY. Thank you, sir. It was our privilege.

Mr. ZIPF. It was our pleasure.

Chairman PATMAN. Without objection the committee will stand in recess until 2 o'clock this afternoon in the same room.

(Thereupon, at 11:45 a. m., a recess was taken until 2 p. m. the same day.)

AFTERNOON SESSION

The hearing was resumed at 2 p. m., pursuant to the recess.

Chairman PATMAN. The committee will come to order.

This afternoon we continue our examination of automation in a specific business situation. At the same time we are grateful for this opportunity to learn the point of view of the trade union on this most significant problem. All of our witnesses and the committee have complimented the attitude of labor toward automation as reflected in the testimony of outstanding labor leaders in our previous hearings.

We will now hear from another representative of the trade unions, Mr. James A. Suffridge, president of the Retail Clerks International Association, here in Washington.

Mr. Suffridge, we are delighted to hear from you, sir, and you may proceed any way that you desire.

STATEMENT OF JAMES A. SUFFRIDGE, PRESIDENT, RETAIL CLERKS INTERNATIONAL ASSOCIATION, AFL–CIO, ACCOMPANIED BY BEN B. SELIGMAN, DIRECTOR OF RESEARCH, RETAIL CLERKS INTERNATIONAL ASSOCIATION

Mr. SUFFRIDGE. Thank you very much, Mr. Chairman and members of the committee.

My name is James A. Suffridge. I am president of the Retail Clerks International Association, AFL–CIO. May I express my thanks to the committee for the opportunity to testify on the subject of automation and its effects on the retail and distributive trades. I am happy that the committee is examining the problem of automation, for its impact on the entire economy is profound. Too often, the vision of automation is one relating only to the manufacturing end of our economic order. Few people seem aware of the fact that the extension of the new technological revolution into retailing and distribution has already been widespread and that its consequences promise to create a situation with which we must be gravely concerned.

The problem we are faced with is simply that of the possibility of a practical fully automatic food store using a combination of electronic equipment and conveyor belts and virtually doing away with human labor. In one such proposed store the customer is to be provided with a large metal key which he then inserts into a special slot in a display case. Food items, behind glass, will be designated by letters and numbers. And as the customer makes his choice, the amount of each item will be recorded electronically and totaled in a completely automatic way.

The customer would present his key to the checkout clerk. The purchase would be automatically brought forward on a conveyor belt already packed into a carton. It is said that 60 items from a total selection of 154 items could be assembled in about 30 seconds. Should a customer forget some item, he would be able to purchase it without returning to the shelves by telling the clerk who would then push a button to bring the desired item forward to the checkout counter. In fact, a system of this kind was displayed in November 1956, at the Waldorf Astoria Hotel in New York. This was one developed by the Independent Grocers Alliance store engineering department and shown at its annual convention last year.

Another system which the engineers have not yet developed into a working model would utilize a series of shopping cards. The customer would mark off the items desired on the card and with different colored cards for the various departments, meats, produce and canned items, it would be a simple matter for the customer to make his purchase. The cards would be placed into an electronic device and then delivered automatically to the checkout counter within seconds. The Independent Grocers Alliance estimates that the use of automated stores would reduce shopping time up to 85 percent and, of course, would result in drastic cuts in personnel.

And there, I think, is the heart of the matter. In our estimation, we are faced with a problem wherein the immediate prospect is the destruction of job opportunities without necessarily providing others in their place. This, I think, is the basic problem that we must face up to as a result of the extension of automated processes to retailing.

Not enough emphasis has been placed on the social and economic effects because we have all been fascinated by the gadgetry, by the technological aspects.

Of course, the mechanization of industry has a very long history. In one way or another man has always sought to make the process of handling materials simpler as well as more automatic.

Most authorities say that an automated plant must include control through instrumentation, that is, a kind of sensing apparatus through electronic devices incorporating feedback principles and a mechanical or electronic handling of materials. But I wonder if we ought to narrow the problem down quite this much, whether we ought to come to the conclusion that a particular process is not automation unless it is entirely automatic.

The fact is, it seems to me, that most of the developments tending in the direction of automatic processes have but one ultimate aim and that is to reduce the human component in the handling of materials and processing. Most authorities will agree that the possibilities for automated development exist in every field of endeavor, particularly where human activities are subject to some degree of repetition. The greatest possibilities for further mechanization, in our industry particularly, lie in the area of the handling of materials. This would be true in warehousing, transportation, as well as directly in retailing.

The illustration which I cited earlier fits in, I think, quite clearly with the notion of automation, for it is an advanced technique for handling materials and for extending automatic control over a distribution process, even making use of devices that would transmit information to some central point—in this case to the computer mechanism at the checkout counter.

The handling of materials is one area in which mechanized processes find their greatest possibilities. I believe the records will show that the first fully integrated handling in processing schemes came into being in the United States around the end of the 18th century in flour mills which began to handle large quantities of grain. During the 19th century, little was achieved in the handling of materials by mechanized means. True, cranes and various similar devices were used for lifting heavy loads and many types of conveyors were known for the handling of materials, particularly in situations where a close physical approach to the process itself was somewhat dangerous, as in the case of ovens, furnaces, and lumbering operations.

Toward the end of the 19th century we find that conveyors and similar equipment were introduced into gas works, and pneumatic grain conveyors were introduced in connection with transferring grain from ship to shore.

Today all sorts of flexible automatic loading devices and materials-handling equipment are beginning to appear on the market. Insofar as the retail and distributive trades are concerned, the outstanding feature is prepackaging both in and out of the store and a tendency in the direction of a more automatic handling of the materials in the warehouse as well as in the retail selling area itself.

Let me illustrate with a brief description of self-service meat operations in a large food chain. A beef loin enters the meat cutting section on a conveyor where the operator of the power saw first cuts the loin into steaks in a variety of thicknesses. The saw operator

passes the cuts to the operator of the trimming table who removes all excess bone and fat from each cut. This operator then places the cuts on aluminum pans with the least desirable side down (if a difference is noted) and each layer of the product is papered to absorb excess juices and retain the bloom of the meat. The filled trays are then placed on a gravity conveyor on which they travel to the wrapping area. In all likelihood the wrapping area would have, as its center, one of the new automatic wrapping machines, which are adjustable to the size of the product and effectively prewrap and bottom-seal up to 18 packages per minute with one operator. These wrapping machines can handle any standard-size tray or board for a variety of products. They are also able to wrap poultry, produce, cold cuts, cheese, and the like.

The wrapped product then goes, by gravity conveyor, to the weighing station where the package is weighed, priced and labeled, using a semiautomatic scale and a labeling machine. From this point, the package is then conveyed, via belt, to the display area or to the holding cooler for use when needed. We ought to note that all these operations were once performed by highly skilled men on the floor, in front of the customer. These skills are virtually being lost and the jobs reduced or even abolished.

This illustrates that in distribution and retailing we are not likely to deal with electronically controlled or computer-controlled machine tool operations, such as setting for automatic boring operations, as in the manufacture of auto motors or with the application of digital and analog systems for data processing. I should like to emphasize again that the problems that we are dealing with are generally related to the handling of merchandise.

I don't know that it is necessary for me to go into the description of the kind of automatic equipment now installed in banking and insurance companies, but we know that the new technological revolution has not stopped outside the door of the retail establishment. One of the most obvious places is at the checkout counter itself. Here an automatic cash register can provide a punched tape record of every sale, thus abolishing clerical work in sales analysis. Such a machine can produce punched tape together with printed information giving details of each sale whenever an item is rung up. Then the sorting, tabulating, and extraction of information can be carried out in the usual statistical manner.

A major area for automatic devices is, of course, in inventory control. An old system, used in many places in department stores today, requires a clerk to tear off half of an article tag as each sale is made and put it in a box. These tags are collected from the departments, sorted the following day into various classifications according to manufacturer, price and other categories. Usually this system is not accompanied by any attempt to maintain a daily figure of floor stock. This usually has to be obtained by hand inventory count directly on the floor.

However, a new automatic system uses different article tags and electronic devices. The tags are usually in the shape of an electronic computer device card, which have the required information punched on them, as well as printed. These cards are sent from the selling department to the central processing department where the informa-

tion is transferred to magnetic tape and sorted in an electronic sorter. Then the information is passed on to the computer where it is processed in one operation—I understand locally that applies in Woodward & Lothrop—to give information on types of sales merchandise remaining in stock, sales by customers and the like. Furthermore, the system can function at night so that each buyer receives a report on the previous day's operations as soon as he comes in in the morning.

In a Midwest mail-order house which sells 8,000 items, it is said that daily orders range from 2,000 to 15,000 at peak periods. A machine such as the one I've just described runs off each night a complete report on all the items in the catalog so that the management can see which items require reordering. All the orders are recorded on a constantly revolving magnetic drum. What happens is that the operator taps out the catalog number and quantity upon receipt of an order. The machine then "searches" the drum surface for the number, reads off the stack total and daily sales total, transmits them to another unit which carries out the calculations, and then puts the new totals on to the drum. All of these operations are carried out in two-fifths of a second. The machine works with 10 operators, but to prepare the information by hand would have required about 150 clerks. Thus, we have achieved high speed and accuracy through machine methods at the cost of 140 jobs. That, incidentally, is Spiegel's in Chicago.

Automatic procedure in retailing is dramatically illustrated by an installation that may be inspected at a supermarket here in nearby Bethesda, Md., a Safeway store. This is an automatic bagging machine at the checkout counter. As the customer approaches the checkout clerk and places the merchandise on a conveyor belt, the clerk adjusts the machine for the size of the order. As the order is checked on the register, the merchandise is placed into a loading bin, with light and fragile items on the top. As the loading bin is filled, the cashier presses a button and the bin pushes the merchandise into an opened bag, which is then lifted onto a receiving platform, while the bin reopens to accept a new load of merchandise. Should it become necessary to resack a heavy grocery order, either at the customer's request or because of injury to the bag, the automatic bagger can do this in less than 10 seconds by merely reloading the filled bag into the loading bin and starting the machine, which automatically does the job of repackaging. Obviously, with a machine of this kind not only are fewer checkout counters needed, but no baggers are necessary.

This illustrates the continuous emphasis on speed in the handling of materials in retail stores. At the recent National Association of Food Chains meeting here in Washington, fixture manufacturers displayed a variety of equipment which hummed with motorized checkouts, packaging machines, computers, and in-store prepackaging, all of which emphasized speed and productivity. One saw at this exhibit push-button controls, conveyor belts, ball-bearing devices, glassed enclosures, all intended to cut down the amount of time a customer needs to spend in a store without cutting down on the amount that she purchases in any one average visit. Turntables were displayed for a faster packaging by checkers and packers at checkout counters.

It is my understanding that the automatic bagging device, which I've just described, was also tested in a Kroger Co. unit in Cincinnati as well as here in Bethesda at a cost of approximately $4,000 per

installation. If this increases productivity—in the sense of speeding up the flow of merchandise through the checkout counter—and eliminates at the same time the need to have an extra employee to do the bagging, equipment of this kind from the point of view of cost will have paid for itself fairly quickly. But, at the same time, it will have eliminated a number of jobs along the floor in a retail supermarket.

The possibilities of adapting electronic devices to retailing are literally immense. They can, for example, be adapted easily to inventory control. In the Washington division of Safeway Stores, Inc., profit-and-loss statements are obtained every 4 weeks within days after the close of each period through the use of 2 so-called baby electronic computers. Because of the new machines, this division of Safeway was able to reduce its inventory by a substantial amount without any loss of service. Management is able to obtain the data it needs to make buying decisions within a few hours.

It is not too farfetched to say that the technological revolution is moving in a direction of developing devices that will scan inventory on the shelves of food supermarkets and report back to reserve stock areas. What this will do to the labor force in the food supermarkets is readily apparent.

In the fall of 1956, the National Association of Shoe Chain Stores indicated the possibilities of adapting electronic devices and automated equipment to shoe chain operations so that the instant the sale is made the price, size, and exact description of the item sold would be recorded and produced on a punched tape with a complete record. This would lead to the elimination of the "size up," the weekly inventory check at the store. The chain headquarters would then have a constant up-to-the-minute statment on which it could rely in determining what shipments are to be made to each unit of the chain.

This would permit, at least, 10 additional man-hours per store each week to be used in selling operations rather than in counting merchandise. The information could easily be adapted to use at the warehouse and provide information for future manufacturing operations. The IBM people have a fully automatic, electronic-punched card transmitter that is capable of transmitting or receiving audible sound at the rate of almost 1,000 alphabetical or numerical characters a minute and converting the sound into standard punched cards. This makes it possible to transmit data electronically from store units to headquarters. It may soon be possible to drive into a gasoline station, have your tank filled automatically and the cost billed to your electronic credit card by machine.

Through various sensory devices, it seems possible to handle even papers electronically. I understand that a step in this direction is being made by the United States Post Office involving the sorting of envelopes by code-reading devices.

One company, the Underwood Rapid Sort, is developing a machine which requires merely the typing of a code on a sales check, a bill or a job ticket, and the paper is whisked to one of 51 appropriate bins in less than one-third of a second. Other devices being experimented with include one that automatically selects from a stock bin any items called for by an operator who simply punches keys on a keyboard. The items are then released onto a conveyor belt. One operator is thus able to do the work of 10 stock boys.

Devices of this kind, used in conjunction with automatic code-reading conveyors obviously would bring about a complete revolution in materials handling and a movement of merchandise into and out of retail stores and warehouses. The more we look at some of these machines, the more of a job nightmare we seem to be facing. For example, Dow Chemical has developed a conveyor system which is tied up with automatically controlled order-stenciling machines. These read the printed product identification on the carton, electronically count the correct number of cartons of each product in order, and then stencil the cartons, thus automatically selecting the order.

The automation principles I described for retailing are also applicable to warehousing. In one installation in a warehouse, there is an automatic system of sorting and distributing merchandise from a receiving platform to 16 different stockrooms located on 3 different floors. Shipment can be effected by reversing the operation. The control device records the destination of all the containers and keeps a complete inventory, adding and subtracting the merchandise as received and shipped. Nothing has to be moved, no records have to be kept other than what the automatic equipment does and provides in the way of information. It is estimated that labor costs in warehousing can be reduced in this way by at least 50 percent, together with a saving of 25 percent in the cost of space, in addition to securing better control of inventory.

In December 1956, Fortune magazine headlined an article on automation in this area with the expression, "The Pushbutton Warehouse." It notes that most warehouse operations today rely on unskilled labor and primitive tools, but as the production lines turn out goods faster than the warehouses are able to handle them, industrial engineers are coming up with new automatic devices that have been successfully applied to this problem. The Hickok Manufacturing Co. stores its belts, garters, and suspenders in inclined chutes very much like candy in a vending machine, enabling one man at a keyboard to pick from stock all the items needed to fill orders. In 3 hours he is able to do the job that used to take 3 men an entire day. The H. J. Heinz Co. has put up a warehouse in Pittsburgh that is able to handle up to 6,000 cases in 1 continuous flow. A network of conveyor belts sorts the cases as they come from production, takes them to stacking machines, and piles them on double-decked wooden pallets.

Lever Bros.' warehouse in Hammond, Ind., incorporates the Heinz techniques but also adds to it order assembling and shipping. Lever's Hammond plant produces 20 different products, all leaving the production line in sealed cases which can be handled most easily on pallets. Photoelectric cells scan the passing cases of soap and powder items and sort them according to product, by counting the series of black streaks inked on the cardboard.

In New York, the Judy Bond Co. uses a computer-controlled conveyor system to assemble orders totaling 6 million blouses a year. Prior to the installation of this equipment, a backlog of several weeks would pile up with overtime required, according to the company. Today, the additional costs have been eliminated.

In White Plains, N. Y., the Alexander department store moved to a new building at the end of 1956 where an automated system to sort and distribute merchandise from the receiving platform to the 16

stockrooms was installed. An automatic order-picker for drug warehouses has also been devised using punched cards to indicate to a machine which boxes and bottles to select from storage chutes and to assemble individual orders at the packing stations. At this rate, it will not even be necessary to have retail displays for many items. With a computer-controlled warehouse, all that's necessary is to take an order from the customer, place it on a punchcard for an automatic computer, put it into the machine and, by means of electrical impulses, release the material from a rack, carrying it to a waiting vehicle. The conveyor system described above for the Alexander installation is actually an integrated stock-selection method in which one dispatcher does the work of a dozen stock clerks. The equipment for this installation is said to cost about $175,000 and to replace about $25,000 a year of human labor.

The advantages of the Alexander system are said to be a speedup in the movement of trucks at the receiving platform, avoidance of congestion on the platform, elimination of the need for elevators or hoists, and reduction of stock-boy traffic. The entire system is controlled by a pushbutton console with a built-in memory located at the receiving platform and operated by the receiving clerk. Merchandise from trucks is automatically distributed—packaged goods on conveyors, hanging goods on monorails. The device takes control of the goods, transmitting instructions to the equipment, including deflectors and other mechanism which take off the correct container or section of hanging goods at the predetermined stockroom and hold it for later disposition. The system is engineered to distribute cartons up to 48 inches long, 28 inches wide, 38 inches high, and 4-foot trolleys of hanging goods. It is even reversible so that goods may be returned from stockrooms to the shipping point. The belts and monorails are along the interior walls, so that it does not interfere with store operations. Regardless of the order in which the units are fed into the system, or the number of units on the conveyors at one time, each gets off at its proper destination.

It would even be possible to develop a completely electronic checkout counter. Merchandise can be marked in a code which would be picked up by an electronic scanner. This would actuate electronic computers and other devices which would not only instantaneously record the total purchases of the shopper but would also record sales information for inventory purposes. If it is possible to have automatic toll-collecting machines on the turnpikes, then it certainly seems completely possible for the engineers to devise a completely automatic retail store. It may well be that the retail store will become ultimately a combination warehouse and home delivery service, plus a communication channel to the home. Thus, the housewife will be able to sit at home and place her order by electronic devices and be billed automatically. Compared to these steps, self-service and self-selection appear primitive. Items will be presold, prepacked, and prepricemarked.

The trend in this direction is evidenced by developments in the supermarket prepackaging. Today, 65 percent of the meat sold in supermarkets is prepackaged, with the largest part of the operation carried on within the supermarket. Only about 10 percent of the prepackaged meat is brought in from outside, but there is no reason why

prepackaging couldn't be extended further. One machine available on the market can wrap in a given time as much meat as five girls can working at top speed. A machine manufactured by the A. W. Gellman Co., of Rock Island, Ill., can wrap 1,320 packages an hour or 22 a minute.

What happens to human labor when material-handling techniques become fully automatic? One engineering concern admits that it has not yet been able to completely eliminate people from a material-handling situation. But Mr. Allan Harvey, of the Dasol Corp., of New York, was able to tell the American Management Association in June 1957, that his concern has already designed warehouse systems which reduce the number of employees to substantially less than half. Mr. Harvey said that, "In a recent installation a high degree of automation has cut direct labor from 1,600 hours per week to 700 hours per week." "Furthermore," continued Mr. Harvey, "of that 1,600 hours a week, 2.1 hours per worker was overtime, and that was completely eliminated."

What is happening is that warehousing and retailing are being converted into distribution centers through which goods, prepackaged, prepriced and labeled, are to flow in a more or less continuous process. The ultimate objective, according to the engineers, is to have an operation which will receive goods from manufacturers and then inspect, mark, allocate, pick, pack, and deliver them to customers with as little stopping as possible. It is estimated that direct labor costs can be reduced by 48 or 72 percent, depending on volume. And as in an automobile factory, the worker can be tied to a moving belt and 100 percent worktime enforced. A controlled system such as I've described brings the work to the few workers that remain and takes it from them again in a never-ending continuous flow. The Dasol Corp. speaks of one automatic warehousing installation in which it cut labor expenditures from $414,000 a year to $161,000—a cut of 61.2 percent. An interesting question to ask of the engineers is how all that purchasing power is to be replaced.

Of course, there are other savings also: in space, so that rent is reduced; lower supervision costs; elimination of delays, and speedup in handling. But while management is working out integrated inventory shipping and sales methods and coordinating all of these processes with production, it is overlooking the simple human problems involved. Perhaps it is true that the wave of the future is to incorporate into materials-handling and retail operations all the technique of data-processing and programing so that all phases of business are linked—production, material handling and selling—yet it is also true that the immediate problem of job displacement is a responsibility that we cannot ignore.

We in the Retail Clerks International Association are concerned, and justifiably so, with the impact that automation has had, and will continue to have, in our industry. It is true that the trend toward automatic processes may not cause immediate major upheaval, but certainly there are specific areas and specific problems that are arising with which we must be concerned. Labor displacement can cause considerable dislocation in community life. These can be dealt with only if we exercise some foresight. Yet, regrettably, in our area there seems to be less exercise of this insofar as the labor force is concerned than there is in other areas.

Are we not faced with a paradox? Automation increases investment in capital costs and decreases investment in direct labor, yet an automated economy can work well only if the economic system is relatively stable. Rapidly changing economic conditions are very upsetting and place an unbearable burden on firms, particularly in times of reduced sales. Virtually all authorities are agreed that automation requires a high level of prosperity. Yet if jobs are destroyed, how long can prosperity last?

I find it difficult to accept the somewhat complacent view that with increased technology we need not be concerned with job loss, for new jobs will eventually be created. This is an easy answer that solves new problems. In making retailing and distribution more automatic, the objective is to reduce the number of manual operations permanently, and thereby reduce the number of the labor force involved in this industry.

It seems to me that there is need for a good deal more study of this problem. We simply cannot assume that displaced people will be in a position to find other types of work; particularly when job opportunities in their industry, after 20 or 30 years of service have contracted. Moreover, we can hardly expect industry, whether at the retailing or manufacturing end, to reverse the tendency toward increasing the amount of capital per worker employed. Actually it becomes technically impossible to revert to less capital-using methods in many fields, so that we cannot merely assume that the economy would automatically reabsorb all technologically displaced workers.

The process is a difficult one and very often is accompanied by considerable hardship on the part of those people who are trying to find a new place for themselves.

I don't mean to suggest that American industry faces the specter of becoming completely robot and completely automatic. Only between 30 to 50 percent of manufacturing industry can use automation in some form or another. Industries such as gasoline manufacture or electrical supplies have a high degree of automation, whereas house building has a very low degree. Automation may not play much part in agriculture, forestry, or professional and other services, but it will have a not inconsiderable part to play in the distribution fields, in warehousing, and retail stores.

Automation increases productivity in retailing, just as it does in a Detroit automobile plant. This certainly suggests that one possible approach would be a more effective sharing of the fruits of automation. I raise the question whether such steps as shorter hours and an improved wage level, as well as passing on savings to consumers, might not be just the kind of counterweights we need to balance the less desirable effects of recent automation, in the distributive trades.

Perhaps what we ought to consider is whether the rate of adoption of automated equipment ought not to take into account its social costs. If firms were required to provide not only for the cost of new equipment, but also to help displaced workers adjust to the new situation, either through compensation pay or through retraining, then might not the rate of adoption be at a pace that the economy can absorb without any serious maladjustments? I don't know that this would seriously slow up the rate of technological change, but if there are benefits to be derived from automation, there are also serious social-economic costs involved to which attention must be paid.

Chairman PATMAN. Thank you very much, sir.

Right there in the last part of your last sentence you made a statement that must receive the consideration of our committee and all other committees working on this problem. "If there are benefits to be derived from automation, there are also serious social-economic costs involved to which attention must be paid." We recognize that fact.

I think your statement is not only thought provoking; it is challenging, and we must view it as such. You may rest assured that everything you have said will be seriously considered.

You have given us some amazing examples here. I never heard of some of this equipment, almost humanlike in their activities.

Mr. SUFFRIDGE. We are not specialists in this line. In fact, it took a long time to reduce it to this number of pages and some fast reading not to take a lot of your time, but if we can answer any questions we will.

Chairman PATMAN. I have enjoyed every minute of it and I know that the members of the committee and Members of Congress reading it will appreciate it.

Would you like to ask any questions, Mr. Lehman?

Mr. LEHMAN. No. Thank you.

Chairman PATMAN. Mr. Knowles?

Mr. KNOWLES. No. Thank you.

Chairman PATMAN. Thank you very much, Mr. Suffridge.

Mr. SUFFRIDGE. Thank you.

Chairman PATMAN. With the completion of Mr. Suffridge's testimony, we now bring to a close these 2 days of hearing on automation and recent trends. We are grateful to all the witnesses for their contribution to this important subject. The hearings will be published and made available to Members of the Congress, libraries, research organizations, schools, and interested individuals. The subcommittee does not plan to issue a report since these materials will be considered in connection with the full committee's report on the 1958 Economic Report of the President.

Without objection, the subcommittee will stand adjourned subject to call of the Chair.

(Whereupon, at 2:45 p. m., the hearing was adjourned, subject to call of the Chair.)

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