Impact of Automation

A COLLECTION OF 20 ARTICLES ABOUT TECHNOLOGICAL CHANGE, FROM THE MONTHLY LABOR REVIEW

Bulletin No. 1287

UNITED STATES DEPARTMENT OF LABOR
James P. Mitchell, Secretary

BUREAU OF LABOR STATISTICS
Ewan Clague, Commissioner

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PREFACE

Automation and other changes in technology have an important impact on virtually all aspects of industrial life. New technology contributes to the continued growth of productivity underlying American's high standard of living. At the same time, it creates social and economic problems such as labor displacement and obsolescence of skills. For this reason, there is deep public interest in the progress of technological change and concern with the problems of adjustment.

This publication is a compilation of 20 articles that have appeared in the Monthly Labor Review over the past 5 years. They describe various labor aspects of automation and technological change. The articles are based on studies, reports, and speeches by research workers and officials of Government, labor, management, and universities.

The articles are grouped under three headings, as follows:

Part I contains articles presenting general surveys of automation and such developments as atomic energy and their social implications.

Part II covers articles discussing the effects of automation on industrial relations in general and on specific collective bargaining relationships.

Part III consists mainly of articles summarizing case studies made by the Bureau's Division of Productivity and Technological Developments. The full studies are available from the Division. The final article dealing with automation in the Federal Government is based on recent Congressional hearings.

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Part I.

General Surveys of Automation and Technological Developments

A Review of Automatic Technology

The Meaning, Outlook, and Implications of America's Most Recent Industrial Development

EDGAR WEINBERG *

AUTOMATIC TECHNOLOGY, automation, or automatization are terms widely and interchangeably used to describe the most recent phase of American industrial development. They cover the increasing use, both in offices and factories, of various types of laborsaving equipment having virtually continuous and, in some instances, self-regulating operation. Instead of small changes to achieve greater efficiency, as in traditional management practice, recent innovations often involve extensively replanning the flow of work and the layout of plants and offices, and completely redesigning products for greater automaticity in production. While these changes are hailed as the beginning of a new era, they are in principle a continuation of past trends.

The purpose of this article is to describe the basic principles and some leading examples of automatic technology, to set forth some factors to be considered in estimating its rate of growth, and to discuss some general implications:

Background

Today's technological developments carry forward the search begun in the 18th century for new mechanical ways of displacing man as a source of energy in production. The Industrial Revolution, the first phase of this movement, marked the transition from dependence on hand labor to the application of power-driven machinery. Many of the principles of automatic technology can be traced to such early developments as Oliver Evan's continuous flour mill, Babbage's calculator, Jacquard's card controlled loom, and Watt's automatic controls for his steam engine. The 19th century saw the steady improvement in speeds, capacity, and efficiency of machines, and their use in virtually every activity of the economy.

The 1920's ushered in the mass-production phase of industrial development. Ewan Clague, in the July 1926 Monthly Labor Review, described improvements in machinery and processes of that period as a "new industrial revolution . . . the most remarkable advance in productivity efficiency in the history of the modern industrial system." Machine operations in mass-production plants were made uniform, reduced to routine, and subdivided into simple tasks. The worker's job became a machine-paced operation on a highly standardized product, with mechanical conveyors employed to bring the work and carry it to the next step of a sequence. This type of specialization resulted in great increases in productivity but also in greater monotony for the operator of production machines and the man on the assembly line.

Automatic technology, starting with the cumulative accomplishments of the past, introduces the possibility of eliminating direct human intervention in operating, guiding, and feeding machines and in controlling processes. Instead of the worker, specialized mechanisms with capacity for

*Of the Bureau's Division of Productivity and Technological Developments.

elementary sensing, discriminating, and counting, can now perform routine tasks of handling materials and information with a high degree of reliability.

As this new movement progresses, job opportunities in more complex control, service, distributive, and creative functions become relatively more important in total employment. Many less skilled jobs become obsolete. A growing awareness of the readjustments that may be required to conserve human values is accompanying these industrial changes. Automatic technology, wisely applied, as Norbert Wiener suggests, holds promise of "more human use of human beings."

Recent Developments

Recent innovations leading toward more automatic technology in industry may be grouped in four categories: (a) automatic machinery; (b) integrated materials handling and processing equipment; (c) automatic control systems; and (d) electronic computers and data-processing machines. The first two categories cover examples of advanced mechanization based on engineering principles already familiar in industry. The latter two encompass innovations largely developed out of experience during World War II in the new fields of electronics, control, and communication engineering.

The emergence of this technology is part of the general acceleration of the Nation's economic growth following World War II. The availability of the results of wartime research, large expenditures for new plant and equipment, and the continued need for a large volume of defense items have greatly stimulated the production of new types of equipment. Like Eli Whitney's system of interchangeable musket parts manufacture, production principles found useful in speeding the output of arms are now used to good advantage in civilian industries.

Automatic Machinery. Some types of specialized machinery which carries out a pre-set cycle of operations with almost no human intervention is found today in virtually all plants having a large output of standardized goods. New models of automatic glassmaking, textile-spinning, and papermaking machinery, printing presses, and wire-drawing machines are constantly being introduced. The basic principles are often unchanged, but improvements in speeds and capacity may greatly reduce the labor required for a unit of output.

A recently developed automatic filling machine, for example, packages cans with 4 ounces of semi-solid baby food, "untouched by human hands," at the rate of 800 per minute. The worker's function is limited to manual pushbutton starting and stopping, observing and adjusting the performance to correct malfunctioning, and repair and maintenance of the mechanism. Such routine decisions as determining when a can is filled are made by tireless, highly accurate, specially designed devices built into the machine.

New models of automatic machines frequently incorporate devices to save labor in inspecting, gaging, and testing, as well as fabricating operations. Also, labor in servicing machinery is now economized by means of automatic lubrication systems which distribute a precisely measured volume of oil to bearings at regular intervals without direct human intervention.

The possibility of mechanizing an industry through intensive research on the redesign of the product as well as of the fabricating machinery is illustrated by new techniques of producing electronic parts. Previously, it has not been practical to devise laborsaving mechanisms for duplicating the complex hand manipulations of producing and assembling electronic components. According to a BLS study, assembling operations employed, in January 1953, about 30 percent of the work force in the electronics industry.[1] With the tremendous civilian and military demand for electronics output, the need for time-saving automatic fabricating methods has become urgent.

A key development in the mechanization of electronics manufacture is the fabrication of the printed circuit board. Instead of hand-wired circuits, conducting patterns are now etched or stenciled on plates by means of specially designed machines. The results are a considerable economy in time and a high degree of uniformity of manufacture.

Another important development is the manufacture of equipment for attaching standard electronic components to printed circuit boards. Assembling these parts can now be done mechani-

[1] Electronics Employment and Labor Force, Monthly Labor Review, October 1953 (p. 1049).

cally at significantly higher rates of speed than by manual methods. In Project Tinkertoy, a research program conducted by the National Bureau of Standards in cooperation with private firms, the components themselves are produced mechanically, using the modular principle of design. Thus, parts of standard circuits are printed on ceramic wafers which are then mechanically joined in various combinations into a variety of electronic components.

Integrated Materials-Handling and Processing Equipment. As faster and larger automatic machines reduce the amount of labor directly engaged in fabricating operations, engineers are turning their attention to developing mechanical ways of saving labor in the movement and handling of materials. The importance of this function (in terms of man-hours of employment) is illustrated by the experience of one large manufacturer of electrical apparatus. (See table.) The trend toward more elaborate processing of raw materials serves to make the moving of goods within plants increasingly more significant. Manual loading and unloading of goods in process, moreover, are often too slow to permit full utilization of the new high-speed production machinery.

The metalworking industries, notably automobiles and ordnance, provide some of the most striking examples of the integration of materials handling and processing to achieve continuous production. Indeed, the word "automation" was coined by D. S. Harder of the Ford Motor Co. to refer to "the automatic handling of discrete parts between progressive processing operations." Automation in this sense is now applied in the machining of engine blocks, pistons, ring gears, crankshafts, and 155-mm. shells. Like the assembly line of the 1920's, methods of materials handling used in the automobile industry are also being imitated by other metalworking plants producing large volumes of standardized goods.

A basic feature of this type of automatic production is the linking together of high-speed automatic machine tools so that a predetermined sequence of boring and drilling operations can be performed on a standardized part, such as an engine block, with virtually no direct human labor. Extensive use is made of specially built powered

Distribution of productive man-hours in a large electrical-apparatus manufacturing company, by major operation, 1948

Operation	Percent of total productive man-hours
Total	100.0
Assembling	27.3
Materials handling [1]	26.8
Machining	21.7
Testing	12.9
Finishing	4.5
Other	6.8

[1] Does not include materials-handling work performed by skilled labor as part of normal activities.

Source. Adapted from table 1 in an article entitled "Materials Handling—Current Experience and Evolving Principles," by R. W. Mallick, appearing in American Management Association Production Series 184: Organizational Teamwork in Production, New York, 1948.

conveyors, or "shuttles," to transport the work from machine to machine; of pneumatic, hydraulic, and electrical devices to turn, load, position, and unload; and of timing mechanisms to synchronize the movement of parts being processed. Inspection after certain operations is also done automatically. The result is a continuous flow of production, except for brief interruptions for changing wornout tools and making repairs.

Integrated handling and processing equipment is also being introduced to save labor in the metal-forming and finishing departments of metal-working plants. Conveyors and chutes are now extensively used to move sand and heavy castings in foundries. "Iron fingers" automatically load and unload heavy presses and stamping machines. In one large plating plant, automobile bumpers pass continuously through a 31-step process, guided by a combination of shuttles and elevators. Operators at an electrical control panel check the process at numerous points.

Significant advances toward more automatic operations have also been made in the handling of bulk materials. New plants for processing such bulk materials as cake mix and grain are now built around a system of belt conveyors, gravity chutes, and pneumatic tubes to provide a continuous flow from raw material to finished product. A fertilizer plant studied by the Bureau of Labor Statistics,[2] for example, combines several processing operations into a single automatic sequence, from loading to bagging, by means of automatic weighing hoppers, screw conveyers, and chutes.

Longer, faster moving, and larger capacity belt conveyers are increasingly used to reduce manual handling in transporting coal in mines

[2] Case Study Data on Productivity and Factory Performance—Fertilizer. BLS Report 63, May 1954.

and utilities, loading and unloading ships, and moving bulk materials at construction sites. The Riverlake Belt Conveyer Project proposes to carry coal and iron ore between Lake Erie and the Ohio River with a minimum of handling via a 103-mile continuously moving "rubber railroad."

In summary, increasing integration of materials-handling and fabricating operations means fewer workers on jobs involving primarily physical strength. Greater use of machinery for these tasks, however, requires workers skilled in the repair and maintenance of costly equipment, engineers trained in designing new machinery and plant layouts, and management executives capable of directing technicians and coordinating mass production and mass distribution.

Wider Use of Automatic Controls. With the large-scale use of automatic control devices in industry, a new phase of the long process of substituting mechanical for human energy begins. Hitherto, technological progress has been concerned primarily with the transfer of manual skills from man to machines, the worker remaining a controller and director. New developments involve the use of improved devices for such operations as sensing, measuring, comparing, and remembering, as well as operating in a predetermined manner. Control of machines by other machines or completely self-regulated production now becomes possible.

Although automatic control devices have long been used in the operation of the telephone system and industrial furnaces, their diffusion on a large scale was greatly speeded by new knowledge and experience gained during World War II. The collaboration of engineers, scientists, and mathematicians in designing servomechanisms for gun positioning, radar, and so forth, as Professors Brown and Campbell of the Massachusetts Institute of Technology have pointed out, "soon focused attention on the essential principles that apply to all control systems." [3]

The basis for automatic control of industrial processes is the technique of "feedback." Briefly, feedback control exists when information about the output at one stage of a process is returned or fed back to an earlier stage so as to influence the process and hence change the output itself. This closed loop between input and output contrasts with open-loop controls where a human operator receives information about the results of a process, mentally compares it with the desired performance, and makes adjustments in the input, if necessary, to achieve the predetermined standard performance. Like the human nervous system, one scientist suggests,[4] closed-loop systems have the remarkable ability to control the application of a substantial amount of force with a minimum expenditure of energy.

The operation of automatic control is exemplified by the simple closed-loop circuit used to control room temperature. In this familiar case, a sensing device of the thermostat measures the controlled variable, room temperature. The reading is then automatically compared with the preset desired value. If some deviation or error is detected, a signal is transmitted to the servomotor or starting switch of the furnace which operates until the desired temperature is reached and then stops. A new factor that alters the room temperature beyond the tolerance allowed sets off this self-regulating system anew.

Plants converting raw materials into finished products through some form of chemical processing are making increasing use of automatic control instruments. Self-regulation of the temperature, pressure, flow, and level of liquids and gases in these processes is often achieved by networks of control instruments. Materials handling in and out of processing tanks, pipes, and chambers is naturally continuous. The result is completely automatic production, from the input of raw material to the output of finished products.

Notable examples of whole plants built around automatic controls are found in the petroleum refining and chemical industries, including atomic processing, which have expanded their capacity fairly rapidly since the end of World War II. Other industries where scientific experts believe advanced planning now aims at fully automatic plants are cement, beverages, paper products, telephone and telegraph, and electric power. Some industries, such as steel, make extensive use of instrument control in important steps of the processing.

As chemical processing is substituted for mechanical operations in other industries such as

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[3] G. S. Brown and D. P. Campbell, Control Systems. (*In* the Scientific American, New York, September 1952, p. 59.)

[4] J. G. Kemeny, Man Viewed as a Machine. (*In* Scientific American, New York, April 1955, p. 58.)

metal refining, the use of automatic controls no doubt will be extended. Improvements in measuring instruments also promise new applications. For example, a new gage employing radioactivity for continuous noncontact measurement of thickness makes possible more exact automatic control in coating paper, plastics, or rubber with abrasives, varnish, or adhesives.

An important objective of using automatic controls in many of these already highly mechanized operations is the finer adjustment and better quality of products made possible, rather than any large-scale saving of direct labor. Direct labor is already a relatively small proportion of the work force. A BLS study of synthetic rubber plants, for example, indicated that workers directly engaged in process operation in 1949 comprised only about a quarter of total plant labor.[5] Maintenance, administrative, engineering, and other overhead labor were the most important occupational categories.

The application of feedback controls to machine tools introduces the possibility of automatic production in industries other than those having continuous processes. While suitable for mass production of standardized parts, the automatic, though not self-regulated, materials-handling equipment and custom-built machine tools described earlier are generally not economical for job-lot production.

Tape control of machine tools provides a flexible method for producing small lots. With this type of automatic control, the tool is guided over the work without human intervention in response to a series of instructions previously recorded in code on such media as cards, paper tape, magnetic tape, or film. These instructions can be changed after each job. Punched-tape programming, for example, is being applied to standard precision-boring machines. While the advantages of such flexible automatic controls are recognized, "much development work still remains," according to one expert, "before control systems can be developed that are low cost, accurate, and versatile enough for all-around use."[6]

Electronic Computers and Data-Processing Machines. As the economy grows in size and complexity, the work of information handling becomes increasingly important. Although mechanization of recordkeeping, accounting, and computing has advanced, the proportion of the labor force engaged in clerical and related work has continued to increase. Scientists and engineers in the past 10 years have therefore devoted considerable effort to developing new and faster tools in this field.

A major advance is the electronic computer or data-processing machine. The direct result of organized research for military purposes, the electronic computer applies principles of communication engineering to the tasks of counting and control. The broad stream of scientific research that produced radio and television also contributed to the development of this remarkable new tool.

Two general types of electronic computers are the analog and the digital. The analog, the first to be developed, is essentially a measuring device and is used to derive answers to engineering problems from the operations of a physical analogy of the problem. Analog computers allow engineers to study the operation and improve the design of a complicated process, without costly experimentation, by simulating its behavior. They are now widely used tools for such problems as designing guided missiles and analyzing the distribution network of utilities.

The digital computer operates as a counting rather than measuring device. Its principal feature is the use of electrical impulses to perform arithmetical operations at speeds far beyond human capabilities. The electronic computer combines several data-processing operations into one machine. The entire processing of data goes on automatically, without the manual transferring of data from one step to the next as in mechanical systems.

The high computing speeds and reliability of these machines have steadily been improved. According to the Stanford Research Institute, "figures can be handled electronically at more than 1,000 times the speed of conventional punched card equipment."[7] A machine introduced in 1953 had 25 to 35 times the speed and capacity of the first large electronic computer produced by the same company in 1948.

Two types of digital computers may also be distinguished: the special purpose and general

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[5] Trends in Man-Hours Expended Per Unit: Synthetic Rubber and Components: 1945-49. Bureau of Labor Statistics, processed, 1952.

[6] J. Diebold, What's Needed to Make Tape Control Take Hold. (*In* Automatic Control, New York, April 1955, p. 48.)

[7] Electronic Data Processing. (*In* Research for Industry, Stanford, Calif., November 1953, p. 5.)

purpose. Special purpose computers consist of specially designed parts to perform a few fixed sequences of computing operations or programs. A large mail order firm, for example, uses a memory unit and computer to keep an up-to-the-minute inventory analysis, item by item, of 12,000 different lines. An airline employs a similar high-speed computer to handle seat reservations. Special purpose, high-speed computers are also used in air traffic control and to analyze unit demand for retail merchandise in department stores.

The general purpose computer can be used for a variety of operations not having a fixed built-in program. Instead, a new program must be developed in each application. Programming for the computer, however, involves time-consuming analysis of procedures and operations which is not subject to mechanization.

The first digital computers were developed for scientific and engineering research purposes in connection with military defense. Their ability to telescope tremendous series of computations taking months into a few hours' work has been of incalculable value in preparing ballistic tables, evaluating airplane designs, and solving problems in nuclear physics. New pathways in scientific research are open because mathematical computations for weather forecasts, interindustry economics, astronomy, seasonal trend analysis—too costly with conventional methods—are now practical.

The marketing and rental in 1953 of high-speed electronic machines specially designed for processing business data probably marked the beginning of a new era in office work. According to a survey made early in 1955, about a dozen large companies have installed data-processing machines and nearly 30 others may have machines installed in the near future.[8]

Although many firms eventually expect to use the computers to obtain new information for management, the first applications are being made on tasks now being performed by slower methods. A large appliance company uses its electronic computer for preparing its payroll, scheduling materials, and controlling inventories. A utility prepares customers' bills. Insurance companies plan to use high-speed computers on premium billing, premium accounting, and actuarial computations.

The possibilities of savings in routine clerical labor appear to be substantial. A chemical company recently reports that its computer produces a financial report in 2 hours that formerly took 320 man-hours and prepares 1,200 manufacturing cost reports in 12 machine-hours, in contrast to the 1,800 man-hours formerly required. Although these comparative figures take no account of the long period needed for developing the complex instructions for the machine, there is little doubt that the electronic data-processing machine is a highly efficient tool for handling the ever increasing volume of information needed in business enterprises for making decisions.

Outlook

Although the general direction of technological change is toward greater automaticity, the actual time it will take each industry to adopt automatic equipment now commercially available depends on a wide variety of economic factors and hence is difficult to forecast. Piecemeal progress, with some industries and processes affected more than others, seems more probable than any abrupt changeover in a short period.

Fragmentary data on past experience with mechanization illustrate the gradualness of technological change. "One of the interesting results," Carroll D. Wright observed in his 1898 study of Hand and Machine Labor,[9] after several decades of mechanization, "is the extent of the hand method of production, even at the present time." W. Duane Evans estimated that hand methods were still used in 1936 in making about one-quarter of all long filler cigars, 19 years after more economical machine methods had been introduced.[10] Boris Stern, on the other hand, in his study of the glass industry found that in 8 years a machine for making glass tubing had entirely displaced the old hand process in the industry.[11] Other studies revealed a similar pattern of gradual change, with variations from industry to industry, depending on economic circumstances.

So far as the immediate future is concerned, a brief review of some general factors accelerating and retarding the spread of technological improve-

[8] P. B. Laubach and L. E. Thompson, Electronic Computers: A Progress Report. (*In* Harvard Business Review, Boston, March–April 1955, p. 121.)

[9] Thirteenth Annual Report of the Commissioner of Labor, Washington, Bureau of Labor, Vol. 1, 1898 (p. 6).

[10] Mechanization and Productivity of Labor in the Cigar Manufacturing Industry, BLS Bull. 600, 1938 (p. 1).

[11] Productivity of Labor in the Glass Industry, BLS Bull. 441, 1927 (p. 6).

ments suggests the likelihood of a fairly steady growth but no economywide revolution. A significant accelerating factor is the increasing supply of new equipment. A McGraw-Hill survey made in 1955 [12] found that firms in the electrical-machinery industry (covering producers of automatic control equipment as well as others) expect to sell about 29 percent more in 1958 than in 1954. Competition and large research and development expenditures by this industry group promise a continued flow of improvements.

Marketing by producing firms also appears to be vigorous. Easier methods of financing the purchase of machine tools, such as tool lease and installment arrangements, are offered to purchasers as incentives to modernization. Four technical journals, devoted exclusively to the field of automatic controls, are now being published.[13] New equipment is described in trade journals and discussed before engineering societies, and management and trade associations.

The demand for laborsaving equipment in the near future, on the basis of overall figures on capital investment, is also likely to be fairly strong. According to the survey of business expectations by the United States Department of Commerce and the Securities and Exchange Commission, investment in new plant and equipment in 1955 by all industry may be close to the 1953 record level.[14] With competition and high operating costs spurring the search for cost-cutting equipment, many firms plan to spend larger amounts on modernization rather than on expansion.

The continued expansion of the chemical-processing and petroleum-refining industries may mean greater demand for automatic control, particularly in new plants. Progress may also occur in insurance and banking, Federal tax collection, patent processing, and postal service, where special committees are now studying ways of introducing electronic data-processing machines. In several large metalworking companies, separate automation departments have been charged to find new ways and areas for using laborsaving equipment.

Certain economic factors tend to retard the development of automation. Because of the high cost of the new types of equipment, automation is generally limited to plants producing a large volume of standardized goods of fairly stable design. Most goods therefore may continue to be produced on a mechanized but job-lot basis. Because of the complexities, progress toward greater mechanization of assembly work is likely to be slower than in fabricating.

Another obstacle to rapid diffusion of automatic technology is the long time needed for designing and custom building the complex specialized machinery. A large scale electronic scientific computer, for example, took about 5 years of research and development and involved the production and assembly of thousands of components from nearly 300 manufacturers. A large insurance company required 2 years for analyzing its methods in order to install a data-processing machine.

Finally, internal factors within the modern corporation often create delays in introducing large-scale changes.[15] The purchase of costly automatic equipment involves long-range planning and complex decisions in the fields of corporate finance, marketing, and personnel. Conflicting interests of stockholders, executives, supervisors, and workers need to be resolved. Installing a high-speed electronic data-processing machine in a large company, for example, means changes in the duties and status of certain executives as well as workers, and their resistance to change may be an obstacle. In brief, the elusive and sensitive human factor may prove one of the important brakes on the rapid diffusion of the new technology.

Some Broad Implications

To clarify the broad implications of the growth of automatic technology, it is useful to distinguish between man's role as a consumer and as a producer. Concerning his welfare as a consumer, it is clear that the per capita amount of goods and services consumed in any economy basically depends on the percent of the population em-

[12] See Business Week, April 23, 1955 (p. 26), New York, McGraw-Hill Publishing Co.

[13] These are: (1) Automatic Controls, Reinhold Publishing Co., New York; (2) Automation, Penton Publishing Co., Cleveland; (3) Control Engineering, McGraw-Hill Publishing Co., New York; and (4) Instruments and Automation, Instruments Publishing Co., Pittsburgh.

[14] Investment and Sales Anticipations in 1955. (*In* Survey of Current Business, U. S. Department of Commerce, March 1955, p. 4.)

[15] See I. H. Siegel, Technological Change and Long-Run Forecasting (*In* The Journal of Business of the University of Chicago, July 1953, p. 147).

ployed, average hours worked, and the output per man-hour. An increase in the annual rate of productivity growth of the private nonfarm economy from 2 percent, the long-term rate, to 3 percent would mean an additional $54 billion (based on constant prices) in national output in 1965, or on a per capita basis, $287 more. This gain in material wealth would also allow for some increase in leisure through shorter workweeks and longer vacations. In short, increased productivity as a result of technological change may be the source of higher living standards in the United States.

The implications of the new technology for man as a producer are more difficult to assess. Broadly considered, one probable effect will be to intensify the shifting of productive resources of workers, management, and capital among various activities of the economy. In this process of change, some individual workers inevitably suffer losses as a result of displacement; others are benefited, as a result of up-grading. Employees in firms that do not adopt advanced techniques of production may become unemployed. Firms that are able to adopt cost-cutting equipment may gain a significant competitive advantage and expand their employment. The total extent of displacement as a result of technological changes will always be difficult to disentangle from other factors that cause economic unbalance.

The record of the past provides considerable support for believing that technological progress may be accompanied by high levels of employment. Carroll D. Wright in the 1890's used the phrase "expansion of labor" to describe the rise and growth of new industries providing new opportunities to offset displacement in older and declining industries. The shift of home activties to the factory, the growth of urban transportation and utilities, and the expansion of distributive, service, and government activities opened new opportunities in the past. In industries in an early stage of growth, such as rayon, autos, and chemicals in the 1920's, Dr. Solomon Fabricant found that productivity and employment both rose rapidly, the gain in total output offsetting the reduction in unit man-hour requirements.[16]

In the future, some accommodation to job displacement, as automatic technology is gradually introduced, may come from a shorter workweek and new sources of industrial expansion such as atomic energy, aircraft, instruments, electronics, and other industries producing equipment for the new technology; industries catering to the leisure needs (travel, home repair equipment, and recreation); new products from industrial research and development; and public programs for highway building and school construction. If the progress of automatic technology is gradual, these industries may provide a source of new opportunities. Public and private policies that contribute to growth of the economy and to high levels of employment will be a major contribution in meeting the problems of job losses occasioned by greater use of laborsaving equipment.

The need for adequate measures to ease the hardships of displaced individuals, to train workers with new skills, and to adjust conflicting interests on the job are likely to be important issues of the transition. These problems were discussed by Professors Baldwin and Shultz in the February 1955 Monthly Labor Review. They constitute a new framework for all groups having an interest in the labor market. Labor, management, and government agencies, responsible for education, vocational training, employment services, unemployment insurance, apprenticeship, wages and hours, and industrial relations, therefore, are likely to be increasingly concerned with the problems created by technological change.

One conclusion that follows is the ever increasing importance of information about the human aspects of technological change. Carroll D. Wright, was aware of the pervasive influence of technology on labor problems when he initiated his pioneering studies of mechanization at the end of the last century. Today a sound basis for policies and programs for easing the transition to the new technology requires a comprehensive system of timely information about such subjects as productivity, employment, unemployment, labor turnover, occupations, consumption, production, and leisure. With broader understanding, automatic technology and greater productivity become the basis for enriching life in a free society.

[16] S. Fabricant, Employment in Manufacturing, 1899-1939, New York, National Bureau of Economic Research, 1942.

Social Implications of Technological Progress

Editor's Note.—*The article which follows was excerpted from a paper presented by Charles D. Stewart, Deputy Assistant Secretary for Standards and Statistics, U. S. Department of Labor, before the Fifteenth Annual Conference of the Canadian Association of Administrators of Labor Legislation on October 3, 1956. In the interest of easier reading, suspension marks to denote unused portions of the text have not been indicated.*

What are the implications of technological progress for labor and labor policy? As government labor officials, we need to rethink many approaches to familiar problems and may find ourselves, within a generation, working in quite a different environment. Perhaps what I can say may be most useful if I touch on implications which have arrested my attention.

Implications for Full Employment

In Canada and the United States, high postwar employment and full employment policy have been facts of overriding importance for labor policy. The welfare of workers is conditioned by the full employment functioning of the economy, more perhaps than by any other set of factors. Now that we have had a large measure of success in overcoming the economic instability and insecurity connected with the business cycle, we have begun to obtain the sweeter fruits of industrialization. Question: Does automation and an accelerated rate of technological innovation threaten to impair the stability achieved, and lead again to serious problems of unemployment?

The problem of displacement or technological unemployment is not new. The reduction in man-hours per unit of production in the new technology is no different in any essentials from those in the past, except I anticipate it may take place at an accelerated rate. The economic theory describing the mechanisms of absorption and reemployment is none too satisfactory, but we know that the process takes place.

Rapid technological change can produce maladjustments which contribute to the irregularities of the business cycle. There will be short-run maladjustments between the supply and demand for labor, accentuating problems of training and mobility. These merge into the more serious problems connected with major structural maladjustments in the economy, which may be seen most clearly in problems of geographic immobility—the problems of sick industries and depressed areas. All of these problems can be eased by general conditions of full employment. In Canada and the United States, we must expect a higher average rate of unemployment than in less dynamic and industrialized countries. But I foresee no appreciable rise in the average level of unemployment during periods of full employment, i.e., in frictional unemployment (the level of unemployment which is consistent with full employment).

Problems of adjustment may be greater but our institutional capacities to deal with them ought to improve commensurately. Here, however, is a challenge to government labor officials who are responsible for improvement in labor market institutions, most particularly the employment service, the unemployment insurance agencies, vocational training and guidance, etc. There is no reason to think, so far as general economic stability and the business cycle are concerned, that our capacities to stabilize the economy through monetary, fiscal, and other policies will not increase more rapidly than the problems we face arising out of increasingly rapid technological progress.

Implications for Shorter Hours

That shorter hours are inevitable with automation and the kind of technological progress we envisage reflects, in many instances, a fear that unemployment will spread if work is not shared. Just as commonly, however, it reflects a utopianism that the new technology heralds a new day of all play and no work.

Whether workers prefer shorter hours to additional income depends upon their judgment as to the relative worth of leisure and income. Progressive gains in productivity and levels of living make this choice easier to make in favor of leisure, but the outcome is hardly predictable. It becomes more and more uncertain as hours input and arduousness of work fall below a point where the physical strain and other detriments of work impinge on health, family life, and full participation in social life, while at the same time the material standards of consumption rise.

I do not know what workweek industrial and other workers will choose in the future. It is interesting to note that with substantially full employment in recent years, little reduction in average hours worked has occurred in nonagricultural employment in the United States. George W. Brooks of the Pulp, Sulphite and Paper Mill Workers said in a paper presented at the recent AFL-CIO Conference on Shorter Hours of Work[1] that factory workers vie for overtime work at premium pay. Woodrow L. Ginsburg and Ralph Bergmann of the Rubber Workers reported that dual job holding is not uncommon with the 6-day, 36-hour week in Akron rubber plants. At present, workers seem inclined generally to place a higher value on additional income than on more leisure, but this may not always be the case.

Some further reduction in hours of work would appear inevitable. This may take various forms. The requirements of economical use of costly productive facilities will lead to much experimentation and variety in the work schedule. It is much more certain that the workyear will be reduced than that the workweek will be substantially shortened.

Aside from questions of industrial safety and health, the government labor official may be most directly concerned with the impact of changing hours in connection with statutory hours standards and administration of overtime provisions in minimum wages. From a social policy standpoint, it is obvious that shorter hours of work and the improved opportunity for voluntary choice of working hours, as the need for income becomes less pressing, will minimize the role of hours regulation in labor legislation. On the other hand, the overtime penalty in the United States Fair Labor Standards Act may be catapulted into the center of political pressure in support of wage bargaining. From what I have already said, I foresee the time when share-the-work considerations ought to have no part in legislative policy in social insurance or fair labor standards. Certainly it is true, however, that the tendency, for some time at least, to shorter hours, or for flexibility in the length of the workweek or workyear, will facilitate readjustments occasioned by displacement and technological unemployment.

Probably the most serious form that the hours problem may take in the future is not that of the workweek, or the workyear, but the hours input in the latter years of the individual's life span. Here again I trust that the relative freedom from want which technological progress holds out to us, will permit increasing freedom of choice to work or not to work on the part of older workers. Unless I am mistaken, there are growing signs that social policy in the future will not rest upon recession-oriented biases toward clearing older workers out of a glutted labor market but on freedom of choice to work or retire

Occupational Skills and Satisfactions

The current interest in the more spectacular aspects of automation and atomic energy developments has focused attention on prospective changes in the skill content of jobs in the new technology. Everyone is agreed that technological change has revolutionary implications for traditional occupations, and the suggestion is that this is increasingly true for the future.

In the United States, at least, I think government labor officials have paid all too little attention to government responsibility in shaping the occupational capabilities of the labor force. For most workers, specialized skills have been acquired through experience on the job. There has

[1] For excerpts from Mr. Brooks' paper, see Monthly Labor Review, November 1956 (p. 1271); and from the paper by Messrs. Ginsburg and Bergmann (p. 1268).

been official support of apprenticeship, but it has not played the same role as in some European countries. Until recently, we have given little attention to the mechanisms by which the public schools fit into the training process. Our attention now is largely centered on shortages and training to meet prospective requirements in the higher categories of scientific and technical skills. In this situation, Secretary of Labor James P. Mitchell has initiated a Skills of the Work Force program to direct public and employer attention to conscious efforts to appraise occupational needs and to effectuate training. The Department's occupational outlook studies and the vocational counseling activities of the employment service, together with job guidance in public schools, will contribute to the process of choice. But the means for training must be provided through public and employer efforts.

Training is the link between labor supply and labor demand. The technological potential can be realized only if the labor supply in kind and numbers is adapted to labor requirements. Individual potentials and satisfactions, under any given set of technological facts, are likely to be maximized under such circumstances. Technological unemployment can be minimized by a flexibly trained labor force capable of meeting the job requirements of a changing technology.

Curiosity about the future leads us to wonder what the net effect of technological changes will be upon the occupational structure of the future. Apparently there is no consensus on this score. Experience to date, during the whole period of industrialization, suggests an enhancement of skills. Automation and related technological developments substitute mechanical and other processes for unskilled labor. The new technology seems to emphasize the need for higher and higher skills for programming and controls. In some situations, there is no question that responsibility is an increasingly important factor, that broad training and specialized intelligence are required. Yet automation apparently takes over some of the skilled operations. Some studies indicate that as certain operations become fully automatized the amount of skill required of production line workers declines, and workers can become qualified to handle automatic operations with only a few days' training.

There would thus appear to be a wide range of occupational opportunities open for the whole range of human intelligence, capabilities, and interests. No one can generalize, I believe, whether job satisfactions will be more or less than in the "good old days." I suspect this will depend upon the individual's status in his job situation, which depends upon contemporary progress in labor-management relations, personnel administration, economic policy, and social legislation.

Protective Labor Legislation

On balance, it appears that automatic technology portends a lessening of occupational hazards and a general improvement in working conditions.[2] This is not so certain, at the present moment at least, with respect to extended application of atomic energy to general industrial uses. But in general, one would expect, with progressive improvements in real incomes and living standards, that working conditions would rise correspondingly. For I think this has been the natural development: Oppressive labor conditions have tended to disappear, with the supervision of the State to be sure, as productivity has relaxed the pressure of penury on the employer. Good labor conditions are good business, of course; and model establishments are a source of entrepreneurial pride; but as in the field of government services, our standards and practice rise as we have the economic means to finance them.

This suggests that protective labor legislation may have a smaller role in the future than in the past. Yet our social standards will rise with changes in cultural perspectives. There is still a long way to go, and there will always be backwashes where the least advantaged workers need outside protection from employer abuses.

Automation promises to relieve more and more workers from dangerous, dirty, heavy, and backbreaking jobs. Industrial hygienists foresee the elimination of a large percentage of traumatic injuries from lifting, handling, and unloading of stock, and contact with fumes and dangerous materials. Illustrative is the 85-percent reduction in hernia cases where automatic machinery was installed in a Ford plant, cited by Walmer.[3]

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[2] See C. Richard Walmer, Workers' Health in an Era of Automation, p. 43.

[3] Ibid., p. 45.

The industrial hygienists are not altogether complacent. Walmer emphasizes the "danger of catastrophic exposures due to ruptures in the lines or of acute exposures where maintenance work is involved." [4] I find also considerable concern for emotional impacts on the worker, either because he may fear displacement or is subject to the need to adapt to new circumstances, or because he is worried over the responsibility which may be his for the operation of costly and complicated capital equipment.

But the experts leave me with some apprehensions when they detail the risks of radiation and the use of new, dangerous materials connected with the industrial applications of atomic energy. Here government labor officials are confronted with new problems, or variations of old problems, in safety standards and workmen's compensation.

We do not know the scope or the immediacy of large-scale industrial atomic developments. But in the United States, we know the traditional workmen's compensation systems are ill equipped to deal with emerging risks and problems of adjudication and compensation. The second-injury problem is made more complicated; the question of causal relationship more baffling; and time limitations on filing more impracticable. So-called schedule type of coverage limited to specific occupational diseases is patently inadequate. Adequate compensation may be more and more costly and never adequate. For, according to medical authorities, radiation diseases may have periods of latency extending up to 30, 40, 50 years. There may be types of radiation illnesses not yet known. So little is known about radiation injury (and exposure from many sources if cumulative) that determination of causal connection is even more difficult than in ordinary circumstances.

In the future, labor departments will need staff to aid in code drafting in the atomic energy field, in training of radiological safety personnel, and in preparation of technical materials for educational and safety purposes. It is suggested that it may be necessary to organize, in cooperation with governmental health agencies, a system of individual radiation exposure records covering industrial, medical, and dental exposure. Workmen's compensation will need to be extended to meet the new risks and the new problems of administration. Particularized standards will need to be developed with respect to hours of work, overtime, perhaps rotating shifts or sabbaticals, and suitability of employment by age, for radiation dangers are aggravated by continuity and length of exposure and are more serious among the young than the old.

Thus, I am sure protective labor legislation is not a passing need in the early stages of industrialization. But it does need reappraisal and adaptation to the needs of the times if it is to maintain its relevancy to the welfare of workers in a rapidly changing society. Our problems, however, are not all in the future. In the United States and in Canada, there are areas which have been little affected by modern industrialization. Our working conditions and living conditions still are generally low, compared with the promise of modern technology. We are at the threshold of a period of great economic growth and change, as indicated by the burst of capital expenditures for expansion and modernization of equipment.

I think it important to bear in mind that our problems may be somewhat different than in the past, that old approaches may not be the most appropriate ones. Government labor officials have a personal responsibility to see that labor legislation is realistic and its administration efficient for the needs of workers in an industrialized society.

[4] Ibid.

Impact of Technological Progress on Labor and Social Policy

EDITOR'S NOTE.—*The material which follows was excerpted from Automation and Other Technological Developments—Labor and Social Implications, Report of the Director-General to the 40th session, International Labor Conference, Part I (Geneva, International Labor Office, 1957). That report, "a brief preliminary survey of some of the problems which automation, atomic energy, and other changes in technology appear to raise in the areas of primary concern to the ILO," was designed to stimulate discussion at the 1957 Conference with a view to developing the ILO's policies and activities in this area.*

THERE IS NO DOUBT that we have entered a new technological era. Automation and atomic energy, unfolding simultaneously, are already causing drastic changes in the world of industry and labor. Despite substantial differences of opinion, no one would deny that they provide a powerful lever for economic growth. They make possible the more rapid development required to keep pace with population growth and to raise living standards.

The Pace of Progress

The key to the labor and social impact of automation and other technological innovations is the rate of speed at which they are introduced. As many have emphasized, if the changes of the last 50 years had been compressed into the space of 5 years, there would have been economic and social chaos. If the changes resulting from automation, the use of atomic energy, and other recent innovations were to take place within the same limited period of 5 years, there would be grounds for grave concern.

There have been long discussions of the factors limiting the introduction and spread of automation and analogous developments. There has been less discussion of the forces accelerating the rate of [its] introduction. One of these is the social demand for higher living standards. Another is the snowballing effect of technical change: one thing leads to another, in the same place and in other places. Related is the specific force of research and development work, the "fully automatic" or "fully electronic" or "fully atomic" solution becoming the scientific ideal. A further and more specialized factor is intensified industrial research.

A less general but highly important factor is the dwindling labor force of certain countries in relation to the trend of population growth or the fact of labor shortage in relation to manpower requirements for planned economic growth. In addition, the very size and complexity of administrative, scientific and technical, and industrial problems in the modern world and the rhythm of operations are calling forth new methods of work and production and new sources of energy.

Finally, automation and developments grouped under this head present certain clear-cut advantages to industry. Some are financial. Of these, the most important is the reduction of direct labor costs. Other advantages are technical. Of these, the most important is probably the fact that automation makes it possible to produce better quality goods and to work with constant precision and within narrower specifications.

Most people tend to believe that the new technologies will spread from one field to another over a fairly long period; that the weight of evidence is in the direction of gradual evolution from country to country as well as from one field of industry and commerce to another; and that this is the most reasonable basis on which to plan socially for the absorption of change.

Few have challenged these assumptions. Nor would I do so. Yet in the interests of caution, it might be noted that only a few years ago automation and the development of atomic energy were both commonly regarded as practical problems for the next decade, not for this one. Things have happened far faster than most qualified observers in both fields expected.

The accelerating tendency toward increasingly automatic methods of production and toward the use of new sources of power is certain to have a profound influence on the pattern and structure of industry and on the location of industrial activity. Technological advance has generally tended toward concentrating production in large, highly capitalized plants with complex technical processes.

A good many trade unions, as well as small employers, fear that monopoly will be a concomitant of automation and that many small businesses will drop out, causing much labor displacement. Leaders of the American Federation of Labor and the Congress of Industrial Organizations have raised this problem and called for study of its implications. The United Kingdom trade unions have urged planning and action so that small concerns may be able to obtain automatic equipment.

On the other hand, a contrary view as to the impact of automation on the size of firm is taken by other observers. For instance, the president of the Carnegie Institution of Washington foresees new opportunities for small business. In his view, "if large manufacturing companies turn to automation in extreme form, they . . . increase their own rigidity and render it more possible for the small industrial unit to prosper by reason of its inherent flexibility."[1]

On balance, however, automation seems likely to lead to a greater concentration of production in large or middle-size units. The number of workers employed at these plants might be smaller; the production might be larger.

With atomic energy and automation together, the factory is no longer tied to a traditional power or labor supply. Industrial moves may be encouraged by the fact that it tends to be more economical and, indeed, in many cases necessary, to install automation and atomic generation in specially designed new plants than in old ones. These factors suggest the possibility and probability of industrial decentralization and plant shifts and the emergence of many social and community problems arising out of plant abandonment.

The Impact on Employment

What is the impact of technological improvements on employment? The answer depends to a large extent on how fast and how generally change takes place. Even more, perhaps, it depends on the buoyancy of the economy. So long as improvements are introduced against a background of high levels of economic activity and a continuing rate of economic expansion, the maintenance of the general level of employment is not likely to be a serious problem provided the occupational shifts required to adjust to the changes can be made.

Past experience shows no reason to believe that technological innovations lead to a decrease in the global volume of employment. On the contrary, it suggests that such innovations, while they may cause declines in some areas of employment, lead in the long run to an expansion of employment by creating increases in other areas. In all [industrialized countries] the most significant characteristic of the postwar era has been the phenomenal growth of quite new industries and service trades and occupations, opening up new employment opportunities in many fields.

So far, the fact of the matter is this: Postwar technological advances have not been responsible for mass displacement of workers in any country or industry. For one thing, automation and analogous innovations are making greatest headway in industries with expanding output and markets and in industries where human power alone could never perform the operations needed to produce the goods we want. For another, normal labor turnover and mobility are coping with a good part of the situation. Finally, in the industrially advanced countries, technological improvements have been introduced against a general postwar background of economic recovery, growth, and expansion and against less severe business fluctuations than in the prewar period.

Most feel that it is impossible to predict the [impact of automation] with present-day tools but that better methods of analysis and forecasting must be found. All agree that, whatever the scale of the impact and related production changes, the employment situation needs continuous watching and careful analysis and that it is in this area of report and inquiry that government services, at all levels, can make a particularly important and immediately practical contribution. On the whole, the trend of opinion among employers and trade unions is optimistic but cautious. Nevertheless, and more particularly in trade union circles, there is an evident fear that things will not go on forever as they are; that a saturation point may be reached; that, even with decreased hours

[1] Editor's Note.—Cited in Automation and Technological Change, Hearings before the Subcommittee on Economic Stabilization of the [Congressional] Joint Committee on the Economic Report, 84th Cong., 1st sess., Washington, 1955 (p. 615).

of work and increased leisure and new and growing demands, employment will soon cease to expand; that old jobs will be displaced faster than new jobs will be created; and that unemployment on a wide scale will be the inevitable result. What is the basis for these apprehensions?

In the United States, the fear is that employment opportunities are not keeping pace with rising man-hour productivity. The same apprehensions are evident in Australia, Belgium, Canada, France, the Federal Republic of Germany, and the United Kingdom. It seems to be the fear of creeping unemployment, developing simultaneously with rising production and productivity and spreading from one industry branch to another, that is at the root of misgivings about the future. The only way in which [these apprehensions] can be countered is by concentrating on the facts, by giving sustained attention to the changing employment situation, and by careful planning not only to promote full employment and economic growth but also to foster the social policies which must underlie and accompany such growth.

It is recognized that large-scale shifts of workers from one industry, occupation, or undertaking to another are an inevitable consequence of technological change and that the necessary adjustments can be made smoothly and easily only in conditions of full employment. In general, the shifts under way seem to continue and reinforce trends already evident—a general tendency away from agriculture and from certain manufacturing industries and toward new or developing manufacturing and service industries and occupations. I would add, however, that according to many observers, the short-run impact of automation and analogous developments may be greater on white-collar employment than on manufacturing employment. Outside of certain manufacturing industries, the greatest potential for automation lies in office work and it is already being introduced rapidly in activities in which data-processing plays a predominant part.

Finally, so far as the composition of the labor force is concerned, the tendency is for young workers to enter employment later and for older workers to retire from work earlier, now that old-age pension schemes are common. In general, it is expected that these trends will be reinforced by recent technological advances. For women, the general tendency has been toward greater numerical participation in the labor force and wider employment opportunities. It may be considered probable that automation and other changes will reinforce this tendency as well. Both handicapped and older workers may find more opportunities for useful employment in the automated factories of the future, as more of the physical functions of production are transferred from human beings to machines.

Some countries anticipate a slowly growing or static labor force in future decades and, therefore, look to the higher man-hour productivity of automation to compensate for relative labor shortage in the active age groups. They believe that this is a most important factor in the overall employment outlook, as well as one affecting the future composition of the labor force.

Technological progress holds out great savings in labor: let us not be afraid to admit this. These savings may be taken in the form of (1) higher output, (2) shorter hours, (3) unemployment; or a combination of the three. The problem, to my mind, is to arrive at a satisfactory combination of the first two and to avoid the third. For some countries, the main danger of unemployment may arise not from too rapid but from too slow progress in automation and other technological developments. As a result, these countries may lose markets to more efficient competitors. This is a real danger in countries where restrictive business practices are adopted by employers and restrictive labor practices are insisted upon by trade unions. Pressure for high wages by trade unions does not clog technological progress, but, on the contrary, may promote it by driving management to install more efficient methods and machines and by expanding the demand for industrial goods and services. But rigid demarcation lines between changing skills, "featherbedding," unrealistic views on apprenticeship ratios or length—these are among the factors which may clog technological progress. Again, unwillingness to take risks, inefficient work organization, the absence of management development policies and training facilities—these are also factors which block advance. The dividing line between measures which are to be regarded as unreasonable restrictions on technological progress and those which are to be regarded as affording reasonable safeguards for the interests of employers and workers affected by technological progress is not easy to draw. The question of where and how this line is to be drawn is one which has international as well as national implications.

Dismissal and Reemployment

The most serious problems naturally arise for workers whose employment is terminated as a result of technological changes. Their future prospects of reemployment depend primarily on the buoyancy of the employment situation.

Much depends on the way dismissals are handled by management. Advance notice—as much as possible—is one important factor. Such notice assures fair treatment to all workers, allows the worker to prepare for the economic adjustment he will have to make. While it is common to find provision for advance notice in modern collective agreements, the period of notice is still very short indeed—frequently somewhere between about 2 days and 2 weeks—far too short to enable any worker to do much advance planning about his future.[2]

A second element of importance is the provision of full information as to the reasons why the dismissals are unavoidable; the maintenance and application of rules—agreed with the workers' representatives—to govern the order and conditions of dismissal are essential to promote understanding and to ensure fair treatment among the workers affected.[3] In general, seniority is the main determinant of the order of dismissal, and this seems to work out in as equitable a manner as any other rule that could be devised. So far as the conditions of dismissal are concerned, the most important factor is financial. What will the worker have to live on? It is my view that employers and all others concerned with the problem would do well to give serious consideration to this question [of dismissal compensation].

A final important element is providing help in making the contacts necessary to find other work. Sometimes direct contacts between plant personnel departments have had excellent results. The employment service, too, can help. Moreover, during a period of rapid technological advance, action to strengthen guidance and counseling facilities is particularly necessary, both as a means of providing employment information in terms of an individual worker's needs and as a means of giving him the personal help and psychological encouragement which may well be necessary. Most employment services are particularly weak in this area and most community counseling facilities are inadequate.

Above all, perhaps, there is the important question of income maintenance during any period of unemployment. In many countries, unemployment insurance now provides a first net of assistance for the majority of workers. But how far are benefits adequate in amount or in duration? On what conditions are they granted? How great a sacrifice is imposed on a worker with continuing financial obligations? Even with the addition of dismissal bonuses and supplementary unemployment benefits of various kinds, is not the worker asked to shoulder too heavy a part of the burden of technological readjustment? These are the questions the workers are asking.

There is a clear need to keep the whole problem of unemployment under review, not merely the services providing financial assistance in the event of it. Most countries have machinery for reviewing the general level of employment. Few have systematic methods for analyzing the content of the unemployed population, for studying the remedies for unemployment. Yet different kinds of unemployment require different kinds of action.

Problems of Labor Mobility

The possibility of labor displacement, combined with the prediction that automation, atomic energy, and other technological changes are likely to promote flexibility in industrial location and to make for rather far-reaching changes in the existing geographical pattern of employment, has focused attention on problems connected with the mobility of labor. It seems generally agreed that in the long run the employment market will have to display a higher degree of geographical mobility.

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[2] EDITOR'S NOTE.—For a description of such agreement provisions in the United States, see Layoff, Recall, and Work-Sharing Procedures, Monthly Labor Review, January 1957 (pp. 1-7).

[3] EDITOR'S NOTE.—For a description of dismissal pay provisions in major contracts in the United States, see Dismissal Pay Provisions in Major Bargaining Agreements, Monthly Labor Review ,June 1957 (pp. 707-713).

This is a point emphasized by many European studies. But it is also agreed that there are considerable limitations on the mobility of workers even in Canada and the United States.

A good many recent studies have found that in practice workers are not so mobile as is commonly believed: that what mobility there is, is achieved only at a price of considerable sacrifice exacted from the worker and his family. Thus, it is becoming more widely accepted that the encouragement of labor mobility, so far as it is needed by events, is a nationwide responsibility; that the workers cannot be expected to bear all the risks and all the costs of economic changes which destroy their jobs; and that broadly based cooperative action has to be taken by government, industry, and labor, first to confine the need for mobility to a minimum by proper study and planning of industrial location and of the introduction of technological improvements, and second to share equitably the risks and costs of the mobility [which] will [still] be required.

The trade unions attach a great deal of importance to the development of a concrete program of action to deal with these problems. Some companies have helped to give practical effect to companywide transfer plans by arrangements [designed] to help the worker move to openings in another plant in the same company but in a different locality. Government services have an important role to play in facilitating interarea employment readjustments and in promoting the kind of labor mobility that is really necessary and does not impose an unduly heavy burden on the workers affected. The employment service is the most directly affected, supplying employment information and advice and often financial assistance. Many other services are also directly concerned, e. g., those responsible for the placing of government contracts affecting local employment opportunities.

There are still further problems which need attention, problems which are perhaps the most difficult of solution. These are the human problems of labor mobility: workers too old to envisage a move, single women reluctant to face life in a new community, men and women bound by strong ties to the community in which they were born, discouraged workers who fear that if they did move they would not find work, workers moved around so much in wartime that they want a settled life, and so forth.

Given the difficulties of transferring people to new areas, cannot more be done to take new job openings to the places where people are? To what extent and in what circumstances is this sound policy? The need is to look at the problems anew and in the fresh terms of the technological changes now occurring.

This is really the crux of the matter: we need a positive approach to all of the employment problems accompanying or likely to accompany the technological developments which are changing the industrial structure. The negative approach represented by the payment of unemployment benefits, while wholly necessary, is not enough. The important results must, as always, be accomplished through a broad and positive approach to changing employment opportunity; and such an approach depends on the cooperation, good will, and practical action of all concerned, directed toward bringing about the [effective and necessary] changes in employment policies and institutions.

An Inquiry into the Effects of Automation

EDGAR WEINBERG*

THE most intensive study since the 1930's of the effects of technological change was conducted last October, when 26 leaders in various fields testified at congressional hearings on automation.[1] The hearings were aimed at developing information on the nature and implications of automation, through studies of selected industries. Major areas of inquiry included the extent of potential employment displacement, the need for training and for retraining displaced workers, and the distribution of anticipated gains in productivity. These and other related questions were discussed by qualified persons in six major fields selected as illustrative of problems which may be faced in the trend toward automation—metalworking, data processing, and the chemicals, electronics, railroad, and communication industries. The relation of the technological changes to the Nation's progress as a whole was reviewed by scientists and economists.

Summarizing its findings, the subcommittee which conducted the hearings pointed up two conclusions from the evidence: first, that "all elements in the American economy accept and welcome progress, change, and increasing productivity"; and second, that although "it is important to note that . . . only a relatively small . . . fraction of the total labor force will be directly involved . . . no one dare overlook or deny the fact that many individuals will suffer personal, mental, and physical hardships as the adjustments go forward."[2] The subcommittee found that "both organized labor and management are apparently aware of and intent upon seeing that the human elements are not disregarded." Concern for the workers affected also underlay the subcommittee's "best and by far the most important single recommendation"—that "the private and public sectors of the Nation do everything possible to assure the maintenance of a good, healthy, dynamic, and prospering economy, so that those who lose out at one place as a consequence of progressive technology will have no difficulty in finding a demand for their services elsewhere in the economy."

This article sets forth some of the highlights of the article hearings. Representative statements by various witnesses have been grouped around six topics relating to automation: the definition of automation; its relation to past developments; trends in key industries; factors affecting the general outlook; some implications; and proposed policies.

Definition of Automation

From a review of the attempts by witnesses to define automation, it is apparent that the term "automation," like "mass production" or "mechanization," encompasses a complex of innovations and that the definitions tend to vary with the experience of each speaker.

Ralph J. Cordiner, president of the General Electric Co., expressing the engineer's viewpoint, defined automation as " 'continuous automatic production,' largely in the sense of linking together of already highly mechanized individual operations. Automation is a way of work based on the concept of production as a continuous flow, rather than processing by intermittent batches of work."

Looking at current developments in perspective, Dr. Vannevar Bush, president of the Carnegie Institution of Washington, defined automation

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[1] Automation and Technological Change. Hearings Before the Subcommittee on Economic Stabilization of the Congressional Joint Committee on the Economic Report (84th Cong., 1st sess.), pursuant to sec. 5(a) of Public Law 304, 79th Cong., Washington, 1955.

Impressed with the "importance of continually increasing industrial productivity," the Congressional Joint Committee early in 1955 had directed its subcommittee (Representative Wright Patman of Texas, chairman) "to study the impact of automation on long-run employment and investment levels." Testimony was given during 9 days in October by 14 industrialists, 6 labor leaders, 3 Government officials, and 3 academic leaders.

[2] Automation and Technological Change, Report of the Subcommittee on Economic Stabilization to the Joint Committee on the Economic Report, Congress of the United States, Washington, 1955.

broadly as covering the "relegation to a machine of the function of performing operations previously performed manually." He added that "Man now has the dream of making machines which are like himself, and which can hence become his slaves. And he has progressed a long distance toward this objective, and will progress further."

Secretary of Labor James P. Mitchell suggested that, subjectively, automation produces a fear of change. In a technical sense, he said, "the word represents technological change, which surely is nothing new."

Relation to Past Developments

In relating automation to past changes, witnesses differed over the novelty of current developments. Dr. Cledo Brunetti, director of engineering research and development of General Mills, Inc., said: "Automation, a newly coined word to describe an old, old process . . . cannot be said to have begun on any certain date, nor can it be said that it will end at any definite time. Automation is in truth but a phase of our continuing technological advance."

Dr. Edwin G. Nourse, former chairman of the Council of Economic Advisers, disagreed with this conception. "[Automation] has its roots in mechanization, to be sure, but something new was added when electronic devices made possible the widespread application of the feedback principle. The three earlier phases of industrialism—mechanization, continuous process, and rationalization—all continue, but have been given a new dimension."

Secretary Mitchell said: "It represents a movement certainly as old as the industrial revolution and probably older. . . . Its latest manifestation, coming as it has in a favorable setting of growth and prosperity, has appeared with relative swiftness and in some ways spectacularly. It has come with such devices as complex automatic systems, electronic controls and regulators, feedback systems, transfer machines, conveyors, and the like."

Trends in Key Industries

Automation in metalworking is merely a general term which involves the steady development of the accuracy and power, speed and productivity of machine tools over the years, according to M. A. Hollengreen, president of the National Machine Tool Builders' Association. As a good example, he cited the progressive automatization of metal cutting lathes from single to multiple spindle tools and thence to automatic chucking machines on which, "by the twenties, it was possible to perform 10 to 15 operations . . . without moving the work by hand." Electric and automatic controls and, more recently, automatic gaging devices enabling the machine to correct its own errors have been added.

Ralph E. Cross, executive vice president of the Cross Co., described the "sectionized transfermatic," one of the most recent developments in machine tool automation. First put into operation in mid-1954, this is a line of machine tools, 350 feet long, which performs 555 machining operations on engine cylinder block castings. It is divided into five sections to minimize "the time lost for changing tools and minor repairs. Any one of the sections can be stopped while the other sections continue to produce at their normal rate."

The progress of automatic equipment in the telephone industry was described by Clifton W. Phalen, president of the Michigan Bell Telephone Co. First introduced in 1920, dial-operated telephones today account for about 85 percent of the total. "Operators are now dialing directly nearly 60 percent of long-distance calls. Customers now dial directly about a quarter of all calls outside local areas." Automatic message accounting (AMA), currently being introduced, "employs punched tapes which register the calling telephone, the called telephone, the time connection was established, and the time connection ended. A machine takes the information off the tape and assembles it for each customer."

A number of innovations leading to more automatic handling of freight cars in classification yards were described by S. R. Hursh, chief engineer of the Pennsylvania Railroad. A new $34-million terminal facility, at Conway, Pa. (on the line between Pittsburgh, Detroit, and Chicago), will handle the tremendous traffic load through a system of automatic retarder speed controls, automatic switching, and similar devices.

The progress of electronic data-processing machines in scientific and clerical work was described by two officials from Government agencies which have done pioneering work in these fields. Robert

W. Burgess, director of the Bureau of the Census, indicated that the Univac, delivered in 1951, has been used effectively on the monthly population and business surveys since 1953. Cost of the current population survey has been cut in half and work that could not have previously been done because of high cost (e. g., adjusting time series for seasonal variations) is now practicable. Dr. A. V. Astin, director, National Bureau of Standards, described FOSDIC (film optical sensing device for input to computers), an automatic machine recently developed by that Bureau for translating data on the record sheets of census enumerators into a form to be fed directly into an electronic computer.

Discussing the use of electronic computers at General Electric Co., Mr. Cordiner revealed their extensive use in engineering and product development and, more recently, in payroll accounting, material control, and general and cost accounting. He also mentioned the company's plans for their application in the near future to billing, inventory and sales reports, budget preparation, and factory scheduling. "It is our feeling," Mr. Cordiner stated, "that the medium-sized computers will have the greatest usefulness for business in the immediate future."

Numerous plants in the chemical and petroleum refining industries already have introduced a high degree of continuous or automatic operation, according to Professor Thomas J. Walsh, of the Case Institute of Technology. Gases, fluids, and powdered solids are handled and processed in pipes or ducts with devices to control the flow and measure changes during the operation. Otto Pragan, research director of the AFL International Chemical Workers Union, pointed out that one indicator of the relatively high degree of mechanization is the total capital investment per production worker: $26,665 in the chemical industry compared with $12,933 for all manufacturing.

In electronic-goods manufacturing, several developments point toward greater automation or mechanization. Dr. Brunetti described Auto-fab, a machine for assembling electronic components on printed circuit boards now being used in large-scale production of computers. Don G. Mitchell, chairman and president of Sylvania Electric Products, Inc., announced that his company is developing new machines for automatically applying hundreds of thousands of separate phosphorous dots on the face of a color television tube, with a high degree of precision.

Factors Affecting the Outlook

Although there was general agreement concerning the trend toward greater automation, opinion varied concerning the rate of introduction of new devices. Some persons foresaw rapid change because of greater expenditures for industrial research. "As a result," Walter P. Reuther, then president of the Congress of Industrial Organizations, stated, "the flow of what may be considered routine technological innovations—new production methods, new materials, and machines applicable only to specific processes or industries, and improvements in work flow—has been greatly accelerated."

In railroading, W. P. Kennedy, president of the Brotherhood of Railroad Trainmen, foresaw a step-up in automatizing freight yards because of large expected savings, excellent financial position of the railroads, and new electronic developments for the automatic handling and dispatching of freight cars. "Railroad capital spending programs . . . are expected to total $20 billion, or double the recent annual rate of investment, in the next decade."

The demand for higher living standards and the anticipated slower rate of growth of the labor force in relation to population change will be major factors accelerating mechanization, according to Don G. Mitchell. A shortage of clerical labor was cited by Howard Coughlin, president of the Office Employes' International Union, as a significant force in greater automation of office work.

The size and complexity of scientific and business problems, Dr. Astin pointed out, require greater use of new methods of data processing. "Advances [in science and technology] have now reached a stage where further progress would be impracticable or uneconomical without them."

Some complex factors that must be considered when adopting automation, were also discussed. D. J. Davis, vice president of the Ford Motor Co., in charge of manufacturing, pointed out that automatic machinery must be highly flexible, so that it can be modified without excessive cost to accommodate expected changes in design of parts. Only limited application of automation is anticipated in Ford's assembly plants because of the scattered location of such operations, and continual changes in body structure and trim design.

Mr. Cordiner emphasized three key factors governing the pace of technological advance: The difficulty of designing workable automation; the financial risks; and the need for management to assure wider markets to justify the investment. Hence, "technological change in industry is a gradual process."

Professor Walter S. Buckingham, Jr., economist of the Georgia Institute of Technology, pointed out that no significant application of automation seems likely in some important industries, such as agriculture, mining, construction, retailing, and professional fields, "because of the highly individualistic nature of the product, the need for personal services, the advantages of small-scale units, or vast space requirements."

Other limitations cited by Dr. Buckingham, as "more temporary, but . . . nevertheless significant at the present time," include: "(1) the high initial cost of the equipment which for the time being at least prevents all but the larger firms from using it; (2) the shortage of highly trained operators and analyzers; and (3) the time required to analyze the problems, reduce them to equations, program the computers, and translate the answers into useful data."

Implications of Automation

There were major differences of opinion as to the economic and social effects of automation. Viewpoints regarding its impact on employment were of two general types: one emphasizing the immediate possibilities of displacement, and the other, stressing automation's expansive effects on employment.

Expressing the viewpoint of the former group, Mr. Reuther stated: "Automation, in addition to the more conventional improvements in machines and work flow, will be increasing the rate of the national economy's rising man-hour output still further. Instead of average annual productivity increases of some 3 to 4 percent, the annual rate of rising man-hour output in the national economy may reach 5 to 6 percent or more . . . [a rate] capable of displacing about 3½ million or more employees each year, if the national economy fails to expand, along with the rapid improvements in productive efficiency."

The prospects of displacement of telephone and railroad workers were set forth in some detail. Joseph A. Beirne, president of the CIO Communications Workers of America, predicted: "If telephone business continues to expand only at the modest 1954 rate, that is, annual increases of 4.6 percent in telephones and 3.8 percent in telephone calls, we estimate conservatively that by 1965 there will be anywhere from 100,000 to 115,000 fewer people employed by the Bell System."

Mr. Kennedy cited specific instances of localized displacement of railroad workers as a result of modernization of classification yards. "At Hamlet, N. C., . . . the number of yardmen has been cut by 35 percent. . . . At the Union Railroad Co., Pittsburgh, approximately 250 yard employees have already been displaced . . . Construction of two new yards . . . at Memphis, Tenn., and Tulsa, Okla., both of which will go into service early in 1956, will in the opinion of the local brotherhood representative affect employment in the two terminals at least 25 percent."

The general expansive implications of automation for employment were described by several witnesses. Secretary Mitchell said, "I repeat, there is no reason to believe that this new phase of technology will result in overwhelming problems of readjustment. Science and invention are constantly opening up new areas of industrial expansion. While older and declining industries may show reducing opportunity, new and vibrant industries are pushing out our horizons." Mr. Cordiner indicated four factors at work to create new and increased employment opportunities. The "chain reaction" of economic growth (due to lower prices increasing the volume of business); the expanding service industries and increased time for educational and recreational activities; expansion of industries for designing, selling, building, and installing new machinery; and the growth of entire new industries as a result of automation.

"On the horizon," Mr. Cordiner saw "an atomic energy industry, a transistor, and semiconductor industry, an industry for the production of the supermetals like titanium and zirconium, and even manmade diamonds. . . . Based on our experience with these [computing] machines . . . it may well be that the computer-derived technologies will be a major source of new employment in the 1960's and 1970's."

Marshall G. Munce, a director of the National Association of Manufacturers, said that a certain amount of "reallocation of job opportunities" will be inevitable, but that the rate of voluntary quitting by workers in American industry is sufficiently high—2 percent per month in manufacturing—to avoid any widespread displacement of individuals. "By not replacing these people as rapidly as they depart, reallocation occurs by attrition alone," he said.

The rapid growth of employment in the electronic, telephone, and chemical industries was cited as illustrative of the expansive effect of automation. "Television today," according to Dr. Brunetti, "would not be a mass market were it not for use of automatic machinery in kinescope . . . and component tube manufacturing."

While witnesses differed on the number of jobs that would be affected, there was general agreement on the nature of changes in skills and occupational requirements. Secretary Mitchell, looking at the historical record, saw a reduction in unskilled workers, semiskilled workers moving into skilled areas, and skilled workers approaching the status of technicians. "We can expect these trends to continue . . . Improvements in industrial technology will reduce the number of boring, routine, and repetitious jobs. And I believe we can expect that this will move all workers to a higher level of attainment and self-development. We can expect to see increased demand for workers with a high sense of responsibility and versatility, for mathematicians, engineers, and technicians of all sorts, and for scientists and researchers. The worker of the future will require better basic education and better training than he gets now."

James B. Carey, president of the CIO International Union of Electrical Workers, believed that the extent of the occupational changes that may result from automation will be comparable to that of the first industrial revolution which replaced the handicraft worker with the machine tender or machine operator. "Automation . . . tends to replace the human regulation and control of machines and thereby changes the machine operator into the supervisor of an automatically controlled operating system."

These occupational shifts have already occurred in a number of industries. At Ford's Cleveland and Dearborn engine plants, according to Mr. Davis, fewer employees engaged directly in production were employed in 1954 than in 1950, but there was a substantial increase in the number of skilled maintenance personnel. In the telephone industry, Mr. Beirne pointed out, the number of professional sales, business office, clerical, and maintenance workers had increased between 1945 and 1953 considerably faster than the number of operating employees.

A similar story was related by Mr. Pragan for the chemical industry: "In 1954, there were 2 production workers to each nonproduction worker, while in 1947 the ratio was as high as three-to-one. . . . The predominance of automatic equipment . . . makes maintenance skills, such as machinists, pipefitters, electricians, instrumentmen, etc., particularly important."

"Preliminary studies made by the Department of Labor," Secretary Mitchell said, "indicate that we have a shortage of skilled workers in this country today. As industry grows more complex, this shortage is bound to increase unless adequate training programs are set up. We must make sure that we do not waste our manpower, our most valuable resource . . ."

Automation's impact on the position of small business was also assessed. Mr. Reuther believed: "For the most part it is the large companies that will be in the best financial position to scrap old equipment and old plants, and replace them with new automated machines . . . thus increasing still more the margin of efficiency which they enjoy over their smaller competitors."

Dr. Bush, however, saw new opportunities for small units to prosper: "If large manufacturing companies turn to automation in extreme form . . . they also increase their own rigidity and render it more possible for the small industrial unit to prosper by reason of its inherent flexibility . . . they can get close to their customers and meet their needs intelligently and they can change rapidly with the times and the trends."

Finally, the implications of automation for the stability of the economy were weighed. Mr.

Cordiner took a generally optimistic view of the consequences of greater mechanization, saying: "With high investments in machinery, industry has one more incentive to keep those machines running as steadily as possible. This provides a great stimulus for better planning, more professional marketing, and all the other techniques for maintaining steady demand and employment."

Dr. Nourse, on the other hand, was concerned about the development of new sources of instability, particularly for the immediate future. "I strongly suspect that we have already built up at many spots a productive capacity in excess of the absorptive capacity of the forthcoming market under city and country income patterns that have been provided, and employment patterns that will result from this automated operation. . . . we have not yet demonstrated our ability to adjust the actual market of 1956–57 . . . to the productivity of the production lines we have already modernized."

Secretary Mitchell, in releasing the figures on postwar trends in manufacturing productivity, pointed out that, "the average postwar gain in productivity does not appear to be extraordinarily high. Our current estimates show an average annual increase from 1947 to 1953, ranging from 3.1 percent by one measure, to 3.6 percent by another."

Proposed Policies

Perhaps one of the most noteworthy features of the policies proposed by witnesses to meet social problems raised by increased mechanization was the general acceptance of the desirability of the technological changes themselves. No one proposed legislation to regulate directly the introduction of new machinery. Many witnesses, however, agreed on the need for special measures, whether public or private, to cope with the labor and other economic problems that may be created.

Dr. Nourse summed up his point of view: ". . . the economic problems posed by this technological advance can be solved only by a combination of competitive pressure, business statesmanship, and constructive public policy . . . rather than with the idea that the problems will take care of themselves or be disposed of automatically by the invisible hand of free enterprise." Mr. Munce cautioned: "Automation clearly will be a blessing to the Nation if it is allowed to grow by natural economic selection and if it is not distorted by unwise and unnecessary efforts to thwart its effects."

Considerable attention was directed to measures that might be taken by companies and unions. Mr. Cordiner declared: "Good planning for automation includes planning for the all-important human problems, as well as mechanical and financial problems." Representatives of the General Electric Co. and other electronic goods companies indicated that they plan changes so that normal attrition absorbs shifts in employment. General Electric provides a wide range of training on-the-job, through training schools, and special technical courses. General Mills has worked out a retraining program for its employees on new jobs, in cooperation with local schools and unions.

Mr. Phalen set forth the Bell System's plans for minimizing the problems of individual employees displaced by dial conversions: setting the date of change 3 years in advance; informing the employees; during the preconversion period, filling vacancies with temporary employees only, and postponing retirements; and retraining and transferring displaced operators to other jobs or communities. "In most cases, as a result of these measures, few, if any, regular employees must be laid off."

Secretary Mitchell cited studies by the Bureau of Labor Statistics of two companies [3] in which, through advanced planning, new automatic machinery was installed with a minimum of disturbance in industrial relations. "Personnel planning is as essential to modern industry as are the new machines." He also described some of the Department of Labor's programs that touch on the effects of automation: case studies of plants; surveys of community readjustment to reduced employment opportunities; a program to expand the skills of the labor force; and a study of the problems of older workers. Of direct importance are the increasing activities in the States to improve the effectiveness of the public employment offices and their unemployment compensation programs.

Adjustments at the plant and company levels to the coming of automation also involve certain

[3] See p. 79.

collective bargaining issues. Union spokesmen voiced labor's traditional demands for a share in the Nation's increasing productivity in the form of higher wages, fringe benefits, and shorter hours. A 4-day, 32-hour workweek was advocated by Mr. Reuther, as "an important step towards minimizing potential social dislocations." Mr. Beirne pointed out that the need for shorter hours for telephone operators has been intensified because "equipment they handle requires more numerous simultaneous operations resulting in increased nervous tension."

Improved transfer and layoff procedures in collective agreements are also sought. Mr. Beirne revealed that the Communications Workers union is seeking provision for interdepartmental and intercompany transfers, and company payment of transfer expenses. A uniform contract covering all Bell System workers was believed best suited to meet these issues. The Office Employes' International Union, according to Mr. Coughlin, is insisting on "bump back" provisions in layoff clauses.

Some special collective bargaining issues in continuous process industries, that might be raised elsewhere as automation advances according to Mr. Pragan, include special premium payments for rotating shifts and split workweeks, and revision of job evaluation systems to cope with the trend toward combining two or more jobs, such as instrumentman and electrician.

Labor leaders generally urged that greater attention be given to protecting the jobs of older workers, who, once displaced, may find greater difficulty in finding new jobs. Mr. Pragan pointed out: "The threat of elimination of entire departments or jobs through automation may make unworkable seniority systems which are based on department or job seniority systems . . . [the senior employee] must not be passed over . . . simply because of age or the disinclination of the employer to provide the training which would enable him to qualify for the job."

Looking beyond collective bargaining, all labor witnesses favored government action for a lower retirement age and a shorter legal workweek. "To provide the expanding markets that are the basis for economic growth," Mr. Reuther, along with Mr. Carey, also recommended a program covering, among other things, a more adequate unemployment compensation system, a Federal minimum wage of $1.25, and Government aid to distressed communities.

Mr. Munce favored an alternative to government action. "The most effective way to increase the buying power of all consumers is through reduction of the cost of the goods and services they buy." Since automation will require large amounts of capital, Mr. Munce proposed a gradual reduction in corporate and individual tax rates.

So far as training and education are concerned, both labor and management witnesses agreed on the need for improved programs, particularly to meet the shortage of engineers and scientists. Mr. Reuther favored company-financed retraining for displaced workers and expanded general, vocational, and professional education.

In connection with the shortage of skills, Secretary Mitchell declared, "we cannot afford discrimination in the utilization of the skills of any group."

Support for more extensive research on the progress and problems of increasing technological development came from several witnesses. Factual information on the effects of automation was considered necessary for planning sound policies of both industry and government.

Mr. Reuther recommended continuing study of automation, with the Joint Committee on the Economic Report serving as a clearinghouse for information developed by government agencies and universities. Among the types of studies deemed essential were case studies of individual plants, and analyses of shifts in employment, collective bargaining provisions relating to technological change, business investment plans, and education facilities.

John I. Snyder, president of United States Industries, Inc., advocated the establishment of a national labor-management council on job opportunities to study the progress of automation, investigate local unemployment problems, and suggest solutions. John Diebold, president of John Diebold & Associates, Inc., recommended extensive studies by the BLS to determine the impact of automation on costs, competition, location, etc., in industries using and producing equipment; on skills, wages, labor relations; and on training and educational requirements. Dr. Buckingham felt that a comprehensive study of the economic system, like the Temporary National Economic Committee's investigations of

16 years ago, was needed to guide the policies of private groups.

Speaking more broadly, Dr. Nourse believed that automation points up the need for more scientific rationalization of national economic policies. "This . . . calls for a simply stupendous amount of grassroots data as to what is actually happening at an infinite number of spots in the economic process." New objective analyses—studies of input-output, consumer expectations, and money flows—seem to Dr. Nourse destined to have increasingly wide application in connection with economic problems created by rapid technological advance.

Recommendations of the Subcommittee

As already indicated, the subcommittee regarded as its cardinal recommendation one that public and private sectors work together to maintain a good, healthy, dynamic, and prospering economy, to assure displaced workers of finding a demand for their services elsewhere.

Although it commented on the lack of need for broad-gage economic legislation, the subcommittee recommended that all levels of government pay serious attention to the need for specific and broad programs to promote secondary and higher education, and to ease the problems and eliminate local pockets of chronic or short-run unemployment, whatever the cause. It suggested that the Federal Government become a model employer.

Other recommendations stressed the desirability of increasing the effectiveness of the United States Employment Service in dealing with the problem of the middle-aged worker and in placing skilled workers, and expressed the subcommittee's interest in improving economic statistics, especially those relating to productivity and occupational shifts. The subcommittee pointed out that industry should, by careful planning and scheduling, attempt to minimize the adjustments of workers and the stoppage of employment. In conclusion, the subcommittee announced its intention "to review regularly the progress of technological change and the evidence of occupational changes."

"Many of our neighbors [in London in the 1850's] were descendants of French Huguenots who fled from France after the revocation of the Edict of Nantes and built their characteristic houses with little leaded windowpanes and in that new home plied their wonderful skill in silk weaving that brought fame and wealth to Spitalfields. But the passing of time had brought shadows to the buildings and changes to the industry. One of my most vivid early recollections is the great trouble that came to the silk weavers when machinery was invented to replace their skill and take their jobs. No thought was given those men whose trade was gone. Misery and suspense filled the neighborhood with a depressing air of dread. The narrow street echoed with the tramp of men walking the street in groups with no work to do. Burned into my mind, was the indescribable effect of the cry of these men, 'God, I've no work to do. Lord strike me dead—my wife, my kids want bread and I've no work to do.' Child that I was, that cry taught me the worldwide feeling that has ever bound the oppressed together in a struggle against those who hold control over the lives and opportunities of those who work for wages. That feeling became a subconscious guiding impulse that in later years developed into the dominating influence in shaping my life."

Samuel Gompers, Seventy Years of Life and Labor, New York, E. P. Dutton & Co., Inc., reissued in 1943 (pp. 4–5).

Labor's Aims in Adjusting to the New Technology

EDITOR'S NOTE.—*The following article is excerpted from an address presented at the Conference on Labor and Science in a Changing World, which was held by the Industrial Union Department of the American Federation of Labor and Congress of Industrial Organizations in Washington, D.C., on January 7-8, 1959.*

Filling the Demand for Manpower

WE ARE TRYING to prepare for the future in the light of scientific, economic, and social forces that have already been set in motion. We know that these forces will make fundamental changes in our personal, working, educational, and community life.

The most obvious of these forces are atomic energy, automation, rocketry, the exploration of outer space, and the almost miraculous breakthroughs that are being made in the Nation's chemical, electronic, metallurigical, and physics laboratories.

Continued progress in all of these fields is necessary because in no other way will we be able to meet the onrushing needs of a population that is expanding as our natural resources are diminishing.

It is only because we can anticipate further advances in industrial and agricultural technology that we can also face the future with confidence.

Let me state, for the record, that labor does not oppose technological change per se. What we do oppose is the inhuman manner in which the new technology is sometimes applied. And since the mission of the labor movement is to protect the economic welfare of American wage earners, we do not intend to ignore the short run just because everyone may be better off in the long run.

The first thing to remember is that it takes manpower to open a frontier. This was true in America in the past—when our frontiers were physical—and it will be true in the future—when our frontiers are scientific.

This need for manpower will be activated by catalytic agents that are already apparent. They include, first, a growth mushrooming so fantastically that, within 21 years, America will have to be able to feed, clothe, house, transport, educate, and otherwise serve the social, cultural, and economic needs of 100 million more people than we have right now.

A second factor is the increasing emphasis on industrial research and development. The search for new methods, machines, processes, and materials affects every phase of industry. Today, public and private agencies are spending more than $10 billion a year on research. Only 6 years ago, they spent about half that amount.

These research and development programs need not only college-trained physicists, chemists, engineers, draftsmen, mathematicians, astronomers, and geologists but, for each of these, a corps of skilled craftsmen capable of translating ideas into action.

The emphasis on research and development leads, naturally enough, to a third catalytic agent in the economy, namely: capital expenditures and the rise of new industries based on the new discoveries that are pouring out of the Nation's laboratories. Millions of people are employed in jobs and in industries today that hardly existed only one generation back. Twenty-five years ago, for example, there were fewer than 100 industrial research laboratories in the United States. Today there are more than 4,000—employing at least a half million people. Twenty years ago, nuclear fission was an abstract theory. Today, more than 120,000 workers—of all types—are employed in the production and application of nuclear products. Only 5 years ago, intercontinental missiles and earth satellites were little more than science fiction. Today, the number of technicians who are helping to probe the secrets of outer space can only be guessed at.

All of these factors directly affect the manpower needs of the new scientific era. And though it is apparent that the opening of the new frontiers of space and science will create—rather than diminish—the need for manpower, it is just as apparent that future manpower requirements are going to be qualitative rather than quantitative.

The day of the unskilled and the semiskilled worker in industry—of the nut-tightener and the bolt-fastener—is almost over. This process has already begun.

But the new technology will not destroy the value of human skills; it is going to raise skill requirements—and demand more of them. And it is at this point that we can begin to get pessimistic. For, in addition to the fact that we do not have enough skilled workers to meet the present requirements of industry, is the even more frightening fact that—at our present rate of progress—we appear to be going backward instead of forward. Let me pinpoint this problem. Right now, there are about 9 million skilled workers in the United States. And when I talk about skilled workers, I mean the journeymen who can read and follow blueprints—who can build, install, control, maintain, and repair a machine or an electronics system. I mean tool makers, die sinkers, machinists, mechanics, repairmen, electronic technicians, maintenance men, machine-tool operators, sheet-metal workers, instrumentation experts, welders, patternmakers, electricians, and others in similar journeyman classifications.

The 9 million workers with these kinds of proficiencies—along with some 5 million professional and scientific personnel—have been called the "key" to America's industrial production.

But, 250,000 of these skilled workers die or retire, or otherwise leave the labor force every year—and we are, at this time, replacing only 100,000 of them through apprenticeships, formal on-the-job training, and immigration. This means that we are currently running up a skilled manpower deficit of 150,000 workers a year. In the next few years, we are going to come face to face with a really serious crisis in manpower—a crisis that will have had its origin in the low depression birthrates of the 1930's. The U.S. Department of Labor estimates that by 1965, we are going to need 137 professional and technical men, 122 managers and officials, 127 clerical and sales people, and 122 skilled craftsmen for every 100 we have today. And here is where we get hooked on the horns of a national dilemma. Although our population will increase by 18 million people by 1965, the greatest proportion of this increase will come in the age groups that are 45 and over or under 25 years of age. According to present estimates, we are not going to have any increase in the number of men who are in what the Department of Labor calls the "prime" working ages between 25 and 44.

This gradual seeping away of the Nation's skilled work force—if allowed to continue—threatens more than the living standards of our fast-growing population. More is at stake here than mere creature comforts. What is really threatened is our security and safety as a free people.

For many years, we discounted the possibility that the Russians could ever match us industrially. We assumed that because communism was inherently vicious in its lack of regard for human life and individual dignity, it must also be inherently incapable of mobilizing an effective work force. Well, now we know differently. As you may recall, the economic schedule of the Russian Government provides for the highest rate of per capita production in Europe by 1965—and in the world by 1970. Although some experts doubt the ability of the Russian economy to reach these goals, I feel that in view of past accomplishments, it is safer to overestimate than to underestimate future Russian potential.

The challenge of Soviet progress, when added to our foreseeable problems of internal growth, means that we must—not in 1 year, 3 years, or 5 years, but right now—begin to plan and implement programs that will enlarge and strengthen this Nation's corps of skilled, scientific, professional, and technical manpower. This means, first, that we must make the fullest possible use of all our manpower—and that, of course, includes our womanpower. In fact, as machines continue to take over the heavier jobs in industry, those remaining can—in most cases—be performed as easily by women as by men. And also while the supply of men in the prime working ages will, as we have seen, remain stationary over the next few years, the number of women in this age group—and in the labor force—will continue to grow. Thus, the skills and aptitudes of women must be more fully developed in the future than they have in the past.

Second, it means that we can no longer afford to indulge in senseless emotional prejudices—that we must remove all barriers to the training and employment of minority groups.

Third, we must make more efficient use of the millions of men and women 45 but under 65 years of age.

And, fourth, we must accent the abilities rather than the disabilities of the estimated 2 million men and women who have suffered serious physical handicaps.

To tap all of these currently undeveloped reservoirs of skill, we may have to amend and enlarge much of our State and Federal legislation relating to workmen's compensation, rehabilitation, vocational retraining, and discrimination based on age and race.

And, quite frankly, we may also have to modify pension provisions in collective bargaining contracts where, and if, they discourage the employment of older workers. I am not, of course, suggesting that we should weaken these provisions. Quite the contrary; I am advocating an extension of the funding principle, and the strengthening of procedures that allow workers to transfer pension rights when they go from one company to another.

But even if we are successful in stretching our available labor supply by all these methods, we will not have solved our basic problem. For, in terms of numbers alone, the Communist orbit has a staggering population advantage that we can never hope to overcome.

I don't want to get too deeply involved in the questions that confront education today, but I do want to state my opinion that the time has come when we must reintroduce discipline, hard work, and high standards of excellence into all levels of the school system.

As Eli Ginzberg has pointed out, a large proportion of our young people are severely handicapped when they leave school and enter industry because they have not mastered the written and spoken word—and because they have no understanding of basic mathematics. These fundamentals are important because we can no longer limit job training to the requirements of a specific job. As our technology changes, the content of industrial job classifications will also change.

This means that workers will have to be increasingly flexible, and that vocational training will have to be grounded more firmly on the fundamentals of mathematics, physics, engineering, and electronics. For it is understanding of fundamentals that gives a worker flexibility, that makes it possible for him to change, and take on new skills as his job changes or as it requires new skills.

The sources of supply of skilled labor also need reevaluation, and, in some areas, vast expansion. Our standards and programs of apprenticeship are good, I think, as far as they go, but unfortunately they are not reaching enough industrial trainees.

Some people claim this is because our young people have a white-collar complex and don't want to enter formal training that prepares them for blue-collar jobs, no matter how skilled or well paid they may be. Industry, as a whole, seems to be aware of the value and need for a skilled labor force, but when we get down to the individual employer, we find that he either depends upon the hiring of workers that someone else has trained—or, if absolutely necessary, sets up limited programs designed to meet his own immediate requirements.

According to the latest figures for 1958, we have approximately 178,000 young people in training that meets the standards of the Federal Bureau of Apprenticeship. Because of the recession, that is several thousand fewer than we had in 1956 or 1957. And it appears to be far fewer than the number of workers who are being trained in industrial skills in Russia today. Recently, for example, the Soviets claimed to have trained 7½ million young workers as skilled hands in 500 narrowly specialized trades during the past 15 years. In 1955 alone, they turned out 92,000 engineering technicians—which is 7 times as many as we trained during the same year.

There is some question as to the authenticity or comparability of these statistics, but in the face of the realities of communism, here again I think it is safer to overestimate than to underestimate the caliber of the Soviet work force.

I am not suggesting, of course, that we wish to copy their system. But at the same time, I think we cannot ignore the spectacular results they have achieved in their technical schools, the so-called "technicums." It is a sad fact that in many of our own urban school systems, the trade schools—the technical high schools—have become the dumping place for the slow learners, the discipline problems, and, in general, the young people the other high schools don't want. As a result, trade schools in many places symbolize educational failure—rather than educational achievement.

By way of contrast, Russian youth competes strenuously for the privilege of being selected for training in the technicums. And not only are most of the students paid—on the basis of grades—while learning, but when the shortages of manpower are anticipated in any given craft, the monetary rewards for learning that craft are increased.

Now whether or not we like the Russian system of education—and there are certainly many elements of rigidity and compulsion we do not like—we must admit that they have at least taken positive and affirmative action to meet their present and future manpower requirements. It is time for us to do likewise.

As a starting point, I would suggest that the Department of Defense add apprenticeship training provisos to every procurement contract. Many companies that subsist almost entirely on defense contracts—and this includes some of the biggest aircraft producers—are today recruiting (a polite word for "pirating") the skilled workers they need from other industries and are doing nothing to replenish the Nation's pool of skilled manpower. When the Bureau of Apprenticeship surveyed the aircraft industry 2 years ago, it found that 70 percent of the companies studied had no facilities for training apprentices. And these companies without apprenticeship programs, incidentally, employed more than half of the work force in the aircraft industry.

The International Association of Machinists and the United Automobile Workers tried to correct this disgraceful situation during the past year by putting the establishment of joint apprenticeship programs on the list of noneconomic demands that were drawn up for the aircraft negotiations in 1958. The results were negative. Not one single new apprenticeship clause was negotiated. And—let us face facts—this is not the kind of an issue for which we can expect the membership to go out on strike. So we had to drop it, even though we recognize that the supply and quality of skilled workers in this industry may one day mean the difference between victory or defeat in our struggle with the Soviet Union.

The lesson of the 1958 negotiations in the aircraft industry is that organized labor cannot proceed unilaterally toward a solution of this problem. It appears rather that the initiative must rest with the agency that controls procurement. And if it will seize that initiative, we will most certainly support it every step of the way.

Another source of skilled labor supply that should be more fully explored is, of course, the technical institutes and junior colleges. In recent years, there has been encouraging growth in the number of such institutions equipped to train technicians for work in such fields as medicine, electronics, and engineering. But this growth has not come fast enough to keep pace with even our present needs. Therefore, I would also suggest Federal grants-in-aid—and technical scholarships—to stimulate further and faster growth of this type of semiprofessional training. If we, as a Nation, can afford to subsidize scores of private profit groups, we should also be able to subsidize our most precious national resource: the skill of our work force.

Four years ago, the National Manpower Council stated that "The Nation cannot afford to wait until crises compel us to consider how to improve and increase skills. The Nation's welfare requires that long-range programs for development of an adequate supply of skilled manpower be instituted now."

That statement was made in a spirit of urgency. Today that urgency has been compounded.

I think the time has come when we must try again to impress on our political leaders and our industrial compatriots the fact that strategic human skills—unlike strategic metals—cannot be stockpiled or taken out of cold storage when they are needed.

Today, the organized labor movement has many points in its program for the building of a better America. Some objectives are long range—some are short range—but few are more important than getting the right range on this problem of training and preserving the skills of the Nation's work force.

—A. J. Hayes
International Association of Machinists

Labor Implications of Peaceful Uses of Atomic Energy

JOHN I. SAKS*

THE APPLICATION of atomic energy technology to industry affects the work force at many points in regard to job opportunities, employment, and training; safety and health protection; workmen's compensation; working conditions; and labor relations. Implications in these areas of interest reflect the newness of the technology, the uncertainty of its place in the established industrial order, and the unique characteristics of atomic energy applied to peaceful purposes.

Background

The fissioning of the atom makes possible great advances in the conquest of disease, increases in the world's food supply, the provision of cheap power, and the application of atomic heat and radiation energy for technical advances in the industrial arts. The greatest potential gain is in the manifold increase of fuel reserves. During the past hundred years, rapid industrialization, tremendous growth in population, and rises in living standards have led to the rapid depletion of fossil fuel supplies. Fissionable fuels assure the continuance of our modern civilization, which is based essentially on the consumption of vast amounts of energy.

The major areas of peaceful nuclear applications lie in (1) atomic power; (2) atomic propulsion; (3) radiation involving (a) isotopes in industry, agriculture, and medicine, (b) food preservation, and (c) plastics; and (4) space and process heating.

Except for the expanding uses of radioisotopes in industry, agriculture, and medicine, and pilot demonstrations of nuclear ship propulsion, the peaceful applications programs are substantially limited to research, design, and development. Atomic activities for the next several years will consequently be dominated by the existing establishments producing atomic fuels and radioactive source materials, instrumentation, controls, and equipment. Atomic fuels production and basic research and development essentially for military purposes are Government-owned, contractor-operated activities. The privately developed ore extraction and atomic components industries are quite small and substantially dependent on Atomic Energy Commission (AEC) program expenditures.

The short-run effects of atomic development on the Nation's economic structure and work force should consequently be minor. By the end of the next decade, however, anticipated technological breakthroughs will undoubtedly advance the development of nuclear power, maritime propulsion, food preservation and radiation chemistry, and possible other uses, making them competitive between 1970 and 1980.

Economic Implications. The timing and extent of expanded peaceful uses will largely be determined by the effectiveness of the atom technology's challenge to current competitive processes for which they may substitute. Large financial investments and years of developmental effort will be required. Success will depend on the size and quality of the technical research and development programs through which the scientific breakthroughs (and subsequent economic applications) must come. Large outlays of technical manpower and money for this purpose will consequently not be as profitable in the short run as returns from comparable investments in established processes.

In the meantime, traditional industries will grow and continue to advance technologically. With few exceptions, raw and fabricated materials used in atomic applications are generally identical with those used in conventional industries. Hence, increased demands for atomic uses, where these are not simply replacements for conventional industry requirements, may be considered as normal growth for these suppliers. Many manu-

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facturers of heavy industrial equipment and several large-scale chemical producers are actively involved in peaceful atomic research and development and prototype experiments. A significant volume of atomic applications should consequently result only in modified shifts in product emphasis for these organizations.

Radiation Safety Protection

Radiation hazards and safety and health protection are among the most significant implications for the work force in the peaceful uses of atomic energy. These involve complex and somewhat indeterminate standards for those working directly in exposure areas, for other workers indirectly exposed at the place of employment, and for the general public. Related also to worker safety protection are issues of workmen's compensation in the event of radiation injury.

Problems of Radiation Exposure. Radiation, invisible and undetectable to the senses, is a unique industrial hazard. Radiation can penetrate matter in different degrees according to whether alpha, beta, gamma, or neutron particles or rays are absorbed. In some instances, heavy lead shielding or several feet of concrete are not sufficient protection against radiation. Hence, special instrumentation, controls, and monitoring, coupled with basic radiation safety indoctrination and job safety instruction, are necessary to guard the worker against this insidious danger.

The effects of radiation exposure are cumulative. Dosages safe at any one time may prove extremely injurious if repeated sufficiently often. Diseases such as anemia, leukemia, bone cancer, malignant tumors, and genetic damage, thus induced may not become evident for many years or even decades. Among other determinants of the specific degree of injury which an individual may suffer are included the quantities and types of radiation absorbed, the length of time of absorption, the relative amounts of radiation affecting different parts of the body, and the radiosensitivity of the individual.

Understanding the hazards of radiation exposure and the use of safety precautions are consequently basic to the widespread use of peaceful atomic energy. On the other hand, with the proper safeguards, working around radiation need be no more dangerous than working in other industrial processes where safety measures must be properly maintained.

Although relatively few persons currently work in radioactive or "hot" areas in atomic installations and research laboratories, radiation exposure is possible in the course of routine plant operations. Unforeseen exposure may arise because of inadequate monitoring or defects in radiation protective measures, through accidents to equipment or improper precautions in the storage or transportation of containers of radioactive materials. Radiation contamination of outside areas, sometimes miles away from the atomic installation, can develop through the pollution of atmospheric dusts, water supply, or sewage resulting from the discharge of industrial waste materials. The development and application of adequate safety and health standards are consequently of major concern to Federal and State Governments and to labor and management.

AEC Safety Programs. The Atomic Energy Commission has always placed primary emphasis on radiation safety in all atomic program development phases. These include the evaluation from the point of safety of the design of reactors, equipment, and components; the procedures for chemical processing of fuels; the planning and scheduling of plant operations; the medical programs for employees; the selection and training of workers; the use of protective clothing, including respiratory masks; the methods of washing; and the location of eating and smoking areas.

Under the 1954 Atomic Energy Act, the AEC has responsibility for setting safety standards to protect workers and the general public from hazards arising out of its operations or products originating therefrom. It may draw on governmental or other resources for carrying out this responsibility. The AEC has adopted exposure standards, established by the National Committee on Radiation Protection and Measurement, as to permissible levels of exposure to external radiation and also as to concentrations, in water or air, of radioactive materials which may be ingested or inhaled. These standards have been progressively raised, i. e., to reduce permissible exposure limits, as more advanced data have been accumulated. For workers in atomic installations, the permissible exposure dosage is generally less than that received from natural radioactive sources in the earth and from cosmic rays. For the general public, levels are set at about one-tenth of industrial levels.

The AEC develops cooperatively with its contractors appropriate procedures and instrumentation to assure continuous conformity to its adopted safety standards and to maintain records of radiation safety activity. Few workers in the contractor-operated installations are actually allowed to reach the authorized limits, and for workers as a whole, radiation exposure falls well below the set standards.

Early in 1957, the AEC issued its revised "Standards for Protection Against Radiation" which are applicable to the activities of its licensees. To assure conformity to adopted standards, all licensees for the construction and operation of nuclear installations or for the use of licensed materials are subject to periodic Government inspection by the AEC's Division of Inspection. The basic responsibility for adherence to the AEC safety standards, however, rests with the licensee whose operations may be suspended or revoked for nonadherence. About 4,000 licenses had been issued to users of radioactive materials as of March 1957, and the number is increasing by about 15 percent a year.

More than 1,700 of a total employment of 100,000 production and research workers in plants and laboratories of the AEC or its contractors were engaged in radiation protection work at the end of 1956. Specialized personnel numbered 1,060, including physicists, chemists, engineers, meteorologists, radiobiologists, and monitors, and supporting technicians and clerical staff numbered 695. It thus appears that AEC contractors have, on the average, been detailing between 1 and 2 percent of their total personnel to carry out AEC protection standards.

The results of the safety measures are reflected in the excellent record since 1945 of Government-contractor operations. Between August 1945 and July 1956, only 16 radiation accidents involving 69 individual exposures were reported. These accidents resulted in 2 deaths, 1 in 1945 and 1 in 1946, and 19 skin injuries. Most of the other exposures were comparatively minor. In 8 of the 16 cases, only 1 person was involved. The largest single accident involved 28 servicemen who received an unexpected concentration of fallout after a 1954 weapons' test. According to contractor reports to AEC, more than 99 percent of nearly 200,000 workers employed during the 9-year period 1947–55 were exposed to less than 5 rem,[1] or less than one-third of the present permissible exposure limit of 15 rem a year.

Atomic Safety Protection in the Private Sector. The outstanding record of accident prevention in atomic installations is attributable to the precautions observed by the AEC in an uncharted field and the revision of safety limits made in the light of its experience. It also stems from the fact that AEC contractors' safety costs are paid for under Government contract. However, safety-protection cost becomes a very real problem with the prospective large-scale extension of peaceful applications to private, competitive industrial processes.

The character of safety supervision in the transition to peacetime operation may suffer because personnel in private establishments may be less familiar and not as alert in dealing with radiation hazards and because costs in a competitive situation may be a controlling factor. The consequence of inadequate protection because of cost or carelessness has been indicated by the history of medical X-ray uses. As a result of inadequate understanding and lack of effective protective measures over a period of decades, the life expectancy of roentgenologists has been shown to average several years less than that of other medical practitioners.[2]

Federal-State Safety Program Relationships. The announced policy of the AEC in regard to the use of licensed materials is to "observe the traditional relationship between the State agencies and private industry on other types of safety matters." [3] One of the methods used by the Commission to effectuate this policy is to invite the participation of officials of interested local and State agencies in the inspection of atomic installations by AEC field inspectors. The AEC thus hopes to assist in training a body of competent technical inspection personnel. The States are also notified when new

[1] The unit of measure of potential damage to man and mammals by radiation and generally equivalent to that produced by 1 roentgen of X-ray.

[2] Report of the Atomic Energy Committee of the International Association of Industrial Accident Boards and Commissions, 1956, p. 7; see also Biological Effects of Atomic Radiation, Summary Reports (Washington, National Academy of Sciences, 1956), p. 35.

[3] Atomic Energy Commission, 21st Semi-Annual Report, January 1957, p. 130.

licenses for the use of materials are issued to establishments or institutions within their borders. In the case of licensed utilization facilities (currently limited to nuclear reactors), the AEC inspects all stages of construction, the testing of equipment, preoperational test runs, and subsequent startup and operations.

In 1955, the AEC established a 12-member advisory committee of State officials from health, labor, and legal departments. The committee meets about twice a year to discuss such matters as the licensing program, regulations prescribing adequate radiation protection standards, or the need for training local officials in radiological health protection.

Since States have the police power to regulate intrastate health and safety matters, the possibilities of conflict in approach and application of radiation safety standards as compared to the AEC program may exist. The constitutionality of State regulation in the atomic energy area was left somewhat in doubt under the Atomic Energy Act of 1954. Some types of State and local action may be possible even where the AEC exercises its authority under the act. Furthermore, the States alone have responsibility for establishing safety standards for radiological hazards growing out of the use of X-ray machines, radium, and radioisotopes produced by particle accelerators (as distinct from those obtained through fission sources).

The need for a more adequate safety-standards program is underscored by the fast expanding area of uses,[4] the limited staff for inspection by the AEC, and the present scant technical facilities of State agencies. The only alternative at this time is the increasing delegation of safety responsibility to licensees. The review procedures under the present AEC regulations can lead to the modification or suspension of licenses in the event of failure to observe regulations, but only after damage is done.[5]

Workmen's Compensation. Special workmen's compensation issues grow out of the unique factors of nuclear radiation. State laws in this field are generally inadequate. The major deficiencies in State workmen's compensation provisions are the lack of full coverage of occupational diseases, limitations on the time period allowed for filing claims for benefits, and the inadequacy of provisions for medical treatment.[6] The complicated legal question of fixing liability in the event of radiation injuries which may appear several years subsequent to separation from atomic energy employment is still to be resolved.

Manpower Characteristics and Training

The scope and character of manpower and training problems in the atomic field are also of significance in considering labor implications of atomic energy. Employment in all phases of atomic energy activity in the spring of 1957 totaled something over 150,000. About 117,000 workers were employed by the Atomic Energy Commission and its operations and construction contractors—103,000 in operations and over 14,000 in construction. (See table 1.) Rough estimates of the balance were as follows: uranium mining, ore reduction, and refining mills, 10,000; research and development financed by private industry, universities, and foundations, 3,000 to 5,000; design, manufacture, and installation of reactors, vessels, components, and auxiliary equipment, 15,000 to 20,000; instrumentation and isotopic devices, 4,000 to 6,000; and miscellaneous, 3,000 to 5,000.

AEC-Contractor Employment. Total employment by the Atomic Energy Commission and its contractors increased approximately 10 percent between December 1955 and March 1957, but was still more than 20 percent below that of June 1952 when construction activity was at its peak. In March 1957, the bulk of employment was concentrated in the production and refinement of atomic fuels used predominantly for military purposes and Government-controlled research and development operations. That type of employment increased 1½ times between 1949 and 1957, whereas construction employment, which increased about 5 times between 1949 and 1952, was approximately the same in 1957 as it was in 1949. These trends are indicative of the expansion of atomic facilities. With the recent completion of new major AEC production installations at Savannah River, S. C., Paducah, Ky.,

[4] 1957 Hearings before the [Congressional] Joint Committee on Atomic Energy, Pt. I, Sec. 202, Statutory Hearings, p. 101.

[5] Atomic Energy Commission, op. cit., p. 129.

[6] See Workmen's Compensation and Radiation Hazards (in Monthly Labor Review, April 1957, pp. 455–459).

and Portsmouth, Ohio, and very large additions to the Oak Ridge, Tenn., and Hanford, Wash., facilities, it is reasonable to expect that operations employment will expand still further.

Based on the general nature of the processes and the types of equipment used, the structure and characteristics of the AEC-contractor work force are most comparable to those in the inorganic chemicals and the petroleum and coal products industries. The bulk of the personnel consist of skilled and semiskilled chemical-process operators, service and maintenance mechanics, and a significant proportion of technical and managerial staff. Atomic installations, however, also employ large numbers of guards, because of the relationship of these plants to national security, and significant numbers of atomic health and safety personnel for protection against radiation hazards.

Most of an atomic plant's personnel are inexperienced and locally recruited at the time of hiring. Where no apprenticeable craft skill is involved, production and service workers are routinely trained on the job. The normal large-scale manufacturing activity characteristics which the atomic fuels and byproducts processing plants appear to have acquired, are reflected in the hours, earnings, and turnover statistics of the AEC-contractor operations. Atomic energy installations compare very favorably with all manufacturing and with industrial inorganic chemicals at all points and only fall slightly below the products of petroleum and coal where stable and profitable oil refinery activities are a dominant factor. (See table 2.)

AEC Installations Work Force Experience. The routinization of atomic production operations is borne out by the experience at the four AEC installations at Oak Ridge, Tenn., and Paducah, Ky. The Union Carbide Nuclear Corp., the operating contractor, assumed responsibility in 1943 at the Oak Ridge gaseous diffusion plant (ORGDP), in 1947 at a second Oak Ridge plant (Y–12, electrochemical byproducts), in 1948 at the Oak Ridge National Laboratory (ORNL), and in 1950 at the Paducah gaseous diffusion plant (PGDP).

Employment at the Oak Ridge plants showed a consistent downtrend from 1947 through 1950, but increased significantly from 1951 to 1954 as large additions were made to existing facilities. Modifications in employment levels in 1955 and 1956 are presumably a result of more effective use of the new facilities. Employment at Paducah has continued substantially unchanged since normal production activity levels were reached in 1952. (See table 3.)

Hourly paid craftsmen, production, and maintenance workers in the 3 production plants made up between 57 and 70 percent of the payroll in December 1956. (See table 4.) Large numbers of security guards and clerical and service personnel made up the weekly paid group of workers. At the ORNL, the different distribution reflects

TABLE 1.—*Employment of Atomic Energy Commission and contractors, 1949–57*

[In thousands]

Date	All employment	Atomic Energy Commission employment	Contractors' employment					
			Total	Operations				Construction
				Total	Production	Research and development	Other	
1957: March	117.0	6.6	110.4	96.2	50.9	39.4	5.9	14.2
1956: December	115.6	6.6	109.0	93.8	50.0	37.9	5.9	15.2
June	110.2	6.6	103.5	90.2	49.7	34.2	6.4	13.3
1955: December	106.1	6.2	99.9	85.7	48.7	30.6	6.3	14.2
June	112.6	6.0	106.5	82.9	48.0	28.8	6.1	23.6
1954: December	130.7	5.9	124.8	78.1	44.2	27.6	6.3	46.7
June	141.9	6.1	135.8	73.3	39.5	27.6	6.3	62.5
1953: December	146.5	6.3	140.2	71.7	38.7	26.9	6.1	68.5
June	148.8	6.9	141.9	71.8	37.1	28.8	5.9	70.1
1952: December	142.8	6.8	136.0	63.4				72.6
June	149.4	6.7	142.7	58.1				84.6
1951: December	124.2	5.8	118.4	52.4				66.0
June	99.1	5.6	93.5	47.8				45.7
1950: December	73.3	5.1	68.2	42.1				26.1
June	63.7	4.9	58.8	39.1				19.7
1949: December	56.6	4.8	51.8	37.2				14.6

NOTE: Because of rounding, sums of individual items do not necessarily equal totals.

SOURCE: Atomic Energy Commission.

TABLE 2.—*Hours, gross earnings, and labor turnover rates of production workers in Atomic Energy Commission and contractor establishments and selected industries, February and March 1957 and March 1956*

Industry and date	Average weekly hours	Gross average hourly earnings	Gross average weekly earnings	Accession rate—	Separation rate—
				Per 100 employees	
AEC and contractors:					
March 1957	40.5	$2.52	$102.22	1.6	1.3
February 1957	40.8	2.52	102.73	1.6	1.2
March 1956	41.1	2.42	99.54	1.6	1.5
All manufacturing:					
March 1957	40.1	2.05	82.21	2.8	3.3
February 1957	40.2	2.05	82.41	2.8	3.0
March 1956	40.0	1.95	78.78	3.1	3.6
Industrial inorganic chemicals:					
March 1957	40.9	2.39	97.75	1.6	1.9
February 1957	40.9	2.37	96.93	1.5	1.5
March 1956	41.0	2.28	93.48	1.5	1.6
Products of petroleum and coal:					
March 1957	40.6	2.58	104.75	.9	1.1
February 1957	40.8	2.56	104.45	.9	.8
March 1956	41.2	2.52	103.82	.9	.7

SOURCE: Atomic Energy Commission and Bureau of Labor Statistics.

the much larger emphasis on research and development, with correspondingly increased proportions of professional and technical staff.

The number of women employed was not significant. Of the 1,887 women employed, only 217 were production workers. However, the limited employment of women in basic atomic production and research activities—12 percent of the total jobs in these 4 plants—compared favorably with female employment participation in industrial inorganic chemicals (8 percent) or products of petroleum and coal (7 percent).

Generally, work at basic atomic installations does not appear to call for special aptitudes or unique industrial backgrounds except in research and development and in some limited specialized operations. This is indicated by the recruitment experience and the worker educational achievement level at the AEC-Union Carbide Nuclear plants. No difficulties were reported in obtaining local labor for basic production operations at these semirural plant sites, nor in training them effectively on the job despite a lack of previous factory experience. At Paducah, 15 percent of all employees had less than a high school education; at ORNL, 20 percent, at ORGDP, 40 percent, and at Y-12, 42 percent. At these latter 2 plants, over 20 percent had had only a grade school education or less.

The weighted average length of service at the end of 1956 was 8.2 years at ORGDP, 6.7 at ORNL, 6.0 at Y-12, and 4.5 at Paducah. Since major personnel additions were made at the Oak Ridge plants after 1950 and Paducah began operations only in 1951, these average periods of service point to a very considerable degree of stability in employment.

The apparently satisfactory character of atomic installation working conditions is also reflected in part in the distances a large proportion of the workers are willing to commute. Fifteen percent of the ORGDP personnel, 9 percent of those at the Y-12 plant, 11 percent at ORNL, and 21 percent at Paducah travel 20 miles or more each way. Four percent of the workers at ORGDP commute 40 miles or more in each direction daily. A major factor may be that these are by far the largest sources of well-paying job opportunities in the area and thus attract rural job seekers within a wide radius.

According to records of exit interviews, voluntary quits because of transportation, housing difficulties, health problems, or dissatisfaction with earnings, hours, or working conditions were negligible.

The accident records at these atomic installations are likewise illuminating in regard to safety as a consideration in expanding future atomic industry employment. During 1956, there were no fatalities or permanent total disabilities in 3 of the plants and only 2 such occurrences in the fourth. Total accident frequency rates per million hours worked for the calendar year 1956 were: ORGDP, 1.72; Y-12, 2.27; ORNL, 0.55; and Paducah, 1.87.

New Atomic Occupations. The character of the manpower requirements involved in atomic reactor construction and operations, in the reprocess-

TABLE 3.—*Employment trends at AEC-Union Carbide Nuclear contractor plants, 1947–56*

Date	Oak Ridge plants				Paducah gaseous diffusion plant
	Total	Gaseous diffusion	Electrochemical byproducts	National Laboratory	
December 1956	14,068	5,382	4,950	3,736	1,761
December 1955	14,282	5,466	5,348	3,468	1,755
December 1954	14,959	6,128	5,520	3,311	1,680
December 1953	13,729	6,206	4,389	3,134	1,792
December 1952	12,770	6,084	3,522	3,164	1,563
June 1952	12,572	5,594	3,732	3,246	[1] 771
June 1951	10,850	4,700	3,125	3,025	
June 1950	8,078	3,932	1,806	2,340	
June 1949	8,230	4,412	1,784	2,034	
June 1948	9,769	5,201	2,223	2,345	
June 1947	10,266	5,579	2,404	2,283	

[1] Employment as of December 1951.

SOURCE: Union Carbide Nuclear Corp., Eighth Annual Industrial Relations Report, 1956.

ing of fuels, in the uses of radioactive isotopes, and in the manufacture of atomic instrumentation, calls essentially for modifications in existing skills. There are relatively few new occupational titles and these are associated predominantly with technical research, design, and development, as the nuclear physicist, and with radiation health protection where health physicist, radiation analyst, radiation monitor, and decontamination technician are identifiable. At the operating level, there are the coolant tester, heliarc welder, and reactor operator.

In-plant radiation safety measures are under the control of specially trained health physicists who generally are also responsible for worker safety training and monitoring of the environment to assure adequate protection for the outside public. Worker safety training includes indoctrination and education programs including health physics lectures, pamphlets, etc. The health physicist, an occupational specialty growing directly out of atomic safety requirements, has usually had postgraduate work in theoretical and applied physics.

The radiation analyst, a subprofessional who works under the health physicist's direction, is qualified to evaluate hazards and make remedial recommendations. He in turn may supervise the radiation monitor who performs a more routine function of operating devices to measure the amounts of radioactivity which might be present in areas of possible exposure. The monitor may also function as part of a decontamination crew or combine the monitoring function with routine nonradiation protection activities. The decontamination technicians act to clean up an area after radiation leakage has raised the radiation level to a point where corrective safety measures must be taken to protect personnel and equipment.

Coolant testers are very few in number and are engaged solely on testing the effectiveness of liquid metal coolants for use in certain types of reactors. These workers are readily trained on the job. Heliarc welders, using an inert gas welding process on metals, are essential in the construction of reactors and auxiliary facilities. Although large numbers may be needed on major atomic projects, ordinary welders with several days' instruction, and other workers with a very few weeks of special training, can usually meet nuclear

Table 4.—*Distribution of employment in AEC-Union Carbide Nuclear contractor plants, by time basis of compensation and sex, December 1956*

Item	All plants	Oak Ridge plants			Paducah gaseous diffusion plant
		Gaseous diffusion	Electro-chemical byproducts	National Laboratory	
All workers	15,829	5,382	4,950	3,736	1,761
Men	13,942	4,693	4,454	3,184	1,611
Percent of total	88	87	90	85	91
Women	1,887	689	496	552	150
Percent of total	12	13	10	15	9
Hourly paid workers	8,590	3,059	3,425	1,030	1,076
Percent of total	54	57	70	27	61
Weekly paid workers	3,269	1,164	662	1,147	296
Percent of total	21	22	13	31	17
Monthly paid workers	3,970	1,159	863	1,559	389
Percent of total	25	21	17	42	22

Source: Union Carbide Nuclear Corp., Eighth Annual Industrial Relations Report, 1956.

construction specifications. Reactor operators are licensed to operate the controls of a reactor panel. This function, originally performed by graduate engineers or scientists, has been progressively downgraded so that high school graduates can be trained on the job and can qualify for AEC licenses. Readily trainable service or production occupations in atomic activities which may take on greater significance, depending on the numbers and types of reactors in use, are the reactor assembler and fuel-element assembler.

Craft Training Requirements. In general, production and craft skill characteristics are identical with those found in related chemical, metalworking, or the construction industries. Craft specifications are, however, far more exacting in the manufacture, installation, and maintenance of material and equipment subject to possible radiation contamination, requiring far more precision work and the development of special methods for handling and working with atomic materials and equipment. This is imperative to provide adequate shielding and leak-proof fittings and joints. Existing craft practices consequently need reexamination in the light of these new circumstances.

Plumbers, pipefitters, machinists, millwrights, boilermakers, machine-tool operators, electricians, and welders are especially affected by this consideration in atomic reactor construction and operating maintenance. Such skill modifications and their extension into new areas of activity call for certain changes in existing craft training. In the short run, much of this training will be in-plant adaptation of the existing pool of skills to the more exacting requirements. In the longer run, changes will be made in organized training programs, including expanded apprenticeship or combined vocational instruction and on-the-job training under the supervision of experienced craftsmen.

Some unions are reorganizing their apprenticeship training programs to take cognizance of the types of performance standards and work specifications required in the atomic field. Millwright, pipefitter, and boilermaker unions have obtained AEC access permits to classified information so as to study the impacts of the new technology on their craft activities.

Professional Manpower Problems. The principal manpower problem in atomic energy development is clearly the shortage of professional skills.[7] Trained engineers and scientists are needed in pure and applied atomic research and development and, to a lesser degree, in nuclear applications. Technical progress in peaceful applications is directly tied to the expansion in numbers of professionally trained personnel devoted to further research and development.

According to the AEC, in September 1956, 19,000 engineers and scientists were employed among the 113,300 workers engaged in its activities. Excluding the 14,800 workers in contract construction, they represented approximately 19 percent of operations, research, and development employment of the AEC contractors. In the specialized national atomic research laboratories where the bulk of the technical developmental activity is concentrated, about 30 percent of the employment consisted of professionally trained specialists.

More than half of all the technicians employed in the AEC program are chemical or mechanical engineers. One-third are physical scientists, mostly physicists and chemists. The remaining one-sixth are biological, medical, and other miscellaneous scientists. This group of professional workers is supported by at least an equal number of technical aids, research and laboratory assistants, and other subprofessional personnel.

The atomic energy industry needs a large, continuing supply of engineering and scientific graduates who would customarily acquire nuclear competence on the job or through supplementary graduate training courses. In the face of national shortages and the keen competition from all other areas in the economy which seek comparable types of professionally trained personnel, satisfying this need constitutes a major problem.

Labor Needs of Atomic Peacetime Uses. Since power is prospectively the largest single peaceful application of atomic energy, its manpower requirements are of particular interest. The AEC roughly estimates that 44,000 workers, including 2,300 engineers, would be needed to operate atomic plants of 175 million kilowatts capacity.[8] This figure is limited to the nuclear heat production function. The manpower for the electricity generation and distribution operations would remain the same for both atomic and conventional type power plants.

This estimate is generally regarded by private power and equipment industry experts as being at least one-third too high, principally because it is based on a manpower staffing pattern used at an AEC reactor, designed and operated for entirely different (nonpower) purposes. Furthermore, they maintain that the introduction within the next 25 years of the largest conceivable nuclear power program will not require the net addition of even such modified manpower estimates. Regardless of source, these estimates need to be offset by the staff which would otherwise have been employed in modern, efficient, conventional type plants for which atomic produced heat will substitute. It is conceivable that with advanced nuclear design, manpower requirements may even be reduced further to some limited degree.

Isotopes in industry have not created any identifiable change in manpower requirements. Users of isotopic control and measuring devices in continuous process industries such as rubber, paper, and cigarette manufacturing claim that they produce large dollar savings brought about by increased efficiency of operation through quality controls, and reduction of wastage, but such

[7] Hearings, op. cit., pp. 12, 13, and 97.

[8] Report of the McKinny Panel to the [Congressional] Joint Committee on Atomic Energy, February 1956, Vol. II, p. 545.

devices have not resulted in the technological displacement of currently employed workers. On the other hand, their use has not created additional manpower needs.

The manufacture, assembly, and installation of the essential atomic instruments, gages, and other devices will create limited demands for additional scientific instrument makers, calibration technicians, lens and gage grinders, etc. The largest increase in this relatively small industry's demands, however, will be in the number of semiskilled assemblers, who can be readily trained on the job.

Atomic Energy and Organized Labor

Organized labor's other interests in atomic energy involve (1) conditions of collective bargaining, (2) interunion jurisdictional matters, and (3) development of worker and public understanding and acceptance of industrial atomic applications.

Collective Bargaining. Certain aspects of atomic labor relations are unique. Nuclear industrial technology emerged as a wartime crash program completely dominated by national defense and security considerations which led the Federal Government to request the unions to refrain from organizing activity and introducing collective bargaining procedures. Only in 1946 did unions win representation rights at Government-owned, contractor-operated atomic installations.

The threat of a strike in 1948 at Oak Ridge, Tenn., led to the establishment by the President of the United States of a labor relations panel for the atomic energy installations.[9] This panel with some modifications made in September 1953, and some additional minor changes in January 1957, may, with the consent of the parties involved, exercise jurisdiction over disputes which threaten to disrupt essential aspects of the atomic energy program. Under the present operational procedures, unions and contractors at AEC installations are expected to negotiate on normal aspects of working relationships (that is, exclusive of security matters) and to make every effort at peaceful settlement of disputes through collective bargaining and full use of the Federal Mediation and Conciliation Service.

The panel's special role is to aid in voluntary settlement only after it is felt that all other procedures have been exhausted and the AEC has determined that a stoppage would have very serious consequences on the program. While the panel has jurisdiction and for 30 days thereafter if it issues recommendations for settlement, the parties to the dispute are to continue existing terms and conditions of employment. If the panel fails to issue recommendations, or if either party rejects the recommendations which may be issued, the parties are free to take further action. From July 1953 to March 1957, 32 cases were heard by the "Ching" panel as compared with 61 cases handled by the earlier "Davis" panel (named after their respective chairmen, Cyrus Ching and William H. Davis).

The AEC has a very immediate interest in all labor-management negotiations at atomic installations because of the special factors of Government ownership of plant and materials and the necessity for continuity of production at certain vital installations. It reserves to itself absolute and final authority on questions of security—an issue of considerable contention in the process of developing effective collective bargaining. The AEC also is in the peculiar position of being a silent third partner to labor-management negotiations since it "reviews labor expenses under cost-type contracts as a part of its responsibility for assuring judicious expenditure of public funds." [10]

One difficulty, suggested by the president of the AFL–CIO Metal Trades Department and other observers, is the lack of economic pressure felt by the management side.[11] The contractors have no capital investment in the installations, do not compete for customers, and lack the motive of profits or the fear of loss as the basis for settlement since they operate on a cost-plus-fixed-fee AEC contract. Thus the strike as the ultimate economic weapon lacks much of its private industry effectiveness.

The history of labor relations in AEC installations has been reasonably smooth partly because of organized labor's recognition of the special national interest in these activities and, according to management, partly because of a certain degree

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[9] See Panel to Handle Atomic Energy Plant Disputes (in Monthly Labor Review, June 1949, pp. 661–662).

[10] General Policy Statement of the U. S. Atomic Energy Commission Relative to Contractor Personnel Management and Labor Relations, 1955.

[11] President's Report, Proceedings to the 46th Annual Convention of the Metal Trades Department of the American Federation of Labor, November 28, 1955, pp. 6–7.

of pressure exercised by Government on contractors to reach settlements which in their private operations might not be so readily acceptable. Lengthy work stoppages at a Hanford, Wash., construction project and at an AEC contractor operation in Buffalo, N. Y., nevertheless did occur in the summer of 1956—basically over wage and other payment differentials. [EDITOR'S NOTE.—A Portsmouth, Ohio, facility dispute ended a day before an 80-day injunction, obtained under the national emergency provisions of the Taft-Hartley Act, expired on August 3, 1957.]

Agreements between operating unions and AEC contractors generally do not contain detailed clauses which are uniquely concerned with conditions of work at atomic installations, although reference is frequently made to the establishment and administration of plant safety programs. Some of these programs emphasize joint labor-management participation on plant safety committees; others require the employer to maintain an adequate safety program including appropriate clothing, devices, and equipment, and the workers, under penalty of caution or discharge for noncompliance, to adhere to the safety regulations; more commonly, clauses state that workers are to be available for medical checkups as determined by management. In general, these safety and health provisions are not so different from those found in labor-management agreements in heavy industry. Clauses which require security clearance as a condition of employment are comparable to those in other defense connected activities.

Some of the AEC contractor operations, being intimately associated with basic national defense interests, are substantially similar in that regard to other military end-products activities such as ordnance and aircraft production. Hence, conditions of collective bargaining which apply in these defense-related industries might be considered as largely applicable to some Government atomic activities. Under such conditions, the essentiality of continuity of operations would be determined on the basis of the particular activity involved and current defense needs. Thus, though strikes have occurred in AEC construction and component installations during the past decade, they have not resulted in the consequences which were once thought inevitable. It might be concluded that normal collective bargaining processes should be permitted in these installations, with necessary safeguards written into the agreements to protect property and processes and to carry on certain essential maintenance functions in the event of failure to reach satisfactory settlements.

In the widening area of peaceful applications in the civilian economy, there is no basis for any modification in normal collective bargaining procedures other than the assurance that basic safety procedures will be maintained at points affected by work stoppages.

Interunion Jurisdictional Problems. Many of the labor relations issues involve interunion work jurisdictions. Jurisdictional problems will continue to grow as a result of the very fluid nature of the evolving atomic technology. The changing craft requirements due to the greater precision specifications in atomic activities will tend to narrow the established divisions between organized crafts. They may lead to possible overlap as, for example, between boilermakers and pipefitters, or between millwrights and machinists.[13] Satisfactory and lasting settlements of such issues will be slow in coming because of the dynamic character of the technology. As additional advances are made and new materials, tools, equipment, and operating methods are brought into use, jurisdictional conflicts may become acute. Some of the established interunion jurisdictional agreements are presently being revised. Added familiarization with the technology and standardization of nomenclature in atomic applications may help minimize the number of potential disputes.

Worker and Public Acceptance of Atomic Energy. Organized labor's leaders who are concerned with the possible impact of peaceful atomic developments on the civilian economy are facing, along with industry and government, the basic problem of securing widespread worker and public acceptance of atomic energy as a characteristic of normal, everyday life. Some feel that the problems of general public education and worker acceptance of the hazards of atomic plants are separate matters. In the latter situation, it is argued, conditions differ only in degree from other types of industrial activity risks, for example, in mining, explosives manufacture, and oilfield operations.

[13] Charles F. MacGowan, International Brotherhood of Boilermakers, before the Atomic Industrial Forum, San Francisco, April 5, 1955.

Adequate radiation safety protection in all situations involving atomic applications are naturally assumed to be a prior condition for their introduction into the civilian economy.

The elimination of many public misconceptions about atomic energy can be accomplished through widespread dissemination of adequate and accurate information. On the general issue of public-worker education, the AFL–CIO top leadership has recommended the establishment of a statutory Labor-Management Advisory Committee to the Atomic Energy Commission to advise on the development of sound atomic labor relations and to assist in bringing about public understanding of peaceful atomic uses through labor's organizational and related media.

[The areas of AEC influence on atomic energy installation policies are the following:]

First, we [the AEC] recognize that it is a role of government to assure that wages, hours, safety regulations and working conditions are adequate in terms of the general welfare, and not substandard in relation to normal industrial practices. Second, with all costs reimbursed by the government, there is no profit incentive to economical operation. Government must assure that public funds are expended judiciously. Clearly we will not substitute our judgment for that of the contractor as to a particular wage rate or working condition. But we do see that the general level of wages is not stratospheric, and that conditions in our plants are not unstabilizing in relation to other plants. Third, we recognize a specific role in enforcement of certain labor laws—more specifically, the Davis-Bacon and Eight Hour laws, as well as the executive order on nondiscrimination in employment. Fourth, we accept a rather specific and paramount role in relation to security of information and of plant.

A fifth area relates to disputes settlement. With well over 90 percent of our effort, in terms of both dollars and people, directed at defense needs, continuity of production is important.

—Oscar S. Smith, Obligations of Government as Owner, Financier and Consumer in Relation to Collective Bargaining (in Labor Law Journal, Chicago, November 1956, pp. 684–685).

Workers' Health in an Era of Automation

Editor's Note.—*The article which follows was excerpted from a paper presented by Dr. C. Richard Walmer, Managing Director of the Industrial Hygiene Foundation, at the Industrial Relations-Production Conference on "Impact of Automation" sponsored by the Industrial Relations and Production Committees of the Industrial Department of the Chamber of Commerce of Greater Philadelphia, on April 4, 1956. Suspension marks to denote unused portions of text have been omitted in the interest of easier reading. The complete paper appeared in the May 1956 issue of Industrial Medicine and Surgery.*

Automation is more than just a word to describe new techniques for mechanically accomplishing work in our plants and offices. Automation signifies a whole new way of life, involving biosocial values as well as technological ones. It will change the living and working habits of people, alter educational patterns in our schools, and raise our standard of living to new heights. This paper is concerned with the effects of these developments [in the field of industrial health].

Industry's Stake in Health Maintenance

The state of health of an individual is determined by a complex combination of factors involved in his adjustment to his total environment. When that environment faces alteration, it is human nature to feel uneasy. In the era of automation, the anxiety of employees is one of the human relations problems which will arise, and these are closely allied to the health and well-being of the worker. Other aspects of automation will bear more directly on the physiological status of the worker, but it is the sum total of all problems, both physical and emotional, which determines the total health picture of an individual.

Anticipation of these problems is as essential to advance planning for automation by industries as are the engineering blueprints and the management studies to determine the economic feasibility of such a move. A company's employees have always been its most valuable assets, and automation is not going to change this. In fact, more responsibility will be vested in employees than heretofore. A larger number of technical jobs, including maintenance and repair of the complex machinery and monitoring of automatic equipment, will call for greater skills and more training and education. Management personnel will be called upon to make major decisions. Errors in judgment [will] be extremely costly.

In addition, each employee will represent a much larger capital investment than heretofore. In 1954, the capital investment per worker in the chemical industry, which is highly automated, was twice that of industry as a whole, or $26,000; and in some plants it is considerably more.[1] The present investment per employee in the electric power generation industry, which is almost completely automatized, is in excess of $106,000.[2]

Thus, automated industry will have an even higher stake in maintaining the health of its workers. Illness not only disrupts production while workers are absent but results in a loss of efficiency during the periods when the worker is on the job but is not feeling well.

The Preventive Medicine Approach

Regardless of the method of manufacturing, there is one approach to health maintenance which is good management policy, and that is preventive medicine. Preventive medicine is concerned with the total physical and mental well-being of the worker, both on the job and at home. Modern methods of environmental control have greatly reduced the possibility of occupational disease and injury. One of the Industrial Hygiene Foundation's member companies has reported a reduction in on-the-job injuries of 63 percent in the

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[1] Automation: Feedback to a Better Economy. (*In* Chemical and Engineering News, October 31, 1955, p. 4648.)

[2] Clyde Williams, Trends in Industrial Research. (*In* Battelle Technical Review, September 1955.)

past 5 years, and this is not an exceptional case. Automation will further eliminate occupational hazards; but nonoccupational injuries and diseases account for 90 percent of absenteeism.

Even the most comprehensive medical program will be less costly than worker absenteeism, [with the resultant] higher operating costs because of substitution of perhaps untrained personnel, spoiled products, higher disability [compensation], increased group hospital and surgical insurance payments, and many intangible losses. Such a program in no way infringes on the general practice of medicine. Industry and its physicians have the opportunity to discover physical conditions which might have gone unnoticed and untreated, and such cases are referred to the worker's personal physician. Also, through health counseling and education, the worker can learn to take better care of his health and to avoid injury. The source of nine-tenths of the accidents are to be found in man's constitution and behavior when confronting the machine.[3] Thus, protecting the overall health of the employee serves the double purpose of keeping him on the job and making him a safer, more efficient worker as well.

Implications of Automation for Health Programs

Let us [consider] the ideal industrial health program as many leading companies have it today and see how it fits the requirements of the automated industry, what adaptations will have to be made, and how they can be accomplished. [It should be noted, however, that] we have very limited experience on which to base an evaluation of the medical needs connected with continuous processing methods of manufacturing.

Environmental Conditions. In the ideal plant, atmospheric contaminants are well controlled. Industrial hygienists keep a constant check at all operations where industrial dusts or toxic fumes or gases are a threat. The harmful properties of all raw materials used in the manufacturing process have been determined through biological tests. The industrial physician is also well acquainted with the specific hazards encountered in his company and with the physiological effects of exposure [to them]. Engineers have employed [atmospheric] control measures in the design of machinery and in ventilation and air-conditioning systems. The same attention is given to ridding the work environment of radiant heat and of noise. Where hazards cannot be completely eliminated, protective clothing and equipment are standard requirements for each worker.

Automation will provide the solution to many such environmental health problems. Workers will no longer be exposed to air contaminants since manufacturing operations will be enclosed. In many cases, workers stationed at control panels [will be] completely isolated from the actual processing area [and] such factors as ventilation, temperature, humidity, and noise [will] no longer affect his performance. In fact, control criteria in fully automated factories are such that the standards of air cleanliness with respect to dust for successful operation of the equipment are far more critical than those for humans. Automation eliminates much of the actual contact between workers and materials, making possible [the] use of ingredients formerly too toxic to [be handled] safely.

In the rubber industry, [for example], raw materials proceed from bins through scales and into the mixer without manual handling. [The industry hopes] to devise automatic machinery to reduce all mixed stocks into pellet or [viscous] condition so [they] can be conveyed to bins over automatic mills for feeding extruders or calenders.[4]

[To cite another example] in one plant manufacturing large metal containers which required manual soldering of side and end seams, resulting in an exposure to lead and solvents, automatic equipment was installed which permitted better ventilation and completely eliminated exposure to the toxic materials. Not only was the workers' health protected, but a superior product was achieved.[5]

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[3] G. Friedmann, The Emergence of the Human Problems of Automation, The Free Press, 1955.

[4] Automation in Rubber Manufacturing, Report of a Symposium sponsored by the Akron Rubber Group, October 28, 1955. (*In* Rubber Age, December 1955.)

[5] C. Richard Walmer, Worker Welfare in the Era of Automation, Special Report No. 7, American Management Association, New York, 1956.

While automation will relieve the [dangers of] day-to-day chronic exposures to toxic materials, there still exists the danger of catastrophic exposures due to ruptures in the lines or of acute exposures where maintenance work is involved. Workers accidentally and drastically exposed to toxic materials will require special and prompt treatment.

Nor will automation eliminate the need for investigating toxic properties of new products before introducing them on the market or, better yet, in the development stages. Where harmful properties cannot be eliminated, codes must be set up for the safe handling and use of the product by the public.

Accident Prevention. Automation will also materially lighten the safety department's task [with respect to the] prevention of physical injury. It will release men from dangerous jobs, and consequently will eliminate most of the traumatic injuries. With true automation the worker seldom, if ever, comes in contact with the machinery. Manual handling of heavy stock in the loading and unloading of machines and in the transfer of stocks within the plant is also eliminated so that there is no danger of physical strain, or injuries such as crushed feet. The Ford Motor Co.'s experience indicates an 85.5-percent reduction in the number of hernia cases where automatic equipment has been installed.[6]

Automation, while not eliminating the need for decisions by human beings, replaces some of man's sensory apparatus in connection with the operating functions of the machine and thus relieves the chance of error in human perception, which is too often affected by such factors as mental stress and physical fatigue. Man no longer needs to pace himself to the rhythm of the machine, a rhythm which may be an unnatural one and result in tension and possible accidents. He does not even need to strain to catch faulty production; for example, in textile weaving operations, safety devices on automatic looms disconnect the machine at the least accident.

Effect on the Medical Department

What effect will [automation] have on the functions of the [industrial] medical department? How can industrial health specialists anticipate the health problems that may be caused by automation in industry? Certainly even less staff time will be required for the treatment of injuries and for traumatic surgery in view of the reduction in safety hazards. But the modern concept of [the] industrial health [program]—prevention rather than cure—will be more important than ever. Industrial psychiatry, health counseling, selective placement through evaluation of the applicant's physical and mental condition—all become important responsibilities of the industrial medical program.

Preplacement Physical Examination. The keystone of a good health-maintenance program in industry is the physical examination, beginning with the preplacement examination, followed up by periodic and special studies. Not only does [the preplacement examination] uncover physical defects which often can be corrected if caught in time, but it assures that an employee will be placed on a job commensurate with his physical and mental ability. Where employee and job are ill matched, the work will not be a source of satisfaction and will create tension and stress in the employee. The preplacement examination is also important, for record purposes, in establishing the degree of injury or disease present at the time of [hiring], since 42 States have "second injury" [provisions in workmen's compensation laws] which make the employer liable only for the [proportion of a worker's disability that is attributable to] newly acquired damage and not for the total disability.

Anatomical or physiological requirements for work in automated industries can be revised. Certainly physical strength will play a lesser role in the production scheme, making possible the

[6] John B. Stirling, Automation, Safety's New Ally, National Safety News, February 1955.

employment of many handicapped or aging workers. It is important that [these groups] be provided for in our economic structure.

Periodic Examinations. The relationship of work to the stress disorders will most concern industrial physicians henceforth. Up to now industrial physicians have looked for the greatest symptoms of stress disorders [e. g.,] heart trouble, high blood pressure, and ulcers, among the executive group. With automation the number of skilled and professional workers will greatly increase. The periodic physical examination in these early days of increasing automation can provide industrial physicians with valuable information as to the degree of occupational stress automation is having on its workers. This type of examination is an excellent tool for keeping abreast of changing industrial health problems and makes possible the further extension of preventive medicine.

The worker will be relieved of the dirty, backbreaking jobs, [and] unpleasant working conditions; he will be taken away from the repetitive, monotonous, highly specialized tasks such as those found on the assembly line. He must, on the other hand, be prepared to fill the requirement for upgrading to semitechnical jobs, such as [machinery] maintenance and repair, and supervisory posts. The challenge may prove [to be] a strain, although for many employees, retraining will solve the problem.

The industrial physician must carefully weigh the stresses of the job against the human capacity of the individual. The periodic examination is the best means for keeping the two in balance and avoiding a breakdown in the health of the worker.

Health Counseling and Education. By making available to employees health educational advice and [literature] on such subjects as home safety, nutrition, and sanitation, industry serves to cut down on nonoccupational illnesses and injuries. into the mixer without manual handling. [The industry hopes] to devise automatic machinery to reduce all mixed stocks into pellet or [viscous] time can affect his health picture. Such interest in the welfare of the individual need not be paternalistic and can be an instrument for good industrial relations. Good morale can be most effective in preventing frustrations and maladjustments.

This new emphasis on preventive and constructive medicine calls for increased attention by our medical schools to the health problems facing industry. Not nearly enough attention is being devoted to preparing physicians to administer health maintenance programs in industry.

Human Engineering. Automation will require that all physicians, both those in industry and those in private practice, know much more about the tolerance of the human organism to the stresses of occupation. Despite the fact that man will be required less and less to work jointly with a machine in the production of goods, the need for attention to [human] stress-strain problems in planning the work facilities and the working environment is not eliminated. Instrument dials and other control panel components at which the employee in the automated industry will work must be designed with the physiological capacities of man in mind.

Summary

Automation will make possible a greater humanization of industry. The working environment will undoubtedly be safer [and] healthier, and many of the hazards will be completely eliminated. Any new medical problems which arise can be coped with by adhering to the principles of preventive medicine, utilizing the knowledge and techniques of industrial health specialists in all the professional fields.

Part II.

Effects of Automation on Industrial Relations in General and on Specific Collective Bargaining Relationships.

The Effect of Automation on Industrial Relations

By itself, the word "automation" has more romance than meaning. When we try to go behind the word itself and describe the kind of technological change it represents, we quickly come up against complexity and vagueness. Nonetheless, there seem to be three quite distinct developments which together embrace nearly everything that can be brought under the automation rubric.

1. The linking together of conventionally separate manufacturing operations into lines of continuous production through which the product moves "untouched by human hands." This first development, which depends primarily on mechanical engineering for its adoption, we shall refer to simply as integration, a term already in wide use in the metalworking industries.

2. The use of "feedback" control devices, or servomechanisms, which allow individual operations to be performed without any necessity for human control. With feedback, there is always some built-in automatic device for comparing the way in which work is actually being done with the way in which it is supposed to be done and for making, automatically, any adjustments in the work process that may be necessary. This second development we shall refer to simply as feedback technology; it is dependent primarily not on mechanical but on electrical engineering knowledge and techniques.

3. The development of general- and special-purpose computing machines capable of recording and storing information (usually in the form of numbers), and of performing both simple and complex mathematical operations on such information. We shall refer to this aspect of automation as computer technology; it rests primarily on new developments in electrical engineering.

Areas of Industrial Relations Affected

Some of the ways in which automation will affect industrial relations will obviously depend on the speed and mass with which it strikes the economy. It is less likely to come as a tidal wave than as a succession of ground swells that will reach different industries at different times and with quite different impacts. Most affected industries will probably have quite a bit of time in which to think through the labor problems automation will create and to plan whatever adjustments may be necessary. It is often possible to do things over a period of time that could not be managed if they had to be done overnight, such as letting attrition work off the surplus labor or retraining key employees.

There are also likely to be some effects on labor relations which are independent of the speed with which automation comes; for example, the upgrading of the level of skills required in the labor force and the reversal of the past trend toward more specialized, more routine, and less interesting jobs. These two examples suggest that automation will not confront us solely with "problems" in the labor field, but will confer some benefits on labor directly, as producers, and indirectly, as consumers.

It is important to state quite explicitly that, at this early date, probably no one can predict with confidence the outcome of specific developments or recommend specific solutions to hypothetical problems. What is needed, and what alone seems possible now, is the development of a general awareness of the kinds of changes and problems automation is likely to bring. Here, then, are some general areas that seem likely to be affected by automation:

1. Automation is likely to permit greatly improved *working conditions*, including greater safety and easier housekeeping.

2. Much thinking about *incentive systems*, particularly individual forms of piecework, will have to be revised or discarded.

3. As some traditional processes and factory layouts are changed, the job of pinpointing *managerial responsibility* for the performance of specific manufacturing operations may become easier; buckpassing among departments may be more difficult to get away with. Foremen are likely to take on increased responsibility. On the other hand, there may well be some forms of automation that will work the other way, that is, they may blur the boundaries of responsibilities that are now clear.

4. *Training* (or perhaps retraining) problems will probably require more attention than they

have since World War II. The training problems are likely to center on the development of new and complex skills for new grades of maintenance technicians, with shifts in operators' skills being relatively minor.

5. A marked change in the work-content of jobs resulting from automation may find expression in three familiar forms: (a) *Wage structures* may often require adjustment; (b) the *traditional jurisdictions* of some unions may be disturbed; for example, by the need to unify mechanical and electrical skills in a new class of maintenance workers; (c) the *internal structure* of some unions is likely to undergo changes; in particular, it may be important for some unions to give special recognition to new, small groups of highly skilled workers.

6. Managements and unions, accustomed to thinking in terms of narrow and rigid *job classifications*, may need to broaden the scope of those classifications somewhat. The same thing applies to thinking about *seniority units*.

7. Finally, there is the *employment* effect. The anxiety and fear which stem from uncertainty concerning how employment will be affected by automation give rise to the most difficult problems of all. It is hardly surprising that union newspapers and current contract demands often reflect these fears, though it is worth noting that most unions seem to be approaching automation without hysteria and with a desire to plan intelligently for what may lie ahead. We cannot shrug off people's fears of being left stranded, of having no alternative job or the time and money to find one in the event of layoff; we cannot down these fears by citing the virtues of technological progress, labor mobility, and individualism. Automation seems sure to bring with it increased emphasis on means of cushioning the shock to the worker who is displaced, and of retraining him to a useful and satisfying role in our society.

Each of the areas noted above deserves careful consideration by managements and unions; and each is worthy of considerably more academic research than has been done up to now. Of course, in many respects the problems are entirely familiar and there is already at hand a large body of research and experience for use as a guide in working them out. As one experienced union leader remarked, "Automation? It may look new to the engineers but, to me, it's an old story. Back in the thirties we called it technological change." But, while broadly familiar, the problems associated with automation do bring some new twists, some new dimensions for consideration. We propose to look briefly at three areas, using as a basis for the discussion what we have gleaned from the limited published information available and our own observations. The areas we have selected are these: (1) the effects on the abilities required of the labor force, (2) the effects on rigidly defined job classifications and seniority units, and (3) the problem of displacement.

Abilities Required of the Labor Force

What will be the impact of automation on the abilities required of the labor force? Will it leave us with a predominance of dull, routinized jobs, in which people are forced to conform to the dictates of the machine? Or is it more likely to open up jobs with greater intellectual challenge and to raise the skill composition of the labor force?

Any discussion of job mix is, of course, a discussion of proportions, of the relative weights of managerial, professional, skilled, semiskilled, and laboring jobs. Generally, automation appears to bring about a change in the mix, so that the resulting weights tend to emphasize the former, more highly skilled rather than the latter, less skilled types of occupations. We have observed this upgrading effect in a limited number of cases, but the conclusion must rest more on *a priori* reasoning than on statistical grounds. It seems reasonable to expect that the ratio of managers to employees will increase, in view of the increased value of the equipment for which an individual manager would become responsible, and of the increased proportion of the total work process inevitably brought under the supervision of one man. The value and complexity of the equipment similarly indicate a need for a higher proportion of engineers and, especially in the case of the electronic feedback and computer technologies, give rise to what amounts to a new occupation in most concerns, that of electronic technician.

In the factory, the new technology takes over most readily the materials-handling and completely routinized machine operations and tends to emphasize, as far as the average plant workman is concerned, jobs directed at "keeping the process going because we just can't stand downtime." As one plant manager explained, "You can't afford to chase all over the factory for a maintenance man when something goes wrong. He's got to be right there and he's got to know something about electrical and hydraulic problems, not just mechanical." So the proportion of maintenance people is likely to increase as well as the skill required of them. This is not to say that all routine or heavy jobs will be eliminated or to overlook the fact that many skilled jobs may disappear or become less important quantitatively. But in terms of overall proportions, it seems likely that automation will have an upgrading effect on the job mix in those areas of the economy where it is employed. This conclusion may be further bolstered by reference to the oil and chemical industries, where automation has had a relatively long history already.

The quantitative impact of automation on employment in those areas of our economy where it is used is almost impossible to estimate. Obviously, firms install the new equipment because it helps them reduce costs. While labor costs are not the only area of savings involved, they are typically a major consideration, so, on the face of the question, we would expect a reduction in employment opportunities, given some framework of total effective demand. But it is much easier to identify jobs that are being lost to technological change than those it is creating. Neglecting the possibility that greater demand may result from lower product prices, there is the virtual certainty that new products will be made technically or economically feasible, particularly by the feedback control devices now being developed. The question, then, is at least an open one. Neither optimists nor pessimists can afford to be too dogmatic about the long-run quantitative effects of automation on employment.

But suppose we assume that the industries where automation is used employ a smaller and smaller proportion of the labor force. Despite a direct effect of upgrading on the job mix, there might be, in the overall picture, a downgrading effect if the adjustments that take place are predominantly in unskilled occupations or in such areas as personal services. That seems to us unlikely, however. It seems as certain as any social trend can be that the demand for professional services, especially medical and educational, will increase rapidly during the next 10 years and beyond. And, with the higher standards of living made possible by technological advance, the adjustment may be made through a continuation of present trends toward longer vacations, more holidays, and a shorter workweek. In that event, we may well see another long-term trend continued: a further reduction in the number of unskilled jobs and an increase in emphasis on the more skilled and professional occupations.

In short, our guess is that both the direct short-run and the indirect longer-run effect of automation on employment will call for more and not less skill on the part of our labor force. We are entitled to a cautious hope that automation may afford a partial answer to those who look at the rising educational levels in the 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; *automation,* however, 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.

The training—or the educational job implied—will obviously become more difficult and more important as the speed of innovation increases. Studies of the skilled labor force and its recruitment, training, and movement, such as that on electronic technicians recently made by the Bureau of Labor Statistics,[1] are given added significance by the technological developments we are discussing. The same may be said for the work of the Bureau of Apprenticeship, and of the many opportunities for adult education in a wide variety of fields. We can expect many of the more alert engineering colleges and community vocational schools to revise their curriculums to take account of automation. Many company apprenticeship programs may be similarly affected.

Job Classifications and Seniority Units

A frequently noted characteristic of our economy is the tendency toward greater and greater specialization of knowledge and of tasks. Work has typically been organized into the smallest possible units, each one of which is a repetitive part of a total process and is so small in relation to the whole

[1] The Mobility of Electronic Technicians, 1940–52, Bureau of Labor Statistics' Bull. 1150, 1954; for summary, see Monthly Labor Review, March 1954 (p. 263).

that a sense of identification with the total process on the part of the person performing the job is almost out of the question. In part, this tendency has been a result of the developing technology. But it is also a result, as we all recognize, of the philosophy which says, (1) break the work process down into the smallest possible components, (2) fit jobs into a rigid structure that emphasizes the duties and the boundaries of the job rather than its part in the process, and (3) put everyone possible on an individual or small-group incentive system which gears pay to output on the particular job. This philosophy inevitably has tended to identify the individual with an ever more narrow task, giving him positive incentives to restrict his interests and no incentive at all to think beyond his immediate work environment or to place his own performance in the context of a total operation. This philosophy also brings with it a tendency to think in terms of seniority units as rigid and narrow as the job classifications in many cases.

Automation is likely to challenge these habits of thought fostered by discontinuous and highly specialized methods of production. From the technical point of view, automation ties operations together physically; in terms of systems, engineering and economics alike, automation requires a new way of thinking about the flow and control of work—a way of thinking that emphasizes continuous movement of work through a total process rather than the stop-and-go progress which is the sum of independent operations.

Almost as a corollary of the reasoning about the effects on skills of automation, it appears that automation will necessitate broader thinking about job classifications and seniority units. For example, when 3 or 4 different types of grinding operations, each now representing a separate job classification, are tied together by automation, one man will be able to operate the integrated grinding line. This man must have a generalized knowledge of grinding; and his changed, broader job classification is likely to carry more pay than any of the old grinding occupations.

As for seniority, existing contract clauses and plant customs may be found unsatisfactory in the light of new needs presented by automation. Where seniority provisions have arisen from a relatively stable operation with long established and clearly defined occupational groups, we suspect that the parties will want to change the rules to provide for increased job changes and transfers of personnel. For example, seniority rules that work satisfactorily in a plant divided into machining, heat-treating, grinding, and assembly departments may not make sense within a new department that combines all these operations in one integrated line; existing rules may also make it difficult to staff a new integrated department with those individuals both parties agree ought to get the new jobs. One management group even suggested that seniority standards would undergo an evolution stemming directly from the need for a more flexible work force. In this view, the development of a work force willing and able to adapt itself to the changing needs of an evolving work process would mean more than mere application of seniority protections to broader units of work. As a standard for continued employment, "ability to learn" would gradually replace "ability to do" the job.

The Problem of Displacement

It would be silly to pretend that there will not be many jobs which automation will abolish. Whether or not it creates, directly or indirectly, as many jobs as it wipes out, no one can know. Despite the inevitable uncertainty as to the speed and scope of automation's impact, this much at least seems certain: There is bound to be a new influence at work which will strengthen the arguments of people who feel that wage earners ought not to bear the main brunt of technological change.

Social shock absorbers, such as severence pay, the guaranteed annual wage, unemployment benefits, careful timing of laborsaving innovations to coincide with business upswings, and increased information-sharing between managements and unions, seem likely to receive increased attention, as automation spreads. If some of these mobility benefits add to the employer's cost of technological change, that alone would not disturb us greatly. Indeed, it is important to recognize clearly at least two types of costs incurred by the displaced worker: (1) loss of income while looking for a new job; and (2) loss of equities built up on the old job in the form of seniority, pension rights, vacation rights, and so on. While unemployment benefits of one kind or another are clearly a way of approaching the first type of loss, the more general adoption of the principle of severance pay for people with substantial equities in existing jobs may be one appropriate way to share some of the initial gains involved. In addition, such gain-sharing should strengthen the hands of both management and union officials as they confront the inevitable short-run pressures that develop whenever jobs are eliminated.

In developing policies to cushion the impact of automation, as with any major technological change, the toughest situations are not likely to be those in which some new machines and equipment are installed in a given plant; the toughest situations are likely to arise from competition between new plants designed for automation and older ones that are not. Sometimes the two plants will belong to the same company, sometimes not. In cases where automation expresses itself as competition among two or more firms not under common ownership, the policies appropriate to it seem no different from those we would like to see in any competitive situation.

But when automation takes the form of changes within a particular firm, then managements and unions have much greater control over the effects it will have and the ways in which these will be handled. For one outstanding characteristic of automation is that it takes time to install. Even after an exploratory stage has been completed, equipment must be designed and manufactured, men must be hired or trained for new occupations, physical installation and transition problems must be faced. All this takes time—not days or weeks, but many months or years. And with problems like displacement and personal adjustment, time, of course, presents a major opportunity that alert and socially responsible companies and unions can use to good advantage. Social responsibility would mean telling new employees that their jobs were temporary, retraining old employees who have the requisite ability, permitting those near retirement to claim pension benefits, and so on.

Automation is likely to have its greatest immediate impact on office occupations. In a sense, that is fortunate, since it will affect a class of workers for whom the blow can be softened most easily, namely female employees working in large offices. Not only is turnover markedly higher among female clerical employees, but the demand for them in recent years has been high in most labor markets.

One further point to be made here is both obvious and obviously too important not to mention. In considering the problem of the displaced and unemployed worker, it is not so important to ask why he lost his old job as how much trouble he has in getting a new one, and what kind of new one he gets. This brings to the fore the educational and retraining problems already mentioned. But even more, it serves to emphasize, for an era of marked if not revolutionary change, the importance of government economic policy directed toward the maintenance of "full employment." Change the level of unemployment by a few percentage points, and the problem of displacement changes from a relatively manageable question of adjustment to a social catastrophe of alarming proportions, in which orderly technological progress becomes impossible.

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Paper From the Fall AMA Personnel Conference

EDITOR'S NOTE.—*This article is excerpted from a paper presented at the annual Fall Personnel Conference of the American Management Association in New York, September 21-23, 1959. Minor changes in wording have been made and suspension marks to denote deletions have not been indicated in the interest of readability.*

Some Problems of Change

CHANGE is an important part of American industry. Perhaps this is nowhere more apparent than in the oil industry. Change has been a ceaseless process throughout the one hundred years since the drilling of the first oil well. While change has been characteristic of our industry for the past century, its pace in recent years has been faster than any of us has ever experienced. In some respects, there has been a broader and more frequent shifting in the past 10 years than in the preceding 25.

This acceleration has had an impact on labor relations. It has challenged traditional employee relations concepts. It has caused unions to react differently because of new strains—byproducts of change itself.

In our company, change has been most dramatic in our refining operations. Technological improvements have enabled many of our operating units to increase product volume without a corresponding growth in employment. Indeed, in a number of units, hiring of wage earners was virtually stopped in 1952 and a program of personnel attrition was undertaken as a means of reducing the surplus.

Subsequently, however, we found that attrition was too slow a means of resolving the problem. Just when our predictions for an efficient force seemed to be working out, another change would descend upon us, one we had to accept in order to stay competitive. Any overmanning thus became even more acute. By 1957, we reluctantly turned to encouraging early retirement and eventually were compelled to resort to layoffs. Perhaps this was one of the biggest changes of all. In a company with a reputation for stable employment, forced reduction itself was a radical departure from what had been the norm.

As the reduction in the work force began to take effect, a new problem arose involving new ways of handling work assignments with a streamlined organization. We have had to restructure our operating organization, and many workers were exposed to retraining in order to fit into the new work arrangements.

It is no wonder, then, that these changes have had a profound effect on the unions. In general we deal with local independent unions. Historically, for us and for our employees, these independent unions have been quite successful, both with respect to gaining good working conditions and in their ability to help maintain an atmosphere of mutual respect and cooperation. Certainly they've succeeded in avoiding strife. But 6 years of restricted employment, followed by job reductions, coupled with a new way of working have had an impact on our relations with these independent unions. Our objective has been to work out solutions to these problems but it is only natural to expect that there would be some strain.

Labor Relations During Change

As a result of our experience, we believe we have learned something about handling labor relations problems associated with change. Probably all these lessons could be summed up by saying that we have learned that it is necessary to appreciate the points of view of others. We can consider these lessons in three separate but related areas.

First, we have come to realize that in introducing and implementing change, an all-out effort for achieving greater participation and personal involvement of supervisors is important. This is to say that in those activities where we involved supervisors at all levels in the development and introduction of change, we had the greatest acceptance. A conviction on the supervisors' part of the inherent worth of a new operating procedure can strengthen management's hand in gaining general acceptance.

In one of our plants, we had a good opportunity to test this principle. Seven years ago, a new program was developed by a very small number of top level management people. Very early, it encountered supervisor resistance. Less than 2 years ago, another new program was conceived at the same plant. This time, the broad concept of the plan was developed by top management who passed the idea down to a committee of 25 supervisors who would later have the task of administering it. They worked out the details of the plan which was then submitted to all 250 supervisors for their comments and suggestions. A considerable number of changes resulted from these comments. We feel sure that this method was largely responsible for the successful acceptance of the change.

This concept does not imply that it is possible to accept all the ideas and suggestions received. But it is possible to inaugurate programs with greater probabilities for success if the first line foreman is involved from the outset.

It has [also] become clear to us that the probability of success is greater if union participation, in its true sense, can be achieved. Perhaps the need for seeing the other fellow's point of view is greatest when we talk about the unions. This points up the need for patience and understanding. We have failed in those instances where we have not permitted sufficient discussion and where we have become impatient with others' unwillingness to accept our point of view.

We are convinced that we must make efforts to convince the union that a given proposal makes sense, and that, compared with the available alternatives, it promotes rather than endangers employee security. In negotiating with the unions, we found it helpful to avoid actions or positions which cause the union to commit itself publicly against the program as a whole. Temporary compromise on some points can be preferable to full-scale union opposition.

Many people like to philosophize that change is good. Over a period of time, it enlarges opportunity and increases the total number of jobs in the economy. But this is not always true in the case of individual plants or individual employees. Consequently, it is not very reassuring to the employees in industries where severe dislocations are taking place or employment cuts are anticipated.

But competitive forces seldom allow management to slow the pace of change for the sake of the stability of employment. What, then, can we do to bolster morale and keep productivity high?

Certainly, we must redouble our efforts to know what employees are thinking. Special efforts are needed to determine as objectively as possible employee reaction to change—even ahead of time, if possible. Once an accurate gage of employee attitude is secured, fears which are groundless can be dispelled and the proposed change put in a light which minimizes basic—and thoroughly understandable—employee resistance. This does not get rid of the unpleasant facts that exist and must be faced. But even these chores, however rough, can be lessened by handling in a way that is direct, fair, and honest.

The best communication efforts are demanded to describe and explain a new program once it has been decided upon, first in broad concept and later in specific detail.

I cannot talk on this subject of change without commenting on the importance of upward communication. Provision for upward communication is vital in the whole approach to effecting change. Here we cannot overlook the supervisor as a main channel. For one thing, this kind of upward communication is probably the fastest. Speed in getting the feedback from employees may allow the early incorporation of worthwhile ideas and suggestions which can help gain acceptance of the program.

It is impossible to overstress the importance of being sensitive to employee views. And we must listen, even when disquieting information is the result. Perhaps the most important thing we have learned is that all levels of management must guard against hearing only what they want to hear.

We in Esso are staking much upon the investments in supervisory training in these directions. We have the conviction that through improved supervisory skills and better concepts of participative leadership, we will be able to continue to make progress, stimulate greater productivity, and at the same time, keep the support of our organization.

—James N. Gorringe
Employee Relations Manager
Esso Standard Oil Co.

Wage-Rate Determination in an Automated Rubber Plant

JOSEPH W. CHILDS AND
RALPH H. BERGMANN*

THE RUBBER INDUSTRY, as most other industries, has witnessed tremendous technological advances in the past few years. Even more automatic machinery will be introduced in coming years. Because most workers in our industry are paid according to an incentive program, it has long been clear that some special attention would have to be paid to the rate and work load problems which accompany major technological change. An agreement with B. F. Goodrich Co., negotiated about a year ago, represented a substantial first step toward dealing with these matters.

While it is common to think of an incentive system providing unlimited earnings opportunity, this generalization does not apply to rubber plants. For each job classification and each standard, there has developed a general understanding on the part of management and on the part of employees as to the quantity of production which can be expected during the shift. This level of production yields a certain level of earnings. And men who have the same job classification, though their specific job may be somewhat different, will tend to have similar earnings for each hour worked.

In some contracts, the parties have specifically provided that earnings are not permitted to exceed a certain level. These "caps" are in effect in other plants without contract language.

The Rubber Workers contracts provide also for special wage payments for unusual conditions. If a machine breaks down, if there is a stock delay, or if the stock is not up to standard, the employee receives a rate guarantee. In some contracts, the guarantee is 100 percent of past average earnings; in others, depending on the condition, the guarantee is some percentage of past earnings—usually 90 to 95 percent.

The Goodrich Incentive-Pay System

Under the Goodrich modified Bedeaux incentive-pay system, there is a base rate which represents 60 units of work. One-sixtieth of the base rate is the unit value. So it is possible, at the end of the shift, to multiply the total number of units of work for which the employee has received credit by the unit value to determine his incentive earnings.

We have no quarrel with the company on the definition of "normal." Both company and union time-study engineers work from the basic assumption that a man walking on level ground at the rate of 3 miles per hour is walking at a "normal pace." A person who is observed to walk at this pace for a full hour has therefore worked for 60 minutes at a "normal." However, the parties have agreed that such walking must be adjusted by an effort rating of 10 percent to allow for fatigue and for personal time. Thus he must be allowed 66 minutes in which to walk that distance. In other words, a walk of 3 miles earns the operator 66 units of work. This means that an employee may take approximately 6 minutes off for personal reasons and for fatigue, and still earn 60 units of work in an hour if he walks at a pace of 3 miles per hour during the other 54 minutes.

Provisions for New Standards. Under the provisions of the master agreement with Goodrich, the company has the right to establish new standards when there are changes in method, product, tools, material, design, or other production conditions. Any revision resulting from such changes must be confined to the element or elements of work in which the work requirements or occurrences have changed since the prior labor standard was established. That clause, in other words, guarantees elemental time as long as the work for that element remains unchanged.

Understandably, each new machine in our industry has brought with it substantial changes in some portions of the job requirement. But other portions are often unchanged. The issue then becomes: what shall be the allowed units of

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EDITOR'S NOTE.—This and the following article, Impact of Automation on Ford-UAW Relationships, are excerpts from papers given at the Conference on Automation and Major Technological Change held in Washington, April 26, under auspices of the Industrial Union Department, AFL-CIO. Selected from among several papers heard at the meeting, these two deal with practical solutions to problems in specific plants.

work (and, therefore, the pay) for the new or changed elements?

If those elements are manually controlled—in the sense that the employee has an opportunity to work as rapidly as his skill and effort permit him—then customary time-study techniques are applied. There may be some differences of opinion on the proposed time allowances, and there may have to be negotiation over the new standard, but the problems can usually be worked out between the parties.

However, technological developments and automatic machines in the rubber industry have meant that an employee's work is being tied, more and more, to the pace of the machine.

The B. F. Goodrich agreement of last year provides a special method of determining the rate of pay for these elements, which might be called "restricted" elements or "machine controlled" elements. For each such element, the employee will be paid at the rate of 97.2 units of work. This is calculated from a formula which provides that the actual machine time shall be multiplied by 90 over 60 (in effect, 50 percent above normal pace) and then increased by 8 percent to determine the allowed units of work for that part of the work cycle. The 8 percent represents an allowance to provide for personal time including lunch.

It is clear then that as more and more elements become machine-controlled elements, and when the time arrives when we have fully automatic operations with the workers required solely for observation and adjustment purposes, the amount of pay will be based upon 97.2 units of work applied against the unit value.

Why did the parties decide upon 97.2 units? It was a negotiated figure. It came partly from the fact that the same agreement established a maximum on earnings. That maximum is 95 units of work per hour. In our opinion, the unit hour which should be established for machine controlled time is the full 95 units per hour before allowance for personal and lunch time. If then, an allowance of 10 percent were paid, the employee's earnings would be protected as automation takes place. However, it was a result of negotiations that led to an agreement on 90 units plus 8 percent. Perhaps it would be well to mention the fact that the parties recognize what any time-study engineer will say, namely, that it is impossible under the Bedeaux system. for an average employee to work at a consistent pace of 95 units per hour. But the incentive system in the Goodrich plants has been so altered over the years that we found many cases of employees regularly earning far in excess of 95 units per hour. Tire builders—and their job is one of the hardest in the plant—were earning about 110 units per hour, week after week.

Since the new agreement provided that the maximum shall be 95 units per hour, all efficiencies above 95 were rolled back to 95, with an appropriate adjustment in the base rate and work standard so that the employee's earnings were maintained for the particular level of production.

Machine-Controlled Operations. The agreement also provided for a somewhat different approach to those jobs where the new machines restrict the employees' earnings opportunity over a substantial portion of the work cycle. For those operations, instead of providing a method of paying for restricted time on an element-by-element basis, the agreement provides for a new method of calculating incentive earnings.

In this new method, the first step is to determine the true physical work required of the operator—the amount of work which he can perform in an hour's time, subject to the limitations of machine-controlled time. Secondly, it is necessary to determine the hourly capacity of the machine. That capacity is computed from the rate at which it operates and from the time in each hour during which it is not operating because the employee is performing some physical work. This capacity is reduced by 8 percent to compensate for personal time, including lunch. When the employee performs his work so that the machine achieves this "adjusted capacity," he receives an "allowance" to be added to the units of work which he has actually performed. That allowance is to bring him up to 90 units of work for the hour. Two alternate methods for handling machine-controlled operations are also spelled out in the agreement. One would apply if the machine capacity cannot be accurately predetermined. The other will be used when circumstances require a variable, rather than a fixed process allowance. Both methods provide for adding to the employee's earned unit hour, to compensate for the machine-controlled time.

Impact of Automation on Ford–UAW Relationships

Ken Bannon and Nelson Samp*

Shortly after World War II, Ford Motor Co. embarked upon an unprecedented expansion program. Not only did this program include the erection of new buildings and the enlarging of others, but wherever possible, the company eliminated the old method of manufacturing and assembling and in its place instituted new methods which employed automated devices in their then most highly developed stage.

Today, automation in these new or enlarged facilities includes: (1) The movement of materials and parts from one operation to the next automatically; (2) replacement of men in the operation of machines by devices called "mechanisms" (servo-mechanisms); (3) replacement of inspectors by control devices which inspect products automatically; (4) the use of mechanisms which count, fill orders, maintain inventories, reorder, give instructions, and are designed with memories that never fail (so long as the machine is in repair); and (5) automatic preventive maintenance (like automatic lubricating systems which not only oil and grease automatically wherever oil and grease are needed but also signal the need for repairs).

The new methods with the highly developed automated devices were a far cry from the crude transfer machines and the in-line machine process of just a few years previous.

The changes in manpower requirements, and those yet to come, required that the United Automobile Workers union give careful attention to manpower problems and related issues, which for the purposes of this paper included the following: (1) rates and classifications for automated jobs or operations; (2) changing skills; (3) retraining; (4) seniority adjustments; and (5) the effect on highly skilled trades classifications.

Rates and Classifications

At the Dearborn and Buffalo plants,[1] which were in existence when Ford began installing automated machinery on a piecemeal basis, the UAW found it difficult to pin down the kind of changes which required action and the negotiation of the necessary new classifications and rates. It was also faced with the technical question regarding the impartial umpire's authority under the contract to determine (a) that these were an expansion of existing rates and classifications (and subject to the umpire's final ruling), and (b) whether these were new classifications with new rates (a strikeable issue).

The Cleveland facility was completely new, and the union had been certified as the collective bargaining agent. There was no negotiated rate and classification agreement. The first move of the UAW Ford Department was to prepare a wage survey of the then-existing stamping plants.

That survey disclosed that average hourly rates for production workers at the Cleveland plant were about 11 cents an hour less than at Dearborn. There were three reasons for this:

1. Rates for similar classifications, generally, were 4½ cents an hour lower, for the most part, at Cleveland.

2. Where there was a rate range for a job, Cleveland plant workers were at the bottom of the range, Dearborn employees at the top.

3. Similar work was classified differently at both plants. Where a job was on the borderline between two classifications at the Cleveland plant, the company had classified the worker in the lower paying classification. At Dearborn, the worker in a similar situation was placed in the higher paid classification.

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[1] As a case study and for illustrative purposes, we have selected our experiences in the Ford stamping division. Prior to Ford's expansion program, stampings had been produced in the company's Rouge plant, Pressed Steel Division in Dearborn, Mich., and also by suppliers such as Murray Body Corp. of Detroit. As part of its expansion program, Ford erected new stamping facilities at Buffalo, N. Y., Cleveland, and Chicago Heights, Ill.

To the union's representatives making the survey, it was apparent that automation and downgrading as a result of job dilution had gone hand-in-hand at the Cleveland stamping plant (where there was a new work force generally inexperienced in factory operations). The difficulties in correcting this within the wage and classification system framework, as unilaterally installed by the company prior to our recognition as the collective bargaining agent, were extreme. Therefore, the union decided to formulate an entirely new wage and classification structure, and bargain for it.

This intention was made clear to the company in the first bargaining session. During this meeting and those which followed, the union discussed that part of our international union's policy statement on automation which concerned classifications and rates to fit an automated factory. Next, it took up statements various Ford officials had made about automation. For example, the company's vice president in charge of manufacturing, said in August 1954, that automation "would act as a prod to our economy" in several ways, one of which, he emphasized, would be "by enabling labor to increase its earning power. . . . production processes have become much more complicated in the departments which use automation. . . . Our production people must be more highly trained."

Additionally, the union negotiators stressed the similarity between statements by the union and those of the company. They did this in an effort to gain an agreement in principle that automated plants require the negotiation of an "automated wage classification structure."

When this phase of the negotiations was concluded, the union asked the company to draw up a new job classification structure shaped specifically for an automated stamping plant. This request was based on the union's belief that the company knew the extent of forthcoming engineering changes at the plant far better than the union. Yet the proposal was rejected by the company which insisted that the union submit a plan.

Meetings were held between the union's negotiators, and workers in the plant were interviewed. Out of these sessions came a proposal, with new classification titles but without wage rates, which was presented to the company. However, in the bargaining sessions, management continued to stick to its previous position. Basically, it insisted that, even though a series of technological changes in stamping processes had taken place in the last 10 years, actual job duties had not changed enough to justify a sharp classification structure revision.

Additionally, the company claimed the Dearborn plant's classification setup could be applied to the Cleveland unit and that the union did not have the right to strike. It said that after accepting the Dearborn classification structure, any problems concerning changes could be worked out through negotiations and, if necessary, arbitration.

Negotiations continued for another 3 months, with meetings approximately once a week with the company making minor concessions, but not conceding the principle. After a strike authorization and a strike vote (2,240 to 159) were taken by the membership, progress became rapid. A few days later, the negotiators reached an agreement which contained a new classification structure and the higher wage rates.

The agreement was a compromise. But, for the first time on such a broad scale in any labor-management contract, it recognized automation in job classifications it covered. The compromise agreement, while it did not apply the classification of "automation attendant or controller" to all jobs sought by the union, did, however, pin down the basic principle sought by the union.

One other major gain was made by the union. Although an umpire previously had ruled that "creeping changes" do not make jobs different enough to call them "new jobs," the new contract recognized the changed work done by press operators on the major lines and by workers in other classifications.

This recognition emphasized the need for barring arbitrators and umpires from laying the basis for the wage and classification structure for the factory of the future. Umpires and arbitrators should have no role in the determination of new classifications and wage rates resulting from automation because there are no objective criteria.

In subsequent negotiations at Ford's Chicago stamping plant, the principle established was given wider application so that more workers were covered. And in negotiations on the 1955 Master Agreement it was given application at the Buffalo stamping plant.

Changing Skills and Retraining

Automation in many cases changes the nature of the skill and training needed on individual jobs. The former single spindle-drill operator or press operator now tends a battery of machines which perform boring, reaming, drilling, milling operations or blanking, forming, piercing, and flanging operations. A top Ford spokesman has stated that there are considerable changes in the kinds of job that men will do in the factory of the future: "The hand trucker of today, replaced by a conveyor belt, might become tomorrow's electronics engineer . . . Drill press operators replaced by automatic multiple drill machines could be trained as future toolmakers." Changes such as these pose serious retraining problems. The company must provide opportunities for such training and guarantee that our members receive a living wage during such period.

Through negotiations with the company, the UAW has amended its apprenticeship training program to provide an opportunity for the older seniority employees to obtain training through such programs. The applicants for such training were previously limited to those between 18 and 26 years of age, but that has now been amended to provide that a seniority employee, who can pass the necessary mental and aptitude tests satisfactorily, can make application and will be eligible for such training, regardless of age. Applicants in this category are further protected by being placed on a different waiting list for entry into such training. This removed the possibility of such high seniority applicants competing for available training opportunities with the younger applicant fresh out of school. Additional points based on length of service are also awarded to such seniority employees, increasing the ratings which determine their standing on the waiting list for such training programs.

It is also necessary to provide for extended advanced training programs for our workers who are already working in the highly skilled trades classifications. Many UAW tradesmen are highly competent mechanics as judged by previous standards. They became so as a result of serving a bona fide apprenticeship or by actively working on the job. They need, however, to have further training on the newly developed mechanical, hydraulic, pneumatic, chemical, electric, or electronic devices which have been developed since they acquired their training in their trades.

Seniority Adjustments

Because operations in many older plants have been discontinued by the company, the UAW has had to be alert to the effects of such action on its members. It has concluded transfer agreements to guarantee the right of workers to transfer with their operations to a new plant or an already existing facility. It has broadened seniority groupings to provide the greatest possible protection in the exercise of seniority rights. This is much easier to do in a new plant than an old one.

In June 1956, for example, Ford opened a new stamping plant in Chicago. In negotiations of November of that year, the UAW successfully concluded negotiations on a wage and classifications agreement. In contrast to the 315 negotiated classifications of work at the Dearborn plant, which is the oldest stamping plant, as part of a program for a broader exercise of seniority, it negotiated just 101 classifications of work in the Chicago plant, even though both plants are comparable with respect to methods and processes of manufacturing. It has further provided for hiring preference for laid-off Ford workers of other Ford plants before new hiring takes place. For the further protection of members in the metropolitan Detroit area, the union has an areawide seniority agreement.

Effect on Highly Skilled Classifications

With the introduction of automation into the Buffalo stamping plant, the management insisted that the complexity of the equipment made it mandatory, in view of the needs of the services of many of the trades, to break down the lines of demarcation between the skilled trades. Accordingly, before the UAW was recognized as the collective bargaining agent for this plant, the company established a classification—automation equipment maker and maintenance—which actually crossed seven recognized trades: diemaker, machine repairer, millwright, welder, hydraulic, pipefitter, and tinsmith.

When the UAW obtained recognition, there were already many workers so classified and receiving the same rate as diemakers, which is the highest rate of any of the seven trades involved. In the subsequent negotiations, the union attempted to get the support of the members to eliminate such classification and return the work to the basic skills but was unsuccessful in view of the rate of pay they were enjoying.

At Cleveland, the union faced an identical situation at time of recognition. However, it received some support from the membership affected and was able to eliminate the classification as such. In this Cleveland plant, there is an automation maintenance department with each worker classified within his trade, although the rate is established for the department as such. Again, efforts to convince the affected workers of the deterioration of skilled trades standards fell on deaf ears.

In the Chicago stamping plant, the UAW again faced the same problem at time of recognition. Here, however, the members affected were willing to fight to maintain the standards of the skilled trades. The workers at that location are classified in accordance with skilled trades standards.

The defense of the integrity of the apprenticeable trades against overlapping and dilution of journeyman standards becomes an increasingly important union task in the face of automation. Success in the performance of this task will require the fullest cooperation of the skilled trades workers themselves, who must vigorously resist management pressure to do work not properly a part of their actual respective trades.

Management in Ford insisted in the 1955 UAW Master Agreement negotiations that the new classification structure and rates for stamping plants would not be effective at the Dearborn plant unless, and until, the skilled tradesmen agreed that the automation equipment maker and maintenance classification covered their jobs. The skilled tradesmen refused and were supported by the production workers, 50 percent of whom would have been eligible for an increase of 5 to 15 cents an hour. They will have an opportunity to correct this in 1958 negotiations.

If successful, a drive to reduce the number of journeymen employed, by overlapping in the skilled-trades classifications, would inevitably undermine the basic skills so that our economy would be left only with men who are jacks-of-all-trades and masters of none.

Longshoring and Meatpacking Automation Settlements

EDITOR'S NOTE.—*Two recent union-management agreements have contained clauses providing for a unique (though by no means identical) handling of an old problem: the introduction of laborsaving equipment. One contract is between the International Longshoremen's and Warehousemen's Union (Ind.) and the Pacific Maritime Association. The other involved two unions—the Amalgamated Meat Cutters and Butcher Workmen and the United Packinghouse Workers—and Armour and Co. The relevant clauses from these agreements are reproduced below.*

PMA–Longshoremen's Union Provision

To allow a certain amount of time (not more than 1 year) for the parties to further study and gain factual experience (1) of actual changes made by laborsaving machinery, changed methods of operation, or proposed changes in working rules and contract restrictions, resulting in reduced manpower with the same or greater productivity for an operation; (2) of savings to the employer because of such changes; (3) of a proper share of such savings to be funded as hereinafter provided; and (4) of the manner of distributing such fund to the fully registered work force:

A. Pacific Maritime Association (PMA) proposes to create a coastwise fund for the fully registered work force, through contributions by the employers to be accumulated during the first ensuing contract year, in the amount of $1.5 million. This amount, in addition to "buying time" for necessary study and experience, represents a recognition by the employers that savings accrue as a result of mechanization and changed methods of operation, and a recognition by the International Longshoremen's and Warehousemen's Union that no additional payment is due for changes made or to be made prior to June 15, 1960. This payment shall constitute a part of the consideration for renewal of the contract, and shall be distributed to the fully registered work force in a manner to be determined. (Tax and legal problems to be resolved.)

B. It is the purpose and intent of the parties, during the course, and as the result of this study period, to achieve and meet the following aims and objectives:

1. To guarantee the fully registered work force a share in the savings effected by laborsaving machinery, changed methods of operation, or changes in working rules and contract restrictions resulting in reduced manpower with the same or greater productivity for an operation.

2. To maintain the 1958 fully registered work force, with allowance for normal attrition.

3. To create a coastwise fund for that work force through contributions by the employers, such contributions to come from savings described in paragraph 1 hereof.

4. To provide that this fund will be separate from contractual wages, pensions, welfare, and vacations.

5. To guarantee the PMA the right to make changes and remove restrictions, along with protection against reprisals for making such changes and enforcement under the contract of such changes if and when made.

During the ensuing year, in addition to making of such study, the following agreements shall be in effect:

(a) PMA will accumulate the $1.5-million fund as provided in A hereof.

(b) PMA shall be free to make such changes as are deemed necessary under section 14 of the present longshore contract and section 25 of the present Clerks' contract, restricted however, by the observance of rules prohibiting individual speedup and unsafe operations. The load agreement shall continue.

Except for changes in operations made hereafter by introducing laborsaving devices in addition to those already used and practiced by him in the past, the employer shall not invoke the provisions of section 14 of the Longshore Agreement or section 25 of the Clerks' Master Agreement during the ensuing year. Nor shall the employer seek a reduction of gang sizes or number of clerks, elimination of multiple handling, or other existing contract or working rule restrictions with relation to operations now existing, except during future annual review negotiations or by mutual agreement.

(c) The parties will continue negotiations on the matters outlined in this proposal for a period of not to exceed 1 year for the purpose of determining a basis for converting the above fund and employer contributions thereto to a continuing basis which will meet the aims and objectives set forth herein. Such negotiations shall not exclude tonnage taxes, man-hour assessments, or any other basis of conversion, nor exclude conversion of present contributions for welfare, pensions, and vacations.

(d) The parties shall continue to operate in accordance with the terms of the contract and working rules, with mutual agreement against reprisals and for enforcement of the contract, working rules, and the provisions of this proposal.

* * *

It is recognized that the employer has the right to select competent men for all operations. When new types of equipment are introduced in connection with the handling of cargo covered by the contractual definitions of work, such new equipment shall be operated by employees under the ILWU contracts, with the understanding that competent men shall be made available by the ILWU, with adequate experience or training. This proposal shall not change the status quo as to assignment of other than ILWU men on existing equipment.

Armour–Meatpacking Unions Provision

It is recognized that the meatpacking industry is undergoing significant changes in methods of production, processing, marketing, and distribution. Armour's modernization program is vital to its ability to compete and grow successfully, thus providing a reasonable return on capital invested in the enterprise and providing the assurance of continued employment for the employees under fair standards of wages, benefits, and working conditions. Jobs are directly dependent upon making Armour products desirable to present and future customers from the viewpoint of quality and price.

Mechanization and new methods to promote operating and distributing efficiencies affect the number of employees required and the manner in which they perform their work. Technological improvement may result in the need for developing new skills and the acquiring of new knowledge by the employees. In addition, problems are created for employees affected by these changes that require the joint consideration of the company and the unions.

The company and the unions have in past agreements provided benefits to soften the effect of some of these changes where employees are laid off or terminated. However, it is recognized that these problems require continued study to promote employment opportunities for employees affected by the introduction of more efficient methods and technological changes.

The company, therefore, agrees with the unions to establish a fund to be administered by a committee of nine, composed of four representatives of management and two representatives selected by each of the two unions and an impartial chairman selected by mutual agreement of the parties. The management and the unions shall each pay for the expenses of their respective representatives on the committee, and the fees and expenses of the impartial chairman shall be paid by the fund. This committee is authorized to utilize the company contributions to the fund for the purpose of studying the problems resulting from the modernization program and making recommendations for their solution, including training employees to perform new and changed jobs and promoting employment opportunities within the company for those affected.

The committee should consider for appropriate action a program of training qualified employees in the knowledge and skill required to perform new and changed jobs so that the present employees may be utilized for this purpose to the greatest extent possible. The expenditures for such a training and retraining program may be authorized by the committee from the joint fund. The committee should also consider other programs such as transfer rights to plants covered by the master agreements where job opportunities remain or are increasing, and should consider any other methods that might be employed to promote continued employment opportunities for those affected. It is agreed, however, that the fund shall not be used to increase present severance pay benefits.

The findings and recommendations of the committee shall not be binding by the parties, but shall be made to the company and to the unions for their further consideration. The final report and recommendations by the committee are to be made no later than 6 months prior to the termination of the contract.

The fund to be utilized for the purposes set forth above shall be created by company contributions made in accordance with the following formula: The contributions shall be in an amount equal to 1 cent for each hundredweight of total tonnage shipped from slaughtering and meatpacking plants covered by the master agreements. Such tonnage figures shall be based upon the periodical Food Division financial statements, and a monthly list of such tonnage for the covered plants shall be presented to the joint committee. The company's tonnage figures shall be final and binding upon the parties. Contributions shall terminate upon the total of the company's contributions reaching $500,000. (Procedure must be established for the disposition of the balance of money remaining in the fund.)

A letter shall be exchanged between the parties setting forth the method and the time for the making of the aforementioned contributions.

Maintenance of Way Employment

EDITOR'S NOTE.—*This article is the first of two based on a study of the problems of insecurity and instability in maintenance of way employment undertaken at the request of the Brotherhood of Maintenance of Way Employes.*[1] *In the foreword to the complete work, Professor Sumner H. Slichter of Harvard University states, "The two most important things about this study are (1) that the Brotherhood insisted that it be the independent work of the economists and that it represent their analysis of problems and their evaluation of proposed policies, and (2) that the study is being made available to all in the industry by being published." The union, he said, had "provided an admirable example of how to approach the problem of policymaking when the issues are difficult and controversial."*

Part II of the study will deal with the seasonal and cyclical instability of maintenance of way employment.

I—Technological Displacement in Employment and Possible Moderating Measures

WILLIAM HABER AND MARK L. KAHN*

TRANSPORTATION ACTIVITY in the United States has multiplied severalfold during the last few decades. The railroad industry has not shared proportionately in the resulting opportunities, however, because of increasing competition from passenger cars, buses, trucks, aircraft, and pipelines. Gross ton-miles carried by rail have increased by only about one-fourth since the 1920's. (See chart.) Meanwhile, technological progress has tripled the productivity of maintenance of way employees. As a result, maintenance of way employment has fallen by more than 50 percent since the 1920's to its present level of 170,000, compared with a decline of approximately 39 percent in total railway employment.

Since World War II, the number of maintenance of way jobs has dropped an average of 680 per month. We are not aware of any other major category of workers—even in some acknowledgedly "sick" industries—in which employment cutbacks have been so persistent and so drastic.

The prospective rate of decline is less severe than during the recent past. Nevertheless, it is clear that hundreds of regular maintenance of way men face long-term or permanent displacement every year for the foreseeable future. The insecurity caused by this gloomy outlook is aggravated by the existence of severe cyclical and seasonal employment fluctuations which greatly exceed the actual short-run variations in physical maintenance of way requirements.

Some Effects of Technological Progress

Aggregate industry data tend to conceal the fact that the degree and rate of technological change varies greatly among the different railroads. Many aspects of the adjustment to changes in equipment and methods must be dealt with on the property at the time innovations are being effected.

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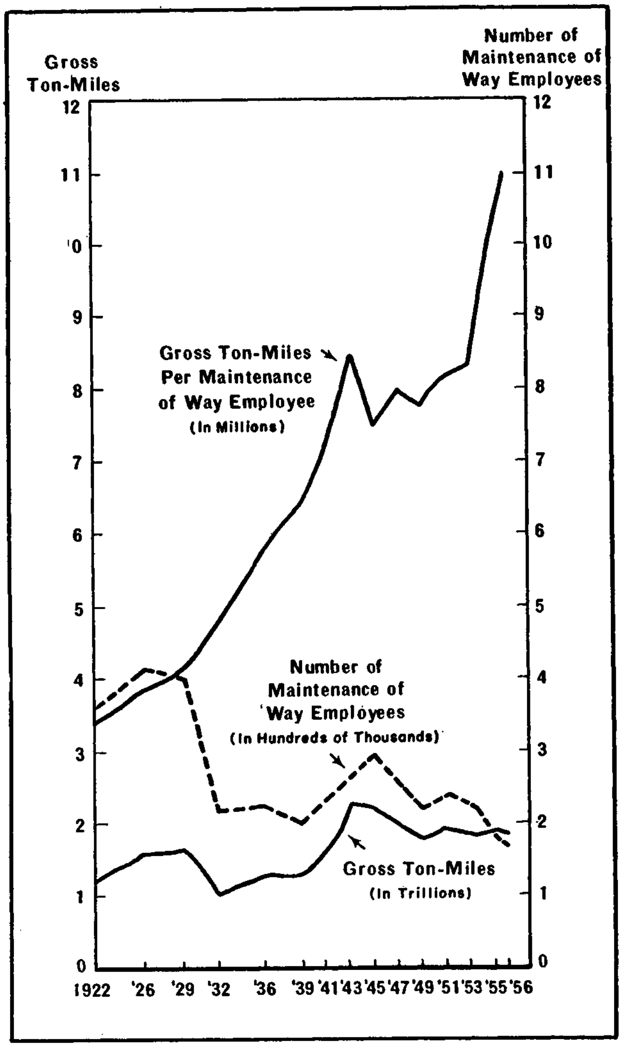
[1] William Haber; John J. Carroll, Associate Professor of Economics, St. Lawrence University; Mark L. Kahn; and Merton J. Peck, Assistant Professor of Business Administration, Harvard University, Maintenance of Way Employment on U. S. Railroads—An Analysis of the Sources of Instability and Remedial Measures (Detroit, Brotherhood of Maintenance of Way Employes, 1957).

Gross Ton-Miles per Maintenance of Way Employee, Class I Railroads in the United States, Selected Years, 1922–56



Although a strong case can be made for nationwide rules of procedure, and for the development of general principles of adjustment, it is essential to retain flexibility in substantive matters at the level of the individual railroad and the corresponding (system) organization of the Brotherhood of Maintenance of Way Employes.

Technological progress has a qualitative as well as a quantitative impact on maintenance of way employment. Mechanization of operations previously performed by laborers with simple handtools creates new occupations associated with the operation and the maintenance of the machinery and raises the average skill level.

Traditionally, most maintenance of way operations were performed by section gangs, with each section gang responsible for a specified portion of the right of way. Mechanization encourages the performance of heavy maintenance by specialized, mobile work gangs capable of using the expensive new equipment efficiently and economically. The territory to be covered must be divisional or even systemwide before the use of some kinds of equipment can be economically justified.

The use of specialized gangs for heavy maintenance often leads, in turn, to a reduction in the number of section gangs, to an increase in the length of sections, and to the use of section gangs largely for policing and inspection purposes only. Employees who are assigned to the mechanized gangs are characteristically required to spend considerable periods of time living away from home in trailers or camp cars.

Shorter Hours of Work

Can a shorter workweek make a helpful contribution to maintaining employment in maintenance of way departments? The 40-hour week has prevailed in the United States for about two decades. On the railroads, however, the 40-hour week was not established until 1949, when the standard workweek was reduced from 48 hours without loss of weekly pay. This achievement meant an increase of 20 percent in the hourly rate of pay.

Early efforts to obtain shorter hours emphasized the desirability of greater leisure to offset the physical strains of work and to permit self-improvement and better family life. Today, because there has been a substantial relative increase in nonwork time, additional leisure is no longer the major consideration. Actually, there is evidence that where sufficient work opportunities are present, workers and unions usually prefer additional income to additional leisure.[2] Only when technological or economic developments threaten to displace substantial numbers of regular employees are unions likely to press vigorously for shorter hours (provided there is no loss in weekly pay) as a countermeasure.

Except among office workers (who are predominantly female and unorganized) only nomi-

[2] See History of Union Efforts to Reduce Working Hours (in Monthly Labor Review, November 1956, pp. 1271–1273).

nal progress has been made in the United States toward a workweek of less than 40 hours. A recent Bureau of Labor Statistics survey of 17 areas [3] found 46 percent of office workers but only 7 percent of plant workers on regular schedules of below 40 hours per week.

Those significant examples which can be found of standard workweeks below 40 hours are among highly paid and cohesive skilled groups (printing and building trades); in fields where female employees predominate (office workers, ladies' garment workers); and in response to imminent or actual technological displacement (mechanized bakeries, brewing industry).

If weekly pay is maintained while hours are cut, there is an increase in the hourly wage rate. Presumably, a similar increase might have been granted without any reduction in hours, thus increasing weekly pay for those who remained employed. Hence, to offset technological displacement by shortening the workweek would, in these circumstances, be a device by which the many are made to suffer losses in earnings in order to benefit the few whose jobs are saved. From a community point of view, as well as from the point of view of the employee majority, the use of shorter hours to counteract permanent reductions in employment is particularly undesirable during periods of prosperity, when nonrailroad alternatives are more readily available.

While it is likely that shorter hours would mean the retention of a somewhat larger number of individuals on the payroll, the extra employment may in the long run fall well short of the theoretical maximum because of offsetting economies. This was the case among maintenance of way employees after they obtained the 40-hour week in 1949. The change from the 48-hour to 40-hour week in 1949 led to a small increase in maintenance of way employment in 1950 and 1951. In a short time, however, employment declined sharply, falling from 256,000 in 1948 to 184,000 in 1954. This steep decline suggests that the advent of the 40-hour week, with its higher hourly labor costs, may have provided an additional stimulus to mechanization.

[3] See Wages and Related Benefits, 17 Labor Markets, 1955–56, BLS Bull. 1188 (1956), table B-3, p. 54; see also Scheduled Workweeks and Shift Differentials in 17 Labor Markets (in Monthly Labor Review, November 1956, pp. 1295–1299).

The economic characteristics of the railroad industry and the personal characteristics of maintenance of way employees suggest that it is not advisable or practical for the Brotherhood to "lead the parade" to shorter hours, nor is it likely that the railroad brotherhoods as a whole will want to establish a shorter workweek before it has become a prevailing practice in the community at large.

Over a period of years, the maintenance of way employees, in common with all workers, will naturally participate in and benefit from a continuation of the historical trend to shorter hours. Leisure is part of the American standard of living and is an appropriate end in itself. We should not confuse shorter hours as a means to leisure with shorter hours as a means to limit unemployment. Both objectives can be borne in mind as policy is shaped.

"Freezing" Employment

Any commitment by a carrier to guarantee a minimum proportion of total employment for maintenance of way jobs, or a minimum absolute number of maintenance of way jobs, if obtainable, would in our judgment prove to be largely superfluous or futile. A specific example of this "freeze" approach was contained in Proposal I of the 1950 Employment Stabilization Program of the Brotherhood: that, on each carrier, the average employment in each maintenance of way class should not fall below the number required to maintain the same ratio to total carrier employment as the average ratio during the 1940–49 decade.

Such a guarantee, if given, might lead to some enlargement of work opportunities in light of the tendency of maintenance of way employment to decline as a proportion of total railroad employment. It could, for example, encourage the makeup of deferred maintenance and the postponement of laborsaving innovations. It might discourage contracting out. On the other hand, it might simply compel the carrier to employ (or pay) more men than it can economically use.

This kind of guarantee would, in our judgment, unwisely impede technological progress. Furthermore, any particular base period would give the already highly mechanized carrier a permanent advantage and would tend to discriminate against those carriers that have encountered more difficult economic circumstances. If applied on the basis of each of the 16 major job categories, as proposed, it would serve to bar many of the unavoidable (and largely desirable) occupational changes that must accompany mechanization. If it maintained jobs by postponing innovations, it would likewise delay the benefits of progress for many employees, such as a higher general level of wages and a larger proportion of better and safer jobs.

We recognize the appeal of such a direct approach, as well as the rationale that maintenance of way employment ought not to suffer relatively more than other classes of railroad employment. Nevertheless, we cannot believe that agreements to freeze the status quo, in either absolute or proportional terms, offer a realistic device for achieving stabilization objectives. Such agreements are unacceptable to the employer because of the arbitrary restrictions thereby placed upon managerial decisionmaking. They are not in the public interest because they might retard desirable reductions in the cost of railroad transportation. There is little likelihood that a public appraisal (for example, by an Emergency Board created under the Railway Labor Act) would elicit the kind of response needed for their obtainment. Finally, such agreements are likely to be self-defeating, given the elastic demand for rail transportation, since keeping costs up would cause a further loss of business to competing forms of transport and an accompanying loss of employment.

Rather, by the use of measures such as those examined below, carriers could make decisions concerning the nature and timing of innovations in light of the full costs and on a basis that would maximize the equities which employees have in their railroad jobs. For those who remain employed, jobs will become, on the average, more skilled, better paid, and less unstable.

A Positive Approach to Technological Change

From the point of view of the Brotherhood, effective implementation of its stabilization objectives requires an approach to technological change that might be outlined in this fashion: "Before a new machine or method is introduced, we want (1) notice that something is going to happen that may affect our people, and an opportunity to confer with management about it. We also want to make sure (2) that the proper individuals are chosen for the opportunities created by the innovation and have access to the necessary training; (3) that appropriate adjustments are made in job classifications and in the rates of pay for new jobs; (4) that workers are adequately compensated for any deterioration in job conditions, such as service away from home; (5) that maintenance of way men be considered for any available employment in other railroad departments; and (6) that the men who are displaced have adequate compensation."

Let us examine each of these matters in turn.

Prior Notice and Joint Consultation. Good contract administration is essential for effective adjustment to new machines and methods. In general, the existing collective bargaining agreements between the Brotherhood and the carriers already make the rates for new positions a matter for negotiation. Effective negotiation ordinarily requires adequate notice of contemplated changes and the holding of conferences before the changes are instituted. When decisions cannot be made in advance, their ultimate application should be fully retroactive.

Many roads already practice prior notice, either formally or informally, and on some carriers there is thorough consultation with the general chairman of the Brotherhood. Unfortunately, our investigations also indicate that on many carriers it is not unusual for new equipment to be introduced without any notice, and for protracted delays to ensue before pay rates and other conditions are determined.

A collectively bargained national rule governing prior notice and joint consultation on changes in machines and methods might prove an effective way to raise the average practice toward the level of the best without interfering with system-level decisions on matters of substance.

Access to New Occupations. Maintenance of way employees should have a preferential opportunity to qualify for new types of jobs in maintenance of way departments. Training for employees who can qualify in a "reasonable" period should be at company expense. This principle has ample precedent in industrial relations practice.

The definition of "reasonable" must evolve from negotiations, often on a case-by-case basis.

It would be affected by the qualifications of current employees in relation to the new job requirements; by the amount of training outsiders would require; by the full costs of displacing regular employees; and by the costs and length of training. In general, the underlying value of a railroading background should not be underestimated.

Experience to date suggests that most carriers have had no difficulty in recruiting competent operators for even the most complex mechanical equipment from the maintenance of way ranks. Extensive training is not generally required for "operator" classifications. However, the maintenance of complex equipment may often require a longer period of specialized training.

Job Reclassification. Orderly wage administration requires the prompt reclassification and rerating of changed jobs or new types of jobs. Our investigations indicate that on many carriers these actions are not taking place or occur only after long delays. Many "laborers" appear to be operating machines.

In addition to new operating and maintenance classifications, special attention should be given to foreman and assistant foreman positions. (These two classifications are represented by the Brotherhood.) The foreman of a specialized and mechanized gang that operates on a district, divisional, or systemwide basis holds a job that is markedly more responsible, and demands more breadth and skills, than the traditional track foreman position. Moreover, the structure and operations of many of the specialized gangs warrant in many cases the creation of an assistant foreman position. This has already taken place on some carriers.

Compensation for Deterioration in Working Conditions. This is too obvious a point to be belabored. If men have to spend substantial periods away from home, living in trailers or camp cars, as a result of their employment in specialized gangs, the associated discomforts are in the carrier's interest. Appropriate compensation, perhaps in the form of per diem travel allowances, should be provided where it does not already exist. Such allowances, like the other costs of innovation discussed in this section, should be systematically anticipated by the carrier when innovations are being planned.

Preferential Hiring. Employees who must be separated from their regular maintenance of way jobs should be given preferential access, on an orderly basis, to any opening in other departments of the same carrier or in any departments of other carriers. Such opportunities are not often available because of the general downtrend in railroad employment and because furloughed men from other departments naturally have the priority on openings in those departments. We are aware, however, of specific instances in which preferential employment has served to keep maintenance of way men in railroading while reducing the cost of unemployment insurance.

When a job opportunity in another department represents an advancement, arrangements should be encouraged which would permit qualified maintenance of way men to bid for the position on a seniority basis and with appropriate safeguards. When any maintenance of way man takes a position in another department he creates an opportunity for a laid-off employee to return to work.

Dismissal Compensation. Most of the Nation's railroads and the 21 major railroad unions entered into the Washington Job Protection Agreement in 1936. This agreement provides dismissal allowances to employees who are terminated as the result of a coordination (consolidation). These allowances continue for periods of up to 5 years, depending on length of past service, and equal 60 percent of previous regular monthly compensation. Also, employees who are shifted to lower paying jobs, as the result of a coordination, are paid the full difference for 5 years, while employees who incur moving expenses or residence property losses are reimbursed by the railroad.

In 1940, Congress amended the Interstate Commerce Act so as to require the Interstate Commerce Commission to impose employee protective conditions in connection with mergers so that employees would not be left in a "worse condition" for 4 years (or a period equal to the individual's previous service, if less). Similar conditions were imposed by the ICC in 1944 for the benefit of employees adversely affected by an abandonment.

Thus, as the result of collective bargaining and public policy, protection of employees who are adversely affected by consolidations and abandonments has become a firmly established practice in the railroad industry. Is it reasonable that when a regular employee loses his job for other reasons beyond his control—such as technological change—he should not be eligible for similar protection?

During the 1930's, consolidations were the major source of job loss for long-service employees. It was natural that special remedies should have been devised to meet that problem. Today, technological displacement takes first position and demands remedial action. Actually, a consistent and equitable scheme of dismissal compensation requires the same benefits for any given class of employees, regardless of the cause of their permanent separation, provided only that the job loss is not the fault of the employee.[4]

Recognition of this principle is contained in a recent agreement between the Chesapeake & Ohio Railroad and the Brotherhood of Railway Clerks dealing with the establishment of a new Univac computer center:

> It is hereby agreed to adopt and apply the beneficial provisions of the so-called Washington Agreement of May 1936 to all employees adversely affected as a result of their work being placed in the Computer Center from time to time so as to provide similar treatment and benefits to those which would have been provided or accorded had the work gone into the Computer Center from two or more carriers and thus constituted a coordination as that term is used and defined in the so-called Washington Agreement.

The specific provisions of the Washington Agreement, the 1940 amendment to the Interstate Commerce Act, and other established precedents, are certainly not sacred. They do provide, however, a useful basis for the development of a mutually acceptable formula.

The alternative to a privately established solution is probably one that is legislatively imposed. The Harris bill (H. R. 4353, 85th Cong., 1st sess., introduced February 5, 1957) represents an effort in the latter direction by way of an extension of benefits provided under the Railroad Unemployment Insurance Act.[5] The collective bargaining route is preferable if mutually satisfactory agreements can be reached.

Summary

The following measures, then, constitute in our judgment the avenues along which a practical program can be developed to deal with the permanent job displacements arising out of changes in machinery and methods and the economic status of the industry: (1) Notice by the carrier and union-management consultation prior to the introduction of new methods or machines; (2) preferential status for current maintenance of way employees for access to new positions in maintenance of way departments and in other departments and for necessary training on company time and at company expense; (3) effective and prompt reclassification and rerating of new jobs, by joint negotiation; (4) compensation for any deterioration in job conditions; (5) preferential reemployment rights and training in other crafts and classes and also on other carriers for regular maintenance of way men who have been displaced; and (6) displacement compensation or severance pay—extending the precedents that have been established in connection with consolidations and abandonments—for all regular maintenance of way employees whose permanent separation (through no fault of their own) cannot be avoided.

Basic to this approach is an acceptance of technological progress and a recognition of its values for the community, the industry, and the employees themselves. In the long run, such acceptance requires an adjustment process that is accepted and understood by all parties and equitable protection or compensation for those individuals who become the casualties of progress.

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[4] For further discussion, see Dismissal Pay Provisions in Major Bargaining Agreements (in Monthly Labor Review, June 1957, pp. 707–712).

[5] In addition to the (roughly) 26 weeks of benefits currently provided under railroad unemployment insurance, the Harris bill would give long-service employees who had exhausted regular benefits and who did not voluntarily leave work without good cause or voluntarily retire the following extended benefits:

Years of service	*Number of 14-day periods of extended benefits*
5 and less than 10	39
10 and less than 15	65
15 and less than 20	91
20 and over	117

Maintenance of Way Employment

Editor's Note.—*This article concludes a two-part summary of a study* [1] *undertaken at the request of the Brotherhood of Maintenance of Way Employes and covering problems of insecurity and instability in maintenance of way employment. Part I, which dealt with the long-run employment decline and possible moderating measures, appeared in the October 1957 issue.*

II—Cyclical and Seasonal Instability and Possible Remedial Measures

William Haber and Mark L. Kahn*

Severe cyclical and seasonal fluctuations in maintenance of way employment aggravate the uncertainty and insecurity generated by the continuing long-run decline.

Cyclical and Seasonal Variations

A substantial proportion of physical maintenance of way requirements is independent of variations in railroad traffic. One might therefore presume that maintenance of way employment would exhibit less cyclical instability than railroad employment as a whole. Actually, however, in comparison to other railroad employment, maintenance of way employment has been about 50 percent more sensitive to cyclical fluctuations. In fact, it is not unusual for the amplitude of these cyclical fluctuations in the number of maintenance of way jobs to exceed the concurrent relative changes in railroad traffic.

Unlike most other aspect of railroad operations, deferral of many types of maintenance is feasible within wide limits without immediately endangering safety. Moreover, under present accounting procedures prescribed by the Interstate Commerce Commission, deferral of maintenance improves the apparent economic position of the carrier. Consequently, deterioration in the cash position of a carrier can be offset, accountingwise, by a downward revision of maintenance schedules.

A managerial policy of using maintenance of way outlays as a balancing item in annual railroad budgets does appear to be responsible for some of the cyclical sensitivity in maintenance of way employment. In effect, short-run accounting and financial considerations often take priority over stability in maintenance of way operations.

Over the long run, haphazard timing of maintenance involves real costs. The prospects for cyclical stabilization are brightened by the fact the railroad managements are giving increasing recognition to this fact. Some railroads, to achieve maximum efficiency and economy on a long-run basis, are already—

> . . . performing renewals (on given sections of track) at fixed intervals of time according to the probable life of existing materials in track and working toward a track condition in which most material will reach the end of its probable useful life at the end of a cycle.[2]

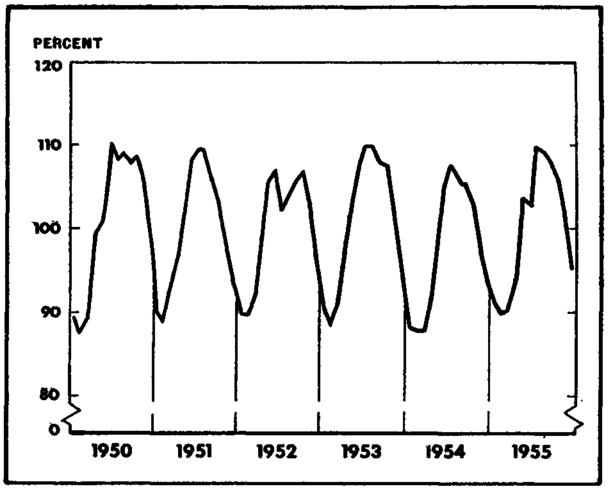
This type of farsighted practice based on cycles of presumptive physical depreciation is inconsistent

*Professor of Economics, University of Michigan, and Associate Professor of Economics, Wayne State University, respectively.

[1] William Haber; John J. Carroll, Associate Professor of Economics, St. Lawrence University; Mark L. Kahn; and Merton J. Peck, Assistant Professor of Business Administration, Harvard University, Maintenance of Way Employment on U. S. Railroads—An Analysis of the Sources of Instability and Remedial Measures (Detroit, Brotherhood of Maintenance of Way Employes, 1957).

[2] Lloyd J. Kiernan, Application of Modern Scientific Research on Railroads of the United States (in Transport and Communications Review, Vol. VII, No. 3, 1954, p. 29).

Employment of Maintenance of Way Workers as Percentage of 12-Month Moving Average, 1950-55



with fluctuating maintenance activities based on short-run accounting motivations.

About one-fifth of the maintenance of way jobs that are present during the midsummer peak disappear by the midwinter low. (See chart.) Aggregate data conceal the fact that for many maintenance of way employees the seasonality problem is even more serious because seasonal variation is much greater on some carriers than on others, and the brunt of the instability is borne by the section and extra gang trackmen—about 60 percent of all maintenance of way employees—for whom a full one-third of summer peak jobs are lost by midwinter.

Since maintenance of way work takes place almost entirely out of doors, weather conditions are certainly a factor in its seasonality. Traditionally, adverse weather has been regarded as the major culprit because of the difficulties (real or assumed) of performing some kinds of operations in winter. Cold and snowy weather is not a significant problem on southern carriers, however, while officials of northern carriers have expressed widely divergent views about the feasibility of winter track maintenance. That some authorities have found that many types of maintenance are practical under northern winter conditions suggests that custom and inertia may account for the extent to which winter layoff practices persist.

Our analysis suggests, in fact, that on many carriers the major source of seasonality is other than climatic. As noted in connection with cyclical fluctuations, there seems to be a common managerial practice of adjusting maintenance outlays to changes in operating revenues. On many carriers, operating revenues exhibit considerable seasonal variation. It is not unusual for an annually conceived maintenance budget to give way before a tightening cash position and deteriorate to a monthly or even weekly level of commitment.

Efforts to reduce seasonality may involve certain types of cost increases, such as the loss of some worktime because of inclement weather or the use of additional man-hours when some kinds of work are performed under unfavorable conditions. On the other hand, greater stability holds out the promise of substantial offsetting economies.

Prospects for Stabilization

There are grounds for optimism about the design and adoption of practical measures for coping effectively with the cyclical and seasonal sources of instability. Given the fact that the underlying maintenance needs, in "real" terms, are fairly stable, the carriers could realize significant advantages from stabilization which should largely offset any costs associated directly with the implementation of a stabilization program.

These advantages may be outlined as follows: (1) stabilization will mean reduced labor turnover, less reliance on inexperienced workers, a higher average quality of personnel, and improved employee morale; (2) long-range scheduling of maintenance based on the presumptive physical life of materials is more economical than the traditional practice of repair or replacement only as testing shows the individual item to be defective; (3) the gains derived from stabilization are enhanced by the continuing increase in mechanization, since stabilization facilitates full utilization of expensive capital equipment; (4) maintenance of way work is cheapest when traffic is lightest, although current practice tends in the opposite direction because of the correlation between maintenance and operating revenues; and (5) stabilization will reduce the cost of railroad unemployment insurance.

Remedial measures may be classified under two headings: (1) positive steps to stabilize the availability of work and (2) protective measures for employees.

Positive Stabilization Measures

Effective annual maintenance budgets, firmly committed and based on long-term physical maintenance programs, would certainly make a major contribution toward stabilization and would appear to make good sense from a carrier point of view. A few railroads have already demonstrated this in practice. Of course, maintenance budgeting per se is a management function, and it may not be the business of the Brotherhood of Maintenance of Way Employes to negotiate with carriers about such matters. On the other hand, it is wholly appropriate for the Brotherhood to advise the carriers that the personal budgets of its members are being upset by the consequences of their prevailing maintenance budget practices.

Apart from the economic sources of short-term instability, there is the problem of subfreezing or inclement weather. This appears to be a significant obstacle to seasonal stabilization, chiefly on northern carriers. On the basis of what some carriers have achieved, it seems likely that additional progress can be made by rescheduling specific maintenance activities so as to leave for cold or bad weather as much as possible of the particular kinds of work that can be economically performed under such conditions, and shift workers to locations where other available work can be carried out.

Ballast cleaning, for example, generally becomes impossible after a week of subfreezing weather, but such activities as laying new rail, rail maintenance, and burning brush on the right of way can be conducted efficiently in very cold temperatures. When carriers have a significant north-south spread in their route patterns, then specialized gangs might concentrate on the southerly segments during the winter months. In this way, climatic variation can be a source of job stability, although at some real cost in altered working conditions. Attention should also be given to possibilities of timing small-scale capital renewal or new capital projects so that they might function in a counterseasonal and even a countercyclical manner. Joint (union-management) study of short-term instability problems, carried out at the system level, should prove helpful on many carriers in developing specific solutions that fit the particular conditions involved.

In connection with both maintenance budgeting and the functional rescheduling of specific operations, it is worth emphasizing that the very deferment of many kinds of maintenance of way work which has been a major source of instability can be redirected so as to make a positive contribution to stable employment by scheduling such work during slack periods.

Protective Measures

The protective measures which are adopted should enhance the established railroad unemployment insurance program so as to provide maximum combined protection for any given additional cost, and they should also encourage managements to take effective positive steps toward employment stabilization.

Minimum Monthly Employment Quotas or Ratios. This type of measure was advocated by the Brotherhood of Maintenance of Way Employes as Proposal II of its 1950 Employment Stabilization Program. Specifically, the Brotherhood asked that:

> The ratio of employees in each major [maintenance of way] class . . . to the total number of railway employees employed by the carrier for each calendar month after the effective date of this rule shall not be less than the average ratio between such forces for the same calendar month of the 10 years 1940–49, inclusive.

This proposal raises questions analogous to those suggested in our evaluation of Proposal I of the BMWE 1950 Employment Stabilization Plan.[3] It would obstruct technological change by preventing occupational realinement within maintenance of way departments and by imposing minimum employment requirements unrelated to changing needs. It would freeze, on each carrier, the particular average seasonal pattern which the carrier happened to experience during the base period chosen. It implicitly accepts as satisfactory the base period seasonal variation. By requiring high employment during the (base period) seasonal peak, it would render impossible a program for stable annual employment even at a level corresponding to the base period annual average.

Minimum Individual Work Guarantees. A different line of attack on seasonal instability is to give a guarantee of employment or pay to the

[3] See Part I of this article, p. 67.

individual worker. The third and last proposal put forward in the 1950 BMWE Stabilization Plan was of this type:

> Each employee who holds employment within the first pay period in January of any year after 1950 shall be guaranteed full employment for the 12 months of that year; each additional employee employed at any time after the end of the first pay period to and including March 15 shall be guaranteed full employment for 8 consecutive months; each additional employee employed after March 15th to and including April 15th shall be guaranteed full employment for 6 consecutive months; and each additional employee employed after April 15th of any year shall be guaranteed not less than 4 consecutive months of full employment . . .

The guarantees proposed above would not apply in cases involving voluntary leaving of employment, requested leaves of absence, retirement, disability, or death.

This is the "call-in pay" approach: "You don't have to employ me, but if you do, I have some minimum work or pay coming to me." This type of provision imposes no particular employment minimum on a carrier. It does create a substantial potential liability which materializes only when a carrier fails to provide an individual with the duration of steady employment which is prescribed. It costs a carrier nothing, at least directly, if employment is stabilized within the specified individual minimums. While not necessarily endorsing the specific guarantee schedule of Proposal III, we suggest that this kind of measure merits serious consideration as a means of providing some assurances to employees and some new employment stabilization incentives to carriers.

The impact of Proposal III, in conjunction with Proposal II, could be intolerably expensive. Under Proposal II, some given number of employees would have to be on the payroll as of the seasonal peak. Once hired, the individual guarantee of at least 4 months of employment would go into force. Since large proportions of maintenance of way men have characteristically worked in only 1, 2, or 3 months during the summer peak, Proposal III would require carriers to give such men more work or pay than during the base period experience. Apart from the criticisms of Proposal II noted earlier, it would be quite impractical to combine Proposal II and Proposal III as proposed in 1950 by the Brotherhood.

Short-Run Work-Sharing. This measure involves a temporary reduction in the workweek so as to spread a given quantity of employment among a larger number of individuals. It is commonly utilized in industries characterized by sharp fluctuations of a seasonal character, such as the needle trades and shoe manufacturing. Many collective bargaining agreements provide for temporary work-sharing (within specified limits or by joint agreement) before regular employees are laid off.[4] From the employer's point of view, work-sharing keeps a productive team together, keeps men from getting rusty, and tends to reduce turnover. If carried too far, however, it can become a share-the-unemployment plan and may run counter to established seniority practices.

A unique feature of railroad unemployment insurance (RRUI) is that its benefits are determined on a daily basis. Maintenance of way men who are partly employed during the course of a week may collect benefits (equal to at least one-half of their regular daily rate) on the other days.[5] Thus, the income loss which work-sharing ordinarily imposes might be partially offset by a work-sharing plan integrated with railroad unemployment insurance. With proper safeguards, and designed to carry groups of regular maintenance of way men through some brief seasonal lull in demand which cannot be otherwise avoided, work-sharing might serve a useful limited purpose.

Railroad Unemployment Insurance. Railroad employees are covered by the only single-industry public system of unemployment compensation in the United States. It is a Federal system, administered by the Railroad Retirement Board and financed by employer contributions. In each calendar year, the uniform rate of employer contribution depends upon the balance in the RRUI account (trust fund) as of the preceding September 30. From 1948, when the present schedule was enacted by Congress, until 1956, carriers paid the minimum 0.5-percent rate. The 1956 contribution rate was 1.5 percent, while the 1957 rate is 2.0 percent. Employer contributions are levied on "taxable compensation," i. e., the first $350 per month earned by each employee.

[4] For further discussion of work-sharing under collective bargaining agreements, see Layoff, Recall, and Work-Sharing Procedures (in Monthly Labor Review, Part I, December 1956, pp. 1385–1393, and Part IV, March 1957, pp. 329–335).

[5] This is a simplified generalization, of course. Any individual's benefit rights are subject to all of the eligibility and disqualification conditions in the RRUI Act.

An employee's eligibility for benefits is based on his "taxable compensation" during the calendar year (base year) preceding the fiscal year (benefit year) in which be becomes unemployed and applies for benefits. To be "qualified," the employee must have earned at least $400 in taxable compensation during the base year. The amount of the daily RRUI benefit is related to total base year taxable earnings, but cannot be less than one-half of the employee's regular daily rate of pay. The maximum daily benefit, however, is $8.50. Benefits may continue for approximately 6 months, except that total benefits paid may not exceed total base year taxable earnings in railroad employment. Disqualifying conditions are generally less restrictive than under State laws, and postpone rather than cancel benefit rights.[6]

There is, however, a fortuitous relationship of potential benefits to the dates of employment and of layoff because of the 6-month gap between the calendar base year and the fiscal benefit year. For example, a man who is newly employed on October 1, 1957, and who works 9 months until he is laid off on June 30, 1958, may start to collect benefits immediately. On the other hand, if a man is newly hired on January 1, 1957, and works a full year before being laid off December 31, 1957, he must wait for 6 months before he is eligible for any benefits.

Two-fifths of the extra gangmen and one-fifth of the section men, helpers, and apprentices failed to earn the qualifying $400 in 1954. Half of the section and extra gang trackmen who collected benefits in 1954–55 collected minimum (half-rate-of-pay) benefits, indicating considerable base year unemployment. Regular employees who work at least 6 months a year, however, can generally count on RRUI benefits to cover their weeks or months of unemployment.

The RRUI system does not provide the individual carrier with a significant economic incentive to stabilize. Whether or not individual carrier experience rating, such as exists under State unemployment compensation systems, would provide such an incentive, the present uniform industrywide rate prevents any single carrier from having a significant effect on its own level of contributions. The higher contribution rates in 1956 and 1957 are, however, making the railroads as a whole more conscious of the current cost of unemployment benefits. One result may be that when job openings are available, carriers will administer more carefully than in the past the preferential hiring of RRUI beneficiaries.

Improvement and extension of the RRUI benefits is an alternative to the development of supplemental unemployment benefit plans at the bargaining table. The Harris bill[7] was a recent effort along these lines. In addition to proposing extended periods of benefits for long-service employees, it would have increased the schedule of daily benefits to a new maximum of $10.20 per day and prescribed a minimum daily benefit of at least 60 percent of the employee's regular daily wage (instead of 50 percent as at present).

So far as the problem of short-term instability is concerned, the kind of legislative approach embodied in the Harris bill would obviously provide laid-off employees with additional protection. On the other hand, because of the uniform contribution rate paid by employers under RRUI, privately negotiated SUB plans may prove more effective in focusing attention on short-term instability at the system level, where positive programs need to be designed.

Supplemental Unemployment Benefit Plans. The railroad industry's first supplemental unemployment benefit (SUB) plan was established on December 27, 1956, by an agreement between the Chicago & North Western Railway Co. (CNW) and 12 unions, including the BMWE, representing the nonoperating employees of that carrier. This plan, possibly a pattern for industrywide negotiations, warrants a brief description here.

The CNW SUB plan provides two kinds of benefits:

(a) Employees with 2 or more years of service will have their public RRUI benefit supplemented so as to yield a combined benefit equal to 60 percent of gross regular pay (or about 75 percent of "take home" pay), subject to a combined maximum of $10.20 a day. Disqualifying conditions are stricter than under RRUI, and include discharge for cause (which RRUI does not include).

(b) Employees with 15 or more years of service are also eligible for so-called "interim" benefits,

[6] Limitations of space preclude a fuller description of railroad unemployment insurance. For further details, see The Railroad Unemployment Insurance Act as amended to September 1, 1954 (Chicago, Railroad Retirement Board, 1954), ch. 6, on which this discussion is based; see also Domenico Gagliardo, American Social Insurance (New York, Harper, 1955), ch. 13.

[7] See Part I, p. 70.

equal to 60 percent of gross regular pay. These benefits are provided by the company after an employee has exhausted his RRUI benefits for the current benefit year, provided the employee will again be eligible for additional RRUI benefits in the succeeding benefit year. Duration of these "interim" benefits depends upon the time of year in which the layoff takes place, and may range from 0 to 6 months.

The plan contains no financing provisions, and its costs are presumably being met by the company on a pay-as-you-go basis. Since such costs can be reduced by stabilizing employment, they can generate a significant additional incentive to stabilize. Other consequences might include the tighter administration of disqualifications and the concentration of instability on lower service employees not yet eligible for supplemental benefits.[8]

The CNW plan specifically excludes "seasonal track forces" laid off between October 1 and the following May 1, and will, therefore, make no direct contribution as it stands to the greatest instability problem in the maintenance of way group. There is, however, a provision that reduction in track-force employment below the October 1955–March 1956 (inclusive) average will not be regarded as seasonal. As productivity rises, this clause will increase the stabilization incentive on the company in relation to this group.

Any SUB plan that makes instability more expensive encourages stabilization, provided the carrier has effective alternative courses of action. Such alternatives appear to be clearly available in connection with maintenance of way work, because of its deferability. Apart from the actual costs, administration of a private SUB plan serves to focus managerial attention on the instability problem in a systematic way.

The method of financing is also pertinent. A plan in which all benefits were paid from a fund, and in which the employer's total obligation was to deposit money at a specified rate into that fund would seem to impose little direct stabilization incentive. At the other extreme—represented by the CNW plan—is a pure pay-as-you-go approach, in which every supplemental benefit is an out-of-pocket cost to the carrier.

An exceedingly strong case exists for the development of a system of private supplementary unemployment benefits. SUB plans on individual carriers will compel serious attention to layoffs, and create a clear relationship between layoff avoidance and SUB costs. The railroad companies would thus be establishing a private experience rating system without the disadvantages which now characterize many State unemployment insurance plans. Since the timing of maintenance work is largely within managerial control, SUB plans should not prove to be costly in practice.

Summary

In light of the preceding observations, the following measures appear to warrant sympathetic examination by the carriers and the Brotherhood as possible approaches to the problem of short-term (cyclical and seasonal) instability: (1) effective annually determined maintenance budgeting based on long-term maintenance needs; (2) functional rescheduling of work, perhaps guided by the results of joint study at the system level, so as to maximize available work during seasonal lows; (3) minimum individual work guarantees; and (4) supplemental unemployment benefit plans or (in lieu thereof) extension of the public railroad unemployment insurance program. Limited short-run work-sharing, integrated with RRUI benefits, may also be a useful method on some carriers for cushioning the impact of temporary drops in employment demand.

*   *   *   *   *

If income and employment stability for maintenance of way employees is given sufficient priority at the bargaining table by the carriers as well as by the Brotherhood of Maintenance of Way Employes, it is our judgment that effective steps can readily be taken, within practical economic limits, toward this objective. We believe that it will be in the long-run interest of all parties to evolve a workable program out of their own negotiations, and to emphasize the collective bargaining rather than the legislative route.

The general problem of employment instability is one that has become the focus of much attention in our society. There is little doubt that Congress could, in the case of the railroads, be persuaded to enact additional legislation to cope with the problem. If collective bargaining bogs down, then congressional action may be the only route along which progress can be achieved.

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[8] The authors have not yet had an opportunity to study the CNW SUB plan in operation.

Part III.

Adjustments to Automation. Summaries of Case Studies and Articles on Office Automation.

Adjustments to Automation in Two Firms

ADVANCE PLANNING with respect to personnel and techniques involved and proper timing with respect to business conditions apparently achieved for two firms an orderly and generally harmonious transition to automatic technology. How the two firms accomplished this transition is described by the Department of Labor's Bureau of Labor Statistics in separate case studies of, first, a large manufacturer of radio and television sets which adopted printed circuitry and automatic inserting machines in producing its 1955 TV receivers; and second, the home office of a large insurance company which installed a digital electronic computer to reduce punchcard operations in the preparation of business operating statistics.[1] The cases are illustrative, rather than representative, of the industries concerned; also, they are not intended to indicate the impact of automatic production methods on employment generally.

Laborwise, the experience with the automatic techniques at both companies had significant implications. On the one side, new jobs were created for which, with some exceptions, brief on-the-job training sufficed. New branches of work were developed to plan for, install, and service new automatic equipment. Some new skills were required. In neither firm did the machines replace workers performing work requiring a high degree of judgment. Nor did their introduction eliminate all hand labor. The electronics manufacturer found hand labor imperative in tasks requiring fine hand movements and involving the use of fragile materials. At that firm, increased responsibility and some differences in work conditions (not described) that followed the introduction of automation, led to higher pay on automated jobs; expanded output, through increased productivity, was expected to offset any reduction in plant employment. After the installation of the digital computer at the insurance firm's home office, employees performing the new functions averaged higher annual salaries than those who worked with the old setup.

Some work using unskilled labor was reduced, however. Of all the workers, women, who formed a high proportion of the work force at both companies and who were commonly engaged in tasks to which the automatic techniques were adaptable, appeared to be most adversely affected.

Certain circumstances were common to both firms. Both had a volume of routine, repetitive work, which was performed chiefly by women. The new devices were installed over a period of years, under long-term programs designed to improve competitive performance (product and efficiency), keep pace with an expanding volume of business, and eliminate high labor turnover among the firms' women workers. Both firms planned further automation, subject to analysis and experimentation. The companies used different methods to advise their employees about the changeover prior to actual mechanical rearrangements. The advance communication by the insurance company, however, was relatively more extensive than that by the electronics manufacturer. The insurance company informed all employees in extensive detail concerning its plans to install the computer. The electronics company informed only its production foremen and union officers of the proposed installation of the new automatic equipment; other nonsupervisory workers learned of the plans via the "grapevine." A policy of no layoffs or downgrading because of technical changes was already established in the insurance company.

At the insurance company, affected employees were not represented by a union. At the electronics plant, the union officials appeared to be

[1] A Case Study of a Company Manufacturing Electronic Equipment, and The Introduction of an Electronic Computer in a Large Insurance Company, both issued in October 1955. The case studies were based largely on interviews with company officials, information in company publications, and, at the electronics company where a collective bargaining agreement was in force, with union officials also. The studies describe the nature of the changes, some effects on employment, productivity, and working conditions, and some of the problems and adjustments reported by management and labor. Case study No. 2 provided relatively more detailed data on the effects on plant personnel of the changeover to automatic technology.

concerned mainly with obtaining for their members a share in production gains through increased wages and related benefits.

Case No. 1

The "Y" Company is one of the largest manufacturers of radio, TV, and phonograph sets. Its plant work has consisted largely of engineering and assembling various models of these products and some military electronics work. The company purchases standard components from suppliers, and installs the completed chassis into companymade cabinets. The conventional methods of assembly had previously involved handling several hundred parts and soldered connections.

Assembly-line methods, with considerable job specialization, had been the dominant features of the company's television manufacturing operations. Component parts, after inspection, went to bins alongside assembly lines. The riveting department had previously attached metal parts, such as tube sockets, to the chassis, and other plant divisions had done the intricate wiring on subassemblies. On each side of a 300-foot table, the workers, nearly all women, using handtools, performed one or more repetitive operations—wiring, soldering, or lacing on each set, or inserting components in predetermined sequence. The completely wired chassis then was moved by conveyors to the line where television tubes were inserted. These chassis were tested electrically and those accepted were conveyed to the next department, where they were bolted into cabinets, and the entire set tested and packed for shipping. On sets made several years ago, nearly 60 percent of the direct labor time was expended on wiring, lacing, and assembling.

The "Y" Company first substituted printed (photoetched) circuitry for many handwiring operations on 5-tube portable radios in 1952. Components were inserted by hand on the board and the underside was hand-dipped in molten solder to complete the subassembly. The company decided in 1954 to use photoetched circuit boards in its 1955 television receivers; in the 1956 models, about 75 to 80 percent of the wire circuits were photoetched on the board. Development of a mechanism to attach components automatically began in 1953 and within a year a machine was inserting components on about 6 boards a minute. A mechanism now in use handles 12 boards a minute and since 1953 other improvements permit the handling of components of various sizes. These advances made possible significant increases in efficiency and improvements in quality.

After the circuit boards are processed and components attached, under the new methods, they are shipped to a central plant for handwiring of the remaining 20 to 25 percent of the circuitry and inserting of the remaining components, attachment of the printed boards to the chassis, and installation of picture tubes, all on an assembly line. The use of printed circuitry has simplified the testing operation.

Introduction of the new methods reduced but did not do away with hand assembly operations. Riveting, tube inserting, installing, testing, adjusting, and packing were only indirectly affected and continue to be largely manual activities. Reorganization of assembly lines reduced overall requirements for handwirers, lacers, and assemblers, jobs held chiefly by women.

The new technology created some new machine-tending jobs, for which no greater skill or training seemed required; only 2 weeks' training was given. Certain new machine operations, utilizing somewhat higher paid labor and some additional skilled occupations, were created. For example, employment of skilled jig and fixture men in developmental, repair, and maintenance work doubled as did the industrial engineering staff; the number of mechanical and electrical engineers more than doubled and the ratio of engineers to production workers increased.

Some unskilled job opportunities were eliminated, but no worker, according to company officials, was laid off as a result of the changes. Some workers were reassigned to final assembly, inspecting, packing, and related operations, as well as to the newly created automated jobs. As printed circuits usually result in lighter TV sets, women could be assigned to some packing jobs.

Pay for the automated jobs was set at 5 to 15 percent above the straight-time rates for unskilled assemblers because of some differences in working conditions and increased responsibility. An individual incentive pay basis was inaugurated for employees who process the printed circuit boards up to the stage where they are fed into the automatic inserting machines and also for some of the workers on the final assembly line. The others received incentive pay on a group basis. Workers who operated the automatic inserting equipment were not under the incentive pay program.

About 2 weeks before the new methods were applied, the vice president in charge of production informed the production foremen concerning the changes. The union officers were also told in advance that the company was trying to improve production procedures. Other workers learned of the changes via the "grapevine."

The experience of the company suggests the possibility of an orderly transition to automatic technology, within the framework of amicable union-management relations. The current collective bargaining agreement, which became effective 3 months after the new procedures were installed in mid-1954, does not include provisions concerning the introduction of new automatic equipment. Under present and predecessor labor agreements, job changes resulting from technological developments are governed by work rules covering technological changes in general. New job vacancies were posted and workers were selected by foremen according to seniority and ability to perform the duties required. Some preference was expressed for male workers.

The changeover was successful largely because the new techniques were introduced at a time of model changeover and employment expansion. The company plans to install 2 automatic units in addition to the 4 now in use.

Case No. 2

The "ABC" Life Insurance Company is a large company selling diversified forms of insurance. Its operations require the rapid and accurate processing of constantly increasing routine paperwork. For the past 15 years, the company has been plagued with a labor shortage. A high proportion of the workers in its home office were recent high school girl graduates, whose brief stay with the company resulted in complete turnover every 5 years. Many of the operating divisions hired high school students on a part-time basis. In the early postwar years, conventional office machinery was used extensively.

Installation of a large electronic computer in the classification sections of division "X" began in early 1954. There were 198 employees in these sections, 800 in the division. As a result of the machine's operation, it was expected that a large number of the sections' employees would be available for reassignment. These sections maintain running inventories of all policies in force and in an average month process about 850,000 policy transactions. The employees in these sections use data from other operating sections—reported on punchcards—and their work involves sorting, classifying, and calculating. They performed this work using 125 separate punchcard machines (not including incidental key punch machines), at a $235,000 annual rental. These employees, who had an average annual salary of $3,700 (table) handled about 3¼ million punchcards monthly. The work required frequent shifting of card decks and maintenance of paper controls.

Installing the computer resulted in an estimated 50-percent net reduction in the budget for the classification sections, 9 percent in division "X." Work in these sections could now be handled by 21 punchcard machines and 85 employees averaging

Wage structure in classification sections in ABC company, before and after computer installation

Approximate annual salary	Employees originally in classification sections		Employees released or to be released for other assignments		Employees assigned to the computer operations		Employees expected in new classification sections [1]	
	Men	Women	Men	Women	Men	Women	Men	Women
$2,500		4						4
$2,800		6		1				5
$3,000		35		30				5
$3,200		35		28	1	1	1	8
$3,400		52		34				18
$3,600 [2]	3		3		1		1	
$3,700		9		4				5
$4,000		16		9	3	2	3	9
$4,300		8		3	1		1	5
$4,600	1	12	1	11		1		2
$5,000		7		3		1		5
$5,400		1		1		2		2
$5,800		3		1		1		3
$6,700		1		1				
$7,200	1		1		2		2	
$7,600	2		1		1		2	
$8,100					2		2	
$8,500	1		1					
$9,000 and over	1				1		2	
Total	9	189	7	126	12	8	14	71

[1] Includes, in addition to the 20 employees working in computer operations, 56 classification sections employees who were retained on noncomputer duties, and 9 employees in the procedure development group.
[2] Noncierical labor.

$4,200 annually. Annual punchcard machine rentals declined to a total of $19,000. The changeover freed 15,000 square feet of floor space. Principal supply savings were the 2½ million monthly punchcards required; the information on the 850,000 policies could be put on 71 reels of magnetic tape and the 1,000 reels purchased at the outset could be erased and reused. The need for paper controls of intermediate totals practically disappeared. Savings are partially offset by amortization charges against the computer; regular maintenance fees to the manufacturer; and costs incident to the "downtime" (about 4 percent) of the computer from mechanical failure. The company found that actual investment would be returned in about 4 years.

Job reductions as a result of the computer installation would take place very largely among clerks performing the large volume of simple repetitive operations in work areas to which automation is suited. The other employees were generally engaged in work requiring experience and exercise of judgment. Company officials pointed out that reduction in clerical jobs would enable it to set up many positions calling for those qualifications. Outside division "X," likewise, the electronic computer was not expected to affect the "substantial number" of positions requiring judgment and experience.

The company planned most carefully both personnel adjustments and the mechanical aspects of the changeover. Employees affected were advised in advance of the impending installation and no attempt was made to gloss over the implications for employment in the classification sections. Individual employees were interviewed with meticulous concern for job preferences in other operations of the company. Except for cases of normal turnover, the employees were, or will be, successfully placed in other company jobs; the home office had 15 other punchcard sections utilizing personnel of approximately equal skill. Job reassignments had not been completed at the time of the study. The company has maintained a consistent policy of not discharging or downgrading workers because of technological change.

An officer of division "X" met regularly with personnel officers in advance, to discuss the many personnel matters, particularly employee transfers. In April 1954, just before space rearrangement commenced, the division chief held an informal meeting of the sections' members, at which he told them the computer was to be installed, gave reasons for the decision, and reiterated the company policy of no job loss or downgrading because of the new work techniques. The prospect of new assignments aroused a natural amount of concern among employees; at the same time, the general reaction was one of interest and understanding.

During the formal trial period, June–October 1954, when the computer was tested in the critical workload area of data sorting, articles appeared in company publications, directed at home office and field staffs. The articles described the possibilities and limitations of the computer; announced directly that some employees in the classification sections would be transferred; and reiterated that even this newest technique would not mean any personnel separations.

To provide a nucleus of computer operators, 8 keymen received from 1 to 6 months' training from the computer manufacturer. Otherwise, the computer staff was trained on the job, a step based upon experience obtained from training the keymen. Every effort was made to use persons already in the classification sections. Some of the new positions involved skills and knowledge not available in the group, however. Criteria for selection of the computer staff were: experience, proficiency in mathematics, and college training (considered desirable, but not essential). Thus, of the 20 computer employees, 9 were from the classification sections, 5 from other sections of division "X," 5 from other divisions, and an electronics engineer, hired from outside the company.

The computer work force consisted of the following employees:

1 supervisor (engineer, man)
2 computer operators and 2 assistant computer operators (men) set up for 2 shifts
1 tape librarian (woman)
1 auxiliary equipment section head (man)
1 converter team head (woman)
1 converter clerk (woman)
1 assistant converter clerk (man)
3 junior converter clerks (men)
1 key punch operator (woman)
1 card and tape file clerk (man)
1 machine room distributor (man)
1 control captain (woman)
1 assistant control captain (woman)
2 control clerks (women)

The employees not selected for computer operation were released to other assignments gradually, after a personal interview and careful review of their record. At the interview, each employee was requested to specify a job preference in transfer. In no case was anyone offered a lower paying job. Those released were transferred to jobs which they could handle with only brief on-the-job training. Their new supervisors were uniformly consulted before the transfers were made; they interviewed the transferees, and are currently satisfied with the new arrangements.

Within the classification sections, six supervisors had developed considerable skill in handling people. The 4 most interested in the computer installation are now permanently assigned to its work force (3 to operation and 1 to developmental work); 1 preferred to transfer to an equivalent staff job in another division; and the remaining supervisor accepted a higher paying nonsupervisory job.

The procedure development group, which studied problems within the computer's range and translated their findings into operations, began with 14 persons; by June 1956, all but 4 will have transferred to a newly created electronics installations division.

The electronics installations division was formed on January 1, 1955, to expand the use of electronic computers in the firm and to provide a pool of skilled manpower. Its chief had piloted the initial studies which led to the recommendation that a computer be installed. The 8 men selected initially for this division had had some prior experience in the field; 21 were added, of whom 13 were selected because of prior experience with specific phases of the company's business; the other 8 were clerical assistants.

In June 1955, home office personnel records were culled to develop a list of individuals who had the experience and educational background required in this highly specialized division. Those listed were invited to take three examinations which would indicate their aptitudes for the work. More than 250 responded, representing practically every division in the firm. By September 1955, 30 persons had been selected, from as many different divisions as possible. The criteria for this selection, in order of importance, were: company experience, seniority, and aptitude ranking. The 60 now comprising the electronics installations division are heavily weighted with those having skills or aptitudes in programming, project analysis, and other related processes. Some will be trained to operate a large computer.

By the end of 1954, the suitability of the electronic computer to office work had been substantially established and the computer officially accepted. Certain factors contributed materially to the success and ease of the adjustment to the changeover: the company's growth to meet an expanding volume of business; relatively high labor turnover with an accompanying shortage of women clerks in its home office; and the basic similarity of jobs among many company divisions, permitting easy transfer of employees.

The company is carefully studying 22 activities under a 3- to 5-year program for possible future installations. It estimated that it would take 1 to 1½ years to develop plans for a specific computer activity and from 1 to 5 additional years to attain problem-free installation.

Adjustment to Automation in a Large Bakery

WORKING within the framework of a long established collective bargaining relationship, the management of a large bakery introduced in 1953 more highly automatic production techniques with a minimum of hardship to its employees. Contract provisions greatly reduced the number of workers who might have been displaced, established rates of pay for new jobs, and guaranteed workers, who might be shifted to jobs of lesser skills, the retention of wage rates at their higher skill levels.

How this transition to increased automatization was effected is described in a case study by the U. S. Department of Labor's Bureau of Labor Statistics.[1] Implications for labor suggested by the study are based on facts developed at the plant and reflect only the experience of the bakery studied. There is no intention to assess the impact of automatic production methods on employment in the industry as a whole. This description, however, should be useful in suggesting the general character of developments that may occur at the plant level as the new methods are adopted elsewhere.

The bakery studied (Z Company Bakery) employs approximately 575 workers. The bakery's entire output of a variety of bread and cake products is sold to a chain of retail grocery stores. In 1948, the demands of the retail outlets had so increased that the bakery officials felt an urgent need for increasing their production facilities. After 2 years of study, the management decided to relocate the company's separate facilities in a single, modernized unit. Construction of the building was begun in 1950; by 1953, the bakery was operating at its new location.

[1] A Case Study of a Large Mechanized Bakery, BLS Report 109, September 1956. This study, based on interviews with company and union officials, is the third in a series of case studies on automatic technology.

Major Technological Changes

The changes in technology introduced at the Z Company Bakery were primarily directed toward bringing about a greater degree of mechanization of the bakery's material-handling methods. The bulk material-handling practices and the breadmaking process have been so integrated mechanically in the new bakery that, except for one stage in the breadmixing operation, there is no manual handling of the product from the receipt of the dry bulk ingredients to the delivery of the finished loaf of bread at the shipping platform.

Location of the new plant on a railroad siding made it possible to replace the former manual bulk material-handling methods with a pneumatic conveyor system especially designed for the bakery. Seven workers are now employed in the entire material-handling department, compared with 24 workers before the change.

Flour and sugar, which formerly came in bags, are now delivered in bulk by special railway cars and trucks. The cars are unloaded through tubes and hoses by a worker who operates the new system from his position at the control panel. By manipulation of the buttons and switches on the panel, the operator channels dry bulk ingredients to storage bins on the top floor. Manual movement is entirely eliminated.

Flour moves from railway cars into bins at the rate of 20 tons an hour with one man operating the system. Previously, it took 24 men, 5 to 6 hours, to move 50 tons into the plant. Output per man-hour for this task under the automatic system is now at least 40 times greater than it was before the change.

New mechanical methods adopted for handling oils and lard in bulk have also substantially reduced labor requirements. The oils and fats are pumped into the plant through steam-heated pipelines which keep them liquid and are stored in special insulated tanks and metered directly into the mixing machines.

In the bread department, which is the most important in terms of employment and volume of product, 1 of 2 previously existing semiautomatic breadmaking lines has been replaced by an automatic line. The processes required in the mixing of the ingredients, the makeup of the dough (including shaping and baking), and the wrapping and slicing of the bread, remain unchanged. However, manual handling of the materials has been virtually eliminated, and the speed and capacity of machines have been increased. Formerly, ingredients were weighed by hand, and certain steps in each operation required manual loading and unloading. Now, ingredients are automatically weighed by scales located below the storage bins and fed into the mixing machines; the movement of the dough in the mixing operation is entirely mechanical except at one point—the removal by hand of the sponge dough from the mixers when the operator judges it to be of the right consistency. Introduction of the automatic line has resulted in substantial increases in output per man-hour in breadmaking operations (based on capacity operations), as shown in the following tabulation:

	Percent
Mixing	240
Makeup	250
Wrapping (including slicing)	512

Personnel Changes

Through collective bargaining, management and union officials resolved problems of displacement, downgrading, and changes in skill levels and earnings which resulted from the technological advances established in the new bakery. On reaching the decision to modernize, company officials informed the business agent of the bakery workers' union of its plan to move. From then until the new plant was in full operation, 5 years later, management officials and union representatives conferred frequently on the changes and their possible effects on the workers. Full information was supplied to the union's business agent so that he could review contemplated job or equipment changes, new jobs proposed, and wage changes, and could make suggestions for cushioning the impact of the changes on workers.

Displacement of Workers. Early in the planning stages, the company estimated that the new plant would require 25 percent fewer production workers. The business agent was told of this estimate. He informed the workers that some displacement was anticipated but did not divulge the exact extent, believing the estimate would be revised downward in the course of negotiations before the actual change.

In 1952, as the building neared completion, a new union contract provided for changes in the daily schedule of hours that had the effect of substantially reducing the estimated reduction in employment. The provision, one which was being adopted by the industry generally, provided for a guaranteed minimum 8-hour day as contrasted with the previously existing 6-hour guaranteed minimum day. Under the 6-hour day, the bakery scheduled its workers so that they worked a 40-hour week over a 6-day period. With the adoption of the 8-hour day, the workers were paid for 40 hours within a 5-day workweek. It was necessary, therefore, to establish a rotating workweek requiring an extra relief worker for every 5 production workers. As a result, the estimated 25-percent drop in employment was reduced to about 5 percent.

Reassignment of Workers. The change to more automatic methods meant some shifting of workers from jobs in reduced activities to jobs in expanding activities. In some cases, the shift meant a downgrading in skill level; in others, upgrading took place. Workers most affected were material handlers, bread-mixer helpers, and the bread-wrapping personnel.

When the management informed the union business agent of its estimated employee displacement, it also gave assurance that any employees shifted to lower paying jobs would be paid at the rate they had been receiving for their higher skilled jobs. This news removed some of the anxiety arising from the announcement of possible job loss. The 1952 union contract formalized the company's pledge.

Some workers with higher skills were shifted to jobs as *sanitors* in the expanding sanitation department. While this represented a downgrading to a lower rated job, there was apparently little discontent over the shift, since these workers retained the higher pay rates of their former jobs.

Workers unable to adapt themselves to the more efficient and faster machines were given the opportunity of working in jobs to which they could adjust. Their rates of pay were continued at the levels of the jobs from which they were moved.

Employment Trends

During 1953, total employment in the Z Company Bakery declined 4.4 percent; the number of production workers fell 8.4 percent. In 1953, the first full year of operation in the new plant, management had to lay off some workers while it became familiar with the new production methods and equipment. When the production problems were resolved, output expanded with increased sales, and employment increased. By 1955, the total number of production workers slightly exceeded the number employed before the change.

Occupational Changes

Adoption of more highly automatic production techniques resulted in the creation of some new job classifications and skill levels. The new job of bulk material-handling equipment man was established in connection with the operation of the pneumatic material-handling system. At first, a licensed engineer was brought in to operate the system since it was thought that there were no workers in the plant qualified to operate it. When some dissatisfaction with the engineer's performance arose, a worker in the maintenance department was given several weeks of on-the-job training at the control board after which he proved quite capable. The second operator—also trained on the job—was formerly a dough mixer in the plant. For both men, the shift meant an upgrading.

Machine operators on the semiautomatic bread line apparently had sufficient flexibility to meet the demands of machine operation on the automatic line. With few exceptions, where a worker was required to operate equipment somewhat more mechanized than previously, on-the-job training for 1 or 2 weeks was sufficient. The training was necessary to adjust to the pace of the new line rather than to acquire new skills. New mechanical material-handling techniques, which substantially reduced the physically exhausting part of the task, apparently compensated for the need to adapt to equipment with faster speeds and increased capacity.

Now, the operator of the automatic bread proof, oven, and cooler system not only has responsibility for the oven but he also controls the automatic equipment which removes baked loaves from pans and cools them after they leave the oven. These steps in the process involved manual loading and unloading chores on the semiautomatic line and were part of the wrapping department's operation.

Operators of the slicing and wrapping machines on the automatic line have also had an increase in responsibility because of the increased number of slicer-wrapper machine units under their control. The operational pace has been stepped up considerably, and the operators are required to observe schedules so that their operation is completely synchronized with the rest of the automatic line.

In recognition of the greater skill required by the bulk material-handling equipment men and the increased responsibilities of the operators of the automatic bread proof, oven, and cooler system, and of the slicing and wrapping machine operators, the 1952 union contract established a new top skill level classification of "specialists" for these three jobs. The company and union officials agreed that the duties of the new jobs in the mixing operation and of the divider operator and the molder operator were not sufficiently different from their counterparts on the semiautomatic line to justify a change in skill level classification.

Wage Changes

The 1952 union contract provided for an across-the-board wage increase of 17½ cents per hour for the bakery's production workers, all of whom are on an hourly rated pay basis. This was in line with raises granted by other firms in the industry at the time. A rate of 18 cents per hour above that paid the previously existing top rated jobs (including machine operators) was established for the new "specialists" classification. Since the change to new methods, in addition to wage increases granted annually, fringe benefits have been expanded.

Implications for Supervisory Personnel

With the change, a new plant superintendent and assistant were brought into the plant. These college trained men were familiar with the production methods of the industry and could apply other industrial production techniques as well as their general theoretical knowledge for use in the industry.

Of the 20 nonworking foremen employed before the change, 10 were successfully retrained on the job to meet the requirements of the new plant. The remaining 10 were replaced by men especially trained for their jobs as foremen. Some were promoted from the ranks and some were hired from the outside. Replaced foremen were laid off if they were relatively new men in the plant. Those with years of service were given other jobs at the rate of pay they received as foremen.

Attitudes Toward Increased Mechanization

From the standpoint of the company, the effort to modernize, on the whole, has been successful. Capacity has been enlarged. Increased output now meets the demands of the chain of retail stores. Unit labor costs have been reduced, although wages have risen steadily. Losses due to wastage and spoilage have been reduced. New and faster material-handling methods have made it possible to deliver a fresher product to the consumer.

The consensus of the workers, as expressed by the local union president, was that the results of the changes on the whole were advantageous to them. The union, as well as the company, takes pride in the orderly transition that well-established collective bargaining made possible. In the union view, an important aspect was the company's early announcement of its plans and its willingness, prior to the change, to consult on issues affecting employment. The change in work schedules which minimized displacement and the decision to maintain wage rates of downgraded employees were particularly satisfactory aspects of the change. The local union president believed the workers have shared in the greater productivity of the plant through the wage increases and fringe benefits obtained in the past few years.

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Labor Adjustments for Changes in Technology at an Oil Refinery

NO REGULAR EMPLOYEES were laid off when the management of a medium-size oil refinery replaced former processes with more automatic processes between 1948 and 1956. A small number of workers were upgraded, nearly half retained their grade, and a sizable group were downgraded. Through collective bargaining, management and labor agreed on seniority and maintenance-of-wage-rate provisions to govern the reassignment of workers and to minimize the impact of the adjustments.

To learn how these adjustments were effected was the main objective of a case study by the U. S. Department of Labor's Bureau of Labor Statistics.[1] The study also yielded information on working conditions and labor relations at a plant with a higher degree of automatic operation than is present in most industries.

The study was intended to be illustrative of the effect of technological change on the work force in the petroleum refining industry. Implications for labor suggested by the study reflect only the experience of the refinery studied, although it also presented some industry background.

The oil refinery studied employed approximately 660 employees in 1956. It is a part of an integrated multiplant company with producing, processing, and marketing facilities located at various points in the United States. Since its construction in 1930, the refinery has undergone a number of changes in plant and equipment leading to greater diversification of output and more automatic control of processing. However, this summary discusses those changes since 1948, as these held the most important implications for the workers.

Major Technological Changes

The major changes resulting from the $20-million modernization program completed in 1949 were the installation of a fluid catalytic cracking unit (a unit in which a catalyst is employed to bring about a desired chemical reaction) and a delayed coking unit (a unit for producing additional gas, oil, gasoline, and gas and coke from heavier residual oil after crude distillation). These units replaced a number of batch-type thermal pressure stills in use since the refinery started. The new units were introduced primarily to upgrade the quality of the gasoline produced rather than to increase substantially the crude oil charging capacity.

One result of the installation of these two units was more automatic and continuous operation of the plant. Changes in temperature, pressure, flow, and level are controlled automatically on the new units which operate on a continuous 24-hour basis, shutting down only about twice a year for cleaning and necessary repairs. The old pressure stills were shut down 22 hours out of every 72-hour operating cycle for cleaning out accumulated coke.

Planning began in 1951 for a $14-million program for increasing crude oil charging capacity and further raising the yield of quality gasoline per barrel of crude oil. This program provided for building an additional crude distillation unit and a new catalytic reforming unit (which replaced a thermal reforming unit) and further instrumentation of existing equipment. The new crude distillation unit was ready for operation by April 1954, and the catalytic reformer started operating in January 1955. Both of these new units are highly instrumented and highly automatic.

As a result of these changes in technology, the quality of gasoline produced was upgraded from an octane rating of 87 in 1948 to 97 in 1956. With virtually the same number of plant production and related workers, crude oil charged per day rose 57 percent—from 35,000 barrels in 1948 to 55,000 barrels in 1956. Direct labor requirements on the new units were about one-third less than on the old pressure stills. However, labor requirements on auxiliary operating and mechanical functions had expanded during the same period.

Planning the Workers' Adjustments

Technological changes in 1949 resulted in the reassignment of 164 workers—about one-fourth of all personnel. Changes in 1954 were less extensive.

[1] A Case Study of a Modernized Petroleum Refinery, BLS Report 120. This study, based on interviews with company and union officials, is the fourth in a series of case studies on automatic technology.

No regular employee was laid off as a result of the changes in either year. Fifteen months' advance planning preceded each of these personnel changes. Management and union representatives jointly discussed the number of workers required on the new units and their qualifications. They also worked out union contract provisions governing layoff, transfer, and promotion in the reassignment of personnel.

Negotiations leading to the 1949 union contract helped to crystallize two basic principles concerning displacement and reassignment of the plant workers. First, length of service was established as the basis for retention of workers in the event of projected layoffs and also as a factor in regulating demotions. The objective was to minimize displacement of older men with years of service at the refinery. Second, the placement of men in newly created or reorganized departments and any proposed change in the application of the demotion or promotion procedures were made the subject of management and union conferences.

Changes in assignment necessarily were made in reference to the lines of progression from one job to another that the technology of the plant required. Although the progression system had existed at the refinery from its very beginning, the negotiations led to setting up of a more formal system. A basic feature of the progression system is that virtually all workers are hired at the plant as probationary laborers and advance to higher paid jobs when available on the basis of their length of service. At each job level, the worker is trained on the job to meet the demands of the next highest classification. After a trial period, a probationary laborer has a choice between 2 routes of advancement, 1 covering operating jobs and the other, maintenance jobs. He is then assigned as a regular laborer to the labor pool of the route he has chosen and his plant seniority is effective from the date of his employment. When a job opening or a chance for "breaking in" at a specific department arises in the chosen route, eligible workers may apply for the assignment and selection is made on the basis of plant seniority. Once a worker is assigned to such a job, he accumulates seniority in the department. Thereafter, he advances in the department on the basis of departmental seniority, irrespective of plant seniority.

To assure operating workers that their seniority rights would be fully protected during the planning and construction period preceding the startup of the new units in 1949, management and union officials agreed that job vacancies in the various departments would be filled on a temporary basis for that period. Workers hired during the period to fill any jobs were told that they might have to step back to lesser paying jobs when the new units were started and senior employees exercised their rights.

Reassignment and Retraining

Production workers whose jobs were directly affected by the introduction of the catalytic cracking unit and other changes were reassigned to other jobs on the basis of their position on special seniority registers established during the bargaining negotiations. Of the 164 workers affected in 1949, approximately 102, or 62 percent, were placed in jobs paying at least the same wage rate they had previously; the remaining 62 workers were downgraded to jobs at lower rates. Under the seniority provisions of the union contract, some of these latter workers were not downgraded in pay immediately. They were protected by a maintenance-of-wage-rate provision which guaranteed affected workers with 5 or more years of service against a reduction in their rate of pay for 6 months after being reassigned.

Among the 102 workers who retained or bettered their job rates were 81 direct operating employees, that is, stillmen, operators, and helpers. There was not much difficulty in reassigning these workers, because the new units used the same job classifications and required all the direct operating employees displaced from the old pressure stills. The remaining 21 employees were coke cleanout workers on the pressure stills.

The 62 workers who were downgraded were the balance of the crew of 83 coke cleanout workers. They were displaced because the new equipment required only 21 men for the cleanout. Coke cleanout workers received relatively high wage rates for performing physically onerous work under unpleasant conditions. With the application of the seniority system, the only jobs open to these 62 workers were as helpers or laborers, which meant their downgrading.

Approximately half of those downgraded had sufficient seniority to be guaranteed against a decrease in their hourly rate of pay for 6 months after their transfer. The remainder, while having placement rights, started with the lower job rate at the time of their transfer.

Most of these 62 workers were still employed by the refinery at the time of the study. No one of this group had obtained a position with a wage rate as high as that for the coke cleanout job.

The 1954 changes involved the reassignment of 12 employees without any downgrading. These employees were transferred from the old thermal reforming unit to the new catalytic reforming unit, on which the same job classifications were used.

Advance training to operate the new equipment was given to both operating employees and supervisors during working hours. This training included in-plant classroom instruction and direct observation of new equipment. Since, as already indicated, continuous catalytic cracking represented a significant departure from previous processing, training for work in this unit was relatively long and extensive. Training for supervisors started 6 months before the new unit began operating. Stillmen received training for 3 months before the startup, and operators and helpers working in the same process unit as stillmen, for a somewhat lesser period. Training for operating the catalytic reformer, another new and unfamiliar process, was also quite extensive. During the training periods, all workers received their regular wage rates and substitute workers were employed to fill their regular jobs.

Employment and Occupational Structure

Total employment at the refinery over the 8 years remained relatively stable (663 employees in 1948, 661 in 1956), with fluctuations resulting mainly from greater construction activity rather than from any significant changes in operating requirements. Production workers made up 84 percent of the total employees in 1949 and 83 percent in 1956.

Of the 4 departments to which production (hourly rated) workers are assigned—operations, maintenance, laboratory and testing, and miscellaneous—the first 2 employ approximately 90 percent of the hourly rated workers. About 50 percent are in operations and 40 percent in maintenance.

Although the overall numbers employed in the two major departments have not changed greatly, there have been several noteworthy shifts in the number of workers required in individual job classifications. In the operations department, the number of employees required for direct processing jobs increased substantially. The number of stillmen increased by 17 percent, operators by about 6 percent, and helpers by 69 percent. The large increase in the helper classification was

Percentage distribution, at 1956 wage rates, of required hourly rated workers [1] in an oil refinery, by 1948 and 1956 occupational distribution

1956 hourly wage rate	1948 occupational distribution					1956 occupational distribution				
	All hourly rated employees	Operations	Maintenance	Laboratory and testing	Miscellaneous	All hourly rated employees	Operations	Maintenance	Laboratory and testing	Miscellaneous
$3 and over	0.4	----	0.9	----	----	0.2	----	0.1	----	----
$2.90–$2.99	7.9	13.3	----	25.6	----	8.9	14.9	----	24.2	----
$2.80–$2.89	33.9	58.7	8.1	12.8	----	24.5	42.8	5.7	12.1	----
$2.70–$2.79	24.6	15.4	37.7	21.5	16.3	33.3	25.1	47.9	18.2	----
$2.60–$2.69	4.2	5.6	1.3	17.9	----	5.3	6.6	1.4	25.5	----
$2.50–$2.59	3.3	.5	5.8	17.9	----	3.3	0.5	5.7	12.7	----
$2.40–$2.49	15.3	6.5	23.3	4.3	55.3	19.1	10.1	29.6	3.0	58.3
$2.30–$2.39	----	----	----	----	----	.2	----	----	4.3	----
$2.20–$2.29	10.4	----	22.9	----	28.4	5.2	----	9.6	----	41.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of workers [2]	556.0	285.0	223.0	23.4	24.6	561.0	281.2	230.0	33.0	16.8
Average (weighted) [3] hourly rate	$2.686	$2.796	$2.568	$2.742	$2.442	$2.691	$2.764	$2.620	$2.732	$2.362

[1] Workers required by the staffing pattern for a 168-hour week.
[2] Excludes supervisors and administrative personnel; the number of hourly rated workers shown does not necessarily represent the actual number of such workers on the payroll.
[3] The rate for each job classification was weighted by the number of jobs in that classification.

attributable principally to an effort to develop a larger number of workers qualified to staff the separate process units. These increases were offset by a large reduction in the number of coke cleanout workers. Shutting down the pressure stills reduced the required number of workers in this job classification by 85 percent, as previously indicated. During 1949–56, the maintenance department experienced increases in the instrument repairman and pipefitter classifications. Increased instrumentation made it necessary to add seven men to the instrument repairman group when the catalytic cracker and delayed coker were introduced. An increase in pipefitter and pipefitter's helper jobs was the result of an agreement between management and union to maintain a balance of one pipefitter's helper for each pipefitter, as well as the greater need for their services in maintaining the plant. The laboratory and testing group also showed some increase.

On the administrative staff, the most noteworthy change was a reorganization of functions and the creation of three assistant plant manager positions which gave greater recognition to the engineering and personnel functions.

Job Content and Changing Requirements

More automatic processing modified some details of production jobs in the operations department but did not require new job classifications. The duties of stillmen, operators, and helpers—the principal operating jobs—now involve more monitoring by means of instruments and less direct manual manipulation of controls. The most drastic change occurred on the coke cleanout job, where mechanical equipment was substituted for hand labor.

The work of maintaining and repairing the extensive equipment at the refinery engages a large group of craftsmen in the metal and other trades: pipefitters, welders, machinists, painters, electricians. These craftsmen perform jobs similar to workers in their trades in industry and construction. Only carpenters, machinists, and brickmasons are hired directly as fully qualified journeymen. Since most of the other craftsmen have received their training on the job, their skills and knowledge of the trade are more or less directly related to the plant's needs.

The duties of the laboratory and testing jobs require professionally trained chemists to make routine chemical tests to determine the octane rating and other measures of product quality. A bachelor's degree in chemistry is a requirement for these workers. Like other production workers, laboratory employees are paid on an hourly basis and are covered by the union contract.

One of the most important personnel developments at the refinery during the postwar period has been the raising of educational standards for both production and supervisory workers. In 1948, the management adopted the requirement of a high school education for employment. In 1953, a preemployment test was designed for applicants for production jobs. The test attempts to determine an individual's ability to memorize, concentrate, observe, and follow instructions. It covers mathematical knowledge through the second-year high school level, i. e., algebra and geometry. An engineering degree is now a qualification sought in selecting supervisors.

The question of more stringent personal qualifications figured in a dispute between management and union in 1954 over a seniority provision in the agreement. The provision read, in part, "Senior employees eligible under this article shall be given preference on (such) jobs in line with their choice of work route advancement." The company felt that the word "eligible" implied that factors other than seniority could be considered in filling posted jobs. The union's position was that the word referred only to seniority eligibility. The issue was submitted to arbitration, which resulted in a decision supporting the company. This same problem was one of the issues in a 1956 work stoppage. The contract ending the strike provided that when a job vacancy is announced, it must be given to the senior plant applicant in line for the job for a trial period of 30 days. Since this agreement, approximately 40 jobs have been posted and filled by the senior person. In each case, the employee has finished his trial period without any questions raised about his qualifications.

Wage Structure and Changes

Production workers in this continuous process plant receive relatively high wage rates. compared with factory workers generally. In 1956, among the operating workers, stillmen received $2.99 an hour, operators, $2.80 an hour, and helpers, $2.71 an hour. In the maintenance department, except for a brickmason at $3.05 an hour, all other craftsmen received $2.77 an hour and craftsman helpers were paid $2.47 an hour.

Changes in job requirements over the 1948–56 period left the overall average grade of production workers virtually unchanged. Thus, the average wage rate in 1956 was about the same as the comparable average for 1948—if the effect of general wage increases is eliminated. In making the comparison, the rate for each job classification was weighted by the number of persons shown on the staffing pattern for each year in that classification. (See table.)

Wage rates advanced each year from 1948 through 1956, except for 1954. The wage changes negotiated during the period were all across-the-board general increases. No special rates have been established as a result of the modernization program.

Attitudes of Company and Its Workers

The company emphasizes the advantages of greater output, improved quality, and lower costs of production in meeting competition. Because refinery processes are constantly changing, officials believe that it is important to have a work force which is adaptable and which can be easily retrained.

The union spokesmen cite benefits in less seasonal fluctuation in employment, and safer and less onerous working conditions, as a result of the new processing methods. They emphasize the importance of the seniority, maintenance-of-wages, and training measures in their collective bargaining agreement in meeting the problems of worker adjustment.

Looking forward, the union officials feel particularly concerned about the impact on job opportunities of the growing tendency elsewhere in the industry to turn over to special contractors certain types of maintenance work at refineries. In their view, this trend may mean a greater loss of jobs than the gradual introduction of technological change.

—Herman J. Rothberg

Division of Productivity and Technological Developments

Adjustment to an Automatic Airline Reservation System

INSTALLATION of an automatic reservation system at a large airline reservation office marked the beginning of a major development in the application of electronics to airline office work. At this major terminal, some office jobs were upgraded as a result of adopting the new system, and new technical and professional jobs were created. Simultaneous expansion of office functions, coupled with planned worker education and retraining, prevented personnel dislocation, even though the labor savings were substantial.

With the number of passengers carried by scheduled airlines increasing to 50 million in 1957, more than 3 times as many as in 1947, manual office methods had become a bottleneck in handling flight space reservations. Automation was first introduced by these lines in 1952 and by 1959, virtually all of the 12 large domestic trunklines will have installed an automatic reservation system. Together, the 12 airlines carry most of the airline passengers and have nearly 16,000 ticket and reservation employees—about 16 percent of all persons employed by these lines.

Automatic data processing is one of a wide variety of technological changes taking place in the airline industry. Other important innovations in this fast expanding industry include the introduction of high-speed, jet aircraft, the growth of helicopter taxi service, mechanization of baggage and freight handling, and the improvement of air navigation and traffic controls through electronics.

The planning and development of one of the first automatic reservation systems by a large airline, and some of the implications for the workers affected, are described in a case study by the U. S. Department of Labor's Bureau of Labor Statistics.[1] The description, though not intended to be typical of changes at other companies, should be useful in indicating the general nature of the developments that may occur at the office level as similar electronic systems are introduced.

[1] A Case Study of an Automatic Airline Reservation System, BLS Report 137. This study, based on interviews with management officials, observation of employees at work (the office employees were not organized), and analysis of occupational and other records, is the fifth in a series of case studies on automatic technology.

Prior Reservation System

The introduction of the electronic reservation system at Airline X, in July 1952, was intended to facilitate the handling of a growing volume of requests and to secure a greater degree of control over flight space inventory. Under the old method, ticket sales or cancellations were posted manually to a ledger which recorded the specific trip, date, and destination. When an entry resulted in the sellout of a flight, this information was provided to the operator of the visual quotation (availability) board and ultimately to other reservation offices. Not only were delays and errors inherent in this system, but it was anticipated that manual inventorying methods would become increasingly cumbersome as traffic expanded, with expense rising out of proportion to the increase in workload.

Development of the Electronic System

Planning for a new system of reservation control was started during World War II. A system was built by an outside firm to the airline's specifications, subsequent to experimentation by a company engineer.

Under the present electronic reservation system, a sales agent checks availability of space by inserting a destination plate into his handset (a metal boxlike device on his desk) and pressing buttons corresponding to the date of the flight and the number of seats desired. If space is available, a light is illuminated on the set. At the same time, availability of alternate flights is indicated. In essence, the new system uses electronic signals instead of oral messages in communicating reservation data, and electronic instead of manual methods in filing and searching information.

Productivity and Displacement

The experience of Airline X suggests that the significant labor savings in certain recordkeeping functions can be handled without dislocation of office personnel, especially if introduced during a period of rapid and extensive growth in the reservation office's activities. One tangible result of the new system was a reduction of about 85 percent in the unit man-years required for the inventory function. A total of 32 man-years, about 11 percent of the total man-years utilized in this reservation office in 1952, were saved. However, since manpower requirements in office functions not directly affected by the new system were rapidly expanding at the airline studied, it was possible to absorb these labor savings without displacement of any individual employee. Moreover, since inventorying flight space and posting flight status were only part of several clerical duties performed by each reservation agent, no specific individual job was eliminated. Actually, the number of employees at the office studied increased from 295, at the time of installation of the computer in June 1952, to 529 in June 1956.

The management of Airline X made special efforts to dispel any fears of displacement and to train its employees in the operation of the new equipment. The personnel office informed all employees that no one would be laid off or downgraded as a result of the changes. Stories published in the company's house organ described the system, emphasizing its value to the sales agent in minimizing telephone calls and facilitating sales.[2]

Training and Job Changes

Office Jobs. In general, office employees in X airline's reservation work were young persons, a large proportion of whom were girls. According to company officials, relatively few considered themselves career employees. Few were over age 40. The policy of the airline was to hire clerical and sales employees at the lowest grade and to promote them to higher paid positions, when available, on the basis of seniority and ability. All employees were paid on a monthly salary basis; commissions or other incentive payments were not paid to reservation employees.

The changeover to the automatic reservation system brought about modifications in the content of office jobs. The strictly routine tasks of posting each sale on a sales control chart and the cumbersome method of using a visual display board to denote availability of flight space were both eliminated. One outcome was some enlargement of the sales function. The job title of "clerk" was replaced by "sales" or "service" agent. An upgrading took place for two employees who perform the functions of Specialist (Reservisor Information) and Assistant to the Specialist. These two new jobs, directly connected with the automatic system, involve the preparation of data on seating capacity and on flight scheduling and the application of complex reservation procedures.

The company initiated a special training program for supervisors, who subsequently trained reservation employees. Classes for training instructors began while the equipment was being installed. About 40 supervisors and lead agents received a week's instruction from the company's research engineer on the operation of the agent's handset and the broader aspects of the reservation system. An instructor's manual was prepared for use in training sales employees on the job.

Instruction on the reservation system is now carried on as a regular part of the basic classroom program for indoctrinating new sales personnel. Recently, the airline lengthened this indoctrination training—which had covered from 5 to 7 days—to 8 to 10 days. After a week of subsequent on-the-job training, under his supervisor, the employee receives an additional 26–33 hours of advanced classroom instruction.

Technician Jobs. Seven new technician jobs were set up in connection with maintaining the new system. The technicians, who were previously employed as repairmen in the airline's radio shop, had worked directly and constantly on equipment. In contrast, the technician now works alone in an air-conditioned, noiseless control room. He works in his street clothes, and the only time he has direct contact with the automatic equipment is during preventive maintenance tests or on occasions when the equipment is out of order. The technicians were given specialized training by the manufacturer of the system, and attended classes 1 day a week for about 6 months.

[2] The attitude of reservation employees, so far as it could be ascertained, appeared to be one of acceptance of the new techniques as a tool of their job. This viewpoint was particularly emphasized in responses of agents in an opinion poll conducted by the airline at the office where a first experimental system was installed in 1946. These agents unanimously agreed that the new system was a convenience to them on their job and helped them to serve the passengers. The favorable reactions of these employees were cited in persuading top officials to extend the experimental system, in 1952, to the major terminal.

Though the actual level of knowledge required to maintain the reservation equipment is not greater than that required for tasks previously performed in the radio maintenance shop, it has now become necessary for the technicians to assume individual responsibility for the equipment and to work under pressure and often without supervision, whenever the equipment is out of order. The technician's function has changed from that of a "production type" repairman who worked on a variety of complex equipment to that of a skilled "watchman" whose task is to maintain one piece of equipment vital to the company's sales operations.

Professional Jobs. A group of professional jobs concerned with electronic data-processing research was also created, following the advent of the new reservation system. This group is comprised of five "systems engineers." These professionally trained persons perform duties which involve planning systems development and extending electronic methods to all clerical activities of the company. Their annual salaries start at $7,000. The qualifications for systems engineers include education at college level and cover a variety of airline experience. It is interesting to note that 4 of the 5 men in the group have college degrees in business administration and the social sciences. All have had considerable and varied work experience with the company.

Outlook

Company officials view the automatic reservation system as a major first step in introducing automation into the airline's complex data-processing activities. Moreover, it is anticipated that all the large reservation offices might eventually be joined together in one vast network, and services among the different airlines interconnected. Such developments might have a more marked impact on airline office employment than the use of electronic data processing in reservation work so far. Other areas of electronic data processing, such as revenue and ticket accounting, are being explored.

Anticipating transition to the "jet age," some airline officials believe that whereas some occupations will be eliminated, wholesale dislocations need not occur provided the changes are gradual and workers are retrained for new positions connected with the planning, programming, and operation of the electronic systems. These officials are of the opinion that they may need a more complete and specific inventory of the skills and educational attainments of their employees than is available at present, to facilitate retraining and reassignment.

—EDWARD B. JAKUBAUSKAS
Division of Productivity and
Technological Developments

Experiences With the Introduction of Office Automation

THE INTRODUCTION of electronic data processing in business offices seems to imply important changes in employment for a broad class of workers and has brought concern over the problems of adjustment to this innovation. In an attempt to find out what problems are involved within an office and how they are being solved, the Bureau of Labor Statistics undertook a study of 20 offices which had installed large-scale electronic computers for processing business data.[1] This article summarizes the principal findings of the study, which covered a variety of subjects: The objectives and results of electronic data processing; the extent of displacement and reassignment of office employees; the practices regarding transferring, retraining, and selecting employees for new occupations; the characteristics of employees whose jobs were eliminated and who were assigned to new positions; and some of the implications of office automation for middle-aged and older employees.

The introduction of a large-scale electronic computer provided a means of achieving not only a larger clerical output in routine activities with the same or fewer employees—a major objective—but also economies in processing time, space, and equipment and greater accuracy. In some offices which were part of industrial operations, the increased flow of information on inventory and other operating conditions, which was previously uneconomical to acquire, enlarged the clerical workload, but by extending management's control, opened up the possibility of achieving savings in nonclerical activities.

About one-third of the employees in the office units directly affected by the change were shifted to other positions. Only a negligible number were laid off. The advanced planning that took place during the long preparatory period was useful in easing the impact of these changes. Such planning involved informing and consulting with employees and their organizations about the changes, establishing procedures for reassigning employees whose positions were being eliminated, and the minimizing of displacement through attrition and turnover. Since the introduction is a long continuing process, with new applications being made step by step, the full impact was not felt at the time the new equipment began to operate.

While the introduction of electronic data processing reduced the demand for employees in routine positions, it opened up a relatively small number of better paid positions for programming and operating the new systems. Administering aptitude tests for these new jobs, selecting a staff, determining salaries and providing the extensive training necessary, both in the classroom and on the job, were critical matters requiring timely attention. Where the offices were organized by unions, one of the key issues that arose was whether the new positions would be within the collective bargaining unit.

The offices in this study—the smallest employed 700 workers—were able to staff their electronic units primarily through promotions. Those selected were chiefly men in their late twenties with some college education and some company experience in accounting and related work. Few women, older workers, or employees from the affected units were chosen for the newly created positions.

Method of Data Collection and Coverage

Information for the study was collected by BLS representatives through personal visits to offices and interviews with management and union officials who had direct knowledge of the changes. Such information consisted of (1) statistical data compiled from personnel records and (2) nonstatistical reports about policies and practices.

The study was limited to 20 private industry offices which were among the first to utilize large electronic digital computer systems for business purposes. These computers sell for $1 million or rent at over $25,000 a month. The offices in the study had at least a year's operating experience

[1] See Adjustments to the Introduction of Electronic Data Processing, forthcoming BLS Bull. 1276 (1960). The study presents information on the practices of each office in reassigning, selecting, and training employees in addition to statistical data on the group as a whole. For a report on the vocational implications of electronic data processing, see Automation and Employment Opportunities for Office Workers, BLS Bull. 1241 (1958). For detailed descriptions of the new jobs, see Occupations in Electronic Data Processing Systems, U.S. Department of Labor, Bureau of Employment Security, 1959.

by mid-1957 when the study was planned. They accounted for more than one-half of the companies which had experience in applying large-scale electronic data-processing systems to clerical work at that time.

Government agencies, firms using computers primarily for engineering, scientific, or industrial purposes, and offices with only small- and medium-size computers were outside the scope of the study. The implications of computer service centers were also not covered.

The 20 offices studied were the central or home offices of some of the largest corporations in the American economy, ranging in size from about 700 employees to about 14,000, with an average of 4,000. Most were in industries that have grown relatively rapidly in the past decade—public utilities, air transportation, insurance, chemicals, electrical machinery, and aircraft. Others were in the petroleum refining, steel, and railroad industries. Seven of the 20 were in insurance.

Planning for Transition

Installing a computer involved a sequence of administrative, technical, and personnel changes that, on the average, spanned 3 years. The long period of preparation and planning needed for the introduction of electronic data processing was particularly useful in avoiding extensive dislocation of employees.

Many offices took advantage of the gradual unfolding of this major change to inform employees in advance about the change and to make explicit their policies about job security. A majority of the offices made statements giving assurance that no employee would lose his job on account of the computer. Hiring was curtailed so that vacancies created by quits, deaths, retirement, and leaves of absence could be filled by employees who might be affected.

In the seven offices with collective bargaining relationships, the union constituted the channel for informing employees about the changes. Existing contracts provided machinery for the application of seniority rules in displacement and transfer and for the determination of wage rates for new positions. In some offices, provisions regarding advance notice and consultation and retraining were negotiated as a result of the change. Agreement was reached in one railroad office to apply the system of displacement benefits that had been in force for workers displaced in the coordination of lines.

Impact of Electronic Data Processing

Extent of Displacement and Reassignment. A year following the introduction of the computer, about one-third of the 2,800 employees in units whose work was placed on the computer had been reassigned to other positions, either within the same unit or elsewhere in the office. (See table 1.) A majority remained in the same position. Close to one-sixth had quit, retired, died, or had taken leave of absence. Nine persons had been laid off.[2] Employment in the affected group was about 25 percent less at the end of the year.

A little over 80 percent of the employees affected by the change were in routine jobs involving

TABLE 1. JOB STATUS OF EMPLOYEES OF THE AFFECTED UNITS 1 YEAR AFTER INTRODUCTION OF ELECTRONIC DATA PROCESSING, SELECTED AGE GROUPS [1]

Type of job change	All ages		Under 45 years		45 years and over	
	Number	Percent	Number	Percent	Number	Percent
All employees	[2] 2,808	100.0	2,164	100.0	644	100.0
No change in position	1,498	53.3	1,059	49.0	439	68.2
Position changed	883	31.4	724	33.5	159	24.7
Reassigned within same work unit	552	19.7	460	21.3	92	14.3
Transferred	331	11.8	264	12.2	67	10.4
To computer unit	52	1.9	46	2.1	6	.9
To other units	279	9.9	218	10.1	61	9.5
Quits, layoffs, and other separations	427	15.2	381	17.6	46	7.1
Quits	328	11.7	322	14.9	6	.9
Retirement and deaths	42	1.5	3	.1	39	6.1
Leaves of absence	35	1.2	34	1.6	1	(3)
Discharges	13	.5	13	.6	-------	-------
Layoffs	9	.3	9	.4	-------	-------

[1] Data relate to employees in affected units of 18 offices, 6 months prior to introduction.
[2] Total excludes 7 employees for whom data were insufficient.
[3] Less than 0.05 percent.

NOTE: Because of rounding, sums of individual items may not equal totals.

[2] The method of determining the extent of displacement, reassignment, and occupational shifting was to record the changes in status that took place among employees in those units over a period of 18 months, beginning 6 months before and ending 1 year after the installation. These periods were selected in order to exclude, as much as possible, the effects of factors other than the immediate installation of the computer. This does not mean that additional groups will not be affected as the use of electronic data processing is extended. Many offices with a large volume of paperwork indicated that the introduction would be a gradual process continuing over some years.

posting, checking, and maintaining records; filing; computing; or tabulating, keypunch, and related machine operations. (See table 2.) The rest were mainly in administrative, supervisory, and accounting work. Only a little over 4 percent were engaged in correspondence, stenographic, and secretarial jobs, i.e., the less routine clerical jobs.

Most of the employees still employed in the offices 1 year after the installation, continued to do the same type of work. About 16 percent of this group were shifted to a different type of routine work, e.g., from computing to posting and checking. A little under 2 percent, a total of 52 persons, were transferred from the affected group to electronic data-processing jobs. Most of these had been doing administrative, accounting, or tabulating-machine work; only a few, chiefly for equipment operation, came from routine clerical work.

Close to one-third of the employees in the affected group had been promoted to a higher grade. A negligible number had been downgraded. Most of the upgrading involved employees under age 45 and to some extent reflected promotions which would have taken place regardless of the advent of the new equipment.

The relatively favorable experience of these offices reflected company policies to provide job security, the high rate of labor turnover during a period of prosperity, and in a few offices, a greater workload to handle information which had previously been uneconomical to acquire. Since these were large offices, employees could be transferred to comparable clerical positions requiring a relatively short period of on-the-job retraining.

Effect on Growth of Office Employment. The groups whose work was placed on the computer represented, on the average, only about 5 percent of total office employment. The proportion varied, depending on the nature of the application and the degree of mechanization.

The immediate overall effect of electronic data processing suggests some retardation in the growth of office employment, particularly routine part-time jobs, for which women were hired. Over the 4 years from December 1953 to December 1957, total office employment at 17 offices for which data were available increased on the average by 7 percent. This increase, however, was less than the 15-percent rise reported for clerical and kindred workers in the Nation as a whole. In 6 of the 17 offices, the increase was greater than 15 percent; in 7 less, and in 4, there was a decrease primarily because of business conditions.

Changes in Grade Structure. The introduction of electronic data processing raised the average grade or skill of office occupations, but only to a slight extent. With the elimination of low-paid jobs

TABLE 2. PERCENTAGE DISTRIBUTION OF EMPLOYEES IN AFFECTED UNITS, BY OCCUPATIONAL CLASSIFICATION 1 YEAR AFTER COMPUTER INSTALLATION

Occupational classification	Employment 6 months prior to computer installation		Occupational classification												
	Number	Percent	All groups	1	2	3	4	5	6	7	8	9	10	Electronic data processing	Separated
All groups	2,772	100.0	100.0	1.6	6.2	6.0	22.3	15.2	0.1	1.3	14.1	15.1	1.4	1.8	15.0
1. Administrative	41	1.5	100.0	82.9	------	4.9	------	------	------	------	------	------	------	7.3	4.9
2. Supervisory	176	6.3	100.0	3.4	80.7	2.8	2.3	0.6	------	------	------	2.3	------	3.4	4.5
3. Accounting and professional	157	5.7	100.0	1.3	3.2	81.5	------	------	------	------	------	------	------	8.3	5.7
4. Posting, checking, and maintaining records	719	25.9	100.0	------	.4	1.1	68.6	4.0	0.4	0.4	3.5	1.7	1.5	.4	17.9
5. Computing and statistical	492	17.7	100.0	------	1.4	2.2	7.1	73.4	------	------	1.8	.4	.6	.4	12.6
6. Correspondence work	[2] 3	.1	100.0	------	------	------	------	------	------	------	------	------	------	------	------
7. Stenographic and secretarial	34	1.2	100.0	------	------	------	2.9	------	------	85.3	2.9	------	------	------	8.8
8. Keyboard or keypunch machine operations	447	16.1	100.0	------	.2	.4	4.5	1.8	------	1.1	72.9	2.2	------	.7	16.1
9. Tabulating and related machine operations	618	22.3	100.0	.2	2.4	1.3	5.5	3.4	------	------	3.6	62.0	1.0	3.1	17.6
10. Sorting, routing, classifying, and filing	85	3.1	100.0	------	------	------	34.1	1.2	------	------	9.4	8.2	23.5	------	23.5

[1] Excludes 43 employees for whom data were insufficient.
[2] Insufficient data to warrant presentation of percentage distribution.

NOTE: Because of rounding, sums of individual items may not equal 100.

that were not filled as they became vacant during the transition, the higher paid group became a larger proportion of the total in the affected group. The classification of the new electronic data-processing positions at the top of the office pay structure also tended to upgrade the pattern. Since these groups at the bottom and the top of the pay structure constituted but a small proportion of total office employment, the net effect on the structure of an entire office was small.

New Jobs. A small number of new positions were created to operate, program, and manage electronic data-processing activities. The average number of persons employed in these units at the time of the study was 29. Close to 7 out of 10 persons in electronic data-processing work were in programming and planning positions; about 25 percent were engaged in operating the equipment; and 8 percent were in administrative and supervisory occupations.

Wage and salary rates were generally fixed through existing job evaluation and personnel classification systems and, where collective bargaining was in force, with union participation. The offices generally rated these new positions at somewhat higher grades than jobs in other data processing, placing them at the top of the office pay structure.

More than 80 percent of all employees in new positions were selected from within the offices. (See table 3.) Those hired from the outside were primarily trainees. Most offices relied on standard tests of learning ability and numerical aptitude to screen applicants for these positions. All offices provided at least 4 or 5 weeks of formal classroom instruction for programmers and on-the-job training for operators of the equipment.

Women comprised about 10 percent of the employees in these new positions, compared with over 50 percent in the affected unit. Of the 915 employees in these new positions, only 52, or close to 6 percent, were employees whose previous work had been directly affected. About 10 percent were age 45 and over, compared with 23 percent in the group affected. Four out of five employees assigned to these positions were upgraded. The typical person selected for programming and planning—which accounted for the largest group of new positions—was a man between 25 and 34 years of age, with some college education, who had been engaged in accounting, procedure analysis, or related work.

Table 3. Occupational Classification of Employees in Electronic Data-Processing Positions, by Prior Occupational Classification

Occupational classification prior to employment in electronic data processing	Percentage distribution of employees in electronic data-processing positions after computer installation study				
	Totals	Administrative and supervisory	Planning and programming	Console operation	Auxiliary equipment operation
All groups: Number	915	69	637	77	132
Percent	100.0	7.5	69.6	8.4	14.4
All groups	100.0	100.0	100.0	100.0	100.0
Accounting and professional	35.4	44.9	43.5	16.9	2.3
Administrative and supervisory	13.3	40.6	11.9	14.3	5.3
Tabulating and keyboard machine operation	13.1	2.9	4.4	31.2	50.0
Posting, checking, maintaining records, and filing	10.7	2.9	9.3	16.7	18.2
Computing and statistical	5.4	----------	6.0	2.6	6.8
Correspondence and secretarial work	2.0	----------	1.7	5.2	2.3
Nonclerical	1.2	1.4	1.1	1.3	1.5
New hires	18.9	7.2	22.1	11.7	13.6

Note: Because of rounding, sums of individual items may not equal totals.

Changeover Problems

While layoffs were averted among those whose jobs were eliminated, reassigning employees and staffing the new positions sometimes involved complex personnel problems. Finding suitable positions for long-service employees—especially supervisors—without disturbing promotion opportunities for other employees presented difficulties. Partly because of the newness of the field, there was some uncertainty about salary levels for the new jobs and the use and validity of test for selecting staff. In some unionized offices, the new position of programmers was included in the bargaining unit only after prolonged negotiations.

Implications for Older Employees. Older employees were affected by change in job status to a lesser extent than younger workers. They benefited from general policies assuring job security, the seniority provisions in union agreements, and similar protective provisions. However, they were not promoted to the newly created electronic positions to the same extent as younger workers, nor were they hired as trainees. Their educational qualifications, employers' opinions, and preexisting hiring practices, as well as their own lack of confidence in their learning capacity, were among the factors retarding their advancement. An acute sense of responsibility and their maturity and experience, however, were important factors in the few cases where they were assigned to electronic data-processing positions.

Where employers have formed opinions about the inflexibility or lack of adaptability of older workers, the introduction of electronic data processing may intensify any preexisting reluctance to hire or promote them. The examples of the successful performance of older employees in these new positions in the offices studied reinforce the findings of research workers on the variability in learning capacity at all ages and underscore the importance of individual appraisal of employees in this field as in others.

—EDGAR WEINBERG
Division of Productivity and Technological Developments

. . . The Bureau of the Census has constructed four duplicates of an electronic machine called FOSDIC (Film Optical Sensing Device for Input to Computers) to be used in transcribing for tabulation the data collected in the 18th Decennial Census of the United States. This will make available five of these electronic machines in 1960. These machines will perform automatically the work which under former methods would require the employment of 2,000 clerical workers.

The pilot model for the Census Bureau's new FOSDIC equipment was developed at the Bureau of Standards by scientists on the Standards and Census staffs. . . . This electronic machine rapidly reads microfilms of census documents and transcribes the data to magnetic tape for direct input to an electronic computer.

—From FOSDIC to Assist in 1960 Census, U.S. Bureau of the Census, July 1959.

The Reactions of Employees to Office Automation

EINAR HARDIN*

WHAT ARE THE CHARACTERISTICS of changes in work environment caused by the installation of an electronic computer? How do employees feel about the computer and the changes it brings? How do employees in departments that are affected by automation differ from those in unaffected departments in their experiences with changes, regardless of cause, in work environment? How do affected and unaffected departments differ with respect to changes in job satisfaction during the installation period and to job satisfaction prevailing after the installation? The present study addresses itself to these questions. It is based on data collected in two questionnaire surveys conducted in a medium-size insurance company, one before and one after the installation of an IBM 650 electronic data processing machine.[1]

Scope and Methodology

The insurance company consisted of a home office located in a small midwestern city (where it was the largest employer of clerical personnel), a branch office situated in a metropolitan area, and claims adjustment offices in various cities. For several years preceding the computer installation, total company full-time employment had remained at approximately 400 persons, and part-time employment was negligible. No layoffs had occurred for at least 5 years. However, employment had declined in the home office and risen in the branch office, primarily as a result of the transfer of many activities from the home to the branch office and the movement, a year or two before, of all home office activities into a new single building from several inadequate facilities. There were few personnel transfers among offices. The company was not a very profitable one but was known as a good employer.

An International Business Machines 650 electronic data processing machine, a standard model with card input and output and with ordinary magnetic drum memory, was installed in the home office in December 1957. After 2 weeks' testing of equipment and programs, the computer was successively given the tasks of checking premium computations performed by agents, computing premiums and assembling policy-declaration data for policies written in the home office, and compiling statistical and accounting reports.

The checking of agents' computations and the processing of policies written in the home office were fully automated by the beginning of May 1958. Conversion of other tasks was not completed until the fall of 1958 or later, but nevertheless, computer utilization, including time for machine testing and repair, rose from 15 percent in January 1958 to 84 percent in April 1958.[2]

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[1] Empirical research addressing itself at least in part to the first two questions has been published by Harold F. Craig, Administering a Conversion to Electronic Accounting (Boston, Harvard University, Graduate School of Business Administration, 1955); The Introduction of an Electronic Computer in a Large Insurance Company (U.S. Department of Labor, BLS Studies in Automatic Technology No. 2, 1955; and Monthly Labor Review, January 1956, pp. 17–19); Adjustment to an Automatic Airline Reservation System (in Monthly Labor Review, September 1958, pp. 1014–1016); Floyd C. Mann, The Impact of Electronic Accounting Equipment on the White Collar Worker in a Public Utility Company, in Man and Automation (New Haven, Conn., Yale University Technology Project, 1956), pp. 32–39; Floyd C. Mann and Lawrence K. Williams, Organizational Impact of White Collar Automation, in Proceedings of the 11th Annual Meeting, Industrial Relations Research Association (Madison, Wis., IRRA Publication 22, 1959), pp. 59–69; C. Edward Weber, Impact of Electronic Data Processing on Clerical Skills (in Personnel Administration, Washington, January–February 1959, pp. 20–26); and Change in Managerial Manpower With Mechanization of Data Processing (in Journal of Business, Chicago, Vol. 32, 1959, pp. 151–163); and Eugene H. Jacobson and others, Employee Attitudes Toward Technological Change in a Medium Sized Insurance Company (in Journal of Applied Psychology, Washington, Vol. 43, 1959, pp. 349–354). A study directed toward the two latter questions has been reported by the author in Computer Automation, Work Environment, and Employee Satisfaction (in Industrial and Labor Relations Review, Ithaca, N.Y., July 1960, pp. 559–567).

[2] The utilization figures were based on a regular one-shift work month.

Fearing that news about the computer installation would have adverse effects upon employee attitudes, the company delayed announcement of the installation until October 1957, and it is unlikely that much information had spread informally through the company before then. At that time, top management made a statement about the impending installation and its purposes, and gave assurances that, in accordance with long-standing company policy, it would not jeopardize any employee's job. No specific guarantee of earnings or of aid in retraining was made. Early in November 1957, all home office employees were called to special information meetings at which technical information was given and questions from employees were answered; however, no specific changeover plans were presented. Personnel whose tasks were to be affected directly by the computer were instructed in the new work procedures during the first week of November. Group meetings in the branch office were not held until April 1958, when that office was to be affected.

The computer installation had a much greater impact on the procedures and tasks of some departments than of others. Home office departments affected extensively, and hereafter called "the computer area," consisted of the IBM key-punching and accounting departments, the programing and office-systems departments, and the internal auditing department. Personnel in this area were given the tasks of computer programing and operation, for which they had to learn new forms, codes, and sorting and tabulating routines, and devise new procedures for correcting errors. In addition, it was necessary for them to punch many more IBM cards than before. However, conventional IBM equipment also remained in use.

The automobile underwriting department of the home office, the general underwriting department of the branch office, and the coding and policy typing departments of both offices were less extensively affected by the computer installation. Personnel in these departments lost many tasks to the computer, but for many of the remaining tasks, they learned new forms, codes, and procedures. They were given practically no new tasks during the period covered by the study. These departments are called "other affected departments" in this article. The term "affected departments" is used occasionally to refer to the computer area and other affected departments combined.

"Unaffected departments" consisted of the remaining home and branch office departments and accounted for the majority of the work force. The claims adjustment offices, which were unaffected by the installation, were excluded from the study.

From November 1957 to May 1958, the supervisors of the computer area and of other affected departments attempted to defer some procedural changes not related to the computer so that they could concentrate on the conversion to automation. Undoubtedly, however, some unrelated changes occurred. No substantial mechanization or reorganization in unaffected departments took

TABLE 1. CHANGES IN JOB OR WORK CONTENT DURING INSTALLATION PERIOD OF COMPUTER AS PERCEIVED BY EMPLOYEES OF THREE DEPARTMENT GROUPS [1]

[Percentage distribution]

Changes in job or work content	Job changes attributed to computer [2]				Job changes attributed to any source [3]		
	Computer area	Other affected departments	Unaffected departments	All department groups	Computer area	Other affected departments	Unaffected departments
All responses	100	100	100	100	100	100	100
1. Promotion	0	0	1	1	0	5	7
2. Transfer	4	2	1	2	4	5	5
Remained in job with work content changed—							
3. Greatly	52	21	3	12	57	22	6
4. Noticeably	13	22	4	10	13	26	13
5. Slightly	9	16	10	11	9	26	28
6. Not at all (or no impact)	22	34	76	60	17	16	39
7. Unknown	0	5	5	4	0	0	2

[1] For definition of groups of departments, see text. In November 1957, before the installation of the computer, the computer area had 23 respondents, other affected departments had 62, and unaffected departments had 161.

[2] Responses to following question asked in May 1958 survey: "Did the computer play any part in the change in your job since last November?" The figures in rows 1 through 5 show the proportion of respondents who said the computer was the main factor or a minor factor in the change they reported. The figures in row 6 refer to those who said either that there had been no change since November or that the computer had had nothing to do with the change.

[3] Responses to following question asked in May 1958 survey: "What has happened to your job since last November?"

place during the period, and the everyday alterations in work methods and tasks were excluded from the study.

Data on employee response to computer automation were collected in two questionnaire surveys conducted in November 1957 and May 1958.[3] More than 90 percent of eligible employees were questioned in each survey.[4] The 246 employees who participated in both surveys were grouped into the computer area, the other affected departments, and the unaffected departments on the basis of their affiliation at the time of the first survey.[5]

The analysis consisted in comparing the responses of the three groups of employees to questions concerning—

1. Perceived changes in work environment (regardless of cause) and feelings about these changes.
2. Perceived impact of the computer upon work environment.
3. General attitudes toward the computer installation.
4. Job satisfaction.

The departmental differences mentioned in the text were all significant at the 5 percent level or better, as determined by the chi-square and other tests.

Impact of Computer Installation

Almost two-thirds of the employees stated in the May 1958 survey that they had been unaffected by the installation of the computer, and very few thought the computer had brought them promotions or transfers. (See table 1.) The proportion of persons reporting computer impact was highest in the computer area and lowest in the departments classified as unaffected. Great changes in work were most frequent in the computer area and least common in the unaffected departments.

The employees were asked in the second survey whether the computer had affected each of 14 aspects of their jobs, as listed in table 2. Approximately 20 percent failed to answer the questions or chose the response category "I have no idea." These respondents were primarily from unaffected departments. Among persons giving definite answers, a majority reported no computer impact. The computer was most commonly perceived to have affected variety, amount, and accuracy of work. It was most seldom thought to have affected pay, promotion chances, and amount of supervision. Most effects, except for job security and promotion chances, took the form of increases, such as more variety and greater amount of work.

On the average for the 14 job aspects, the three groups of departments differed noticeably in the frequency and direction of perceived computer impact. In the computer area, 58 percent of those giving definite responses said the computer had an effect, and 96 percent of the effects they reported were increases. This compared with 36 and 71 percent, respectively, in other affected departments and with 15 and 90 percent, respectively, in the unaffected departments.

The computer area and other affected departments did not differ from each other in the frequency of reported impact on job security, promotion chances, and pay, and on accuracy demanded by the job, work variety, and workload. However, the computer area reported more frequent impact upon evaluation of importance of job; amount of supervision; skill, planning, and judgment required; and work interest. Furthermore, it reported more increases than decreases for each of the 14 aspects, but some differences were slight. In the other affected departments, the requirements for accuracy, skill, responsibility, and judgment were raised significantly more often than lowered, while the reverse was true for promotion chances.

After the installation, one-third of the employees thought it very likely or quite likely that

[3] The questionnaire surveys were conducted by the author in cooperation with William A. Faunce, Gloria Cheek, John Nangle, and George Won. The questionnaires employed many of the items used in the study by Jacobson and associates.

[4] Ineligible were company officers, building maintenance employees, employees whose work typically required them to spend more than half the time away from the office, and part-time employees. A total of 283 usable questionnaires were obtained in the first survey, and 295 were received in the second. Further details of the survey procedure and of the identified questionnaires employed are reported by the author and Gerald L. Hershey, Accuracy of Employee Reports on Changes in Pay (in Journal of Applied Psychology, Washington, August 1960, pp. 269–275).

[5] Only 10 of the respondents moved from one of the three groups to another during the following 6 months, mostly from unaffected to other affected departments of the branch office.

TABLE 2. CHANGES IN 14 JOB ASPECTS DURING COMPUTER INSTALLATION PERIOD AS PERCEIVED BY EMPLOYEES OF THREE DEPARTMENT GROUPS

[Percentage distribution]

Job aspect	Department group [1]	Changes attributed to computer [2]					Changes attributed to any source [3]				
		Total	Increased	None	Decreased	Not available	Total	Increased	Same	Decreased	Not available
1. The amount of variety in my work.	Computer area	100	74	26	0	0	100	65	35	0	0
	Other affected departments.	100	37	37	20	6	100	42	39	19	0
	Unaffected departments	100	17	55	2	26	100	46	50	3	1
2. The amount of work required on my job.	Computer area	100	74	22	4	0	100	70	30	0	0
	Other affected departments.	100	39	34	24	3	100	42	45	11	2
	Unaffected departments	100	19	53	2	26	100	52	42	4	2
3. The degree of accuracy demanded by my job.	Computer area	100	65	35	0	0	100	57	43	0	0
	Other affected departments.	100	56	37	5	2	100	35	63	2	0
	Unaffected departments	100	12	63	0	25	100	27	72	0	1
4. My control over the pace of my work.	Computer area	100	48	43	9	0	100	35	56	9	0
	Other affected departments.	100	21	64	10	5	100	30	60	8	2
	Unaffected departments	100	9	63	2	26	100	25	67	6	2
5. The importance of my job for the company.	Computer area	100	57	39	0	4	100	52	48	0	0
	Other affected departments.	100	21	65	8	6	100	27	65	8	0
	Unaffected departments	100	5	68	0	27	100	25	73	1	1
6. The amount of supervision I get on my job.	Computer area	100	48	48	4	0	100	26	70	4	0
	Other affected departments.	100	5	87	6	2	100	11	78	11	0
	Unaffected departments	100	4	68	2	26	100	12	76	11	1
7. The amount of skill needed on my job.	Computer area	100	74	26	0	0	100	52	48	0	0
	Other affected departments.	100	34	61	3	2	100	37	58	5	0
	Unaffected departments	100	9	66	0	25	100	30	67	1	2
8. The amount of responsibility demanded by my job.	Computer area	100	70	30	0	0	100	61	39	0	0
	Other affected departments.	100	39	55	3	3	100	40	52	6	2
	Unaffected departments	100	12	65	0	23	100	41	57	0	2
9. The amount of planning I have to do on my job.	Computer area	100	61	39	0	0	100	39	61	0	0
	Other affected departments.	100	11	78	6	5	100	31	63	6	0
	Unaffected departments	100	11	62	0	27	100	34	62	2	2
10. The amount of judgment I have to use on my job.	Computer area	100	70	30	0	0	100	56	44	0	0
	Other affected departments.	100	24	68	3	5	100	36	58	6	0
	Unaffected departments	100	11	65	0	24	100	40	57	1	2
11. The degree to which my work is interesting.	Computer area	100	65	31	4	0	100	61	35	4	0
	Other affected departments.	100	24	60	13	3	100	42	43	15	0
	Unaffected departments	100	14	62	1	23	100	36	59	4	1
12. The amount of security I feel on my job.	Computer area	100	31	65	4	0	100	31	65	4	0
	Other affected departments.	100	11	66	20	3	100	26	55	17	2
	Unaffected departments	100	6	67	3	24	100	21	72	4	3
13. My chances for promotion to a better job.	Computer area	100	22	74	4	0	100	22	78	0	0
	Other affected departments.	100	5	68	17	10	100	8	68	22	2
	Unaffected departments	100	3	66	2	29	100	15	72	9	4
14. The amount of pay I get on my job.	Computer area	100	30	70	0	0	100	56	40	0	4
	Other affected departments.	100	10	77	2	11	100	39	61	0	0
	Unaffected departments	100	6	68	1	25	100	46	53	0	1

[1] For definition of groups of departments, see text. For size of department groups, see footnote 1, table 1.

[2] Employees were asked in the May 1958 survey to check one of the following: "For this aspect of my job, the computer caused (1) a great increase, (2) some increase, (3) no change, (4) some decrease, (5) a great decrease, (6) I have no idea what the computer may have done." The table column heads "Increased," "None," "Decreased," and "Not available" correspond to responses 1-2, 3, 4-5, and 6 plus no response, respectively.

[3] Employees were asked in the May 1958 survey to check one of the following: "How has this aspect of your job changed in the past 6 months? 1. Much more now, 2. More now, 3. No change, 4. Less now, and 5. Much less now." The table column heads "Increased," "Same," "Decreased," and "Not available" correspond to responses 1-2, 3, 4-5, and no response, respectively.

the computer would influence their jobs in the following year or two. People in the computer area were most convinced of this (83 percent), followed by those in other affected departments (61 percent), while a minority of employees in so-far unaffected departments thought they would be affected (21 percent).

Fifty-eight percent of the employees who saw the computer as a major or minor factor in the change of job or of work content over the 6-month period said they liked the change, while 21 percent expressed indifference, and an equal proportion said they disliked the change. Among those who thought computer impact on their jobs in the subsequent year or two was very likely or quite likely, 10 percent disliked the prospect, while 29 percent did not care, and 58 percent liked it. Both past and prospective computer impacts were liked more strongly in the computer area and unaffected departments than in the other affected departments.

No questions were asked about employee feelings concerning the impact of the computer upon specific job aspects. Since responses to other questions indicated that the employees usually preferred increases in a job aspect to decreases, the computer impact on specific job aspects was apparently more often liked than disliked.

Sixty-one percent of the employees in both the computer area and other affected departments felt that the changeover to the new computer had been only slightly disrupting or not disrupting at all, while 20 percent saw it as quite disrupting, and 9 percent felt it had been very disrupting. More than one-third of employees in unaffected departments had no opinion.

According to answers given before the installation of the computer, the vast majority of the employees either liked the fact the company had decided to install a computer or were indifferent. Dislike of the decision was reported by 5 percent, indifference by 27 percent, and positive approval by 63 percent. Disapproval was absent from the computer area and most common, 13 percent, in the other affected departments. Table 3 shows that the majority of the employees continued to like the computer installation after they acquired some experience with it and its effects. Forty-one percent of the employees in affected departments changed their feelings about the computer from November to May, with increases and decreases in liking being equally numerous. In the unaffected departments, 54 percent changed their minds, primarily from positive feelings to indifference.

Answers to other questions also failed to show negative attitudes toward the computer after the installation. The personnel of unaffected departments often did not know whether the computer had been a good thing or a bad thing for employees. However, regardless of department affiliation, those who had an opinion usually thought the computer had been a good thing. A majority of those with an opinion favored wider use of the computer; this feeling was particularly pronounced in the computer area.

Impact of All Job Changes

In the May 1958 survey, about two-thirds of all participating employees reported that job changes—most commonly, changes in work content without promotion or transfer—had taken place since the computer installation for a variety of reasons. Changes were reported more often by employees in the computer area and in other affected departments than by employees in unaffected departments, and great and noticeable changes in work content were more predominant among the first two groups, particularly in the computer area. Sixty-one percent liked the changes experienced during the 6-month period, 18 percent disliked them, and most of the others professed indifference. Likes and dislikes of the changes were distributed very similarly in the three departments.

In the second survey, the employees were also asked what changes, regardless of source, they experienced in each of the 14 job aspects over the 6 months. In all departments combined, the net change in job aspects was most frequent for variety and amount of work and was least frequent for amount of supervision and promotion chances. Increases significantly outnumbered decreases for

TABLE 3. GENERAL ATTITUDES TOWARD THE COMPUTER AFTER INSTALLATION, BY EMPLOYEES IN THREE DEPARTMENT GROUPS [1]

[Percentage distribution]

General feeling toward computer installation [2]				Computer good or bad for employees [3]				Desirable extent of computer use [4]			
Response	Computer area	Other affected departments	Unaffected departments	Response	Computer area	Other affected departments	Unaffected departments	Response	Computer area	Other affected departments	Unaffected departments
All responses	100	100	100	All responses	100	100	100	All responses	100	100	100
I like it very much	48	18	11	A very good thing	44	31	15	Much more widely than now.	30	13	9
I like it	39	45	28	A good thing	44	40	36	More widely than now.	44	34	20
It makes no difference to me.	9	27	50	Neither a good thing, nor a bad thing.	12	13	10	About the same as now.	9	21	20
I dislike it	0	8	7	A bad thing	0	0	4	Less widely than now.	0	0	1
I dislike it very much.	0	2	0	A very bad thing	0	0	1	Much less widely than now.	4	0	1
I have never given it a thought.	0	0	2	I have no idea	0	13	30	I don't know	13	30	42
No response	4	0	2	No response	0	3	4	No response	0	2	7

[1] For definition of groups of departments, see text. For size of department groups, see footnote 1, table 1.
[2] The question, asked in the May 1958 survey, was as follows: "What is your general feeling about the fact that the company has installed a computer?"
[3] The question, asked in the May 1958 survey, was as follows: "Considering everything, do you think the computer has been a good thing or a bad thing for the employees in [the company]?"
[4] The question, asked in the May 1958 survey, was as follows: "In your opinion, would it be a good idea to use the computer more widely or less widely in this company than is now the case?"

all aspects except amount of supervision and promotion chances. For most aspects, however, a majority reported there was no change during the period.

Employees in unaffected departments tended to report less net change in job aspects than did employees in the computer area or the other affected departments. However, the differences were very small for many of the individual job aspects. The computer area and other affected departments combined reported significantly more change in accuracy requirements, importance of job, work interest, and job security than did unaffected departments.

The three groups also differed somewhat in the direction of the change in job that was reported. In general, the number of increases relative to that of decreases tended to be higher in the computer area and in unaffected departments than in the other affected departments. This relationship was statistically significant for variety and amount of work, importance of the job to the company, responsibility required, work interest, job security, and promotion chances. The computer area did not differ from unaffected departments in the direction of change on any of the job aspects. Even in the other affected departments, increases exceeded decreases for most aspects, but decreases in promotion chances were reported significantly more often than were increases.

Most net changes in job aspects were in a direction employees liked. Among those who reported a change in any job aspect after the computer installation, from 61 to 93 percent said they liked the change or liked it very much, up to 10 percent reported indifference, and from 2 to 31 percent disliked it or disliked it very much. Indifference was expressed most often toward changes in amounts of work and supervision and least often toward changes in work interest and job security. Likes were most numerous relative to dislikes in the case of accuracy, skill, and responsibility and fewest in the case of promotion chances, amount of supervision, and job security.

Considering the 14 job aspects together, responses stating that changes were liked outnumbered the expressions of dislikes by 10 to 1 in the computer area and in unaffected departments, but only by 3 to 1 in the other affected departments. In the last group, the changes in importance of the job, amount of supervision received, amount of judgment required, job security, and chances for promotion were disliked as often as they were liked. However, no aspect was significantly more disliked than liked even in these departments. In the computer area, the changes in 11 of the aspects were liked more often than disliked, but changes in pay, which were all increases, were disliked as often as they were liked. Employees in the computer area perceived few changes in job security and chances for promotion, and the number of likes and dislikes for these two changes did not differ significantly.

As suggested by the responses to pay changes in the computer area, some changes were perhaps reported as disliked, not because they went in the undesired direction or disrupted the status quo, but because they did not go far enough in the desired direction. Similarly, some expressions of approval possibly meant that although the change was really undesirable, it was too small to disturb materially a pleasant status quo.

Department Differences in Job Satisfaction

The same 24 questions concerning job satisfaction were asked in each survey. Since the questionnaires were identified, it was possible to determine whether each respondent's reported satisfaction in each of these 24 respects had risen, remained the same, or fallen from the first to the second survey. As an average for all departments and items, 33 percent of the 246 respondents showed increased satisfaction, 39 percent showed no change, 24 percent showed decreased satisfaction, and 4 percent did not answer.[7] Because of response unreliability, however, these figures somewhat overstate the frequency of genuine change.

Absence of change was equally common for all 24 items. Increases in job satisfaction were significantly more numerous than decreases for 15 items. These included all of the items listed in table 2 (excepting promotion opportunities), and items described as "the relationship between you and your supervisor" and "the information you receive concerning changes in the company and in your job." In addition to promotion opportunities, other exceptions were the way changes were handled, kind of work done, the company, amount of information, accuracy of information, understandability of information, promptness of information, and the job as a whole. But for no item were decreases in satisfaction significantly more common than increases.

The preponderance of increases over decreases in satisfaction was probably not related to the computer, and there were no other large changes in company behavior that would easily explain the net increases in satisfaction. More plausible explanations lie in the continuation of the 1957–58 recession (affecting heavily the automobile industry of the region and making the insurance company employees happier about their jobs), and in a variety of special factors.

The three groups of departments showed few pronounced differences in the frequency and direction of change in job satisfaction. In fact, significant differences were found for only 3 of the 24 items. Satisfaction with pay changed equally often in the three groups, but the computer area showed fewer increases relative to decreases than did the other two groups. Satisfaction with the promptness of information changed less often in the other affected departments, but increases were equally common relative to decreases in all groups. Increases were more predominant among changes in overall job satisfaction in the unaffected departments.

Nevertheless, there were signs of a pattern of differences. For the first 12 items on table 2, the average frequency of change was lower in unaffected departments than in the other two groups, while the ratio of increases to decreases was smallest in the other affected departments. For the remaining 11 of the 23 specific job aspect items, the average frequency of change did not differ among departments, but the proportion of increases in satisfaction was lower in the computer area than in the other two groups. The first set of items covered primarily intrinsic job aspects, while the second set covered pay, job tenure, relations to management, and information.

According to the second survey in May 1958, employees as a group showed little satisfaction with chances for promotion, amount of pay received, the way of handling changes in the company, and the promptness of information. They were notably satisfied, however, with accuracy and skill requirements and responsibility.

The three department groups differed little in satisfaction with individual job aspects after the computer installation. Complete satisfaction

[7] Because of its bulk, the table showing the changes in job satisfaction and the May 1958 level of satisfaction by aspect and department was omitted from the article. Interested readers may obtain copies of the table from the author.

with amount of supervision and skill was most pronounced in the computer area. The largest proportion of respondents "somewhat satisfied" or "not satisfied" with variety and with kind of work done was found in other affected departments. For all other job satisfaction items taken individually, including overall satisfaction, there were no significant departmental differences, whether the comparisons pertained to the proportion of completely satisfied respondents or to the proportion of respondents that were somewhat or not satisfied.

On the average for the 24 items, however, complete satisfaction was most commonly reported in the computer area, while the other affected departments showed the largest proportion of somewhat or not satisfied respondents. The department differences in average proportions of completely satisfied and somewhat or not satisfied respondents were about the same for the first 12 items as the latter group; the only significant variation was that the computer area was less often dissatisfied and the other affected departments were more often dissatisfied with the first set of items than with the second.

Conclusions

The results of the study indicate that the installation of the computer by the insurance company affected the work environment of a number of employees in several respects, that most of its effects were those that employees desired, and that the computer installation was liked more often than disliked. However, the departments affected by the computer and those not affected differed little in the frequency and direction of net change in most job aspects although there were significant department differences for some aspects of the job. Employees in the computer area (which gained work tasks as a result of the installation) and employees of the unaffected departments liked the net changes more than did employees of the other affected departments (which had lost work tasks because of the computer and had been required to adjust to partly new methods of work). The employees of these other affected departments showed less gain in satisfaction with intrinsic job aspects than did the personnel of the other two groups. Computer area personnel tended to become comparatively less satisfied than other employees with job tenure, pay, relations to supervisor and company, and information practices. Most department differences in job satisfaction change were slight.

Except for the installation of the computer and the resulting adaptation of work methods, there were no large technological changes in the company during the period studied. The fact that affected departments and unaffected departments were found to differ little in perceived job changes, in feelings about these changes, and in changes in job satisfaction indicate that the computer had only moderate effects upon work environment and job satisfaction. This conclusion, which agrees with the author's conclusion from a previous study of computer automation,[8] suggests that the installation of an IBM 650 computer is not a radical or extensive enough operation to cause a substanial reversal or acceleration of existing trends in work environment and job satisfaction. The computer area's slightly declining satisfaction with information practices and with the company's way of handling changes suggests, however, that the process of installing a computer and of adapting work methods to it may cause noticeable, though presumably temporary, dissatisfaction unless management handles the conversion with great skill.

[8] See Computer Automation, Work Environment, and Employee Satisfaction (in Industrial and Labor Relations Review, Ithaca, N.Y., July 1960, pp. 559-567).

Office Automation in the Federal Government

Because the Government has a large volume of routine recordkeeping, Federal administrators and technicians have been greatly interested in the economies of personnel, time, and money possible with electronic data processing. From the earliest stages of development of this new technology, Federal agencies have been among the leaders in adopting electronic computers for business as well as scientific purposes. These innovations represent the latest step in a continuing search for more efficient equipment going back as early as 1889, when Herman Hollerith of the Census Bureau pioneered the use of mechanical data processing equipment.

The impact of office automation on Government employees has also been receiving special attention. The Subcommittee on Census and Government Statistics of the House of Representatives Committee on Post Office and Civil Service conducted hearings in 1959 and 1960 to determine the extent of office automation in the Federal Government and to explore the implications of these technological changes for Federal clerical workers. The subcommittee, under the chairmanship of Representative John Lesinski of Michigan, heard witnesses from the Bureau of the Budget, the General Accounting Office, the Veterans Administration, the Treasury and Post Office Departments, and several Government employee unions. In addition to the testimony by the witnesses, many exhibits were also submitted to the subcommittee.

This article summarizes material presented in these hearings concerning the impact of office automation on employees (primarily clerical). It presents information on such topics as computer applications and savings, problems of displacement and reassignment, personnel planning for technological change, selecting and training personnel for electronic data processing (EDP) positions, and attitudes of employee organizations toward automation.[1]

Extent and Examples of Use

Since the Bureau of the Census first introduced a large-scale electronic computer for business purposes in 1951, the application of EDP systems has grown rapidly. According to a recent Bureau of the Budget survey, there were 414 computers of all sizes located in Government agencies in fiscal year 1959.[2] An earlier report, included in the hearings, noted that 8 out of 10 of all medium- and large-scale computers were located in military establishments, and that 2 out of 3 were programed for business applications, the remainder being used to process scientific data.[3] The rapid growth of electronic data processing in Government agencies will probably continue. By 1961, agencies informed the Budget Bureau that they expect to have 646 computers in operation.

Among examples of computer uses described in the hearings are two business applications in the Treasury Department that involve hundreds of millions of transactions annually: the payment and reconciliation of Treasury checks and the auditing and accounting of U.S. savings bonds.

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[1] The article is based on the following two volumes: Use of Electronic Data-Processing Equipment, Hearings Before the Subcommittee on Census and Government Statistics of the Committee on Post Office and Civil Service (86th Cong., 1st sess.), Washington, 1959; and Office Automation and Employee Job Security, Hearings Before the Subcommittee on Census and Government Statistics of the Committee on Post Office and Civil Service (86th Cong., 2d sess.), Washington, 1960.

[2] See Inventory and Cost Data Concerning the Utilization of Automatic Data Processing (ADP) Equipment in the Federal Government for Fiscal Years 1959, 1960 and 1961, Executive Office of the President, Bureau of the Budget, May 1960. This report, to be prepared annually, was not included in the hearings.

[3] This report on manpower problems related to adoption and use of EDP systems was prepared by a private research organization for the Bureau of the Budget's Interagency Committee on Automatic Data Processing. The function of this committee is to coordinate the activities of various users of EDP equipment and to act as a clearinghouse for disseminating information on developments in electronic data processing.

In the Veterans Administration, a large-scale electronic data processing system will be used to establish and maintain insurance records for over 6 million policyholders. Officials claim that this operation will be "the most extensive computer application undertaken by any major life insurance operation." This program will eventually draw the premium, loan, dividend, and billing records into one major file. The system will then be used to perform high-speed posting, billing, and accounting operations, and will store a complete, up-to-date record on a magnetic tape, which will constitute the master record file.

Some Economic Effects

A striking, though not necessarily typical, case of substantial direct savings achieved through the use of electronic data processing systems is the Treasury's check payment and reconciliation operation. Transferring this function to computers centralized in the Treasury Department the responsibility for an operation that had previously been performed jointly by the Treasury Department, the General Accounting Office, and certain Federal Reserve banks.

Table 1 shows the amount of direct savings. Although the workload increased 14 percent, employment declined 48 percent—with the result that output per employee more than doubled (up 120 percent). Unit labor costs declined 44 percent, while equipment rental per unit of output rose 85 percent; total unit costs declined 32 percent.

TABLE 1. COMPARISONS OF PRODUCTIVITY AND UNIT COSTS OF GOVERNMENT CHECK SYSTEMS, BEFORE AND AFTER THE INTRODUCTION OF AN ELECTRONIC DATA PROCESSING SYSTEM

Item	Before EDP (fiscal year 1956)	After EDP (fiscal year 1959)	Percent change
Workload — checks	345,000,000	393,000,000	+13.9
Number of operating employees	1,552	803	−48.3
Total cost	$7,188,000	$5,569,000	−22.5
Labor cost (including retirement and other fringe costs)	6,101,000	[1] 3,891,000	−36.2
Equipment rentals	579,000	1,222,000	+111.1
Other costs [2]	508,000	456,000	−10.2
	Indexes (1956=100)		
Output per employee	100.0	220.2	+120.2
Employees per unit of output	100.0	45.4	−54.6
Cost per unit of output	100.0	68.0	−32.0
Labor cost per unit	100.0	56.0	−44.0
Equipment rental per unit	100.0	185.3	+85.3
Other costs per unit	100.0	78.8	−21.2

[1] Includes a 10-percent pay increase granted classified workers in 1958.
[2] Includes costs for shipping and communications, forms and supplies, and indirect costs.

SOURCE: Derived from data presented in Office Automation and Employee Job Security, op. cit., pp. 76–77.

Indirect operating economies should greatly increase with the improvement of management control techniques which would result from the centralization and consolidation of data for EDP operations and from the preparation of more meaningful and timely reports. For example, a GAO report (included in the hearings) stated that numerous electronic systems are currently applied in Defense Department supply operations in which the Government has over $50 billion in inventories. Even small percentage savings achieved through a reduction in inventory levels could yield substantial annual savings. The report states: "The unique ability of electronic systems to rapidly combine and analyze data regarding resources and needs in integrated systems in these programs holds promise of achieving these savings."

Displacement and Reassignment

In the hearings, various Treasury officials described the impact on employees that resulted from the use of computers to process check payment and reconciliation and to perform savings bonds auditing and accounting operations.[4]

The changeover relating to check payment and reconciliation affected employees in three agencies: the Office of the Treasurer, the General Accounting Office, and the Federal Reserve System. The electronic system went into operation in June 1957 after a 17-month phased conversion from a mechanical system. Table 2 shows the changes effected from June 1956 to June 1959 (data were not presented for the Federal Reserve System).

Only 174, or 23 percent, of the 755 persons affected were retained in the same unit for continuing operations. Over one-half were transferred, most going to other activities within their organization; only 31 employees, 4 percent of the total, went into the new unit. Through special placement efforts, about 11 percent went to other agencies. Nearly 14 percent resigned or retired. Two were laid off.

[4] Data on characteristics (age, sex, education, etc.) of affected employees and those selected for electronic data processing, extent of their upgrading or downgrading, and their subsequent work assignments were not reported in these hearings.

TABLE 2. REDUCTIONS IN EMPLOYMENT IN AFFECTED UNITS IN THE OFFICE OF THE TREASURER AND THE GENERAL ACCOUNTING OFFICE, JUNE 1956 TO JUNE 1959

Personnel actions	Number	Percent
Total personnel as of June 1956	755	100.0
Retained for continuing operations	174	23.0
Temporarily retained [1]	70	9.3
Transferred	399	52.8
To new EDP system in the Office of the Treasurer	31	4.1
To other activities within the Office of the Treasurer or the General Accounting Office	244	32.3
To other Treasury bureaus	44	5.8
To other Government agencies	80	10.6
Resigned, retired	104	13.8
Deceased	6	.8
Laid off	2	.3

[1] In order to complete residual operations in GAO under old system. Of these 70 employees, 59 were subsequently assigned other duties within the GAO, 2 were transferred to other agencies, 4 resigned or retired, and 5 were laid off.

SOURCE: Office Automation and Employee Job Security, op.cit., p. 75.

Automation of the auditing and accounting of savings bonds in the Treasury Department had a more unfavorable outcome for employees. Despite serious efforts, it was difficult in this case to find other jobs for these workers because a large number were clerical employees whose skills were not in demand and who did not want to relocate in other cities.

The introduction of the computer affected 889 people in the Bureau of Public Debt and caused the closing of audit branches in Chicago and New York and the curtailment of operations in the Chicago departmental office. Electronic data processing of punchcard savings bonds was started at a new office in Parkersburg, W. Va. (at that time classified a labor surplus area). Other bond processing operations were transferred to the Cincinnati branch.

Personnel changes were extensive. (See table 3.) Of 889 employees, over one-third, mainly in lower clerical grades, were laid off. Sixteen percent resigned, giving such reasons as ill health, home responsibilities, and the desire for further education. Three percent were transferred to other Public Debt offices; 35 percent went to other Government agencies. Nine percent of the total personnel, all from the Chicago departmental office, obtained jobs with private industry.

Bureau officials reported that few of those in Chicago and New York whose jobs were eliminated were willing to move to Parkersburg when offered jobs there. The 458 employees required in the Parkersburg installation were recruited locally. And Bureau officials trying to locate other jobs for those displaced found that there was little demand for people doing such routine clerical work as alphabetical filing and keypunch card work.

Planning for the Change

Federal officials made advance efforts to cushion the impact of office automation on employees. It was reported that agencies adopted such policies as sharing information with employees concerning technological change, using attrition to minimize layoffs, transferring employees to other positions, and retraining employees for reassignment to new jobs.

The Treasury Department adopted a policy of informing employees of changes well in advance. In the Office of the Treasurer and in the Bureau of Accounts (affected by another installation), employees were informed nearly a year before scheduled conversion dates. Ivy Baker Priest, the Treasurer of the United States, met with employees of the Office of the Treasurer to assure them that everything possible would be done to alleviate hardships that might arise. In the Bureau of Accounts, a memorandum was sent to regional offices setting forth the probable effects impending operational changes would have on employee job security. This memorandum was supplemented by visits of agency officials to each of the six regional offices scheduled to be closed. During these field visits, the officials discussed personal employment problems with the individuals who would be affected by the changeover.

In the Veterans Administration, providing employees with advance and periodic information concerning technological change is an integral part

TABLE 3. REDUCTIONS IN EMPLOYMENT AT THE NEW YORK AND CHICAGO OFFICES OF THE BUREAU OF PUBLIC DEBT, MARCH 19, 1957, TO JUNE 30, 1958 [1]

Personnel actions	Number	Percent
Total affected	889	100.0
Transferred	336	37.8
To other Public Debt offices	25	2.8
To other Government agencies	311	35.0
Obtained jobs with private industry (Chicago office)	78	8.8
Resigned because of ill health, home responsibilities, desire to further education, etc	143	16.1
Retired	14	1.6
Laid off	318	35.8

[1] No layoffs have been necessary since June 30, 1958, and none are foreseen.

NOTE: Because of rounding, the sum of individual percentages does not equal 100.

SOURCE: Office Automation and Employee Job Security, op. cit., p. 83.

of basic personnel policies developed for EDP situations. Commenting at the hearings on personnel procedures already initiated, Edward R. Silberman, Assistant Administrator for Personnel, stated: "We wanted our people to know what was going on and how they stood at any given time . . . [and] we wanted to provide a ready access to management."

These personnel policies were spelled out in a letter from Sumner G. Whittier, VA Administrator, to his department and office heads well ahead of the initial computer installation. Subsequent information was provided in periodic newsletters, bulletins, etc., and during conferences held by agency officials with employee groups. Information supplied included a description of electronic data processing, types of jobs and number of employees likely to be affected, and reassurance that the agency would do everything possible to minimize displacement. A basic orientation course on EDP, lasting from 3 to 40 hours, was given to 17,500 employees.

Mr. Whittier instructed department heads to inform managers of the occupational categories and number of employees to be affected at each VA station "as soon as possible, but not later than 6 months prior to the conversion date for the particular station"; and it was also decided that employees adversely affected would be given a minimum of 90 days' advance notice.

Some agencies formulated in advance explicit policies for EDP installations which provide for maximum use of attrition where necessary. A Department of the Army regulation (AR–1–250) specifically states: "Resultant personnel adjustments will be minimized wherever possible through attrition or retraining and reassignment in preference to reduction-in-force procedures." A joint Treasury Department–General Accounting Office report (included in the hearings) noted that the long time period necessary for planning the computer installation provides maximum opportunity to utilize attrition.

In the future, agencies plan to rely heavily on attrition to provide jobs for employees displaced because of automation. The Internal Revenue Service will soon begin to install a centralized data processing system, and Commissioner Dana Latham stated in a letter to IRS employees on August 12, 1959, that "we will make every effort to effect changes gradually so that most, if not all, of the necessary personnel cuts can be made by attrition."

An integral phase of advance planning was the development of administrative procedures for transferring surplus employees to other jobs. The Treasury Department's Bureau of Accounts (Division of Disbursements), for example, instituted a "job freeze" and instructed that all vacancies be reported to the central personnel office to determine whether employees displaced because of the closing of certain field offices could qualify for the openings. Bureau officials also discussed with other Federal agencies and local civil service offices the placement of these surplus employees.

The VA estimated at the hearings that automation will create 1,259 surplus positions in VA offices throughout the country during fiscal years 1960–62. Commenting on the importance of advance planning, Mr. Silberman stated: "The need for reassignment actions will be anticipated in sufficient time to take full advantage for outplacement of employees." In some instances surplus employees in regional offices will be offered transfers at Government expense to VA hospitals in need of their services.

Providing displaced employees with opportunities to develop skills needed for new jobs was recognized as an important prerequisite to making an orderly change. Some agencies made efforts to provide training programs in advance. The Treasury Department (Office of the Treasurer), for example, offered a refresher course in typing to all affected employees who had some typing skills; employees who could then qualify for typing jobs were placed in these positions as they became available.

Selecting EDP Personnel

The creation of new jobs and the selection of personnel to fill them presented extensive administrative problems. Table 4 shows the staffing, in 1958, of primary EDP jobs as reported by 236 computer installations. Two-thirds of the employees were engaged in planning and programing activities for computers, one-fourth were digital computer systems (console) operators or peripheral equipment operators, and a small group, only 8 percent, administered the EDP systems.

TABLE 4. NUMBER OF EMPLOYEES IN PRIMARY EDP OCCUPATIONS (AS OF MARCH 31, 1958) AT 236 GOVERNMENT COMPUTER INSTALLATIONS

Primary EDP occupation	Positions filled	
	Number	Percent
All occupations	3,742	100.0
Digital computer administrator	301	8.0
Digital computer management analyst	615	16.4
Digital computer programer	1,773	47.4
Electronic technician	83	2.2
Digital computer systems operator	621	16.6
Peripheral equipment operator	349	9.3

NOTE: Because of rounding, the sum of individual percentages does not equal 100.

SOURCE: Use of Electronic Data-Processing Equipment, op. cit., p. 85.

The agencies' general practice in filling EDP positions was to select employees only from their own staffs. A 1958 survey (see footnote 3) of recruitment practices at 129 military and civilian agencies showed that nearly two-thirds of the agencies filled EDP positions only from their own staffs; one-tenth filled them only from outside sources; and one-fourth used both methods of recruitment.

The reasons cited for preferring to recruit from within were the shorter training time required where the employee knows the paperwork process and the improvement in morale where there are advancement opportunities. At the same time, some reported that they needed to seek employees outside their own agencies because of the shortage of talent among their workers.

Written aptitude and intelligence tests were widely used. Of 129 agencies reporting types of selection methods, 7 out of 10 administered one or more tests, primarily to applicants for programer and computer operator positions. In addition to various Civil Service examinations, tests designed specifically to show programer aptitudes were used. In cases where written testing devices were not used, interviews and other formal practices were frequently employed.

The magnitude of the selection task is illustrated by the experiences of the Treasury Department and the General Accounting Office. All the employees working in the units affected by the conversion were invited to take an aptitude test. Of 470 persons tested, 77 were selected for training, and 23 were assigned to electronic positions. Not only aptitude tests, but also supervisors' written evaluations were taken into account. Final selection of the 23 employees who were to become the regular programers or operators was made on the additional basis of marks achieved in programing school and the satisfactory performance of programing duties on subsequent detail assignments.

Training in EDP

Training for EDP operations was a complex task partly because of the various types required. Training was needed not only for the development of programers and console operators, but also for the orientation and indoctrination of higher levels of management.

A survey for the Bureau of the Budget showed that the Government relied almost exclusively on computer manufacturers for the training of programers and operators. Several sources were drawn upon to give EDP indoctrination to middle and top management—manufacturers, Government agencies, universities, professional associations, and consultants, etc.

The Government paid salaries and any tuition and transportation cost of trainees. Manufacturers generally provided free classes for programers and operators from agencies using their equipment.

An illustration of the extensive amount of formal training given is the program at the Philadelphia office of the Department of Insurance of the Veterans Administration, where 2,700 employees were involved. Representatives of computer manufacturers gave on-the-site courses to employees directly involved in computer operations; 20 persons were each given 150 hours of programing; 5 employees, 24 hours of peripheral equipment operation; and 5 persons, 12 hours of digital computer console operation.

In preparation for other clerical jobs created by this EDP installation, several hundred employees and administrators were given classroom training dealing with use of records and documents involved in programing. In addition, all 2,700 employees received orientation courses lasting 1½ hours.

Some agencies gave tests to trainees in order to weed out unsuitable candidates. At one agency, instructors gave periodic tests of material covered, with the result that 25 to 30 percent of the trainees were dropped out. At another agency, 7 percent of the programer trainees were dropped on the basis of monthly evaluation reports by supervisors.

Attitude of Employee Organizations

Officials of Government employees' unions stated that they did not oppose automation, but wanted specific efforts made to avoid hardships arising from EDP installations. Some approved the advance preparations made by the VA, and they felt that similar efforts should be made prior to future technological changes. They suggested a number of specific protective measures.

Vaux Owen, president of the National Federation of Federal Employees, recommended a five-point program:

> (1) Thorough and definite planning ahead . . . of all departments and agencies prior to adoption of automated procedures. (2) Retraining programs . . . for all employees before they are displaced by automation so that [they] may be qualified for reassignment to other positions. (3) Positive reassignment procedures . . . so that employees can feel some assurance they will get reassignments in their own or another Federal agency. . . . (4) Definite placement programs . . . to place in suitable jobs in private industry those who cannot be reassigned in the Federal service. (5) Advance information . . . about plans for installing automated procedures, and just which categories of employees, and how many will likely be affected, and when.

Owen also proposed "an inventory of the skills of the people in the different agencies" as well as an inventory "of those who want to develop new skills."

Besides making similar recommendations, George Riley, legislative representative of the American Federation of Labor and Congress of Industrial Organizations, called for early retirement benefits for unretrainable employees affected by automation who have a specified minimum of service and are past a certain age. He also recommended severance pay for employees dismissed.

A number of administrative changes were suggested to carry out these proposals. James K. Langan, operations director of the AFL–CIO Government Employes Council, suggested that "the Congress lay down a policy that would require the agencies to have personnel management work closely with the installation engineers to reduce to a minimum the adverse effect upon employees." Riley recommended "the formation of a central transfer unit with authority to overcome resistance of uncooperative agencies." James Campbell, president of the American Federation of Government Employees, called for a transfer facility in the Civil Service Commission which would serve as a governmentwide clearinghouse for reassigning employees and assisting displaced employees to relocate.

Langan pointed out that Government employees do not have the same facilities for collective bargaining as employees in private industry have, and, consequently, that there is a challenge for the administration and the Congress to develop model personnel practices to handle the problem of automation.

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