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THE NATIONAL RESEARCH PROJECT

On Reemployment Opportunities and Recent Changes in Industrial Techniques

GOVERNMENT PUBLICATIONS
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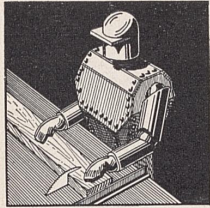
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THE NATIONAL RESEARCH PROJECT

On Reemployment Opportunities and Recent Changes in Industrial Techniques*

The Project on Reemployment Opportunities and Recent Changes in Industrial Techniques was initiated in 1935 as part of the Works Progress Administration's national research program. In establishing this project,¹ the Works Progress Administration recognized the necessity for study on a broad front of the dynamics of technological change in relation to the development of our national economy. The general assignment for the project was to inquire, with the cooperation of industry, labor, and governmental and private agencies, into the extent of recent changes in industrial techniques and to evaluate the effects of these changes on the volume of employment and unemployment.

The approach to the assignment may be formulated in approximation as follows.² The problem of technological change in our economic life has two basic, related aspects: first, the effects of change in industrial methods on the production of goods and services and on the volume of employment afforded thereby, and second, its effects on the employment and unemployment experience of individual workers and on labor market relationships.

Study of the first involves the determination of changes in labor productivity, the determination of the types of technological changes which help to explain the changes in productivity, and the analysis of these changes in the economic context in which they are found. Thus, such questions as changes in the utilization and costs of raw materials, equipment and power, the growth of capital, changes in market requirements, and the relation of output to capacity are relevant to an analysis of changing industrial techniques and their effects on the volume of employment and production.

* Prepared by Edmund J. Stone, Assistant to the Director of the National Research Project.

¹ David Weintraub and Irving Kaplan are, respectively, Director and Associate Director of the project.

² A more complete statement which defines the analytical approach to the problem and presents the scope and perspective of the work is given by Irving Kaplan in the *Research Program of the National Research Project*, Philadelphia, Pa.: WPA National Research Project, August 1937.

The second problem, the effects of industrial change on individuals attached to producing units in the economy, is concerned with the employment and unemployment experience of workers in various industrial segments of the economy. Major importance is attached to the work histories of individuals in selected industrial situations in terms of the frequency and duration of periods of unemployment and the frequency and character of changes in occupation, employer, and industry. These are analyzed in the light of the characteristics and history of the industries and working population of the situation selected for inquiry.

The integrating principle of the analyses undertaken is the conception of technological change as inseparable from its context of historical economic relationships. The problems studied are the time and manner in which technological change takes place and the effects which it has on trends in production, employment, and the incidence of unemployment.

From the point of view of governmental agencies dealing directly with problems of the unemployed, the project's work embraces two separable questions: What are the prospects for a higher or lower level of unemployment? In which industries, occupations, or locations is the impact of technological change on employment opportunities most significant?

The Studies and the Cooperating Agencies

The objectives of the various studies and the kinds of data collected are further indicated in the following outline:

I. General statistical studies, based primarily upon previously available materials, designed to yield a historical picture of the relation of trends in productivity, production, and employment in American industry as a whole and in its component parts.³ In addition,

³ Harry Magdoff in charge.

employment and unemployment data have been assembled for an analysis of long-term trends in employment in the several groups of industries and occupations.

II. Special studies of selected industries, to acquire material for the construction of a comprehensive picture of the incidence of technological and managerial changes on employment and production in individual producing units and industries.

A. *Manufacture*—1. Studies based on surveys of individual plants in the brick and tile, lumber, cement, beet-sugar, and flour-milling industries are being conducted in cooperation with the National Bureau of Economic Research.⁴ Special efforts were made to obtain data, related to changes in labor productivity, on percent of capacity produced, prices, costs, capital devoted to the production processes, and equipment changes. Attention has also been given to a consideration of the volume of labor embodied in the raw materials and equipment utilized. A survey of machinery and equipment manufacture was undertaken⁵ to furnish some of this information, and to supply material for an analysis of the rates at which different types of mechanization have been introduced and the conditions influencing changes in mechanization rates. The United States Tariff Commission, the Federal Trade Commission, the Department of Commerce, and the Forest Service Research Division of the Department of Agriculture have provided special tabulations or reports.

2. Surveys of individual plants in the boot and shoe, leather, silk, cotton and rayon textiles, cotton garment, cigar, and cigarette manufacturing industries were undertaken in cooperation with the Bureau of Labor Statistics.⁶ These studies cover records of production, employment, and pay rolls, and explanations of productivity changes in terms of such factors as the introduction of machinery and reorganization of operations.

3. A study of changes in job requirements of manufacturing plants in Minnesota is being conducted in cooperation with the Employment Stabilization Research Institute of the University of Minnesota, which made a similar study about 5 years ago.

B. *Mining*—Studies of changes in output per man as conditioned by changes in production, mechanization, and physical conditions of mining are being conducted in cooperation with the United States Bureau of Mines.⁷ The following extractive industries are covered: bituminous coal, anthracite, petroleum and natural gas, iron ore, copper, lead, zinc, silver, gold, phosphate rock, gypsum, stone, sand, and gravel. This work is based

largely on data available in the files of the United States Bureau of Mines, supplemented by field inquiries.

C. *Agriculture*—Studies of changes since 1910 in the volume of agricultural production, labor utilized, and output per worker are being conducted in cooperation with the United States Department of Agriculture.⁸ The agricultural economics departments in the agricultural experiment stations of California, Illinois, Iowa, and New York are also cooperating. These studies include an evaluation of the effects of such factors as changes in techniques, mechanical appliances, and farm practices. Principal crops and livestock products are covered. Material available in the Department of Agriculture and the State agricultural experiment stations has been supplemented by a field survey.

D. *Transportation*—These studies, conducted in cooperation with the Railroad Retirement Board,⁹ include a history of technological changes in the railroad industry and their effects on railroad labor and on the operating efficiency of the roads, an analysis of employment and unemployment records for 400,000 workers in the railroad industry, and a field study of supplementary employment and of unemployment among railroad workers.

III. Studies of the effects of industrial change on labor markets and on individual workers. These studies are designed to throw light on such factors as the frequency and duration of periods of unemployment; the frequency and character of changes in occupation, employer, and industry; the occupational mobility of workers of different ages or with different types of industrial experience; the sources of the labor supply in new and expanding industries; and the geographic mobility of labor in relation to the migration, expansion, or decline of industries. Most of these studies are based on field work conducted by the project. They include the following:

A. Studies in the Philadelphia labor market, conducted in cooperation with the industrial research department of the University of Pennsylvania,¹⁰ include an employment and unemployment survey; a study of job openings, new applicants, and placement records of the State employment office; and an analysis of the employment histories of workers in selected occupations and industries.

B. The analyses of work histories of railroad employees were referred to above.

C. Studies using employment histories and background material from selected industrial situations were made in 14 different localities.¹¹ One of these

⁴ Harry Jerome and William A. Neiswanger in charge.

⁵ Under the supervision of J. Van Horn Whipple and George Perazich.

⁶ Under the direction of Boris Stern of the Bureau of Labor Statistics.

⁷ O. E. Kiessling of the Mineral Production and Economic Division of the Bureau of Mines in charge.

⁸ John A. Hopkins in charge.

⁹ A. G. Silverman of the Railroad Retirement Board in charge.

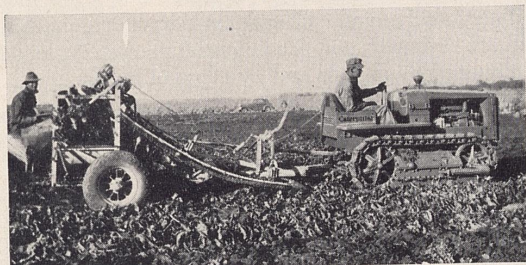
¹⁰ Gladys L. Palmer of the Industrial Research Department in charge.

¹¹ Initiated with Francis M. Vreeland in charge; field work completed and tabulations and analysis of results conducted with H. Paul Douglass in charge.



U. S. Sugar Beet Association

TOPPING SUGAR BEETS BY HAND



Urschel-Scott Beet Harvester

LIFTING AND TOPPING BEETS BY MACHINE

studies, in Manchester, N. H., is conducted in cooperation with the Social Security Board.

Summaries of Reports Published

Summaries of the findings on a number of the studies undertaken have been prepared and published. These include reports on various aspects of the extractive industries, agriculture, and manufacturing, as well as a more general statement on the relationship of unemployment and labor productivity. Numerous other studies in technology and in productivity in selected industries, and of effects of industrial changes on labor markets and on individual workers, are nearing completion.

Upon publication these reports are made available to interested persons. Judging from the variety of inquiries and comments received, the reports have been found useful for many purposes. For example, copies have been mailed on special request to commercial, industrial, and financial institutions; labor union organizations; national, State, and local governmental agencies in a number of foreign countries as well as in the United States; trade journals; private research organizations; professional workers; teachers and students of economics and allied fields; and interested laymen.

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The nature and the findings of the studies already published are summarized in the remaining paragraphs of this discussion.

Unemployment and Increasing Productivity

"Unemployment and Increasing Productivity"¹² deals in a general way with the over-all changes in the Nation's productivity, employment, and unemployment since 1920, and emphasizes some of the important questions which must be taken into consideration in any attempt to deal with the problems of unemployment. According to this report, the growth in total output from 1920 to 1929 was not sufficient, in the light of the increased productivity and the growth of the labor supply, to absorb all the available manpower; the result was a substantial volume of unemployment during this entire period. It is estimated that, in order for unemployment to drop to the 1929 level by 1937, goods and services produced would have to reach a point 20 percent higher than obtained in 1929, even if the productivity level of 1935 remained unchanged.

An undetermined but substantial proportion of the unemployed in any single year has probably consisted of workers displaced from their jobs in one way or another by the employment dislocations which accompany technological progress. The notable expansion in employment which took place between 1920 and 1929 was due almost entirely to the rapid growth of service activities; their occupational requirements differed so widely from those of the basic industries which registered declines that it is extremely unlikely that all the workers displaced from basic industries obtained new jobs in the service industries. It is concluded that the outlook for the immediate future seems to be in the direction of further technological progress toward a level of productivity substantially higher than that attained prior to 1929. The rate of advance differs, of course, in different industries, but since our economic system has not evinced an ability to make the necessary adjustments fast enough, it may be expected that the dislocations occasioned by technological progress will continue to present serious problems of industrial, economic, and social readjustment.

Mining

The report "Technology and the Mineral Industries"¹³ presents an over-all picture of recent techno-

¹² David Weintraub and Harold L. Posner, Philadelphia, Pa.: WPA National Research Project, March 1937. Prepared for the National Resources Committee and also published in its report, *Technological Trends and National Policy*, Washington, D. C.: U. S. Government Printing Office, June 1937. Pp. 67-87.

¹³ F. G. Tryon, K. C. Heald, T. T. Reed, G. S. Rice, and Oliver Bowles, Philadelphia, Pa.: WPA National Research Project, April 1937. Prepared for the National Resources Committee and also published as a chapter in its report, *Technological Trends and National Policy*, Washington, D. C.: U. S. Government Printing Office, June 1937. Pp. 145-76. This chapter is based to a considerable extent on results of the cooperative arrangement between the project and the U. S. Bureau of Mines, and was issued as an introduction to the series of "Mineral Technology and Output per Man Studies" in the several extractive industries.



Walter W. Bradley

SMALL-SCALE PLACER MINING

logical changes in the major mining industries and developments in exploration techniques. Increasing depth of operations, pitch of beds, and distance of underground haulage, and declining thickness of veins or grade of ore are discussed as factors tending to offset the effect of improved technology on total employment in mining. It is concluded that, in general, the outlook for the next 10 years as compared with the 1920's appears to be one of increasing total labor requirements in oil and gas, of labor displacement in coal, and of little change in employment in metal mining. For the extractive industries as a group, there seems little chance that total employment, during the next decade, will rise much above the level of the '20's. Output per man will continue to increase, though probably not as rapidly as during the '20's. The long-run view, though the date at which the situation will present itself is not predictable, is clearly one of increasing physical difficulties and declining output per man-hour. Meanwhile, mechanization is changing the kind of workers needed underground, favoring younger men educated to work with machines, and increasing the need for technical men and supervisors.

A report on small-scale gold placer mining¹⁴ provides the first comprehensive data on employment and production in the small-scale gold placer mining industry. During 1935 more than 28,000 of the unknown but larger number of individuals who tried their luck at placer mining made at least one sale to a bullion buyer. For the 28,000 miners who made one sale or more, the average number of days worked was 45, the average daily gross income was \$1.60, and the average gross earnings for the year were \$72. Relief officials in Western States had frequently requested information that would enable them to evaluate income prospects in small-scale gold mining, which was often suggested as a means of self-support for large numbers of the unemployed. The report demonstrates conclusively that this suggestion can no longer be taken seriously.

¹⁴ Charles White Merrill, Charles W. Henderson, and O. E. Kiessling, *Small-Scale Placer Mines as a Source of Gold, Employment, and Livelihood in 1935*, Philadelphia, Pa.: WPA National Research Project, May 1937.

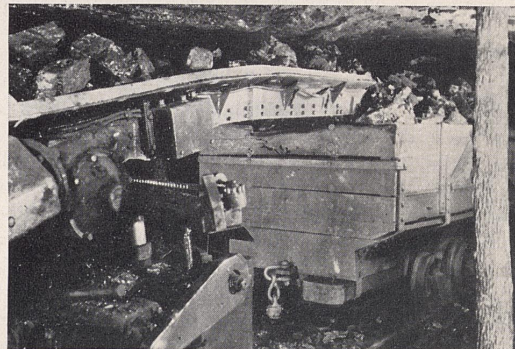
A considerable proportion of even the relatively successful miners were dependent upon public relief agencies for a part of their support. About three-fourths of the men engaged in placering only temporarily. Many of these itinerant miners had skilled trades and had gone into placering because of lack of job opportunities elsewhere. Three-fourths of them were more than 40 years old, and about one-half were over 50.

Preliminary results of a study of installations of loaders in underground metal and nonmetal mines are presented in another report.¹⁵ Yearly sales since 1923 are tabulated for scraper loaders and for shovel loaders, both of which are currently being introduced into mines at a significant rate. In 1936 the sale of shovel loaders greatly exceeded sales during any previous year. The field distribution of installations is mapped by kind of loader and by kind of mine. It is noted that conveyors, which are now used in many coal mines, have also been introduced into a few metal and nonmetal mines. Changes in the types of machines sold are reviewed, and the potential market for loaders is discussed by regions and by types of mines.

¹⁵ L. N. Plein, F. E. Berquist, and F. G. Tryon, *Mechanization Trends in Metal and Nonmetal Mining as Indicated by Sales of Underground Loading Equipment*, Philadelphia, Pa.: WPA National Research Project, June 1937. Some of the data in this report were published in the *Engineering and Mining Journal*, May 1937.



U. S. Bureau of Mines



Goodman Manufacturing Co.

LOADING COAL BY HAND AND BY MACHINE

A fourth report on the mining industries deals with bituminous coal and anthracite.¹⁶ Data by States and by counties, derived from the 1935 Census of Business, are presented in some detail on the number of workers employed, wages paid, volume of production, and cost of fuels and supplies. A brief analysis relates the 1935 data to earlier censuses. These data showed a decline in the number on pay rolls in bituminous coal mining between 1929 and 1935 of 23,000 men, or 5 percent. In the anthracite mines the decline was 50,000 men, or 35 percent. In 1935 wages constituted 61.2 percent of the value of products at the mine in bituminous coal, and 57.1 percent in anthracite. A new employment series, the average number of wage earners excluding shut-down periods, is presented for 1935.

Agriculture

A report on the sugar-beet industry¹⁷ points out that the introduction of trucks and tractors, the development of improved and enlarged equipment for field operations, and the general improvement of farm practices have resulted in a considerable reduction in the labor required per acre of beets during the last quarter century. At the same time, the propagation of new and disease-resistant seed varieties has increased yields per acre. Cost estimates on available designs of beet-harvesting machinery indicate that these machines, capable of displacing a large part of the hand labor now required, had attained an economic advantage over hand harvesting in 1936. Unless there is a much greater expansion of sugar-beet acreage than can now be anticipated, it seems clear that extensive mechanization would necessarily diminish the amount of employment afforded by the sugar-beet crop to hand laborers.

Stripper-type cotton harvesters have been in use for some years in certain low-yielding cotton areas where once-over machines are sometimes economical as stand-by equipment, according to a report dealing with mechanical cotton pickers.¹⁸ The report discusses recent developments in mechanical cotton pickers adaptable for use in heavy-yielding, level, or gently rolling areas where careful picking is necessary. It is estimated that 150 million man-days of labor are required to harvest a crop of 12.5 million bales, or labor enough to provide constant employment for almost 4 million hand pickers throughout a season of 40 work-days. Thus, widespread introduction of a mechanical harvester would have serious effects on the labor market

¹⁶ *Employment and Related Statistics of Mines and Quarries, 1935: Coal.* Part I—"Bituminous Coal" by F. G. Tryon, W. H. Young, M. E. Wilson, and F. E. Berquist; Part II—"Pennsylvania Anthracite" by F. G. Tryon, M. Otero, W. H. Young, and D. C. Ashmead, Philadelphia, Pa.: WPA National Research Project, June 1937.

¹⁷ Loring K. Macy, Lloyd E. Arnold, Eugene G. McKibben, and Edmund J. Stone, *Changes in Technology and Labor Requirements in Crop Production: Sugar Beets*, Philadelphia, Pa.: WPA National Research Project, August 1937.

¹⁸ Roman L. Horne and Eugene G. McKibben, *Changes in Farm Power and Equipment: Mechanical Cotton Picker*, Philadelphia, Pa.: WPA National Research Project, August 1937.



Anderson, Clayton & Co.



Rust Cotton Picker Co.

COTTON PICKING—MANY HANDS AND ONE MACHINE

of the South. It would probably also tend to reduce the number of tenants and sharecroppers, stimulate the use of tractors and improved machinery in other phases of cotton culture, result in a geographical shift of cotton-producing acreage to areas best suited for mechanized tillage and harvest, and increase the size of cotton farms.

In evaluating the economic prospects for one-row machines of the type experimented with during the 1936 harvest, the report concludes that the cost of picking 100 pounds of seed cotton by machine was about \$1.65 as compared with about \$1.00 for hand picking in the same area. With an improved, two-row machine the cost of picking might be reduced to about 65 cents per 100 pounds. It is estimated that it will require several years to develop such an improved machine, and that in such an event, half the Nation's cotton acreage may be involved in 10 years, throwing a maximum of 2,000,000 hand workers out of employment during the picking season of about 40 work-days. It is concluded, however, that a displacement of only a half-million pickers within the next 5 or 10 years is more likely.

Manufacturing

The field study dealing with aspects of leather manufacture covered the four principal subdivisions of the

industry—the production of sole, side, and kid leather and calfskin. According to a summary of this study,¹⁹ output per man per hour, in pounds or square feet of leather, increased 25 to 28 percent between 1923 and 1935, with half of the gain registered after 1933. It is concluded that the reported changes in labor productivity reflect principally the improvement of the organization and management of labor, and the increase in the size of plants resulting from the concentration of production in a smaller number of producing units. It is also pointed out that if the full-time hours per week had not declined during the period from 1923 to 1935, the total number of wage earners employed by this industry would have declined by 19,000—with the actual increase in productivity and the actual decline in output—instead of the actual decline of only 9,000.

Estimates as to the extent to which the technology of cotton-textile production has advanced since 1910 are made in a summary of a study on the cotton-textile

¹⁹ John R. Arnold, "Labor Productivity in the Leather Industry," *Monthly Labor Review*, July 1937.

industry.²⁰ The extent of the advance is presented in terms of the decline in man-hours per unit of output which could be achieved in various cotton textiles by mills utilizing the best machinery and equipment available in 1936 as compared with mills similarly equipped as of 1910. The study covers eight kinds of fabrics (carded broadcloth, combed broadcloth, sheeting, carded-filling sateen, canton flannel, print cloth, lawn, and terry cloth), and finds that the reduction in labor time per unit of output made possible by improved machinery and equipment ranged from about 32 percent for carded-filling sateen to 60 percent for terry cloth. Analysis by departments shows that in six branches of the cotton-textile industry the greatest advance occurred in spooling and warping. Although terry cloth and lawn showed a considerable advance in the spooling and warping department, their greatest improvements took place in the weaving department through the adaptation of automatic looms which were already available in 1910 for the other fabrics.

²⁰ Boris Stern, "Mechanical Changes in the Cotton-Textile Industry, 1910 to 1936," *Monthly Labor Review*, August 1937.

