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PUBLIC AFFAIRS PAMPHLETS

AMERICA'S FACTORIES

BY MAXWELL S. STEWART

Has American industry reached maturity?

Does the machine make for unemployment?

What industries continued to grow through the depression?

PUBLIC AFFAIRS PAMPHLETS
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AMERICA'S FACTORIES

1899-1937

By MAXWELL S. STEWART

TODAY, as never before in our history, all eyes are on our manufacturing industries. We are dependent on these industries for the airplanes, tanks, trucks, ships, and other military supplies necessary for our defense. Our safety depends in large measure on the efficiency of American industry in comparison with the industries of the totalitarian powers.

It is hard to believe that only a few years ago we were complaining that our industry was too efficient. Yet during most of the last decade we were disturbed because machines were displacing men with seemingly increasing speed. We turned out many more goods in 1937 than we did fifteen years earlier with no more men in our factories. And it seemed to some that technological unemployment would ultimately destroy our social structure.

Now the shoe is on the other foot. We are bending every

This pamphlet is based on *The Output of Manufacturing Industries, 1899-1937,* by Solomon Fabricant, published by the National Bureau of Economic Research, a study which was made under a grant from The Maurice and Laura Falk Foundation, Pittsburgh.

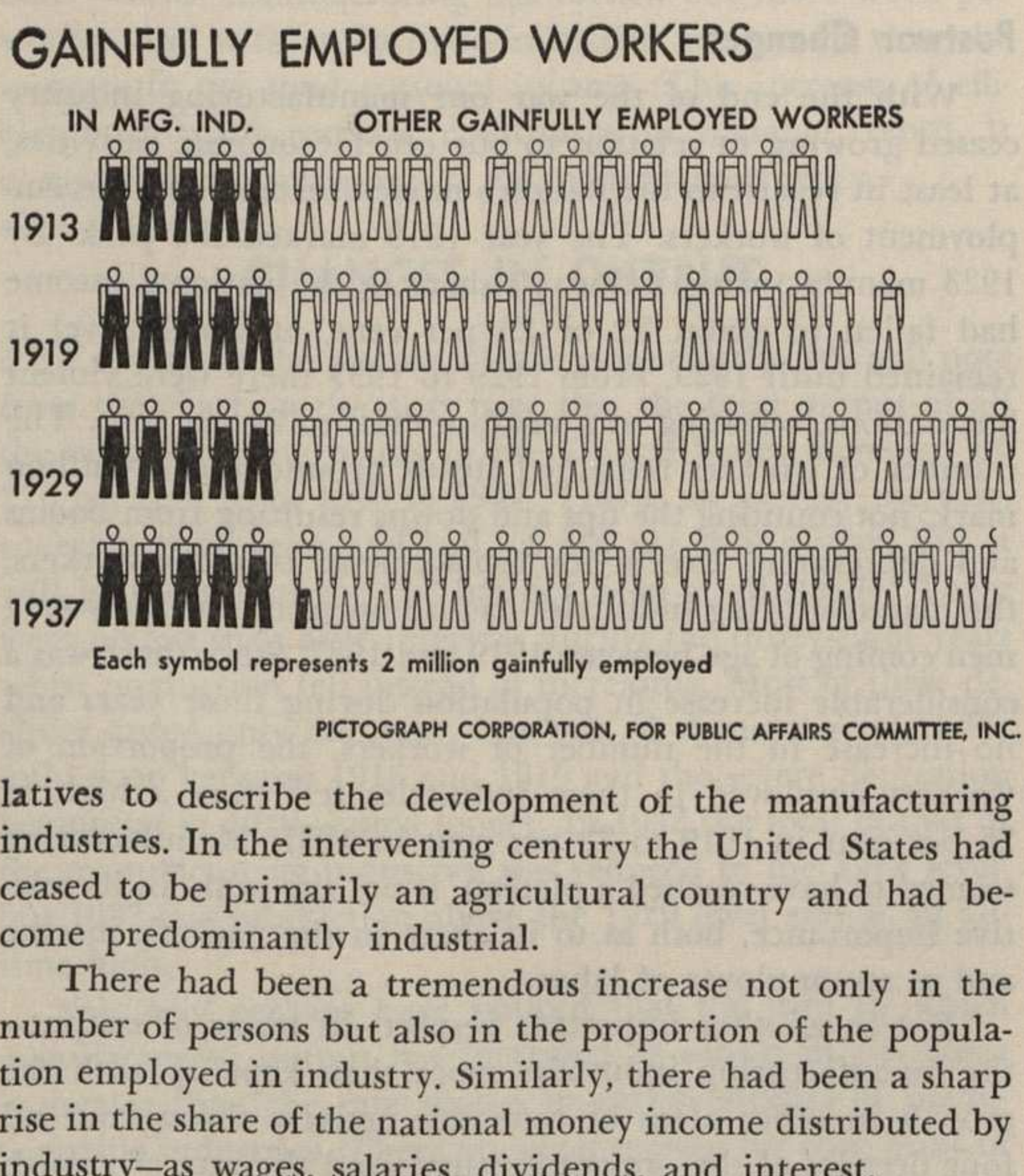
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effort to increase production with what skilled manpower is available, and we are profoundly grateful for the increased efficiency of American industry. But there is still much about the growth and relative efficiency of our manufacturing industry that is not fully understood. We tend to think of it as a whole rather than as the many separate industries which combine to make America the greatest manufacturing nation of the world. We are likely to think of the spectacular growth of a few industries, such as the automobile, radio, and electrical industries, and fail to recall that while some have skyrocketed, most have grown much more slowly and a few have actually lost ground since the turn of the century. To put it differently, although these years have been marked by growth for industry as a whole, they have also been marked by great changes within the field of manufacturing. Some of our greatest industries scarcely existed four decades ago. Others have matured. A few have stagnated. We live in a different industrial world from that of our fathers, and the changes have greatly altered our everyday life.

Growth of American Industry

For the first time in our history we have a detailed description of the development of our industry over a period as long as four decades. This may be found in a recent study made for the National Bureau of Economic Research. The study covers four of the most eventful decades in our economic history. It carries us through the placid growth of the first decade of the century, through the frantic growth during the first World War, through the boom period of the 20's, through the catastrophic depression of the 30's, and ends with the relatively prosperous year of 1937, the latest peak prior to the present war. The study is confined to this period because it is only beginning with 1899 that the United States Census of Manufactures began to provide reasonably complete information on the manufacturing industries, and full information for the years after 1937 is not yet available.

For the beginning of American manufacturing industry we should have to go back to the founding of the Republic. As early as 1791 Alexander Hamilton remarked on the substantial beginnings of the growth of manufactures in a report specially devoted to that subject. More than a century later, in 1902, the United States Industrial Commission used superlatives to describe the development of the manufacturing industries. In the intervening century the United States had ceased to be primarily an agricultural country and had become predominantly industrial.



There had been a tremendous increase not only in the number of persons but also in the proportion of the population employed in industry. Similarly, there had been a sharp rise in the share of the national money income distributed by industry—as wages, salaries, dividends, and interest.

This trend continued on into the present century. Just before the beginning of the first World War, in 1913, manufacturing industries employed some 8 or 9 million persons—about 20 per cent of the total number of workers in the

United States. They distributed about 19 per cent of the nation's total income. The war speeded up this growth. Between 1913 and 1919 manufacturing industry's share in the national income rose from 19 to 25 per cent. The number of workers increased to 10 million, or 26 per cent of the total number of workers.

Postwar Changes

With the end of the war our manufacturing industry ceased growing in relation to our other economic activities, at least in regard to the nation's money income and the employment of workers. The year 1919 marked the peak. By 1923 manufacturing industry's share in the national income had fallen to about 22 or 23 per cent, at which level it remained until 1929. From 1929 to 1937 there were violent fluctuations, resulting in a small net rise to 24 per cent. The number of workers remained steady around the 10-million mark, not counting the ups and downs resulting from booms and depressions. Except for replacements of older workers, the manufacturing industries had no openings for the young men coming of age between 1919 and 1937. Since there was a considerable increase in population during those years and no increase in the number of workers, the proportion of workers employed in these industries fell from a high of 26 per cent in 1919 to 22 per cent in 1937. Manufacturing seemed to have reached a plateau, if not the peak, in its relative importance, both as to its share in the nation's income and as an employer of labor.

But in another important respect—in terms of output—the manufacturing industries more than kept up with the growth in other areas of economic activity throughout all four decades of the present century. And the rate of growth was even more rapid in the second half of the period. Between 1899 and 1919 the output of our manufacturing industries rose 20 per cent more rapidly than the entire national output; between 1919 and 1937 it rose about 35 per cent more

rapidly. Thus there has been no letup in the relative growth of manufacturing industries measured in terms of their output. This discovery is all the more surprising when we consider that there has been a decline in the relative number of workers in manufacturing and no increase in the share of manufacturing industries in the nation's money income. In other words, manufacturing has turned out more work per worker, and with an increase in income no greater than the increase in the total national income. This increase of efficiency, in many respects, constitutes an enviable record. It is especially encouraging in the present emergency.

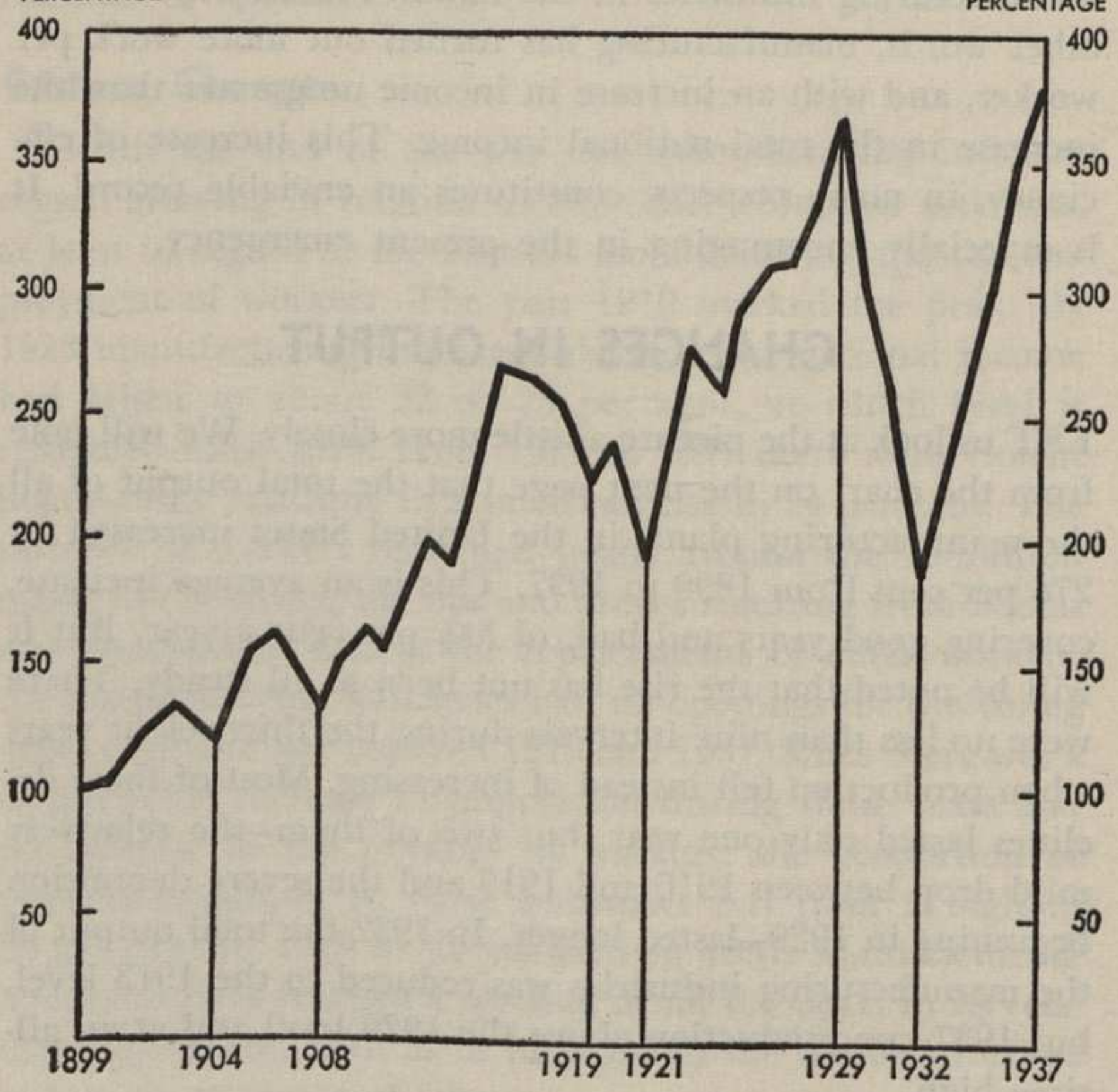
CHANGES IN OUTPUT

LET us look at the picture a little more closely. We will note from the chart on the next page that the total output of all the manufacturing plants in the United States increased by 276 per cent from 1899 to 1937. This is an average increase, covering good years and bad, of 3½ per cent a year. But it will be noted that the rise has not been at all steady. There were no less than nine intervals during the thirty-eight years when production fell instead of increasing. Most of these declines lasted only one year, but two of them—the relatively mild drop between 1916 and 1919 and the severe depression beginning in 1929—lasted longer. In 1932 the total output of the manufacturing industries was reduced to the 1913 level, but 1937 saw production above the 1929 level and at an all-time high.

You may perhaps have noticed that the rate by which manufacturing output has increased as shown in the chart is greater than the rate shown in earlier studies of manufacturing industries. There are good reasons for this. Most of the previous estimates of industrial production have given too little weight to new and developing industries. As industries grow older, they grow less rapidly. New industries are constantly appearing which could not be taken into account

in earlier estimates. The National Bureau of Economic Research made every effort to include as many industries as possible, new and old, large and small. And adjustments were

OUTPUT OF ALL MANUFACTURING INDUSTRIES



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made for the growth of the new industries for which exact figures are lacking. As a result, it was found that the growth in manufacturing during the thirty-eight years was definitely larger than had been generally supposed.

As a matter of fact, the contribution of the manufacturing industries has increased even more than the chart indicates. The figures we have been citing take no account of

improvements in the quality of manufactured goods. Some manufacturing industries, moreover, have made great progress in eliminating wastage. If we could take quality and efficiency into account, the manufacturing industries would have an even better record.

Output and Population

The significance of the growth in production becomes especially apparent if we compare it with the growth in population. During the thirty-eight-year interval, the population of the United States increased from 75 million to 129 million, or 73 per cent. This represents a gain of 1.4 per cent a year. Manufacturing output, as we have said, gained 276 per cent, or 3.5 per cent a year—which is more than twice as rapidly. It is estimated that in 1937 our manufacturing industries were turning out twice as much for each person in the population as they had done in 1899.

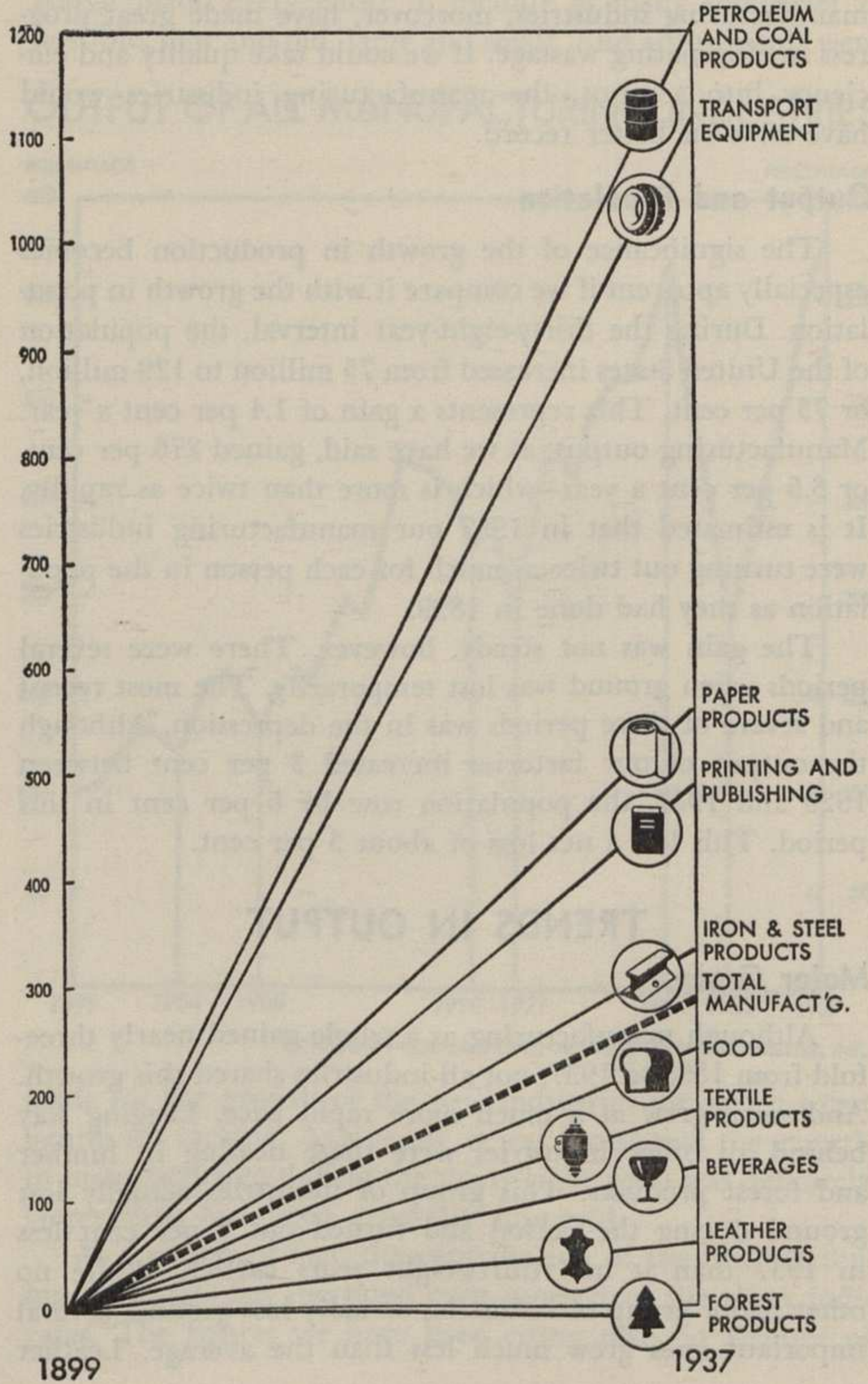
The gain was not steady, however. There were several periods when ground was lost temporarily. The most recent and severe of these periods was in the depression. Although the output of our factories increased 3 per cent between 1929 and 1937, the population rose by 6 per cent in this period. This left a net loss of about 3 per cent.

TRENDS IN OUTPUT

Major Groups

Although manufacturing as a whole gained nearly threefold from 1899 to 1937, not all industries shared this growth. And some grew at a much more rapid pace. Lagging way behind all other industries were those dealing in lumber and forest products. This group of industries actually lost ground during the period and turned out 7 per cent less in 1937 than it had thirty-eight years earlier. While no other major group of industries actually lost ground, several important ones grew much less than the average. Leather

PERCENTAGE OF CHANGE IN OUTPUT
1899-1937



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products, for example, rose only 69 per cent, or less than the growth in population which was 73 per cent. The output of the beverage industries increased only 132 per cent, and the textile industries increased their output only 180 per cent.

In contrast, the output of transportation equipment—notably automobiles—increased by more than twelvefold, as did the production of petroleum and coal products. Chemical products, paper products, and printing and publishing grew six- or sevenfold. Such basic industries as the food and the iron and steel industries were close to the average in increase of production.

Individual Industries

Changes in individual industries* were naturally more varied than in broad groups. We find, for example, that the output of no less than eleven out of the sixty-one industries on which we have information actually declined between 1899 and 1937. Thirteen other industries failed to keep up with the increase in population. Chief among those losing ground were those providing transportation equipment other than automobiles and aircraft. These included the making of carriages, wagons, locomotives, railroad cars, ships, and boats. Other industries which lost ground during the period included those producing linen goods, turpentine, lumber mill products, clay products, flour, pianos, and chewing and smoking tobacco.

The automobile industry enjoyed the most spectacular rise during the thirty-eight-year period. This industry, which was in its infancy in 1899, increased its output by no less than 180,100 per cent. Well behind is the cigarette industry, which increased its output by 4,226 per cent. Four other industries—petroleum refining, milk canning, beet sugar, and hosiery knitting—enjoyed rises of over 1,000 per cent. They were followed by cement, canned fruits and vegetables, miscellaneous chemicals, and manufactured ice. Next come silk

* See table on p. 30.

and rayon goods, and then three closely related industries with almost identical rates of growth. The pulp, paper, and printing and publishing industries each grew about 500 per cent in output.

Not always do we find related industries enjoying the same rate of growth. It is true that petroleum production has kept close pace with the development of the automobile. And rubber tires have also shared the gain. But blast furnace products and steel mill products are rather far apart on the list. And the various foods are quite far apart, reflecting changes in the food habits of the American people. We find, for example, that the output of ice cream, confectionery, sugar, and canned goods rose much more rapidly than the growth in the population. Meat packing and flour production, on the other hand, failed to keep up with the increase in population.

Although in several instances new industries gained at the expense of old, this did not always lead to a decline in the older industries. The carriage industry, it is true, gave way before the automobile. But we find increases in both butter and oleomargarine, and in cotton and woolen goods in face of spectacular gains by the silk, rayon, and knit goods industries. The shift from home baking and sewing is clearly reflected in the growth of the baking and clothing industries. This also explains the failure of flour and cloth to share the gain. The discrepancy between the rates of growth of pig iron and steel is due in part to the savings of materials resulting from increased efficiency in industry. Changes in the character of our foreign trade have also influenced the production of some of our industries, and have caused industries to grow at various rates.

Changes in 1929-1937

We have said that there was practically no change in the output of our manufacturing industries between 1929 and 1937. Nevertheless, about half of them enjoyed gains which,

in some instances, were quite large. There was a gain, for example, of more than 200 per cent in the output of mechanical refrigerators and rayon. The output of glass and tin cans jumped some 60 per cent. Canned fruits and vegetables, and lace goods each gained 50 per cent, while the output of washing machines, radios, chemicals, and wood pulp was up by 40 per cent. Cigarettes, and silk and rayon goods improved by some 30 per cent. Quite a number of other industries turned out a greater volume of goods in 1937 than they had in the boom year of 1929—outstripping the growth in population. This suggests that despite the depression many American industries have not ceased to grow.

Among the industries that showed a decline between 1929 and 1937 we find that the greatest decline, in several cases, occurred in those which had been on the toboggan since the turn of the century or longer. The output of locomotives, lead, planing mill products, clay products, pianos, cement, and lumber mill products dropped by more than 25 per cent. More modest losses were suffered by the industries turning out manufactured ice, copper, cigars, tires, ships and boats, linoleum, flour, coke, and pig iron. Apart from the old industries already in decline, the greatest losses in the 1929-1937 period were among the building and construction industries. This drop reflects the failure of the construction industries in 1937 to recover the heights reached in the great building boom of the 1920's.

SPECIAL INDUSTRIES

PERHAPS the best way for us to understand the special forces affecting the growth and decline of manufacturing industries is to examine some of the more important ones separately and in some detail. We cannot in the space of this pamphlet examine all the industries covered in the study of the National Bureau of Economic Research. But the following are of special interest.

Automobiles

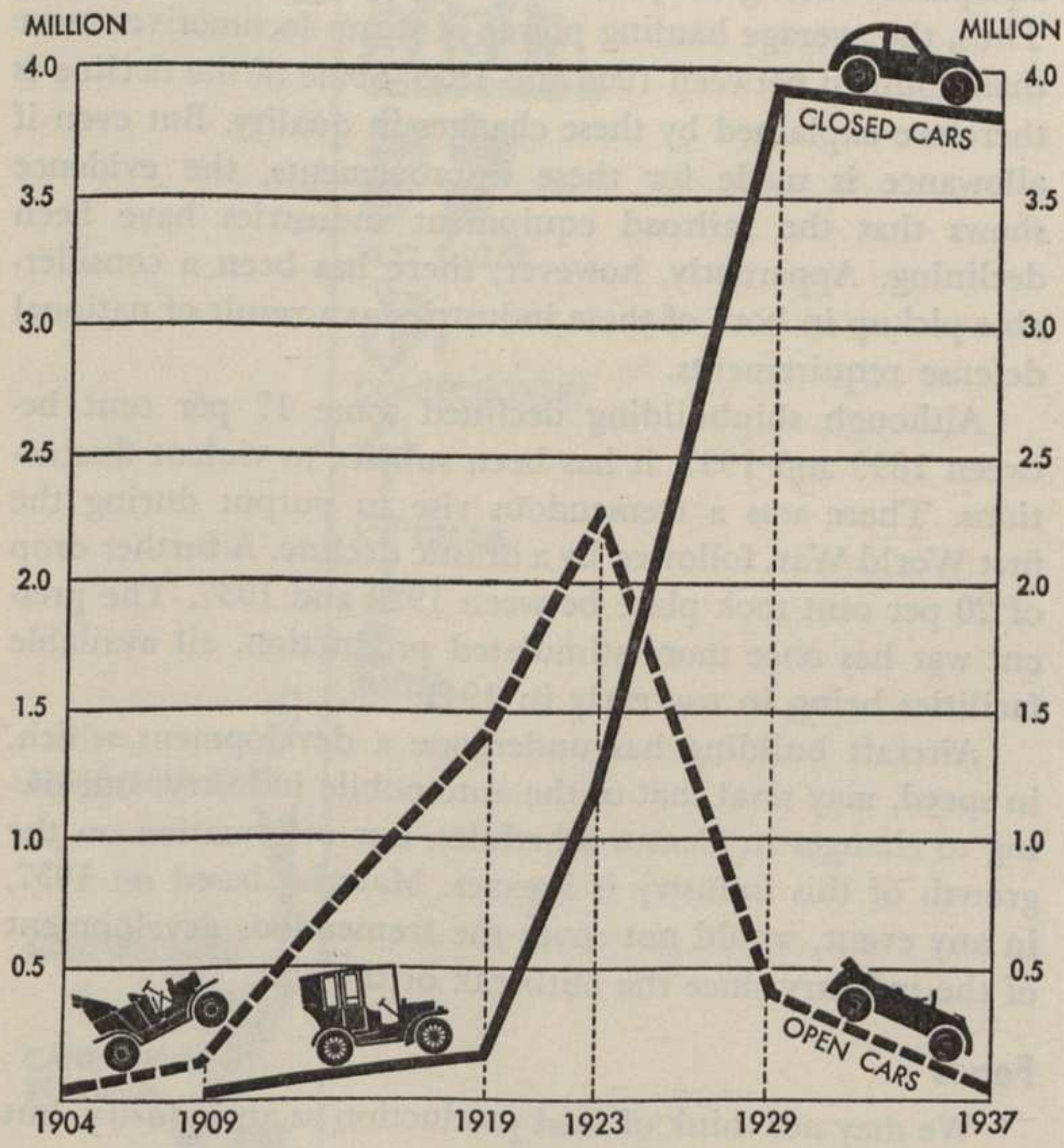
The automobile industry has frequently been credited with much of the economic advance which has been achieved during the present century. There is much to back up this claim. Until about 1900 the industry was in an experimental stage. The automobile of the day was a crude product of home or workshop. Each manufacturer had to make his own parts. By 1930 the automobile industry was consuming 15 per cent of all the steel produced in the United States. It was using 69 per cent of the plate glass, 18 per cent of the hardwood lumber, 51 per cent of the upholstery leather, 15 per cent of the copper, and 26 per cent of the lead. It brought about a dizzy expansion in the gasoline and rubber tire industries. Although not the only new industry to develop during the period, it was large enough in itself to account for a considerable part of the industrial expansion of the period. Without it, our industrial picture would be drastically different and much less encouraging.

In addition to its dramatic growth, the automobile industry provides the most spectacular examples of technical development. The motor cars of today bear little resemblance to the horseless carriages of four decades ago. Great improvements have been made even in the last ten or fifteen years. Between 1925 and 1935, for example, one of the leading makes of cars increased its wheelbase by 12 per cent, its horsepower by 350 per cent, its weight by 42 per cent, its acceleration by 128 per cent, and its maximum speed from forty to eighty miles per hour—a full 100 per cent. In addition to these other improvements, the 1935 car had as standard equipment antirattle devices, braces, dash gauges and meters, locks, shock absorbers, windshield wipers, safety glass, and a counterbalancing crankshaft. All of these devices had been available in 1925 but at extra cost. Yet the 1935 car cost little, if any, more than the inferior one of ten years earlier.

Other Transportation Equipment

Meanwhile, as we pointed out earlier, the output of most other kinds of transportation equipment has declined as automobile production has increased. The output of carriages, wagons, and sleighs has decreased almost continuously since 1904. The net decline between 1899 and 1937

PRODUCTION OF OPEN AND CLOSED PASSENGER CARS



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was 95 per cent. Most of the drop has occurred since 1914, when automobile competition really began to get serious.

Strangely enough, the decline in the production of locomotives has been almost as great as that of carriages—amounting to 79 per cent between 1899 and 1937. Much of the decline has occurred since 1923, when a peak of 3,100 locomotives were turned out. In 1937 the number was only 380. A parallel but less serious decline has occurred in the production of railroad cars. Total output fell by 22 per cent between 1899 and 1937. The output of both these types of railroad equipment was greatly affected by quality improvements. Thus, the average hauling power of steam locomotives more than doubled between 1905 and 1935. Some of the decline is therefore explained by these changes in quality. But even if allowance is made for these improvements, the evidence shows that the railroad equipment industries have been declining. Apparently, however, there has been a considerable pickup in both of these industries as a result of national defense requirements.

Although shipbuilding declined some 17 per cent between 1899 and 1937, it has been subject to violent fluctuations. There was a tremendous rise in output during the first World War, followed by a drastic decline. A further drop of 20 per cent took place between 1929 and 1937. The present war has once more stimulated production, all available facilities being in use early in 1941.

Aircraft building has undergone a development which, in speed, may rival that of the automobile industry. But owing to changes in Census schedules, our information on the growth of this industry is inexact. Material based on 1937, in any event, would not cover the tremendous development of the industry since the outbreak of the war.

Foods

We may not think of food production as an industry, but actually it ranks among the leading industries of the country.

OUTPUT OF SELECTED FOOD INDUSTRIES

1929 -1937

DECREASE

INCREASE

SAUSAGE

FRUITS AND VEGETABLES, CANNED

MILK, CANNED

OLEOMARGARINE

BEET SUGAR

CONFECTIONERY

ICE CREAM

BUTTER

BREAD AND CAKE

MEAT PACKING

CANE SUGAR REFINING

FLOUR

Each symbol represents 10 per cent of the 1929 production

PICTOGRAPH CORPORATION, FOR PUBLIC AFFAIRS COMMITTEE, INC.

It stands fourth among the manufacturing groups, being surpassed only by the textile, machinery, and iron and steel industries in the total value of its products. It is a complicated industry, having some twenty-nine different branches—some obviously much more important than others. Although the industry as a whole gained substantially during the four decades, there were wide differences among the different branches, reflecting, in part, changes in diets and food habits.

MEAT PACKING

Meat packing, which is among the most important of the branches, remained about stationary in comparison to the number of potential consumers. Its gain of 66 per cent was slightly less than the increase in population. This is all the more surprising since there was an important shift of slaughtering from farm and retail shop to the factory. Though there was little change in the total output per person, there were important changes in the *kinds* of meat produced. In 1899 only 58 per cent of the meat was fresh meat; the remainder was either cured, canned, or otherwise preserved. By 1937 approximately 73 per cent of our meat was fresh and only 27 per cent preserved. Part of this change was due to improved methods of refrigeration, but the fact that the proportion of cured meats was practically as high in 1919 as in 1899 suggests that other factors, such as changes in food habits and foreign trade, are at work.

We also find a considerable shift in the variety of meat. In 1899 as much as 49 per cent of all the meat produced consisted of pork. By 1937 pork had dropped to 37 per cent, while the relative amounts of beef, mutton, and lamb had advanced slightly. Veal, which had been only 1 per cent of the total in 1899, provided 6 per cent of the total in 1937. Since pork is the meat most frequently preserved, this change in meats is not unconnected with the shift from preserved to fresh meats referred to above.

FLOUR MILLING

Flour milling suffered a drop not only in relation to the population but in actual output during the thirty-eight-year period. Total production declined by 8 per cent while the population was rising by 73 per cent. The entire decline has taken place since 1919, which was the peak year. Again we find the average somewhat deceiving. For wheat flour, which is by far the most important of the industry's products, did not decline, but rose nearly 20 per cent between 1899 and 1937. Buckwheat flour, on the other hand, dropped by more than 80 per cent, while corn meal and corn flour fell off by nearly three-quarters. Although buckwheat flour was never used enough to be important, the decline in the use of corn meal more than offset the increase in the use of wheat flour. As with meats, the decline in production reflected a drop in the use of these products by the American people. But it is also due, in part, to a drop in exports. At first sight it may seem surprising that as the output of bakeries rose, production of white flour fell. But this reflects a decline in baking in the home as well as a decline in the export of flour.

CANNED GOODS

In contrast to both meats and flour, the output of canned fruits and vegetables—one of the most important branches of the food industry—rose very rapidly. Production in 1937 was 800 per cent greater than in 1899. And the gains were fairly constant in each of the four decades covered by the study. Although the canning industry as a whole seemed to be gaining almost as rapidly in 1937 as at any time during the period, there was a slowing down in the growth of many particular kinds of canned goods. But new varieties of canned goods were constantly being introduced. And only a very few varieties had reached a peak of production before 1931. These included canned hominy (1929), canned apples (1929), dried peaches (1919), and dried raisins (1925).

Although much of the gain of the canning industries reflects a shift from home-cooking and home-canning to the use of factory-canned goods, this is not the only reason for the industry's remarkable growth. There was a sharp increase in the total of home- and factory-produced canned fruits and vegetables.

SUGAR

Both the beet and cane sugar industries have expanded their output. But the growth in the output of beet sugar was much the more rapid. Beet sugar production increased 1,700 per cent; cane sugar, 100 per cent. The rise in beet sugar is accounted for only in part by increased cultivation of sugar beets in the United States. There was also a gain in the amount of sugar extracted from each pound of beets. The domestic cane sugar industry has been greatly stimulated since 1927 by the manufacture of celotex from a by-product of cane crushing.

A CHANGED PICTURE

The slow growth of the great staple food industries, such as meat packing and flour milling, and the rapid growth of the canned goods industries has changed the character of the food industry in the past four decades. In 1899 meat constituted 28 per cent of the output of the entire food industry. Flour accounted for another 18 per cent. The two together provided more than two-fifths of the output of the industry. In 1937 the situation was quite different. Meat packing accounted for only 13 per cent and flour for only 5 per cent of the total. The two together made up less than one-fifth of the output of the industry as a whole. Canned fruits and vegetables, on the other hand, jumped from 5 per cent of the total in 1899 to more than 12 per cent in 1937. Rice, butter, cheese and milk, and ice also gained during the period. Although beet sugar made a striking advance, the sugar industry as a whole had a smaller share in the total.

Many of the changes in the food industry reflected, as we

have already suggested, a shift from home- and farm-canning and food preparation to increasing food preparation in factories. But it is more than that. The American diet has undergone marked changes during the present century. We eat less meat and grain products. And we consume a greater amount of sugar, dairy products, and fruits. Individuals spending between $1.25 and $1.87 a week for food ate, on the average, 123 pounds of meat, fish, and poultry annually in the years 1885-1903. This was cut to 85 pounds in 1935-1937. A similar reduction occurred at each level of income. Since the average income rose during the period, the reduction in the use of meat was not quite as great as indicated above. But it was enough to change the character of our food industries appreciably.

Machinery

The record of the machinery industries is of special importance to us today because of its crucial role in national defense. We must have new machinery in vast amounts to turn out the sinews of war. And the machinery industries make not only machinery itself, but also the parts for use in the manufacture of machinery. Even in 1937 machinery ranked first among American industries, having risen from fourth place since 1899. Today its commanding position is even greater.

Unfortunately we do not have as accurate or as complete figures on the machine industries as we do on many of the others. But estimates based on dollar values indicate a remarkable growth, far exceeding that of manufacturing as a whole. The total value added by the machine industry in 1937 was more than eight times greater than in 1899, a rise 50 per cent above the corresponding increase for all manufacturing industries combined. First in size of growth were pumps. Electrical machinery, business machines, and washing machines were close behind. Each of these rose more

than three times more rapidly than total manufacturing. Foundry and machine shop products—the most important classification from the standpoint of national defense—show a gain exceeding that of total manufacturing by 13 per cent. At the bottom of the list, with declines in comparison to total manufacturing, we find sewing machines and agricultural implements.

ELECTRICAL MACHINERY

The gain in the production of electrical machinery, 2,500 per cent, is even more significant than it appears at first glance. For it not only means a tremendous advance in this one vital industry, but also indicates a vast increase in the use of electric power in all industries and increases in their efficiency. In 1899 only about 5 per cent of the power used in manufacturing plants was electrical. Thirty years later, about two-thirds was electrical. The capacity of power equipment, electric and steam, used in factories has increased much more rapidly than the number of workers and—although this is not quite certain—somewhat more rapidly than the quantity of output. We shall see the importance of this when we consider the growth in the productivity of workers during the period.

MECHANICAL REFRIGERATORS

Among the new industries which have made astounding gains, none have been more spectacular than those producing mechanical refrigerators. A total of 5,000 mechanical refrigerators was produced in 1921. Eight years later, in the boom year of 1929, the total was 900,000. In another eight years, 1937, the output had risen to 2,800,000. In this last period alone—the period of the depression—the rise exceeded 200 per cent. As might be expected, the rise of mechanical refrigerators wrought havoc with the production of iceboxes. In 1937 the sales of iceboxes were cut to one-third of the 1929 and one-tenth of the 1925 sales.

Iron and Steel

Another industry of basic importance to national defense is iron and steel. This great industry ranked among the first three in the United States, both in 1899 and 1937. Not a new industry in any sense of the word, nevertheless it gained 327 per cent in the period. This gain was extended over each of the four decades except the 30's, when the industry's output fell off 11 per cent as a result of the depression.

In addition to growing, the industry underwent important internal changes during the thirty-eight years. We find, for example, that pig iron, which represents the first stage of iron and steel processing, increased only 171 per cent in volume. The output of the steel mills, on the other hand, quadrupled between 1899 and 1937. One reason for the more rapid growth of steel may be found in the shift from the Bessemer to the open-hearth process. Although the open-hearth process is slower and requires more expensive equipment, it yields better steel, permits the use of inferior ores, and—most important in the present connection—makes use of scrap iron and steel as well as pig iron. Only 28 per cent of the steel made in 1899 was open-hearth. This figure was raised to 91 per cent in 1937. It is estimated, moreover, that owing to technical improvements 10 per cent less iron materials were used in producing a ton of steel in 1937 than were required in 1909. Improved designing of furnaces and greater control of the manufacturing process helped cut the amount of metal losses.

Technical advance has also brought considerable improvement in the quality of steel and steel products. For example, as a result of these advances the front fender of an automobile can now be stamped from a single sheet. Formerly, fenders were made from two sheets which had to be joined together. Furthermore, the fine grain and dense polished surface of modern sheet steel has reduced the time needed to paint automobile-body parts from a minimum of forty-eight

hours to six. In this way technical advances in the iron and steel industry have greatly contributed to the efficiency of industries using steel.

Another example is in the tin plate industry. Tin plates have been improved remarkably. As a result, it has become possible to can certain kinds of acid fruits which could not be canned in the past. These and other improvements have greatly increased the efficiency of the canning industry.

Chemical Products

Still another industry vital to defense is the chemical industry. This industry has grown in importance. It ranked ninth in 1899 and seventh in 1937. During this period it grew about 600 per cent.

The most important branch of this industry is the one listed by the Bureau of the Census as *chemicals, not elsewhere classified*. It includes establishments producing acids, nitrogen compounds, sodium and potassium compounds, aluminum compounds and alum, coal-tar products, and plastics. Until 1923 it also included rayon. Many, if not all, of its products are used in national defense industries. Quite apart from these requirements, however, the industry has enjoyed a remarkable growth. Between 1899 and 1937 its output grew by 2,500 per cent. In the first decade output doubled; in the second and third decades it almost tripled; and even in the depression years of 1929-1937 it rose more than 70 per cent. If rayon and compressed and liquefied gases (no longer classified in this group) are omitted, the long-term gain is not so huge but remains close to 750 per cent. Especially large gains were made in the output of phosphoric acid, sulphuric acid, borax, coal-tar dyes, and some less well-known chemicals.

Gains in the production of explosives were much more moderate, being only 267 per cent for the thirty-eight-year period. After a large gain in the first decade, the rate slowed down in successive decades. Among the products in the explosives industry are gunpowder, dynamite, and nitroglycer-

ine. Ammunition and fireworks are classified elsewhere. The chief gains occurred in the output of explosives approved by the Bureau of Mines. Production of blasting- and gunpowder declined.

The spectacular rise of the *chemicals, not elsewhere classified* group (including rayon and gases) may be seen in the fact that its output accounted for 42 per cent of that of the entire chemical industry in 1937 as compared with 10 per cent in 1899. The relative contributions of all other branches of the industry declined: Cottonseed products from 8 to 2 per cent; fertilizers from 7 to 4 per cent; even paints and varnishes declined in relative importance, although only one other branch of the industry rose more rapidly in output.

Textiles

Textiles have quite another story to tell. During the greater part of the period 1899-1937, the textile manufacturing industries were the most important of our manufacturing industries. And of the various branches of the textile industry, the cotton goods industry is by far the most important. Cotton goods production grew rapidly during the first decade of the century, slowed down during the war, expanded again during the 20's, and declined by 1 per cent between 1929 and 1937. The total gain for the thirty-eight-year period was about 100 per cent, only slightly above the increase in population.

As with other industries, we find significant changes occurring within the industry. During the first twenty years, when the total output of the industry rose by 60 per cent, napped fabrics and twines remained practically unchanged, and the combined output of sheetings, shirtings, and muslin increased only 14 per cent. Plushes and corduroys, however, increased by 400 per cent. Further changes took place in the last two decades. But although changes were constantly occurring in the importance of different kinds of cotton cloth, there does not seem to have been any shift to the more expen-

sive varieties. Coarse yarns were used to about as large an extent in 1937 as they had been in 1899. Some progress had been made, however, in the quality of each type of cotton cloth as a result of improvements in the manufacturing process.

In woolens we find an increase in output of only 60 per cent, which is less than the rise in population. Most of this gain occurred in the first ten years, when production went up 44 per cent. After two decades of relative stagnation, a rise of 14 per cent took place in the 30's.

The failure of the cotton and woolen goods to increase rapidly may be accounted for by the dramatic rise of silks and rayons. The output of silk and rayon goods in 1937 was six times as great as it had been in 1899. The progress of rayon goods has been particularly spectacular. Until 1919 the output of the silk and rayon goods industry consisted almost entirely of silk goods. By 1937 only about 20 per cent was silk and silk mixtures. The amount of rayon used in the industry increased seventyfold between 1914 and 1935.*

OUTPUT AND PRODUCTIVITY

SUCH an increase in the aggregate output of manufacturing industries as occurred between 1899 and 1937 could not have taken place without large gains in the productivity of labor, capital, and business enterprise. To be sure, there was a lot more capital at work. And the growth in population provided wider markets as well as a greater supply of workers. But neither the increase in capital nor the growth of the population was large enough to account for the tremendous rise in output. And it is probable that the increased efficiency of industry accounts, in part, for the increases in capital and, possibly, for part of the growth in population.

We have already had an indication of the increase in

* More details concerning the above industries, and information about many other manufacturing industries, will be found in *The Output of Manufacturing Industries, 1899-1937.*

efficiency in the unusually rapid growth of the machinery industry. The substitution of machinery for hand labor, of large machines for small, and of complex machines for simple ones has been a fundamental means of progress. It has not, however, been the only one. Increased efficiency in the use of raw materials has added considerably to our productivity. Savings in raw materials has often been far greater than the cost of making the savings, and has led to a good-sized decline in the total cost of a manufacturing process. For example, important economies in the use of raw materials have been achieved in plants dressing, concentrating, and smelting copper, zinc, and lead ores. Striking savings of materials have also been made in the manufacture of beet sugar, in steel mills, and in coke ovens through similar technical advances.

Improved Quality

Improvement in the quality of goods has also helped to increase productivity. For example, improved machinery has been introduced in the men's hosiery industry that uses less labor and at the same time turns out hosiery with patterns and designs that could not have been made previously at a reasonable cost. The improvement in the machine made possible the improvement in the product. Similar results have been achieved through the development of standardization. In many industries this has made for greater precision and has thereby improved quality and at the same time reduced costs. This kind of development is characteristic of a developing economy. Progress occurs on all fronts, each advance supporting and stimulating others.

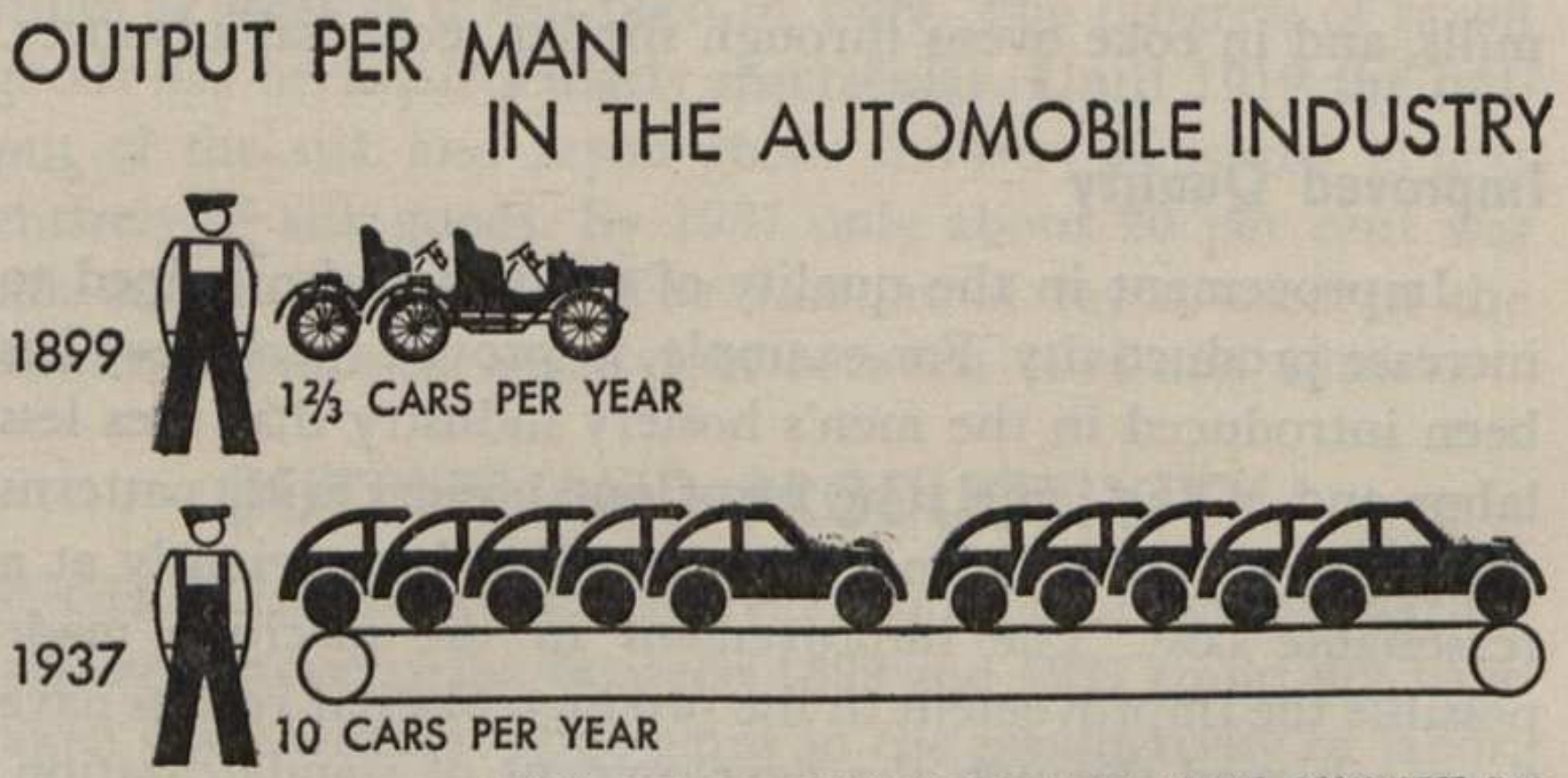
Price and Productivity

Price also seems to be closely related to progress in production. It is interesting to note that the manufacturing industries that have forged ahead in production are usually the ones in which there has been more than an average cut

in prices. In contrast, the industries which have maintained higher than average prices, as compared with industry as a whole, have lagged behind the others. It probably worked both ways. The industries which cut their prices were able to sell more and hence increase their output. And, at the same time, industries have found that increased output, particularly when achieved by better technical methods, has made possible reductions in the costs and thus in prices.

Productivity and Employment

In recent years many people have blamed the machine and increased technical efficiency for unemployment. It has



been said that our widespread unemployment was a direct result of technological advance. The facts obtained from the present study indicate, however, that many of the industries which have reduced the amount of labor needed for each article—either by new machines or more efficient methods—have increased their production so greatly that they have actually employed more labor than ever before.

The automobile industry provides us with the most dramatic example of this tendency. In 1899 it employed 2,200 men and produced only 3,700 automobiles and trucks. Thus it took six men a year to turn out ten cars. Thirty years later

the industry employed 447,000 men and turned out 4,360,000 passenger cars and 820,000 commercial vehicles. With the aid of a much larger amount of machinery, better materials, and improved methods, ten cars were produced for every man employed—or over six times as many as in 1899. Yet the number of men employed in the industry was more than two hundred times as large.

This is undoubtedly an extreme example, but there are many others. Between 1929 and 1937 the rayon industry, for example, greatly reduced the number of workers required for each pound of rayon yarn, but at the same time it increased the number of employees in the industry by 40 per cent at a time when half our industries were cutting down the number of jobs.*

MANUFACTURING AND OTHER INDUSTRIES

MANUFACTURING is, of course, only a part, though an important part, of our entire industrial system. It is affected by changes in other industries; and other industries, in turn, are affected by changes in the manufacturing industries.

We find that the total output of all industries, manufacturing and nonmanufacturing combined, more than doubled between 1899 and 1937. The increase was 30 per cent greater than the rise in population. One reason for the increase was, of course, the great advance of the manufacturing industries. Without them the rise would have been much less impressive. Yet the rise in the manufacturing industries was made possible by the growth of other industries which gave people increased buying power. Then, too, some of the increase in manufacturing output was due, as we have seen, to the shift from domestic to factory production of such things as bread,

* Further study of the problem of productivity and its relation to employment is now under way under a grant from the Maurice and Laura Falk Foundation. The National Bureau of Economic Research will publish the results in the second volume of the series of which *The Output of Manufacturing Industries, 1899-1937,* is the first.

canned fruit, and clothing. Women also tended to use more appliances in the home, such as washing machines and vacuum cleaners. There is a limit to this sort of thing, of course, since the time may come when all home production has been transferred to the factory. But this limit is still far from having been reached.

Another thing which seems to have helped the manufacturing industries to grow in comparison with other industries is increased specialization. They have taken over a good deal of work formerly done by other industries. They have produced new machines and supplies which have lightened the task in other fields. Perhaps the best example of this may be found in the mechanization of agriculture. By producing tractors, agricultural machinery, and gasoline and oil, the manufacturing industries have made it unnecessary for farmers to breed as many horses or to grow so much feed. Similarly, the making of butter and the slaughter of cattle have been transferred from the farm to the factory. While manufacturing itself has been relieved of certain burdens—such as power production—it gained much more than it lost by the trend toward increased specialization.

We also find that manufacturing has profited by the changing nature of our foreign trade. At the close of the last century approximately 43 per cent of our exports consisted of crude foodstuffs and crude raw materials. By 1937 only 25 per cent of our exports were of this type. Meanwhile, our manufactured exports rose from 57 to 75 per cent and the greatest increase occurred in finished manufactures, the most highly fabricated type. These rose from 22 per cent in 1899 to 49 per cent in 1937.

Recent Changes

It happens that 1937, which was taken as the final year in the present survey, is especially satisfactory for this purpose. It was a relatively good year, the peak following the Great

Depression and preceding the present war. It is probable that in the future 1937 will prove to be as widely cited as a base year as was 1913 in the period during and following the first World War.

During 1938 and 1939 our factory output, according to the revised Federal Reserve index, averaged below that of 1937. But in 1940 it averaged some 9 per cent above the 1937 level. And an even greater increase was registered during the opening months of 1941. If we had detailed information regarding these changes, it would undoubtedly alter the picture given in this pamphlet at many places. The heavy industries, especially machinery and iron and steel, have had their relative positions greatly improved as a result of the requirements of the defense program. Some of the consumer goods industries have been unaffected. But we must recognize that these changes, like those that occurred between 1914 and 1919, are abnormal and largely temporary. They should not be confused with the more fundamental shifts described in this pamphlet which reflect, for the most part, normal, peacetime adjustments. It is from this picture, rather than from emergency conditions, that we may hope to learn the fundamental laws of growth, maturity, and decline as they affect the various parts of our economic structure.

HOW SOME OF OUR INDUSTRIES HAVE GROWN

Listed According to Percentage of Change in Physical Output 1899-1937

Industry	Percentage of Change
Automobiles	+180,100
Cigarettes	+4,226
Petroleum refining	+1,920
Milk, canned	+1,810
Beet sugar	+1,688
Hosiery, knit	+1,202
Cement	+838
Fruits and vegetables, canned	+792
Chemicals, not elsewhere classified	+741
Ice	+668
Silk and rayon goods	+512
Pulp	+505
Printing and publishing	+494
Paper	+465
Rice	+416
Outerwear, knit	+393
Paints and varnishes	+391
Coke-oven products	+380
Zinc	+318
Liquors, distilled	+315
Steel-mill products	+313
Butter	+309
Tanning and dye materials	+292
Copper	+272
Explosives	+267
Wood-distillation products	+259
Fertilizers	+248
Blast-furnace products	+171
Cheese	+158
Jute goods	+134
Wool shoddy	+116
Cotton goods	+101
Cane-sugar refining	+101
Fish, canned	+96
Hats, wool-felt	+90
Shoes, leather	+87
Salt	+82
Cane sugar, not elsewhere made	+67
Meat packing	+66
Cottonseed products	+63
Leather	+61
Woolen and worsted goods	+60
Liquors, malt	+60
Underwear, knit	+52
Carpet and rugs, wool	+52
Lead	+51
Cordage and twine	+38
Hats, fur-felt	+26
Gloves, leather	+16
Cigars	0
Pianos	−5
Tobacco products, other	−6
Flour	−8
Clay products	−15
Ships and boats	−17
Cars, railroad, not elsewhere made	−22
Lumber-mill products, not elsewhere classified	−32
Turpentine and rosin	−32
Linen goods	−44
Locomotives, not elsewhere made	−79
Carriages, wagons, and sleighs	−95

FOR FURTHER READING

Bell, Spurgeon. *Productivity, Wages, and National Income.* Washington, Brookings Institution. 1940. $3

Bureau of the Census. *Biennial Census of Manufactures: 1937.* Washington, Government Printing Office. 1939. $2.25

Burns, A. F. *Production Trends in the United States Since 1870.* New York, National Bureau of Economic Research. 1934. $3.50

Fabricant, Solomon. *The Output of Manufacturing Industries, 1899-1937.* New York, National Bureau of Economic Research. 1940. $4.50

Gainsbrugh, Martin. *Manufacturing Resources for Defense.* New York, National Industrial Conference Board. Studies in the Economics of National Defense, No. 7. 1940

Magdoff, H., Siegel, I. H., and Davis, M. B. *Production, Employment, and Productivity in 59 Manufacturing Industries, 1919-1936.* Philadelphia, Works Progress Administration. National Research Project. 1939

National Resources Committee. *Technological Trends and National Policy.* Washington. Government Printing Office. 1937

Nourse, Edwin G. *America's Capacity to Produce.* Washington, Brookings Institution. 1934. $3.50

Stewart, Maxwell S. *Income and Economic Progress.* New York, Public Affairs Committee. Public Affairs Pamphlet No. 1. Revised Edition. 1938. 10c

———. *Industrial Price Policies.* New York, Public Affairs Committee. Public Affairs Pamphlet No. 23. 1938. 10c

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261

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