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POWER, MACHINES, AND PLENTY

By Gloria Waldron and J. Frederic Dewhurst

THE TWENTIETH CENTURY FUND

Productivity

THE PUBLIC AFFAIRS IDEA: 1936-1948

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By GLORIA WALDRON
and J. FREDERIC DEWHURST

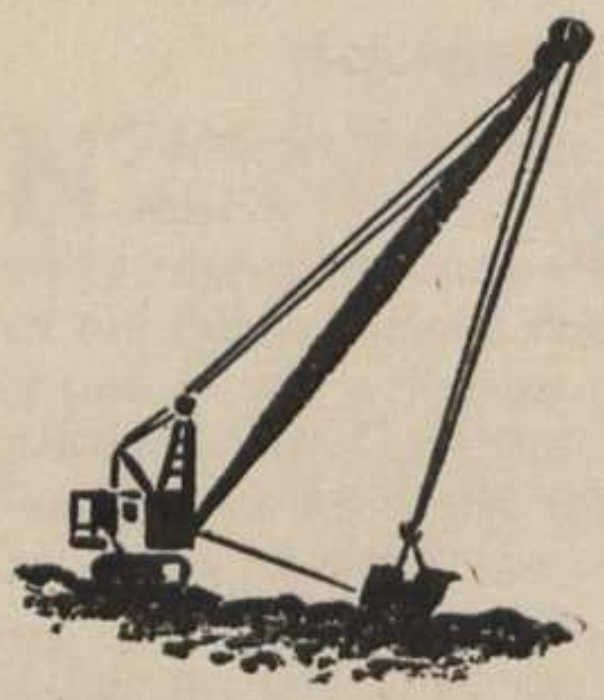
A Miner's Grandson

Steve Davies' grandfather came to America from South Wales in 1885. He was a coal miner as his father had been and his father's father. He took his family to Pottsville, Pennsylvania, and there he got a job in the anthracite mines. Steve's father, then fifteen, was his helper. Their tools were a pick and a shovel, a hand drill, an axe, a hammer, a mine car, and a scrawny mule. One-and-a-half man power plus one mule power plus the explosive force of black powder and fifty dollars' worth of equipment turned out two and a half to three tons of coal in a long ten-hour day. The old man earned about a dollar a day.

This pamphlet is based largely on *America's Needs and Resources* by J. Frederic Dewhurst and Associates. (Published by the Twentieth Century Fund, New York, 1947.)

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All this and a jumble of other thoughts passed through Steve's mind as he switched on the seven motors of the great new monster machine he was about to put into operation. "At bottom, I'm just a coal miner, too," he thought, "even if it takes more brain than muscle."



The slim, dark-haired young man grinned to himself thinking how surprised his grandfather would be to see him sitting high in the air manipulating levers with both hands and feet to swing the long 180-foot "boom" back and forth. At the end of the boom was a 32-ton bucket, big enough to hold seventy-two men. The huge teeth of the bucket picked up about thirty tons of rock every time Steve dipped the boom down. Then the big machine swung around and dropped the rock into a pile. On one side, the excavation was producing a small canyon—on the other, a small mountain. The big machine would go on scooping up the rock—the "overburden" as miners call it—until Steve reached a hard, glittering vein of anthracite. Then smaller machines would move in and scoop up the coal in much the same way.

Neither Steve's father nor his grandfather would find it easy to believe that not all miners have to grovel like moles under the earth's surface any more. The idea of mining anthracite in the bright sunlight would seem wildly fantastic. But that's what happens in strip mining where miners and excavator machines—"dragline excavators" they call them—work out in the open on the coal vein after Steve's big monster excavator has stripped off the overburden.

A dozen men working seven hours in a strip mine can turn out 200 tons of coal a day. In an underground mine twenty-four miners average maybe sixty tons a day. In other words, the strip miner can dig almost seven times as much coal as an underground miner. But the strip miners have the aid of vast, expensive machinery. Contrast Steve's $750,000 excavator with the $50 worth of tools his grandfather worked with. The big excavator Steve was operating weighed 1,150

tons. Its parts arrived in fifty different freight cars and it took forty men working a hundred days to put it together.

Steve's Shovel

Steve was a skilled mechanic and engineer. He had to be skilled to operate this new dragline excavator. The company wouldn't turn over this costly machine to a novice. "But it's just a fancy pick and shovel in a way," he thought, "a $750,000 pick and shovel." The new machine could gobble twenty-five cubic yards of rock in a single bite.

Steve's grandfather would be even more surprised if he knew that Steve earned $9,000 a year. He had at his command 1,750 horsepower, the equivalent of about 2,200 of his grandfather's mules. A slight move of the levers and Steve could make the bucket on the end of the boom swing nearly one hundred feet up or dip one hundred feet down.

The Mechanical Slaves

Steve's shovel is the symbol of industrial progress in the United States. Its story is that of countless generators, electric cranes, drill presses, turbines, diesels, bull-dozers, tractors, gang plows, airplanes, and locomotives. It is the drama of power harnessed on a scale never dreamed of before—of Yankee ingenuity and doggedness—of the achievements of "dreamers and doers." It also may be taken as the symbol of electric phonographs, sound film projectors, skyscrapers, express elevators, egg beaters, vacuum cleaners, dial telephones, and a million other devices that make American life so marvelously fantastic to the foreigner. We are the most "waited-on" people in the world with our millions of mechanical slaves.



Many a foreigner has sighed in wonderment at the way we waste everything but man power. Wherever a machine can lessen the work of a human being, we use it. Witness the electric baggage trucks that trundle through the bowels of every great railroad station, the electric-eye doors in Pennsylvania Station in New York, and the escalators that take you and your baggage effortlessly from one level to another.

The non-American gasps when he remembers the hand trucks and human sweat that move his baggage in other parts of the world, the hordes of porters, young and old, that swarm noisily over the traveler at the stations and docks of other lands. Human labor is used even for personal transportation in China. The bearer of the sedan chair or the ricksha boy is more than a quaint Chinese institution. He is the symbol of a largely unmechanized economy.

What Americans Take for Granted

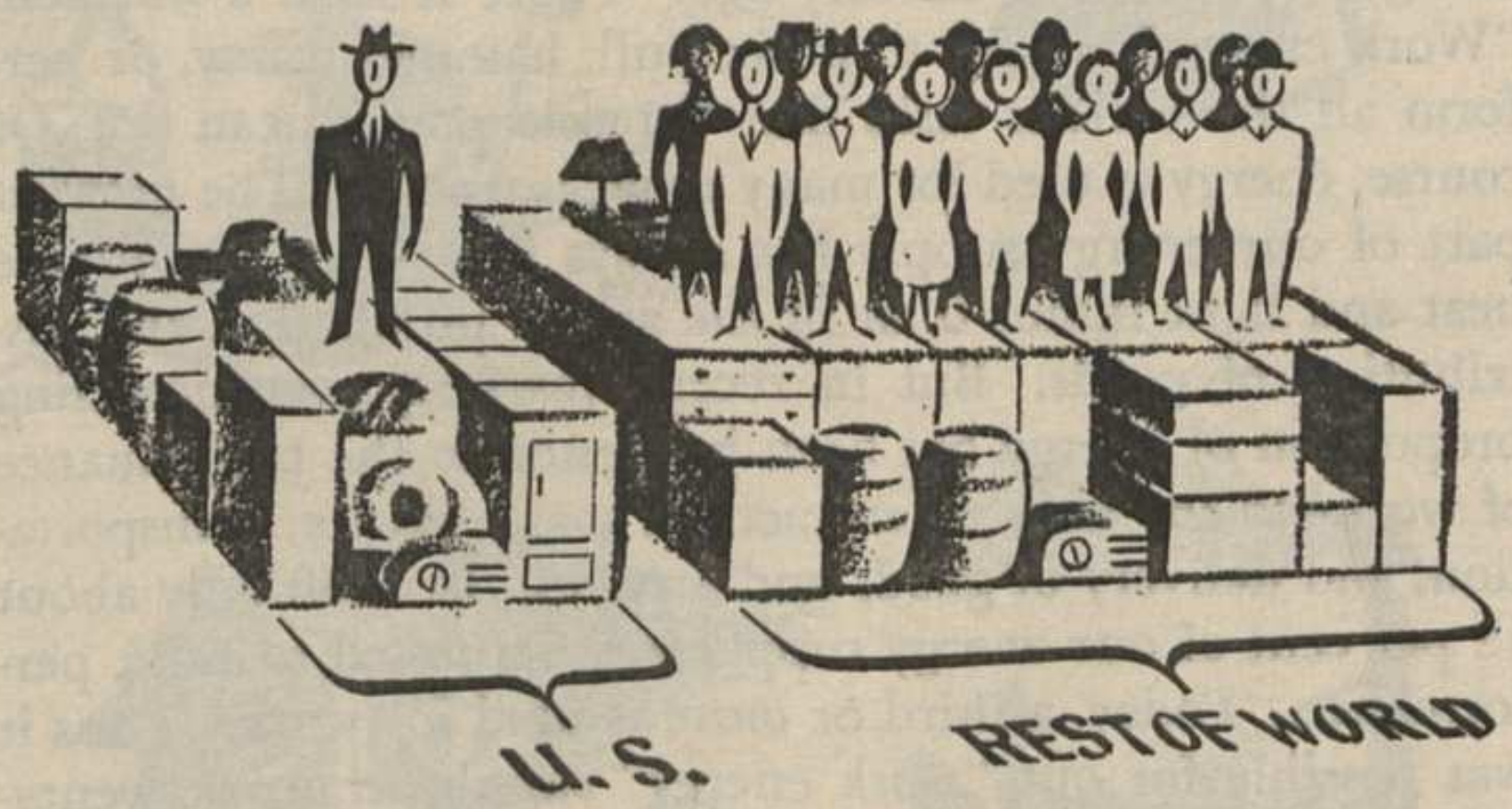
Almost any schoolboy knows that the United States is the most mechanized nation in the world—and the richest. He knows that we have more electricity, more automobiles, refrigerators, and telephones than anyone else. But few of us fully comprehend the comfort and enjoyment in everyday life that large-scale mechanization has brought—or how it has happened—or what it really means. After all, we take completely for granted the fact that—even in the depths of depression—nobody is likely to starve or freeze to death or be long homeless. To most of the people living in the world, this represents an unbelievable degree of security. The average Chinese or Mexican would also find it hard to believe that we drink water from any faucet and eat food in any restaurant and yet rarely get typhoid or dysentery; that we can sit down indoors almost anywhere in the country without sharing our meals with the flies and our bodies with the mosquitoes.



This was not true in our own country thirty or forty years ago and it is not true in nine-tenths of the rest of the world today. Ordinary sanitation and comfort—insect screens, pure water, paved roads, and central heating—are still as far from the reach of most of the world's two billion inhabitants as television sets and a college education.

THE SECRET OF PROGRESS

HOW many Americans realize that with less than one-fifteenth of the world's population we produce and consume one-third of all the world's goods and services? The average American's standard of living is four or five times above the



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HARRY A. HERZOG FOR THE PUBLIC AFFAIRS COMMITTEE, INC.

average for all the rest of the world, and, of course, many, many times higher than for the hundreds of millions who exist far below the average.

It would be easy to understand our astonishing progress from the horse-and-buggy age if we possessed more than our share of the world's land area and natural resources. But we don't. The simple fact is that we have about 7 per cent of each—about the same as our proportion of the world's population.

What is the secret of our progress, then? In a word, it is *power*. It is to be found in the most lavish use of energy the world has ever seen. It reflects the most ingenious applications ever devised to harness coal, gas, oil, and water power

to multiply human labor. We have used every possible source of energy. Yet we are always finding new and more efficient sources until we have finally reached the most powerful of all sources—atomic energy.

More Energy for Work

Today we use nearly twenty-nine times as much "work energy" as we did a century ago. There it is in a nutshell. "Work energy" is used to push, pull, hammer, carry, or perform all the various tasks that "muscle power" can do. Of course, energy is used for many other purposes. The greatest part of our energy supply has always been used to provide heat and light rather than in the actual production and distribution of goods. But in recent years an ever-increasing proportion of energy has been harnessed to the performance of work—to the tasks of extraction, manufacture, transportation, and delivery of goods and services. In 1850 only about 12 per cent of our energy supply was harnessed to work performance. Today, a third or more is used for work. Thus it was possible for our "work energy" supply to grow twenty-nine times while our total energy supply grew only fourteen times.

Where does energy come from? First and foremost from that primary and basic source—the sun. Without solar heat, life on earth would not exist. There would be no crops, no coal, no *people*. The sun is the source of all energy. But solar heat is used very little in the direct performance of work. Like wind and water, it is abundant and free, but expensive and difficult to harness.

Discovering New Energy

Man has always had to work. In different ages and different parts of the world he has labored in a vast number of ways to obtain his food and shelter. For some millions of years he had only his own muscle power—or as some would contend, woman's muscle power, for women were the burden-bearers in primitive societies. When he began to cultivate crops and settle in villages, he learned to use the



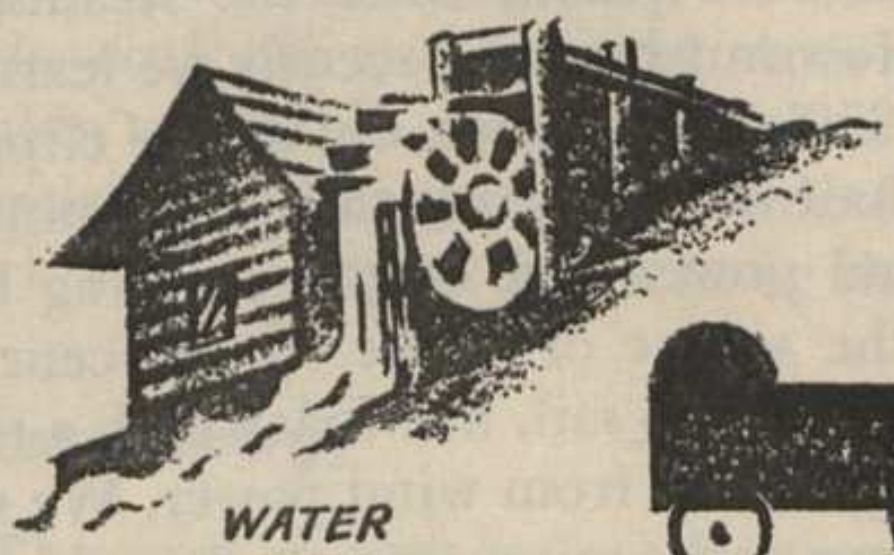
MANPOWER



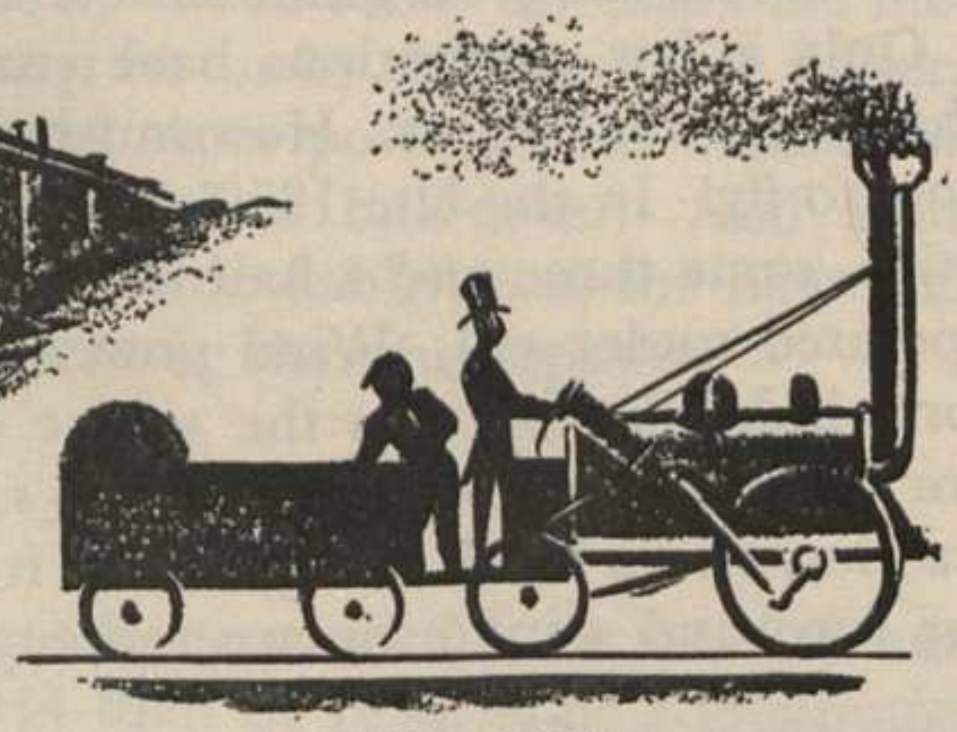
ANIMALS



WIND



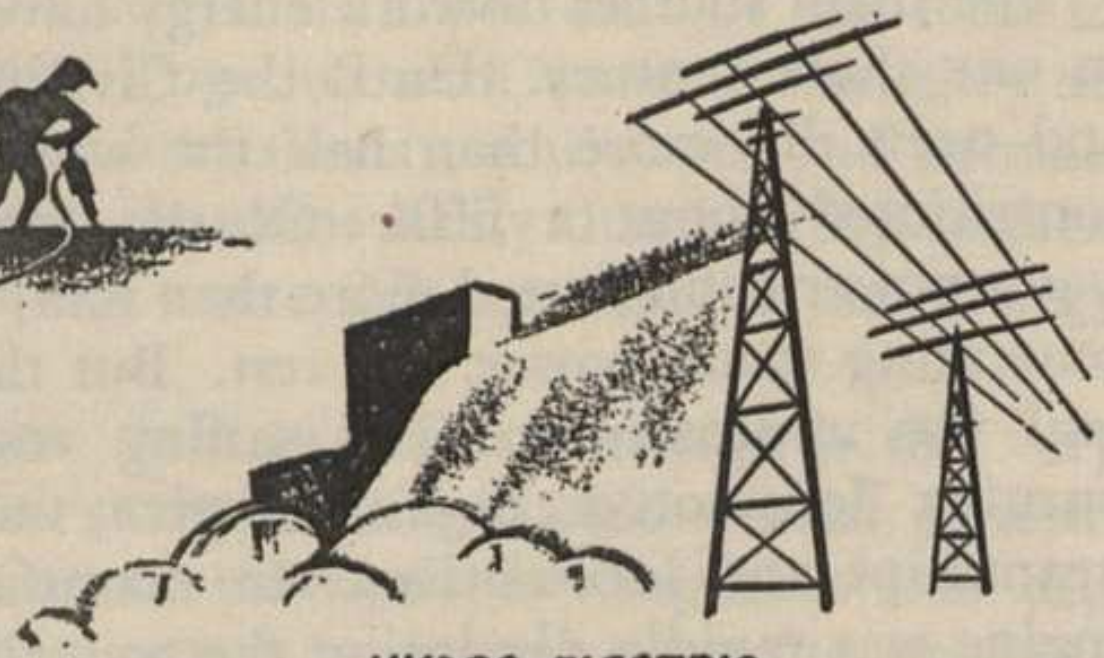
WATER



WOOD-FUEL



MINERAL FUELS
OIL, COAL, GAS



HYDRO-ELECTRIC

Man's material progress has been achieved by his discovery and harnessing of new forms of energy.

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muscle power of the domesticated ox. Later, he added the horse and other domesticated animals. He learned to use wind power for moving his boats and ships. He discovered how to use water and wind to turn wheels. He learned how to burn wood for power as well as for heat. Step by step, slowly, he added new sources of energy to his own. It was like a child learning to crawl. And then suddenly the child began to walk erect, to run, and constantly to outdistance himself: man learned how to use mineral energy to multiply his own labor a thousandfold. And this in our great-grandfathers' time.



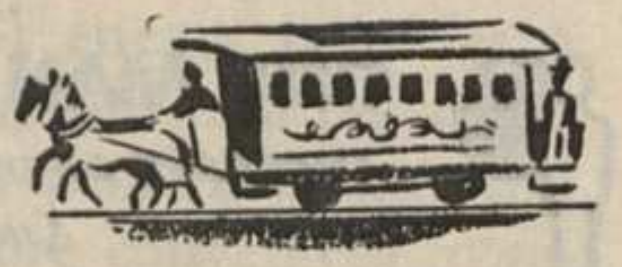
Only a few generations have passed since the steamship challenged the clipper. How much more recently we learned how to fly! In the late 1850's—the golden era of the clipper ships—some three and a half million gross shipping tonnage operated under sail. Wind power, not only for sailing but for windmills, too, was the source of about 10 per cent of our work energy. Men still love to sail, but today only a tiny fraction of our work energy comes from wind power. We sail for fun; and windmills are more picturesque than useful.

From Oxen to Steam

The main sources of work energy have completely shifted in one short century. Until the Civil War, horses, mules, and oxen did more than half the work of America. Men contributed about a fifth. Of the remainder, wind and water power contributed more than half, and wood and coal, generating steam power, the rest. But the age of steam and coal was approaching. The sailing vessel and the wood-burning locomotive began to give way to coal-powered steamships and locomotives. In manufacturing, the steam engine was rapidly displacing the water wheel. By the end of the century coal supplied nearly 50 per cent of our work energy. But even in 1900, half the work of America was still done by the sweating, straining muscles of animals and men.

A New Era

Then, about a half-century ago, the electric trolley began to displace the horsecar in a few big cities. A few playboys began to tinker around with the horseless carriage. A new era was born. Everything changed — transportation, communication, methods of production, our homes, our schools, our cities, our entire way of life. The age of electricity and the internal combustion engine was here.



By 1944, the horse had nearly vanished from our streets. Animals supplied less than 2 per cent of our work energy that year—and human beings supplied only 4 per cent as compared with more than a fifth in 1850. By that time most of our work was being done for us by the inanimate mineral fuels—coal, oil, and gas—and water power. Poor old Dobbin couldn't possibly compete with a bull-dozer. And men's muscles began to grow somewhat flabby, too, for now their work required more horse sense than horsepower.

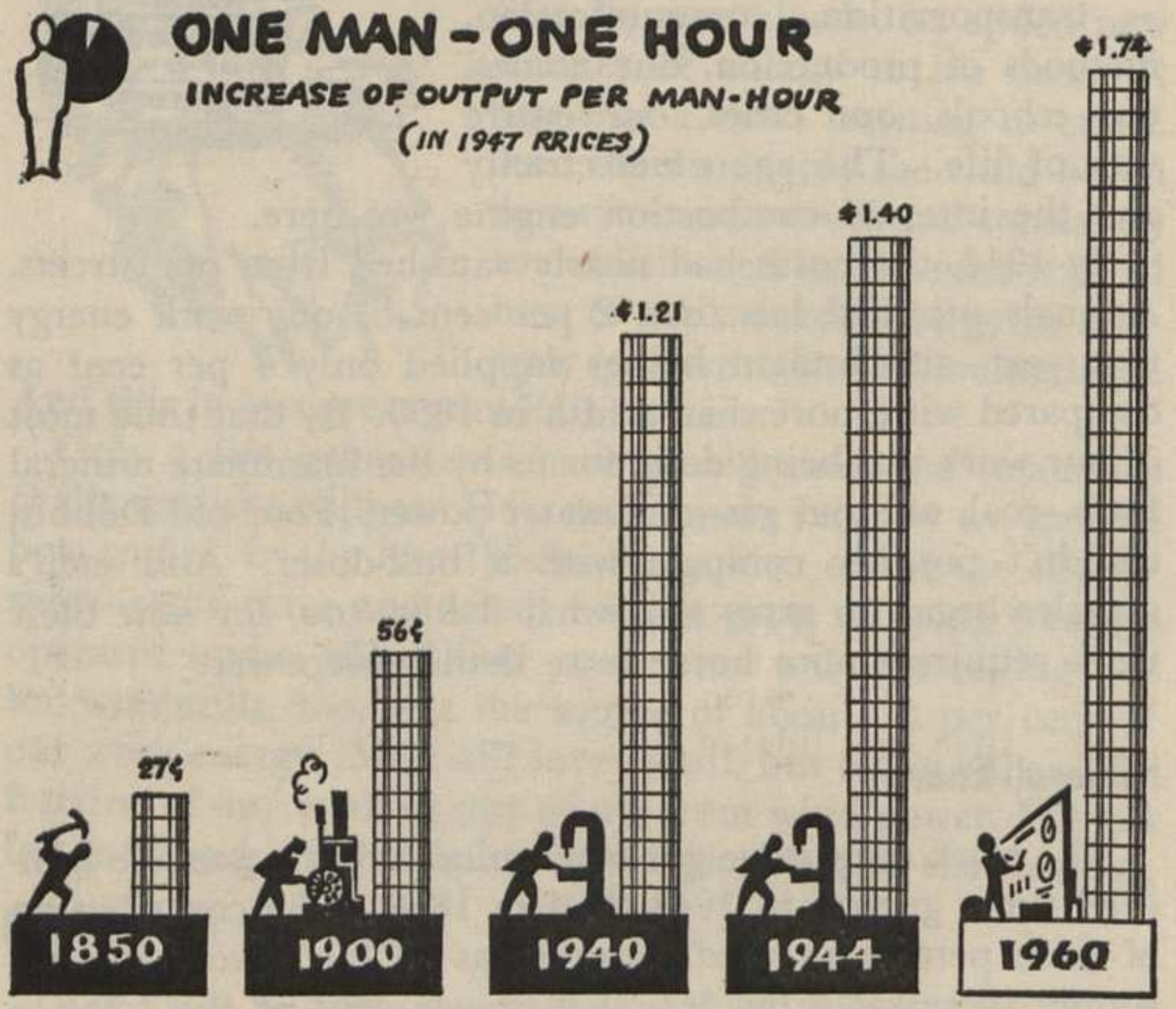
Mineral Energy

The work output we got from mineral fuels was five hundred times greater in 1944 than in 1850. The contribution of coal, petroleum, and natural gas to our "work-energy" supply increased from less than 5 per cent of the total to more than 87 per cent. Together with water power, they do 94 per cent of our work for us today, while men and animals do a meager 6 per cent. It seems likely that by 1960 human beings will contribute a mere 2.5 per cent of our energy output.

This great dramatic shift to mineral energy is the very basis of technological progress. One could almost concentrate the whole history of economic development into this simple transition: man power to animal power to machine power.

The shift to machine power changed America from a rural agricultural nation to an industrial giant. It also made men's

lives easier and richer. In 1850, the average American worked seventy hours a week. Today he works forty-three. In 1850, our average American produced about 27 cents' worth of goods an hour. Today he produces about $1.40 worth in dollars of the same purchasing power.



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In other words, on the average a man can produce about five times as much in an hour today as he did in 1850. Economists would say his output per hour or his productivity has increased over five times. It was this advance in productivity that made it possible to increase the net output of goods and services twenty-nine times from 1850 to 1944, even though working hours were much shorter and the population only six times greater. And this quintupled productivity in turn rested largely on the fact that Americans as a

group had at their disposal all the marvelous advantages of mineral energy, five hundred times as much as in 1850.

Advantages of Mineral Energy

Whether delivered as electricity to the farm or factory, produced under the hood of an automobile, or generated in the hold of the *Queen Mary,* mineral energy provides a greater concentration of power than could the most ingenious and efficient use of untold human and animal labor. And mineral energy provides power in a more convenient, compact, mobile, and controllable form. The famous "Borax 20 Mule Team" reached a speed of six to eight miles an hour. It was probably the biggest sum of animal power ever brought under the control of a single driver—outside of the circus. But the frailest of women drives around today with three times as much lethal horsepower, and a potential ninety miles an hour under the hood. Steve Davies operates one machine with the power of 2,200 mules.

In a single day, the Consolidated Edison System in New York delivers enough electricity to do the work of three million draft horses or ten times as many hard-working men. Last year the Consolidated System turned out about as much energy as the total work output of the entire nation in 1850!

The greatest advantage of mineral energy is that it is cheap as compared with animal or human energy. Cost is crucial. Many forms of energy have never been used because they cost too much to harness to practical uses. Wind power, for example, is both unlimited and free, but costly to use. Similarly, we have not learned a practical way of using atomic energy for peaceful purposes.



Compared to machines, men and animals are costly. The upkeep is too high. Any farmer will tell you that horses spend more time standing around eating their heads off than working. Men have to be fed, clothed, and sheltered. That is why even slave labor is not cheap. Our mechanical slaves get along on cheaper "food" and require

less attention than either men or animals. Aside from the morals involved, the use of forced human labor is a sure sign of industrial backwardness.

The Value of Man Power

Electricity is delivered at a cost of one to four cents per horsepower-hour. A draft horse can be hired for 75 cents an hour. The present rate of $1 an hour for common labor would mean that human energy would cost $10 per horsepower-hour.

On the whole, animal energy probably costs thirty to a hundred times as much as mineral energy, and human energy from three hundred to a thousand times as much. No wonder we waste everything but man power! No wonder we electrify our kitchens as well as our factories! We even have "mental" labor-saving machines—for example, the electronic calculator that performs such astounding feats as multiplying 94,267,546,829,347 by 74,392,864,576,249 in one-fiftieth of a second. No wonder Americans are accused of being demons for speed and efficiency. In purely practical terms, we want to get the most out of our costly man power, so we devise mechanical marvels to replace it, supplement it, augment it, and conserve it.

Our subway and bus systems deliver workers to their jobs in less time than it takes to harness a horse. Our DC-6's get the businessman to his next appointment before he has even finished the morning newspaper. Washing machines, electric ranges, and vacuum cleaners enable a housewife to clean and cook and work outside the home, too, if she wants to. Mimeograph machines do the work of hundreds of secretaries. The farmer has his tractors and milking machines. A mechanical cotton stripper can harvest an acre of cotton in six hours. One man with the aid of his muscles and a mule would need 140 hours.

Before Machine Power

We take our mechanical slaves so much for granted that we can hardly imagine what it was like without them a hundred years ago.

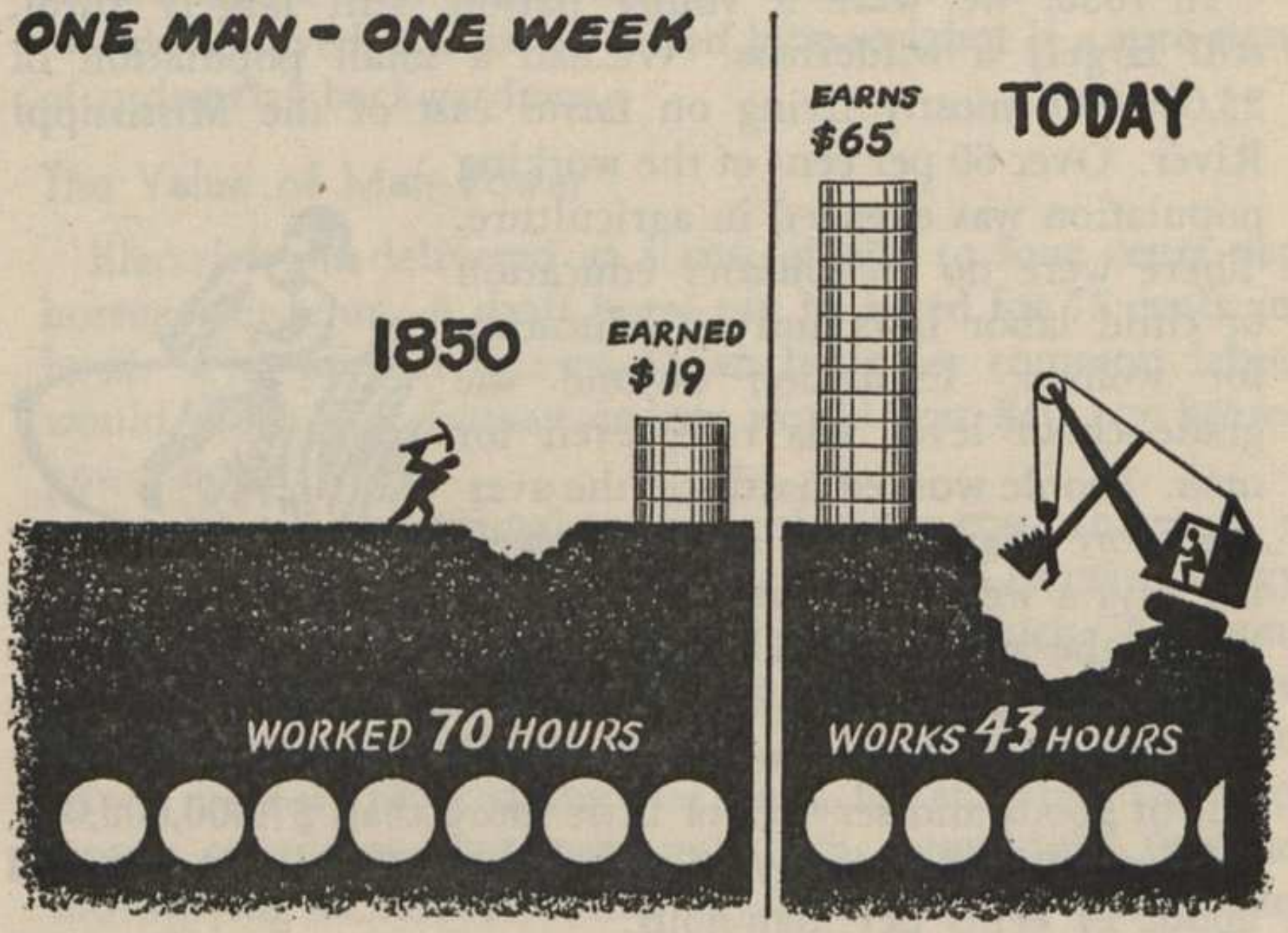
In 1850, we were a young nation, still largely rural, still largely a wilderness. We had a small population of 23,000,000, mostly living on farms east of the Mississippi River. Over 60 per cent of the working population was engaged in agriculture. There were no compulsory education or child labor laws and no education for women. Education beyond the grade-school level was rare, even for men. People worked hard—on the average more than seventy hours a week, six days a week. In terms of what he could buy at today's prices, the average worker (including rich and poor, farmer and city worker) brought home about $19 in his weekly pay envelope. About seven million workers turned out a total output of goods and services of little more than $7,000,000,000. This amounted to an average of about $300 per capita, and about 27 cents per man-hour.



AFTER MACHINE POWER

TODAY, the average young man or woman has completed at least three years of high school, lives in a small city, and is in some nonagricultural occupation. One person out of every five in our labor force is self-employed. One out of every four is a white-collar worker. Less than 20 per cent are in agriculture now. By 1944, the population had increased to 138,000,000—six times the 1850 total. The number of workers had increased to over 63,000,000—eight and a half times the 1850 number. Average weekly hours had dropped sharply to less than 47 hours a week—or by more than a third.

At the peak of our war effort in 1944, American workers turned out about $215,000,000,000 worth of goods and services in today's purchasing power, or twenty-nine times the amount we produced in 1850. Instead of a per capita average of $300, the average was nearly $1,560, over five times greater than in 1850. Even with the much shorter hours, the weekly



Since 1850 the average work week has decreased about one-third while average weekly pay (in dollars of the same purchasing power) has increased more than three times.

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pay envelope, averaged for all workers, was $65—or three and a half times larger than in 1850.

Productivity the Key

This achievement in the course of a century far surpasses that of any other great nation in any similar period. The key was a constantly growing rate of productivity—the amount that one worker could produce in an hour. Clearly the only way to produce twenty-nine times more goods and services with only five and a half times the amount of human effort—as we did from 1850 to 1944—was to increase the rate at which a man could produce over fivefold. And this increase in productivity in turn rested on a tremendous use of mineral energy. If both productivity (output per man-hour) and working hours still remained at the 1850 level,

we would need some two hundred million workers to produce as much as we did in 1944. With the shorter work week of 1944, we would need over 300,000,000 workers—over twice the whole population!

Here are some figures in index numbers that show our enormous strides in productivity. The output in 1930 is taken as 100.

Productivity Increases

	Output per Man-Hour					*Output per Worker*
Year	Mfg.	Bitum. Coal Mining	Anthrac. Mining	Petroleum Refining	Steam Railroads	Agriculture
1909	48.8	62.1	87.2	65.9	.....	73.9
1925	83.3	89.5	100.9	97.7	91.9	98.7
1940	135.2	126.2	.....	.....	138.2	115.1

These are striking figures: An increase of nearly 180 per cent in what a man can produce in the manufacturing industries, about 100 per cent in bituminous coal mining, more than 50 per cent in agriculture, and all in thirty years!

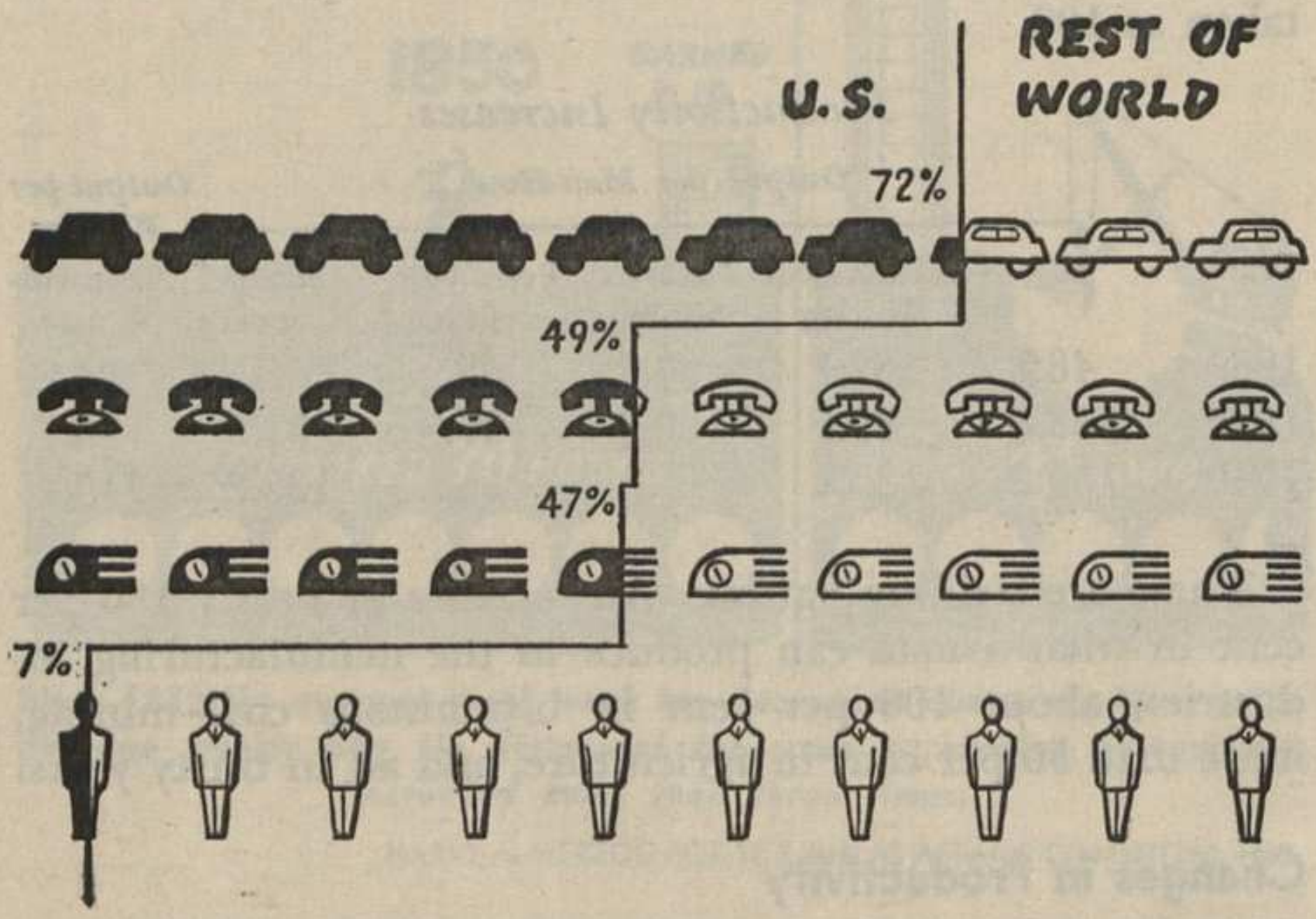
Changes in Productivity

Although increasing productivity underlies all our economic progress, most people do not really understand what the word means. They tend to think of productivity as the total volume of production instead of seeing it as *the average amount a man produces in a given time*. Productivity is most conveniently measured in terms of output per man-hour. It is often incorrectly thought of as "labor efficiency," but there is far more to it than that. As any industrial manager knows, some workers are more skilful and efficient than others because of better training or higher intelligence. Not much can be done to increase basic intelligence, but skill can be raised greatly by training. Knowledge and understanding go hand in hand with education.

Every businessman knows, too, that the productivity or efficiency of a particular business can vary widely, depending

upon the energy, ability, and loyalty of the workers, the competence of the management, and the morale of the organization as a whole.

Variations in productivity are influenced, too, by whether times are good or bad. During the early days of the war



Before the war, the U. S. with seven per cent of the population had a huge proportion of the world's autos, telephones, and radios.

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boom, unit operating costs declined when plants began to operate at near-capacity. A decline in costs meant an increase in productivity since more was being turned out at less cost. During the depression when many plants used only a small fraction of their capacity, overhead costs were high and economic losses heavy.

It is true that a "statistical" increase in the average output per man-hour can easily be registered when an entire industry operates below capacity, if it uses only the most efficient plants and workers. During the depression a kind of futile increase in productivity often resulted from the fact

that only the best plants, machinery, and workers were used while the rest stood idle. Those that did operate were, therefore, extremely efficient. This obviously did not represent any desirable gain in productivity because the gain was made at the expense of total production. Progress comes when both average output per man-hour—productivity—and total output rise, when nearly all of our plants and workers are efficiently employed.

If the least efficient workers and plants in an industry could operate as efficiently as even the average—not the best—and if we could avoid big depressions and booms, our productivity could be raised much higher than it is now. On the average, productivity has increased in the United States 18 per cent each decade since 1850. We could easily top this, as indeed we did in 1920 to 1940. Whether we make rapid or slow progress depends on many things.

Essence of Productivity

Efficiency of labor and management is not so important as most people think. The skill of the individual worker is important but less so than the tools he has to work with. The most energetic and skilful shoemaker in the world working with hand tools of a century ago could never remotely approach the productivity of today's semiskilled shoe worker who has the aid of automatic power-driven machinery.

New and better machinery spells out greater productivity. This is the essence of the American economic system: the multiplication of human energy with machinery using mineral energy. True, the initial cost of such machinery is heavy, but in the long run it does our work for us more cheaply than human beings and animals alone ever could.

Heavy investment is as important as inventive genius to our economic system. Blast furnaces, railroads, steam shovels, and drill presses require enormous amounts of capital. We have seen that Steve Davies' dragline excavator cost a cool three-quarters of a million dollars. In contrast, Steve's grandfather had only $50 worth of capital equipment. So he worked harder and produced less.

These costly instruments are what make America the land of plenty that it is.

Productivity and Income

Today's costly instruments, capital facilities bought with the savings of investors, enable us to turn out more goods and services and thus to enjoy a constantly higher standard of living. The steep rise in the amount of output per worker during the past century has been closely tied to a parallel increase in capital facilities per worker. More and better tools rather than harder physical work have been the key to greater productivity. And income has steadily risen with productivity—*real income,* what our wages and salaries will buy.

Of course, productivity isn't the only key to higher income and greater security. Wise social security legislation, wise business practices, and strong, intelligent unions are part of the picture, too. But advancing productivity, based on machine power, has done more than anything else toward raising wages and the standard of living. As a matter of fact, our national income has increased by almost the same amount as our total work output, about twenty-nine times. More machine power means higher income because more machine power means more and cheaper energy for work. We can almost reduce it to an equation: MMP = HP = HI (more machine power equals higher productivity equals higher income).

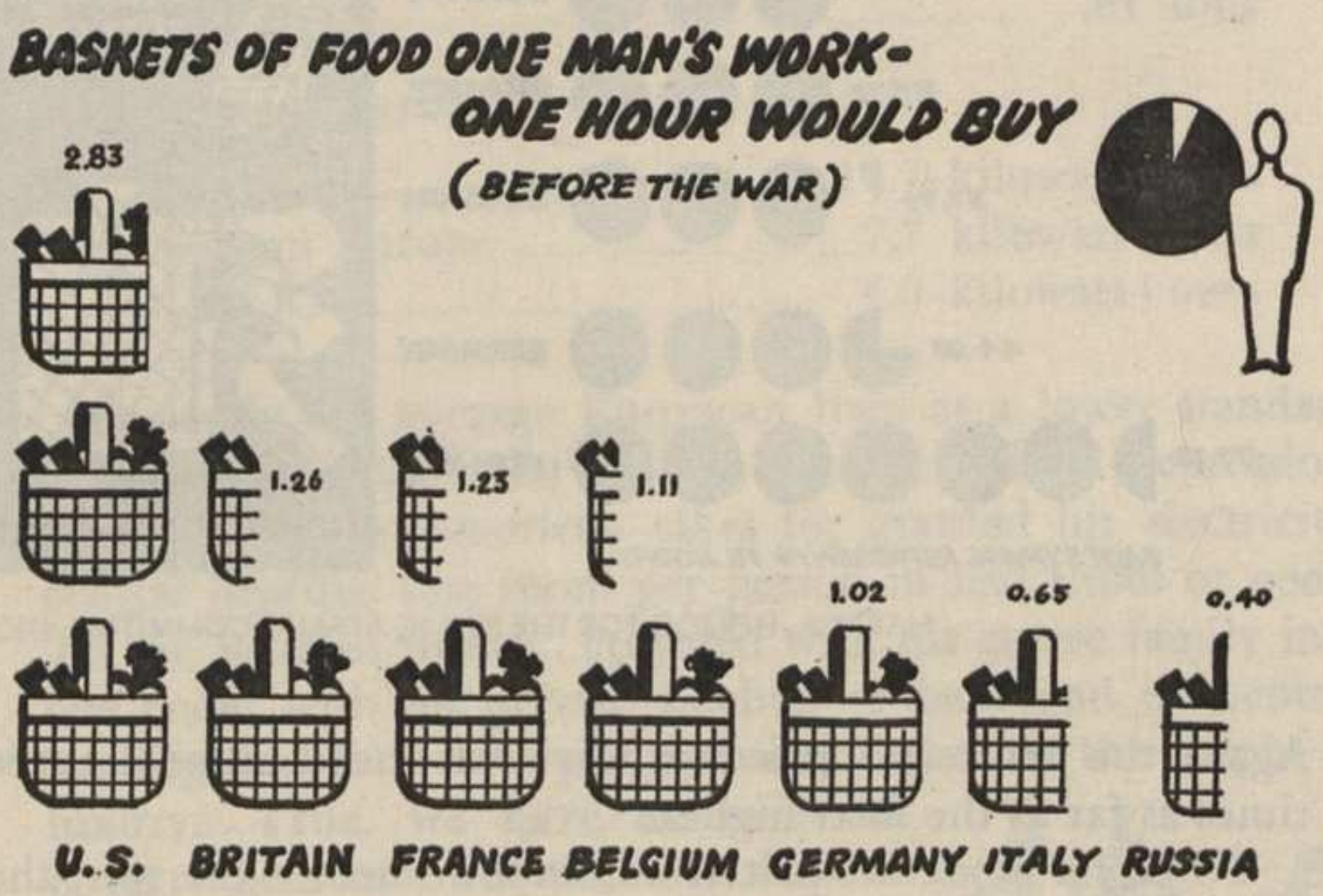
The U. S. and Other Countries

Perhaps some comparisons with other countries will help show how far out in front our productivity has put us. *Factory Management and Maintenance** published figures showing how people lived here as compared with certain countries in Europe just before the war. The figures are rough and probably somewhat inaccurate because no one

* August 1940 issue, "What Industry Can Do for America."

has enough detailed knowledge of wages and prices in all these countries to make exact comparisons. But they are interesting for general indications.

Just before the war, then, when Europe was better off than now, the United States had 72 per cent of the world's automobiles, 49 per cent of all the telephones, and 47 per cent of the radios. In addition to our vast fleets of trucks and busses, we had one passenger car for about every five people, enough to take our entire population for a ride at once. In England and France it was one car for every eighteen persons, in Italy one for every ninety-three.



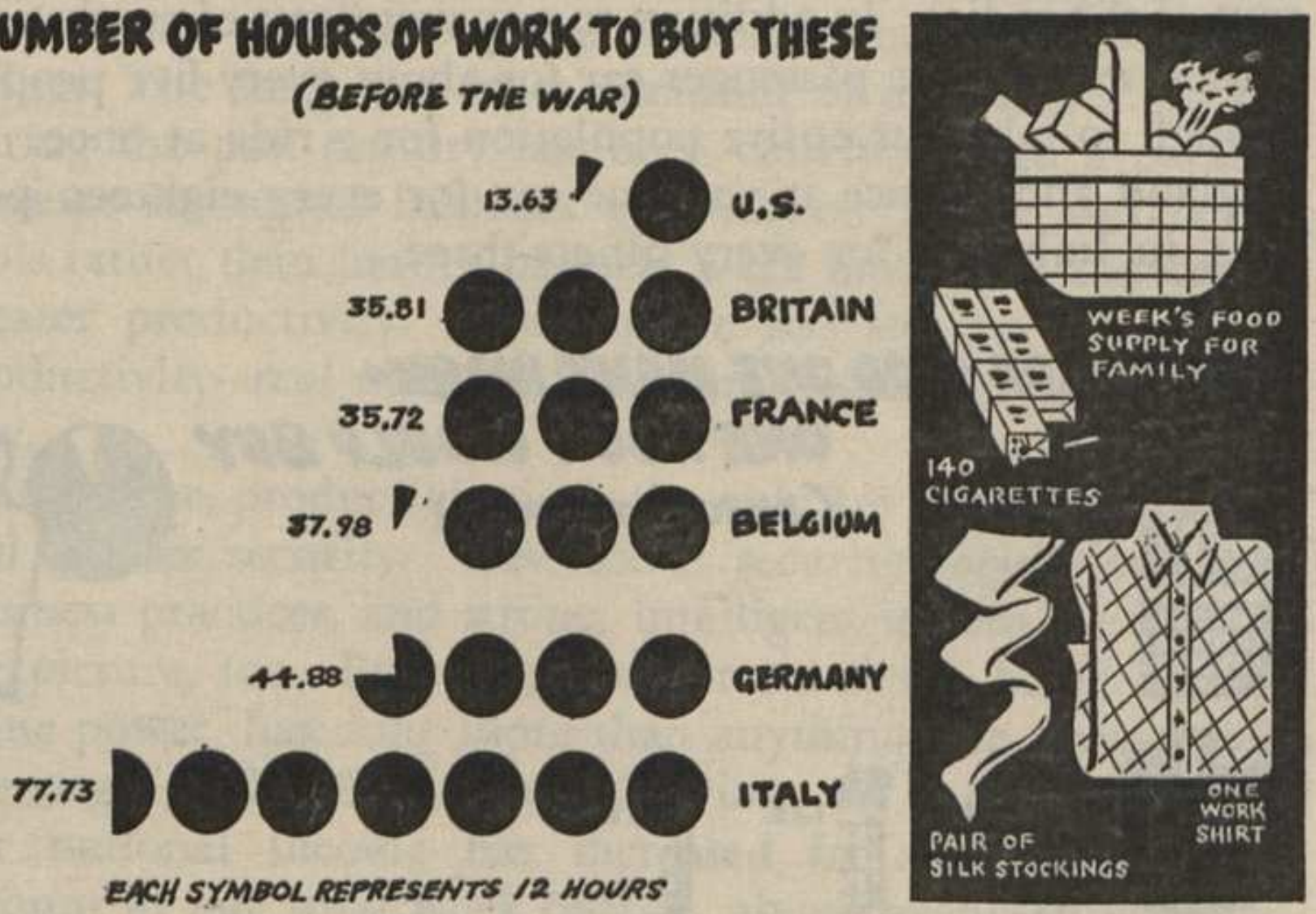
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But let's see how available an essential like food was to workers in different countries. The above chart shows how much food (in baskets of balanced items, including bread, butter, beef, and so on) one hour of work would buy here and in European countries before the war.

The American worker, with the earnings of one hour, could buy more than twice as much as even the British, French, or Belgian worker. He could buy more than seven times as

much as the Soviet worker. If figures were available for Asiatic workers, they would, of course, be even lower.

A week's food for a family of four, a week's cigarettes (140), one work shirt, and one pair of silk stockings cost this much in hours of work:



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Again the United States was way out ahead—almost three times as far as the next highest.

To buy a moderate-priced automobile before the war, the French factory worker had to work over 7,000 hours, the German worker over 5,000 hours, the English worker 3,500 hours, and the American worker only 853 hours.

Some more recent figures have been published in the *A.F. of L. Monthly Survey** to show what the economic goals for 1950 will be, roughly. They are based on official sources, such as the U.S.S.R.'s five-year plan and the European Recovery Program. Goals for *per capita* production of steel are as follows:

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* November-December 1947

U.S.A. (1950)	.62 tons
Western Europe (1951)	.21 tons
U.S.S.R. (1950)	.14 tons

The figures for textiles are:

U.S.A.	83 yards
Western Europe	35 yards
U.S.S.R.	22 yards

For grains:

U.S.A.	1.14 tons
Western Europe	.25 tons
U.S.S.R.	.61 tons

For electric power:

U.S.A.	19.7 kilowatt-hours
Western Europe	7.7 kilowatt-hours
U.S.S.R.	4.0 kilowatt-hours

Probably the average European lives at a lower standard in good times than the average American in a depression. For the average American takes for granted his electricity, central heating, one room per person in bad times or good. To the Russian worker, crowded with his entire family into one room with no private kitchen or bath and no central heating, our homes would probably represent the height of luxury. True, we have extremes of poverty here too, but the vast mass of Americans live like princes in comparison with their foreign brothers. And it is impossible even to compare the standards of India or Turkey or China with our own.



But we are certainly not satisfied with our achievements as they are, because many Americans are still below what we consider a reasonable standard. And there is no reason why we should be. If constantly increasing productivity has taken us this far on the road to economic well-being, why not farther?

Well, as usual, there are a few "ifs and buts." We've been looking at the bright side of the picture. Now let's look at the gloomy side—at what we'll call obstacles to increased productivity.

OBSTACLES TO PRODUCTIVITY

Do Machines Take Jobs?

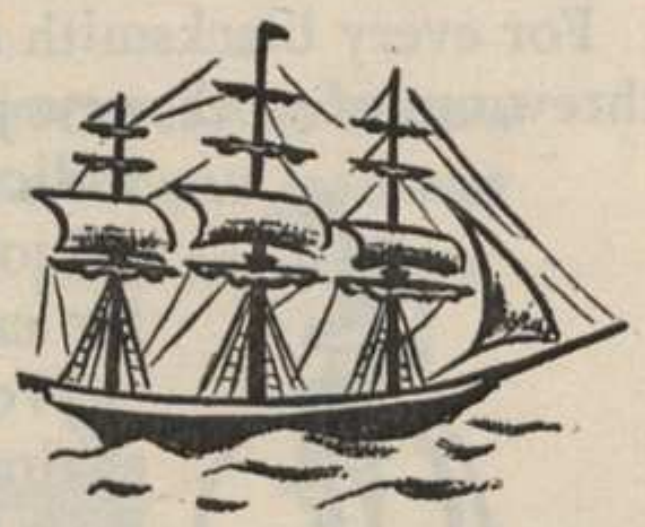
Obstacle Number One: Fear of the goose that lays the golden egg. The key to increased productivity, remember, is new and more efficient machinery—like the monster strip-mining machine that Steve Davies operates. The machine is the goose that lays golden eggs for all of us. But some people fear the machine. They fear that it will take their jobs. Sometimes they make rules against its use. For example, many painters refuse to use spray guns.

In the 1930's it was popular to talk about "technological unemployment." Long reports were written about it and serious estimates of the "technologically unemployed" were calculated. Well, in a sense some 150,000,000 *nonexistent* human beings are technologically unemployed in America. That's how many more workers we'd need to produce today's goods and services at the 1850 level of productivity—before machine power. Machines are diabolically substituting for those 150,000,000 nonexistent people.

The idea of a persistent or cumulative technological unemployment is an absurdity. Nevertheless, it is easy to understand why there is often resistance to the introduction of labor-saving machinery. Such machinery may mean disaster to the person who is displaced. Over the long haul, however, it is only through such displacement that material progress is possible. If all the men operating canal boats, livery stables, and blacksmith shops in 1830 had stayed in business, and their sons had followed them, railroads would still be a luxury for the few and the automobile a plaything



of the rich. If capital, workers, and businessmen had failed to go into new industries and to create new ways of doing things we'd still be living in log cabins and driving one-horse shays.



In reality, we've had our golden eggs and eaten omelettes, too. Increased productivity has not only given us a vast increase in the amount and kind of goods, but we've had a steady expansion in the percentage of the population that works. No signs of technological unemployment here. And, to make it more striking, we've had a shorter and shorter work-week. With the exception of a few costly and painful depressions, we've had our "cake" in the form of expanding full employment and "eaten" it in the form of greater leisure and higher living standards.

Machines Make Jobs

Aside from the fact that the use of machine power has created whole new industries—automobiles, railroads, airplanes, telephones, telegraph, motion pictures, radio, and television, to mention just a few—it has also increased the number of jobs in the older industries. Here are some figures for a few occupations: In 1880 there were 141,000 wage earners in the steel industry; in 1937 there were nearly 470,000. In 1890 there were 165,000 wage earners in the printing, publishing, and allied industries; by 1940 there were 683,237.

Here are some more comparisons:

Industry	*Wage Earners*	
	1870	1930
Glass	9,573	72,229
Food	86,711	516,346
Textile	253,045	955,622
Lumber and furniture	86,239	537,060

Notice the increased number of jobs in former handicraft industries: 655 per cent in glass; almost 500 per cent in food;

over 275 per cent in textiles; and more than 500 per cent in lumber and furniture. Of course, the population grew also—but only by a little over 200 per cent during this period—in no case as much as employment in these industries grew.

For every blacksmith and skilled glass blower the machine threw out of work, new jobs have been created. One estimate indicates that in the 1920's approximately 2.8 jobs were created in growing industries for each job lost in a vanishing one.



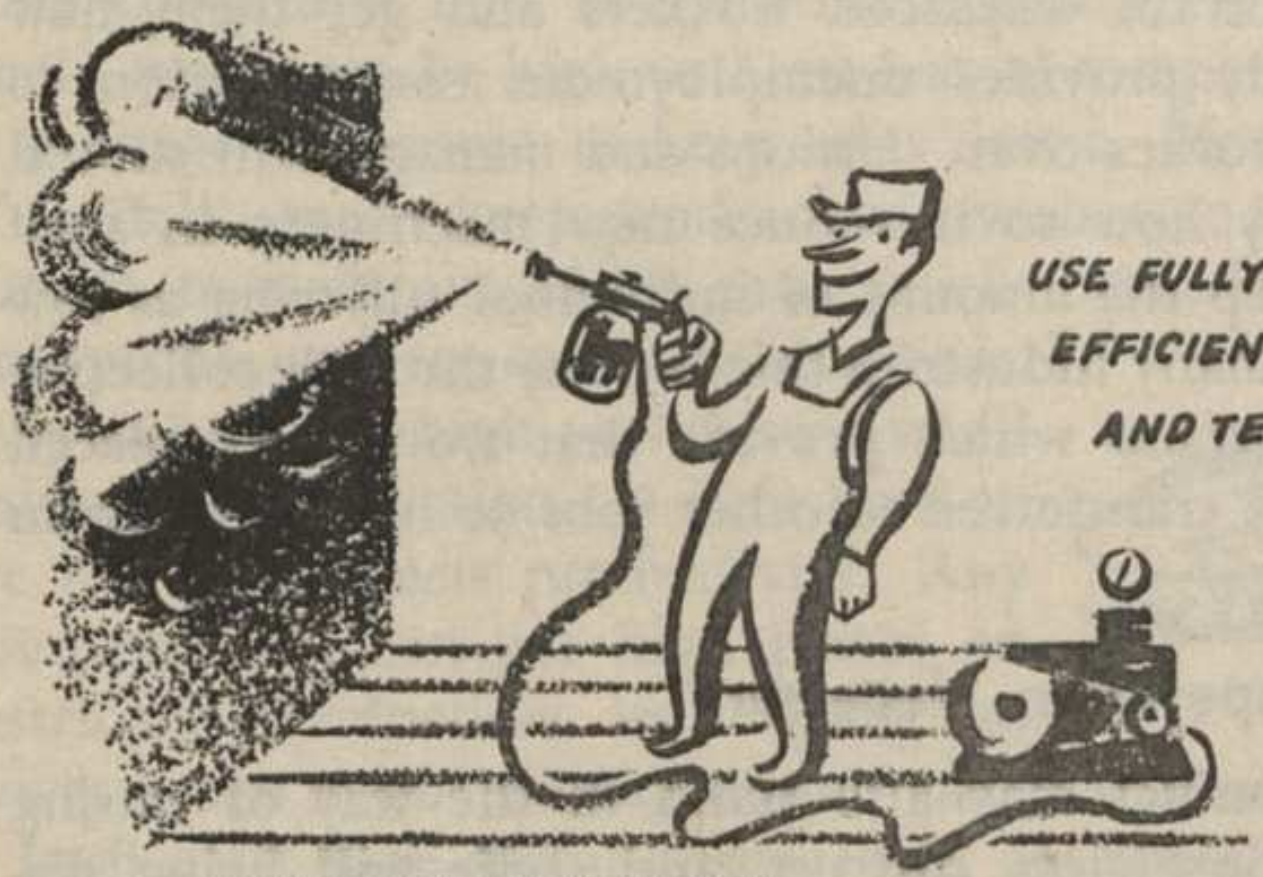
Workers have a right to be protected against individual economic injury, but they hurt themselves and everyone when they fight against technological improvements. The housing industry is a notorious example of resistance to new techniques, of feather bedding and other devices to "protect the worker's job," and of monopoly practices to "prevent cut-throat competition." The end result is a wasteful, inefficient, high-cost industry with terrible ups and downs. No one gains. The worker loses because his employment varies so drastically. He makes good money when he works but he doesn't work a lot of the time. The consumer loses because he has to pay such a high price for a house. The nation loses because many of its citizens live in unhealthy, crowded quarters, which are all they can afford, and because one of its most important industries suffers chronic fits of depression.

Contrast the housing industry with the auto industry where every mechanical device is used to the fullest to turn out better, cheaper cars. The truth is that resistance to technological changes has made housing a primitive, handicraft industry in a mechanized, power-driven world. Most workers can own good automobiles, but they cannot afford to buy a good house!

No one wants to see painters lose their jobs because spray guns can do the job faster and better than paint brushes. But there will be *more* steady jobs when more people can afford new houses. The painters are very shortsighted.

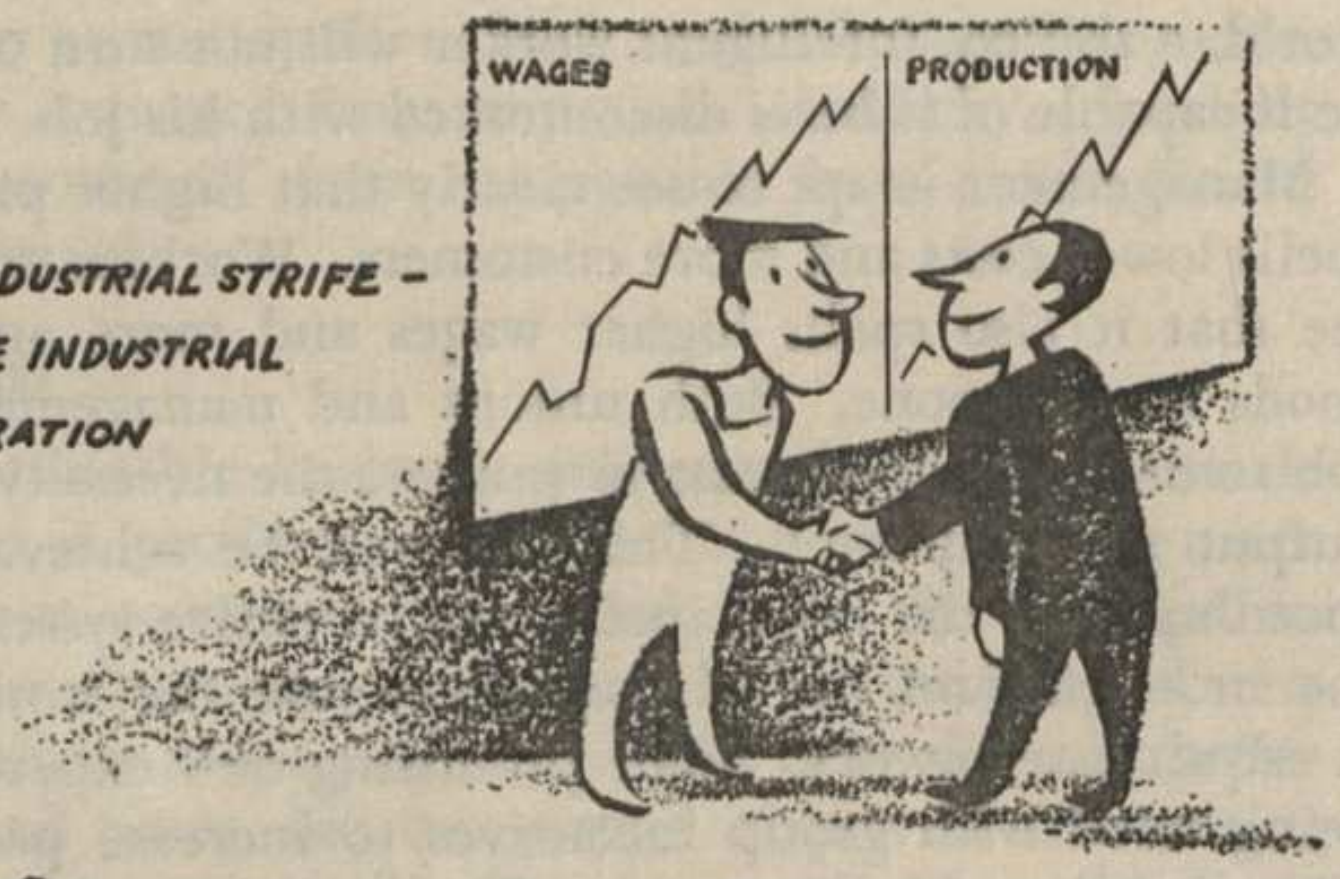
For these workers who are displaced in industry by machines, we must work out arrangements to ease their

TO INCREASE OUR PRODUCTIVITY



USE FULLY ALL KNOWN EFFICIENT MACHINES AND TECHNIQUES

REDUCE INDUSTRIAL STRIFE - INCREASE INDUSTRIAL COOPERATION





ENCOURAGE INVENTIVENESS AND NEW ENTERPRISE BY INCREASED INVESTMENT IN NEW PRODUCTS AND TECHNIQUES

HARRY R. HERZOG FOR THE PUBLIC AFFAIRS COMMITTEE, INC.

shift into new industries and jobs. The government can help to retrain displaced workers and get them new jobs. It already provides unemployment compensation to help tide the worker over. Unions and management should consider jointly how to introduce new machinery in such a way as to keep the amount of individual suffering as low as possible. In many industries this is done through collective bargaining contracts which provide that workers displaced by machines be transferred to other jobs or have first claim on new jobs.

Industrial Cooperation Necessary

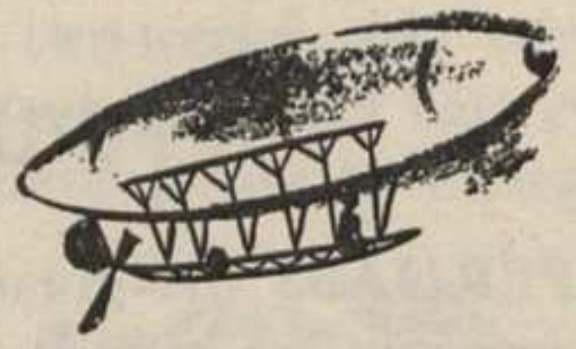
Industrial conflict may also stand in the way of raising productivity. Suspicion, distrust, and strife will bring disaster economically. Even with the best machinery in the world, a skilled, intelligent worker will not turn out all that he is capable of if he is discontented with his job.

Management is apt to see clearly that higher productivity spells lower costs and more customers. Workers don't always see that it also spells higher wages and more and cheaper goods for everyone. Both unions and management have a job to do in getting across to workers the necessity of raising output per man-hour. This can best be achieved, not by speed-ups and the usual ineffective incentive systems, but by the most efficient use of machinery and the worker's skill. It requires teamwork. Some promising new experiments are being tried with group incentives to increase productivity. They involve the payment of bonuses or profit sharing for everyone in the factory when the average output per hour increases. One thing is sure: where good relations exist between workers and management, new ways of increasing productivity can be worked out.

Monopolies

Our first two obstacles to increased productivity were resistance to technological improvements and labor-management strife. A third and very hard-to-handle factor is the effect of monopoly. When one or two companies have pretty

close to a monopoly of an industry, they will act differently from companies in a competitive industry. Under a monopoly, prices can be high without fear of competition. There is no urgent pressure to keep costs down. Monopolies very often deliberately keep production low so as to raise demand enough to maintain a high price level. Instead of small per-unit profits on large quantities of goods, they may aim at high profits on a small volume of production. It isn't hard to see how this affects productivity. Any company that can get high prices on restricted production isn't going to worry much about raising output per man-hour.



Inefficient, high-cost industries that are protected by tariffs from competition from foreign industries are in much the same position as monopolies. Not much increase in productivity can be expected from any "sick" industry, especially when it is "protected" from competition from more efficient industries abroad.

Boom or Bust

The unpredictable business cycle may be a fatal obstacle to large gains in productivity. It is the huge question mark behind all our economic hopes and fears. We learned in the 1930's that depression puts a halt to the building of new plants, machines, and equipment. Not only do men suffer bitterly in bad times, but our system of private investment almost comes to a standstill. People are afraid to risk their savings in new ventures during the uncertainties of a depression. And yet willingness to risk capital in new plants, new types of equipment, and machinery is essential to technological gains. Productivity makes real strides only in a dynamic, expanding economy where investors are willing to risk their capital on new discoveries and inventions.

Somehow we have to learn to prevent the excesses of booms that lead to collapse. We are constantly building up an arsenal of weapons to combat the violent fluctuations of business cycles. We've learned how to regulate credit and

the security markets, how to use public works and taxation to avoid booms and busts. We have a huge reservoir of social security funds to guard against a drying-up of buying power.

We shall never do away with business fluctuations altogether, but the violent "boom and bust" pattern we can surely avoid. If we can't, the future looks gloomy indeed.

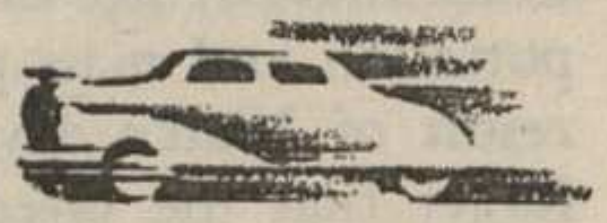
FUTURE PRODUCTIVITY

PERHAPS the greatest obstacles to increased productivity are ones we cannot control at all or which we understand only dimly. Another war or a world-wide depression would set us back a long way. Then there are the intangible factors which psychologists and sociologists need to look into. What stimulates the inventiveness and daring that result in new technological discoveries? What makes a man willing to risk capital in a new industry? Do our present tax laws need to be revised to promote savings and investment and to encourage risk-taking in new ventures? Does our twentieth century emphasis on "security" widen or narrow our horizons? We could easily get tangled up in a vast web of economic, social, and psychological factors if we tried to unravel the whole problem here. What we need to do is to concentrate on uncovering new ways of stimulating inventiveness and investment, the twin keys to greater productivity.

The main thing to remember is that increases in productivity, the secret of our well-being, are not inevitable. We'll have to *work* at getting further increases. Our record is impressive—extremely impressive—but we need even higher productivity to assure ourselves of better housing, adequate diets for everyone, more education, and greater leisure. Americans always want more for their children than they themselves had and they usually do get more for them. Let's look ahead a little to about 1960 and see what our children can look forward to if productivity increases at an average rate of 18 per cent as it has since 1850, which is a fairly modest assumption.

Life in 1960

We shouldn't expect 1960 to usher in a push-button dream world but the chances are that all of us will enjoy greater income, greater leisure and education, and a more healthful life. Instead of working forty-three hours a week on the average, we ought to be down to less than thirty-eight hours. Almost every worker ought to have a two-weeks' paid vacation. Nearly every family ought to have a passenger car. At least half our youngsters ought to have a junior college education.



In 1940, income per household for the whole population averaged $2,900. In 1960, it can easily be $4,000 for a shorter work week. Both figures are estimated in 1947 dollars. They are based on an average output per man-hour of $1.21 in 1940 and $1.74 in 1960.

If productivity continues to go up and we avoid war and depression, we should have our housing problem well under control by 1960, too. Nearly every family should have an apartment or house in good condition with running water, electricity, and a telephone. As a nation, we should enjoy over 59 per cent more goods and services in 1960 than we did in 1940—a total production of over $250 billion as compared with $157 billion (in 1947 dollars). That's what rising productivity can achieve for us—a nearly 60 per cent rise in the standard of living in twenty years!

It's as simple as ABC. If we turn out more goods and services in 1960, we get more back. Money income doesn't count so much. As everyone knows now, inflation means both higher incomes and higher living costs. Greater productivity must go hand in hand with higher wages and incomes if we are to be any better off.

The long-time trend in the United States is for the gains of higher productivity to go increasingly to low-income groups. As the standard of living rises, the very poor and the middle groups get a bigger share of the gains—especially after Uncle Sam has taken his share—than the high-income

groups. Thus higher productivity helps wipe out extreme disparities. Of course, it's not a purely mechanical process. Trade union action and government legislation help decide how much of our gains go to the neediest groups.

Progress Is Not Inevitable

We tend to take progress pretty much for granted in this country. After all, the whole continent was a wilderness three centuries ago. We don't even inquire too closely into the reasons for our achievements. Probably most people think that the age of steam and electricity, of modern transportation and mass production, was simply the *inescapable* result of Watt's development of the steam engine. They forget that the Greeks of the Alexandrian period experimented with a rudimentary steam engine. But the Greeks were not prepared, for many reasons, to use it for industrial purposes. Many people attribute our achievements sweepingly to "our richness in natural resources," to "democracy," "free enterprise," or just plain "know-how."

All of these are important. But even taken together they do not fully explain our remarkable industrial progress. There was nothing inevitable at all about America's strides in productivity. Other countries started on the road to industrialism before we did. Most of the basic industrial inventions originated in Europe. A few other countries have as great a land area and are also rich in natural resources. Some countries have larger populations. Other countries have shared our form of government and our type of economic system. The fact remains that our productivity, our standard of living, is higher than in any other country. Certainly, political and social factors are partly responsible. America provided a climate of freedom and expansion for risk-taking and innovation. It welcomed change and competition in products, ideas, tools, and methods. It put great emphasis on material achievements. It welcomed restless, courageous people from all over the world. Just coming to America was quite a risk for our early settlers. But no one or two of these facts alone fully explain our progress. It

might not have happened; it did because of a unique *combination* of factors.

Clearly, there is nothing inevitable about future progress. Whether we continue to increase productivity depends finally, as it always has, on the combined wisdom and action of individual Americans. It depends on all of us—inventors, managers, businessmen, investors, workers, and consumers. It is our joint decision, conditioned by our hopes and fears, expressed in the halls of government, in offices, factories, and in the market place, that will determine whether we can continue to multiply the fruits of the Power Age. That is the challenge for all of us.

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