1-1-1955

Calling all jobs: An introduction to the automatic machine age

National Association of Manufacturers (U.S.)

calling all jobs

an introduction to the automatic machine age

FOREWORD

Population experts tell us that America in 1975 will be a nation of 220 millions, 60 millions more than we have today.

These new Americans will need many things — food, homes, clothing, cars and TV sets, transportation and education.

Today's luxuries will be tomorrow's necessities. And there will be new and wondrous luxuries produced by the Aladdin's lamp of industry.

Machine development will make this dream a reality.

In addition to goods of every description, Americans in 1975 will need more jobs to support an expanding population.

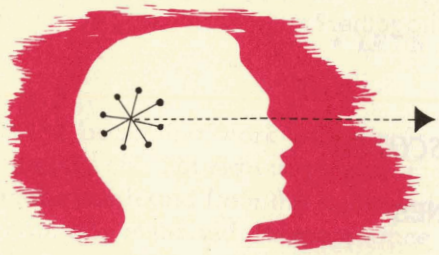
Can we have wonderful and more efficient machines and jobs in increasing numbers at the same time?

The history of industry says we can, the practice of industry says we will.

NATIONAL ASSOCIATION OF MANUFACTURERS
2 East 48th Street
New York 17, N. Y.

November, 1954

Calling All Jobs



AN INTRODUCTION TO THE AUTOMATIC MACHINE AGE

The Question

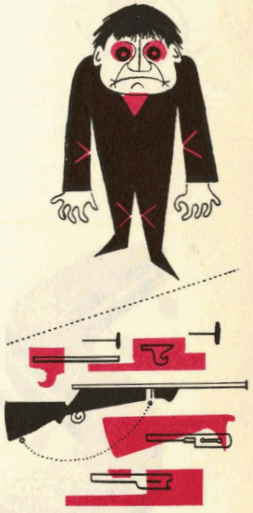
• **FRANKENSTEIN OR ELI WHITNEY**

Everybody's heard of Frankenstein and his monster.

Just as many have heard of Eli Whitney and his cotton gin.

Ordinarily one would not think of linking them together.

They were contemporaries. About the time Percy Bysshe Shelley's wife was giving painful literary birth to the doctor and his ungrateful monster in a Swiss village, the inventor of the cotton gin was perfecting his principle of interchangeable parts in the production of a shipment of Army muskets.



Both exerted and still exert tremendous influence on world civilization.

Mary Shelley told the basic story of a creature rebelling against its master. Every schoolboy knows one or more of its hair-raising variations.

With his principle of interchangeable parts Eli Whitney made possible the modern methods of mass production which have given America the highest standard of living in world history.

But man's mind is less intrigued by fact than by fancy. He sees a new machine doing the work of 100 men and, seeing it, assumes the machine will forever take away the jobs of 100 men.

His imagination links Frankenstein and Eli Whitney.

He asks: If we go on this way, won't machines some day destroy us altogether?

The Question Underscored

• **MAN READS SCARE HEADLINES**

Revolution in processing! Machines do the work and man looks on! . . .

The push-button is out of date! Now we have the buttons that push themselves . . .

Great silent monsters as long as a football field, larger than a house, grinding out products day and night, while men stand by . . .

Behind flashing eyes electronic brains work magnetic fingers!

Eniac, Oracle, Univac, Multra, Armatrol, Serva, Tinkertoy!

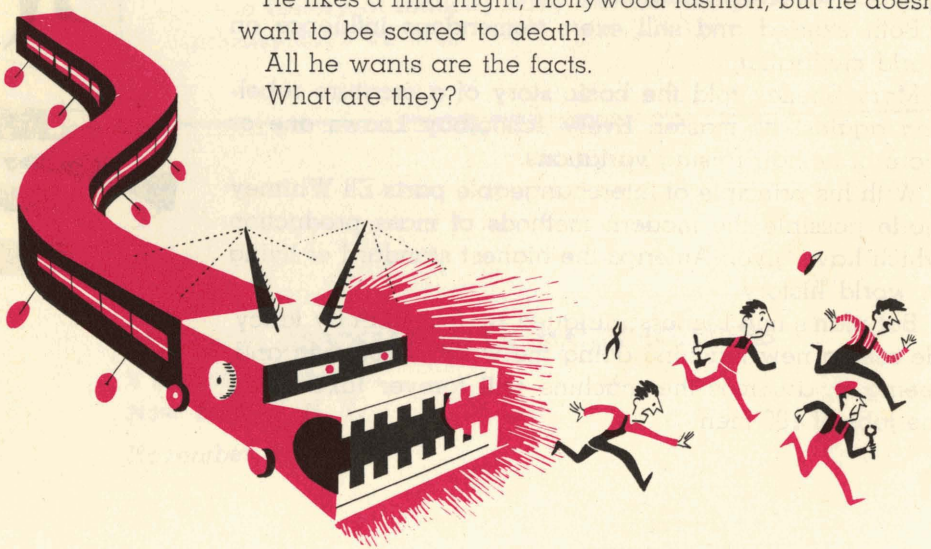
He sees cartoons of galloping factories, gnashing crowbar-like teeth, in pursuit of workmen who have no chance of escape.

No wonder man goes to bed and dreams technological nightmares.

He likes a mild fright, Hollywood fashion, but he doesn't want to be scared to death.

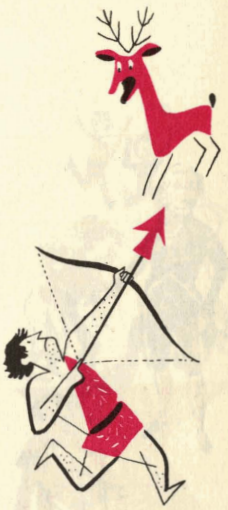
All he wants are the facts.

What are they?



The Nature of Employment

• LET'S FIRST SEE WHAT WORK IS



In the beginning work was simple enough. It was the continuing effort of man to survive. From his environment, from the earth and from the fruits and beasts of the earth, he painfully extracted the sustenance which enabled him to survive.

Food was his primary need. Without it he died. Given food, he had the strength to fight on for shelter, for clothing, for the defense of his family.

It was touch-and-go as long as he had only the weapons that came to hand. Often he was forced to roam far and wide for the food that would keep body and soul together. None but the hardiest succeeded.

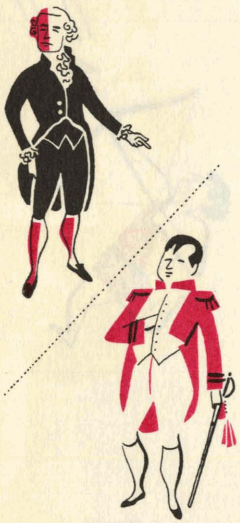
Farming implements enabled him to settle down. Some men multiplied their hands by hiring or enslaving workers.

These men were few, and as recently as one hundred and fifty years ago, the average man was a drudge who toiled a lifetime only to leave behind as little material wealth as he had at birth.

Then men adapted the machine to the commonplace things of life.

Came the Revolution

• THE REVOLUTION WAS MANY-SIDED



It was philosophical and literary, as well as political and industrial.

It involved thinkers and writers, Voltaire and Franklin, Montesquieu and Locke, as much as it involved kings and revolutionists and counter-revolutionists, Louis XVI and George III, Washington and Mirabeau, and the Corsican who made himself Emperor of France.

When the Bastille fell in 1789, it marked the end of many things. Gone forever was the world of powder-and-patch. Feudalism was as dead as the bones of Charlemagne Slavery was going out of fashion with box-wigs and snuff boxes.

It was the emancipation of many men from drudgery.

It was the dawn of the Machine Age.

Of course machines had always been with us. From the earliest times they had been used to impress, frighten and kill people. In Greece, Rome and Egypt skilled machinists made dragons to hiss, rigged temple doors to open and close, built engines to hurl stones and release arrows.

Until the Industrial Revolution, no one had thought of the machine as a source of power for such a tool of man as the loom.

It was an idea that paid off.

But when inventors began to design machines that would lighten men's tasks, multiply their productivity, raise their standard of living by increasing the fruits of their labor, there occurred a strange paradox.

Almost from the beginning men fought against the machines. The machines frightened them.

The Frankenstein Complex

• IT HAS VERY OFTEN ERUPTED IN VIOLENCE

A few hundred years ago, in Paris, the quill penmen rioted against the introduction of printing machinery.

In 1661, when a loom was set up in Danzig to weave from four to six webs at once, the authorities suppressed it because it hurt the poor, who took heart, seized the inventor and drowned him in a nearby creek.

Little wonder the Industrial Revolution was delayed.

One hundred and fifty years ago, in Nottinghamshire, England, when the machine age was just beginning to open up new vistas, the hand-knitters broke into the mills at night with sledge-hammers to destroy Cartwright's new power loom and Crompton's spinning mule.

Lurid handbills were struck off and oratory became frenzied in 1832 when the first steam railroad was built to run from New York to Philadelphia. Philadelphia, it was said, would become a suburb of New York.

Karl Marx of course was loud in his condemnation of machines. The father of socialism described them as the soul of capitalistic exploitation.

One American called for the adoption of a law against new inventions because they threw men out of work.

As late as the second quarter of this century, Senator Joseph O'Mahoney said — "Science and invention are to blame for the present unemployment in America." Senator Champ Clark felt that machines should be taxed.

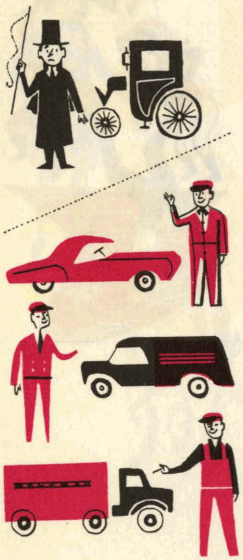
A New York building contractor called for a law putting machines on a 40-hour week.

And today you hear it said — "I don't like this new-fangled automation. It's going to throw guys like me out of work."

There's nothing new under the sun, even in the category of unfounded complaints.

The Crux of the Matter

• A LITTLE KNOWLEDGE IS A DANGEROUS THING



But the full facts are rewarding.

Machines do destroy jobs. Their very nature is to do away with work methods that have outlived their usefulness.

It's the old story of the hydra-headed monster in a pleasant vein. One head is lopped off and two grow in its place.

The auto age made things tough for buggy-whip makers. They groused until they found new and better jobs. It was not only the automobile that had been invented. Occupations in undreamed of variety sprang into being overnight.

Take chauffeuring. The word chauffeur, strictly speaking, means one who tends a fire. The modern census lists chauffeurs properly as the commercial drivers of cars and trucks.

Work of this kind mushroomed after 1920. By 1930 the number of chauffeurs had increased by 687,000, while teamsters and draymen fell off by 309,000, so that they practically became extinct.

Still the number of chauffeurs increased, and, although they totaled a million and a quarter by 1940, their ranks went on swelling with the result that another 451,000 were added by 1950.

It is an example of the way inventions make work.

Between 1850 and last year the United States increased its population from 23 to 161 millions.

That's roughly seven times.

Production, computed at today's worth, went up from $12 billions to $308 billions.

That's 25 times!

This was made possible because the work was done with 94 per cent mechanization in 1953 — contrasted to 6 per cent in 1850.

Did the workers suffer?

Not according to the facts.

The population multiplied itself seven times — workers multiplied themselves nine times! Seven and a half millions to 67 millions!

That's one of the facts of economic growth —

Jobs increase faster than population.

And they multiply faster than machines.

Dial telephones are going in all over the country. Yet we have more telephone operators than ever before.

Inventions tend to produce more and cheaper products.

In 1921 5,000 electric refrigerators sold for $550 each. When 6,200,000 were made in 1950 by mass machine methods, the average price was $258, less than half.

In 1910 you could expect to pay more than a dollar for every hundred miles of use you got out of an automobile tire. Today you can expect to get one hundred miles out of ten cents worth of tire.

Thomas Edison spent thousands of dollars on the working models of his inventions. Today you can buy his products, much improved, sometimes for a few cents.

As Henry Ward Beecher observed about a century ago, "A tool is but the extension of a man's hand, and a machine is but a complex tool. And he that invents a machine augments the power of a man and the well-being of mankind."

An Ad in the Papers

- **IT TOLD OF A STUDY BY A RESPECTED INVESTMENT HOUSE**

"A second industrial revolution — automation — has been gaining impetus in the United States. It may be described as . . . the supplementing of man's senses and his brain power by devices which collect and process information, transmit it to the point needed and there

either control machines or present the processed information to human beings for their use.' It involves the automatic control of a continuous flow of a complete industrial process.

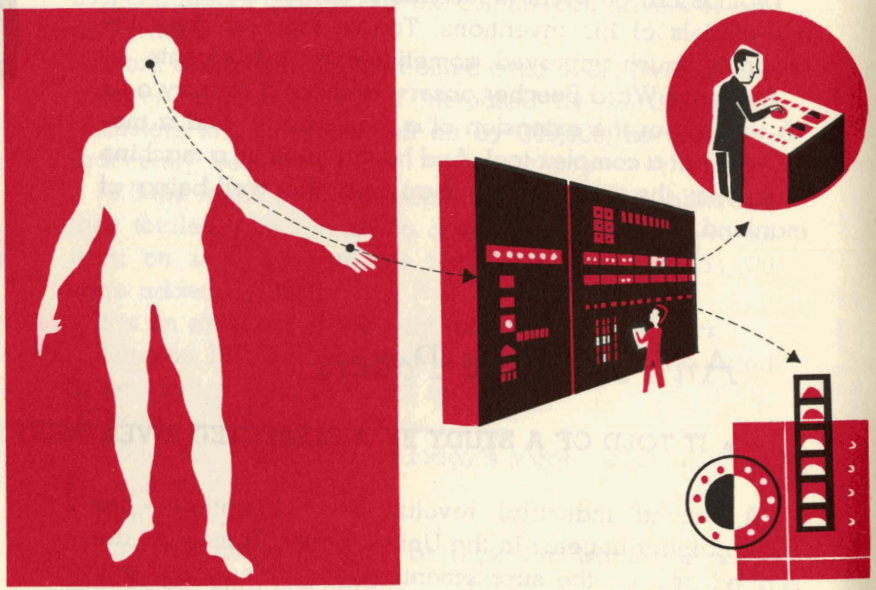
"Automation is still in its infancy but, even now, a vast field of application can be foreseen. . ."

Then the investment house's study went on to list some twenty-odd concerns in the three distinct fields of data processing, electronic components and control instruments.

It advised investors to put their savings in those companies.

The study was a brief one —

But wait! There's literature a-plenty on the subject.



A Mountain of Words

• AUTOMATION, CYBERNETICS, PRODUCT RETHINKING . . .

Operation Research, the workerless factory . . .

The writers have been having a field day. So busy have the gee-whiz pens become that it is difficult to separate industrial fact from science fiction.

Already it is impossible for one man to read through the mountain of words, though he live to the age of Methuselah.

Indeed, if he did live that long most of the writing would be out of date.

The two most frequently used words in the new jargon are "automation" and "cybernetics."

There is some doubt whether the word "automation" was first coined by D. S. Harder, a Ford Motor Company vice president, or John Diebold, a young writer and consultant on the subject.

What makes it more confusing, Harder uses the word in the limited sense of the automatic transfer of a product from one processing unit to another, while Diebold's definition is, "both automatic operation and the process of making things automatic."

The word "cybernetics" has a definite origin. Dr. Norbert Wiener, professor of mathematics at MIT, and Arturo Rosenblueth, of Harvard University, coined it in the summer of 1947.

Said Dr. Wiener at the time, "We have decided to call the entire field of control and communication theory, whether in the machine or in the animal, by the name Cybernetics, which we form from the Greek word, steersman. We also wish to refer to the fact that the steering engines of a ship are indeed one of the earliest and best developed forms of feed-back mechanisms."

The feed-back mechanism is the soul of cybernetics. It's what makes your thermostat click.

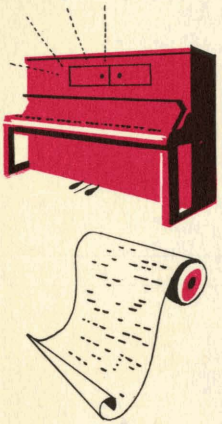
History of Automation

• TWO SCHOOLS OF THOUGHT HOLD SWAY

One will have you believe we stand on the threshold of a brave new world that will have us knee-deep in pesky robots before we know it.

The other supports the thesis that industrial machinery has undergone a continuous process of improvement which has been most pronounced in the last six or seven decades.

The weight of evidence appears to support the second view.



The flour mill built by Oliver Evans on the edge of Red Clay Creek near Philadelphia in 1784 came about as close as you can get to automatic operation. Grain was fed into the mill by bucket conveyor. Water power moved it over a series of endless belts, and screw conveyors carried it through coarse and fine grinding operations until the finished flour emerged.

Many writers mention the loom Jacquard set up in Paris in 1801 as an automatic machine operating from punched cards. Contemporary designers of automatic machinery rely heavily on the principle of punched card operation.

Americans of an older generation can recall the player-pianos, whose mechanism was put in motion by rolls of perforated paper.

Contemporary automatic factories started in 1920 with the A. O. Smith automatic automobile-chassis fabrication plant.

Although the Ford Motor Company's Automation Department was not officially named until April, 1947, the first application of automation was on a valve guide bushing, somewhat before that date.

"The automatic handling came into play by a method of turning these parts so that the large end always first

entered a conveyor which took them through the machining operations," a Ford survey says.

"These parts were simply slid down a slotted trough. The slot was wide enough, but too short for the bushings, thus forcing the parts to tilt. Because the large end was heavier, the small end could pass over the slot without dropping; only when the large end passed over the opening did the piece drop. Thus no matter which end passed first, each piece always fell with the large end down."

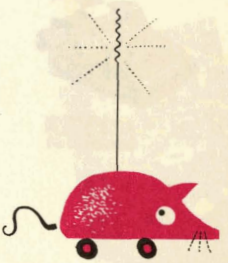
Automation is just another way of spelling imagination.

Genius with Low I.Q.

• **THERE'S A MOUSE IN BELL TELEPHONE LABORATORIES**

He's a rubber mouse with copper whiskers you can call Mickey.

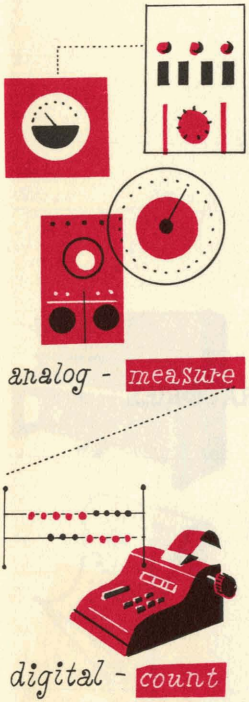
Scientists send Mickey galloping through a complicated maze in search of cheese.



The startling thing about Mickey the Mechanical Mouse is the oftener he goes and finds the cheese the less time it takes him to do it.

The ability to profit from experience was once thought to be a peculiar property of the human brain. Now it appears that scientists have been able to endow machines with this gift. The machines are of course limited in their intelligence. You might call them geniuses of low I. Q.

They're popularly known as electronic brains, and "may be analog computers which show results in non-numerical terms such as lines on a chart or digital computers which show results in terms of numbers which can be recorded."



In simplest terms analog computers **measure.**

The speedometer in your car and the water gauge in your basement are analog computers. Multiply the gadgets and add a dash of electronics and you get Project Typhoon with its 6,000 plug-in connections, 100 dials and 4,000 electron tubes.

Still, no matter how you glamorize it, Project Typhoon is nothing more than a glorified light meter rigged to record in terms of voltage the performance of a missile in flight.

Similarly, digital computers **count.** Since their lifeblood is electronic, they count pulses of current as an adding machine counts teeth in a rotating gear.

Problems with the instructions and data necessary to solve them are fed into the machine in the form of stacks of punched cards, or rolls of perforated or magnetized tape. The machine has three different types of memory, batteries of swiftly spinning magnetized cylinders, reels of magnetic tape and banks of cathode ray tubes like little television tubes.

Most people are acquainted with the adding machine. Feed it the figure four and a gear moves the distance of four teeth. Give it another figure, this time three, and the gear moves another three teeth.

Now, if you want, you can get the machine's reaction to the problem — four teeth plus three teeth. The answer is seven.

In the same way, when you have fed all the data to an electronic brain, you give it the problem and receive a reaction based on the data the machine has.

The pioneer Eniac can add or subtract 5,000 numbers a second, multiply or divide 50.

American Airlines in New York City has an electronic brain called Reservisor whose mechanical memory retains a record of all seats available on 1,000 flights. At the push of a button Reservisor shows which flights have vacancies for a given destination on a given date.

The U. S. Air Force has a transoceanic statistical information set-up which transmits data at the rate of 1,000 characters a minute, from punched cards in Casablanca to punched cards in Washington.

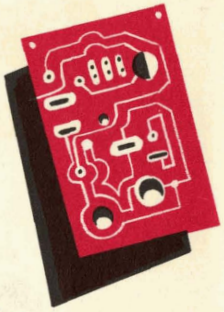
As a poet wrote — perhaps with needless bitterness — in the Combat Forces Journal —

"Punch the button, officers and enlisted men, old and young, experienced and green,

"Just punch the button and send them on their way, for everyone in the Army now is a number in an IBM machine."

Brainless but Bright

• SO LEONARD ENGEL TERMS THE ROBOTS



"Automatic calculating machines are no more 'brains,' " he says, "than a drop-forge is a fist."

As brilliantly stupid as they are, they can be harnessed to run machines singly or in teams. One of the best descriptions is in John E. Arnold's "The Role of Design in Automation"—

"On the numerically controlled milling machine developed by the Servomechanisms Laboratory at the Massachusetts Institute of Technology the two motions of the head and the motion of the table are controlled by means of a pre-coded punched tape. The complete instructions for a series of operations, including position of tool, depth of cut, cutting speed, etc., are calculated and then encoded as punches on a paper tape. The directing mechanism of the machine transcribes the tape code into

electrical impulses" which, to paraphrase a lengthy description, through a system of feedbacks and analogs turns the shaft, and controls and synchronizes the motions of the head and table.

"Actually, all that the designers of this machine have done is to replace the information stored on a blueprint in front of the operator with the same information on a piece of punched tape."

Once more our old friend the player-piano, on whose roll the notes of music appear as perforations.

Incidentally, if you have a knotty problem, and can't afford your own electronic brain, you can rent one.

On a weekly, daily or hourly basis.

Along with the "brain" goes a staff of experts who understand its special feeding problems.

It's in the Works

- **THE AUTOMATIC FACTORY IS NOT MERELY COMING.**

It is already here, although its impact is not so weighty as the tonnage of newsprint on the subject would indicate at first.

As Matthew J. Murphy has pointed out in "Problems in the Push-Button Factory" — "Automatic production will undoubtedly be a slow, creeping revolution for most plants and managements. But a revolution it will nevertheless be — in industrial relations and in management's own attitudes."

The Stanford Research Institute put out a recent study which indicates the trend.

Factory sales of data-processing equipment were nil in 1940, $25 millions in 1953 and, it is estimated, will reach $500 millions by 1960.

Factory sales of instruments for industrial control were $3 millions in 1940, $65 millions in 1953 and are expected

to reach $150 millions by 1960.

Newspapers have given wide publicity to some automatic machines and tools.

In March a new company called Multra Corp. announced a machine tool named Multra, which can be tooled and retooled for the assembly of a virtually unlimited variety of products.

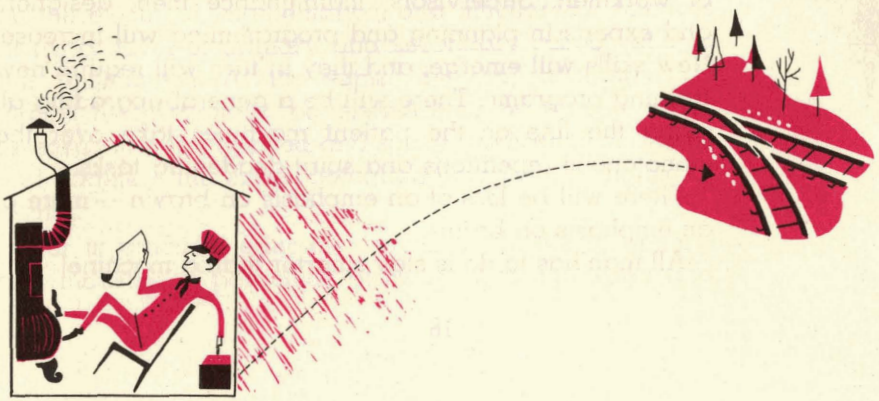
In Detroit the Cross Company is putting together a $2 million machine tool as long as a football field, which will perform 540 mechanical operations and turn out engine blocks at the rate of 100 an hour.

Thompson Products Company of Cleveland has a tool bigger than a house which machines the housing for a jet turbine in ten minutes.

A 275-ton, all-automatic, wire-rolling mill has been delivered to the Anaconda Wire and Cable Company at Great Falls, Montana, in 1,920 crates on 15 freight cars.

The Southern Pacific Railroad has laid out close to $4 millions on a system of dispatching along 95 miles of track in desolate sections of California and Oregon. It will enable a dispatcher 200 miles away to push a button that will light a gas burner to keep a switch from freezing.

It all bears out what Vannevar Bush has said — "Wherever logical processes of thought are employed — that is, wherever thought for a time runs along accepted grooves, there is an opportunity for the machine."



What About Workers?

- **HARRY M. DAVIS WROTE A CLASSIC LINE**

He said in Scientific American — "The first phase of the Industrial Revolution meant the mechanization, then the electrification, of brawn. The new revolution means the mechanization and electrification of brains."

The workerless factories some writers speak of are a myth today and will remain one tomorrow.

General Motors Corporation points out it has 200,000 more employees in spite of all the new and modern equipment it has installed in the past few years.

"Automation at Ford conserves manpower, but it does not eliminate men from the industrial scene. Instead it saves men from many burdens and hazards of industry and gives them jobs which utilize their brainpower more effectively," says Ford's "Automation Summation."

The late Philip Murray said when addressing the C.I.O. as its president in 1951 — "I do not know of a single, solitary instance where a great technological gain has taken place in the United States of America that it has actually thrown people out of work. I do not know of it, I am not aware of it, because the industrial revolution that has taken place in the United States in the past 25 years has brought into the employment field an additional 20 million people."

Manufacturers, however, can look for a change in types of workmen. Supervisors, maintenance men, designers and experts in planning and programming will increase. New skills will emerge, and they in turn will require new training programs. There will be a general upgrading all along the line as the patient machines take over the monotonous repetitions and spirit-deadening tasks.

There will be less of an emphasis on brawn — more of an emphasis on brains.

All man has to do is stay smarter than a machine!

• THE SKY'S THE LIMIT

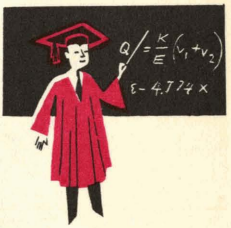
Productivity will zoom. George H. Kendall of Multra gives some indication. He points out that Multra raises the productivity of each worker ten to 20 times. The same results are obtained to a greater or lesser degree from other automatic devices which are entering the industrial lists in ever larger numbers.

During the first half of this century the fruits of production nearly doubled. Electric power plants at the present time turn out five times more juice than 20 years ago with 15 per cent more workers. And now Congress and the President have opened the way for industrial development of the atom. Hold onto your hats because we're on our way!

What conclusions are to be drawn from all this?

Undeniably, there are responsibilities, including the responsibilities of industry for alert management, proper machine tools, preventive maintenance, tool control, safety and the reallocation of manpower to dry up temporary pools of unemployment.

Heavy as these obligations are they are no graver than the responsibility placed on education. Industry's growing demand for skilled and trained personnel will tax our school facilities and the resources of our educators. There is need to readjust our curricula to put greater emphasis on the electrical, mathematical and mechanical sciences at every level of primary and secondary school, and in our universities. At the same time our institutions of higher learning must be encouraged to pursue wider research in pure, applied and social sciences to stimulate and augment the experimentation going on in industrial plants.



Nor is practical education enough. As life in general and industry in particular grow more complicated and

technical, the danger of America's suffering from a cultural lag becomes more acute. Those who direct our educational destinies would err fatally if Americans were transformed into highly specialized cavemen woefully deficient in the arts and letters.

Only through man's misfeasance could the machines destroy man.

Industry has a share in this responsibility. It must continue to work hand in hand with educators and all other good citizens in supporting and improving our schools, colleges and universities, both public and private. Businessmen must be ready to back the program regularly with financial contributions in addition to giving of their time and interest.

With the cooperation of Americans in all walks of life, our standard of living will skyrocket, prices drop, markets expand and the tempo of prosperity accelerate. More and more workers will be needed in the fields of recreation and amusements, of education and the arts. The work week will shorten, the hours of leisure lengthen.

Here again broadened education plays its role, for the

world of literature, music and the humanities lies open to all. Let America show this God-given boon has not been given in vain. Let America prove the wisdom of Thomas Alva Edison's words — "The stomach is the only part of man which can be fully satisfied. The yearning of men's brains for new knowledge and experience and for pleasanter and more comfortable surroundings can never be completely satisfied."

The future is a door standing ajar. We stand on the threshold of a golden tomorrow. Let the worker face what is to come with hope in his heart, not with fear in his mind. Automation is a magical key to creation, not a blunt instrument of destruction, and the worker's talent and skill will continue to merit reward in the fairyland of the world to come.

For the expanding, dynamic economy of America, the sky is indeed the limit. Now more than ever we must have confidence in America's capacity to grow. Guided by electronics, powered by atomic energy, geared to the smooth, effortless workings of automation, the magic carpet of our free economy heads for distant and undreamed of horizons. Just going along for the ride will be the biggest thrill on earth!

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