

There is still much to be done. The last quarter of a century may be regarded as a preparatory period for, in the years to come, discoveries even more amazing will be revealed, and more than that, there will be an exceedingly wide application of these disclosures.

RAILWAYS SAFER THAN HOMES

By C. R. GRAY

President, Union Pacific Railroad Co.

IN their efforts to provide the traveling and shipping public with more comfortable, convenient and safer service and at the same time to overcome rising taxes and increased wages, American railroads in the past thirty years have greatly depended upon the engineering and scientific fields.

Thirty years ago the "Consolidation Type" locomotive was the heaviest and most generally used power plant in freight service. This locomotive weighed 300,000 pounds and had a pulling power capable of handling thirty-four average loaded freight cars on an average one per cent grade. Today, without considering the Mallet type, used for helpers, which run even higher, locomotives are in use which weigh 803,000 pounds and which are capable of handling eighty-five average loaded freight cars on an average one per cent grade.

The advancement in locomotives has been accomplished in several stages, designed to make possible not only the handling of larger trains but also to reduce the operating and maintenance costs and particularly to reduce fuel expense. In this connection, during the past thirty years there has been developed the superheater which saves twenty per cent in fuel and the feed water heater which saves ten per cent in fuel. At the same time the mechanical stoker, mechanical lubricator, power reverse gears and other improvements have been perfected.

Along with the advancement in locomotives and to make their use possible, the 80-pound rail which was in general use in 1901 has been supplanted by the 130-pound average of today. With the heavier rail there has come improved rail fastenings, better ties, heavier ballast and more permanent structures.

In passenger service the all-steel car has completely supplanted the wooden equipment formerly used with the result that there has been a great advancement in comfort and safety. Numerous improvements have taken place which add to the attractiveness of traveling, principal among these being improved seating, better lighting, heating and ventilating and modernized sanitary equipment.

Today safety in railroad travel has been developed to such an extent that accident insurance companies write policies on the premise that a traveler is four times as safe on the railroad train as he is at home or on the street or driving his own car.

THE PAST ASSURES THE FUTURE

By ALEX LEGGE

President, International Harvester Company

BACK in 1902, as I recall those days, the average man thought that most of our major mechanical problems had been pretty well solved, and that we were equipped with about all the mechanical means and adjuncts of living that we really required; yet look at the tremendous and revolutionary advances that have been made since that time in practically every department of mechanical science.

Thirty years ago we were just coming into the automotive age. The total United States registration of passenger cars in 1902 was 23,000. I wonder what would have happened to any prophet of that period if he had dared to predict a total registration in 1930 of twenty-three million passenger cars, besides nearly three and one-half million motor trucks. As a matter of fact, motor trucks did not come into the production picture until 1904.

The aeroplanes, radio, moving pictures—what a host of mechanical marvels the last thirty years have produced, each of them profoundly affecting the whole race, each of them the foundation of a new world-wide industry!

But to my mind no mechanical development in all this wonder-working period outranks in economic importance the application of automotive energy to agriculture—the advent of the internal combustion tractor which ushered in the power farming age. Thirty years ago Dobbin was still supreme and unchallenged as a source of power on the farm. In 1902 the tractor was still only a dream, a thing for some far off future. And today there are perhaps a million tractors on the farms of the United States, and thousands of farms that have no horses at all!

Surely we who look back on such a record of progress in three decades cannot be so blind as to believe that science, invention, engineering and manufacturing will stand still during the thirty years that lie just ahead. If we need anything to strengthen our faith in the accomplishments of the future, we can find it by reviewing our accomplishments of the past.

WORLD WAITS NEW IDEAS

By F. O. CLEMENTS

Technical Director, Research Laboratory, General Motors Corp.

THIRTY years ago a new thing captured the world's fancy. It started as a fad, grew as a means of recreation and today has become a necessity and the basis of our largest industry—the automobile. But approximately five years ago an unhealthy

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idea crept into this as well as other leading industries—the standardization idea. The whole thing was based on the thought that we had reached the millennium, that it was no longer desirable to create new things but make thousands of the old products to sell more cheaply. And the whole world became sick from over-production of articles which it was thought were permanent.

We have convalesced for two years. And, consciously or unconsciously, the world has been purged of the idea standardization germ. I honestly believe that today we have a healthier outlook than ever before. People were never so receptive to new things. We enter the new year with better organized means of getting new ideas and new products into existence.

Nearly every business has its research department—a procurement department for new ideas. And 1932 will go down in history as one of originality—a constant striving to break away from the stereotyped.

THIS CHANGING WORLD!

By EDWIN C. ECKEL, C. E.

Mining and Engineering Geology

EACH great war period brings vast loss and vast extravagance. From 1789 to 1815 the whole civilized world engaged in savage wars; from 1853 to 1871 another war period involved all the leading nations in turn; from 1912 to 1920 our recent experience, counting in the preliminary Balkan wars and the post-war Russian and other civil wars—made up in intensity what it shortened in time. In every case the world has come out of such a period with high prices, inflated currencies, great material and human losses. And in each case, after a decade or so of deflation and difficulty, the world has regained slowly its sanity and its sense of economy, and has gone ahead to new prosperity by the aid of new processes, new products, and new raw materials.

Each time that a new period of prosperity has come to a temporarily impoverished world, it has come in a new form, not in a mere copy of the old or pre-war type. The world before the Napoleonic wars, for example, was a world of hand labor; it had no steam engine, it had practically no machinery of any sort, steel was a rare metal and iron was made chiefly in cold-blast charcoal furnaces. The world which, after Napoleon, came again to life around 1825 did so with the help of the steam engine, coke, fuel, the hot blast, railways, steamships and textile machinery.

In similar fashion the great war period 1853 to 1870 killed some industries and some processes; the post-war prosperity was based on entirely new things. Some of these new things, we may recall, were Bessemer and open hearth steel, the devel-

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opment of electric power, the telephone, refrigeration, cables, coal tar products, the Lake Superior ore ranges, by-product coking, the trolley car and the motor car.

So today if you look for the first signs of renewal growth, it will be idle to look for them among the older mines and processes and products. For the one thing of which you can be sure is that the main features of our next period of world prosperity will be new things. In the two industries with which I am most closely acquainted such signs of new progress are I believe quite clearly apparent, though as yet masked by general trade depression. For unless I am utterly mistaken as to conditions and probabilities, the steel industry in its next boom will not be concerned so much with common steels as with the newer alloy steels, and the cement industry is likely to rise to new heights not on the older types of product but on the new high-strength and high-speed cements which are coming rather broadly into use even now. So in other industries the people who wait for old processes and old products to reach their pre-war importance are likely to wait forever in hopeless discontent, and this applies to great corporations as well as to individuals. Those who will attain success in the next period of prosperity will be those who are expecting to use new ways of doing things, who are willing to make and use new products of better type. Carnegie made steel rails, not wooden cart wheels, and Rockefeller wasted no time on whale oil.

It is absolutely certain that in the near future the world will again begin using annually increasing quantities of necessary raw materials, manufactured products and services; that is a corollary of normal increase in world population. It is to my mind at least almost equally clear that such increase in consumption will begin very soon, probably in 1932 for many lines of activity, and that in many lines, notably ferro-alloys and certain chemical products, we will be making new records in annual output before 1935. In all that development the United States, being exceptionally favored as regards supplies of foods and raw materials, will have the opportunity to take the lead, not merely in quantity production but in technical advance. And that, after all, is the only real base of all our modern civilization. We can very easily do without lawyers and politicians; we cannot realize a modern world without artisans and technicians.

Accepting the practical certainty of an American revival in tonnage outputs beginning slowly in 1932 and reaching new levels by 1935, we must guard against expecting two other things, which the mentally inert will expect to accompany trade revival as matters of course. I am referring to rising prices and to revival of old industries. As to the one, average prices will probably rise again, but not to the extravagant heights of 1921-1929; profits will be made best out of increased outputs at moderate price levels. As to the other, I have already expressed

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my conviction that the coming period of prosperity will be marked by progress along new lines; there may be many old mines and mills which will never re-open, as partial offset to the many new ones which will come into existence as new raw materials are found, new processes invented, new products offered to a waiting market.

THE MAGIC OF SCIENCE

By DOYLE E. CARLTON

Governor of Florida

STORIES like those of Aladdin's Lamp, the Magic Carpet, and Open Sesame, cultivated the imagination in the East when progress was in its swaddling clothes. The marvelous things which were reputed to be accomplished by magicians, by fairies, by the use of talismans, by magical words or by the mythical gods of Greece and Rome drew heavily on imaginative credulity for centuries.

But when alchemy was dropped for chemistry, astrology for astronomy, magic for **mechanics**, and mythology for physics, the wand of science brought forth more wonders than were ever dreamed of in the Arabian Nights, the adventures of Baron Munchausen, the stories of Hans Andersen or the speculative romances of Jules Verne.

The mastery of steam, steel and electricity has brought more changes in the history of man than all the "Fifteen Decisive Battles of the World." Measured by the effect on the lives of the teeming millions now living, the advance made in the me-



Fuddy Were Better Than Roads in Kansas in 1904; the Car Shown Was the First Automobile to Cross the Continent Under Its Own Power



It Would Not Be Considered Very Elaborate Today, but This Street Car Was the Last Word in City Transportation Early in This Century

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chanical arts has done more than all the theories of all the philosophers of the past. The continents have been transformed by the genius of man. Civilization has been metamorphosed by the march of progress during the last few centuries more than during any previous thousand years.

The next move should be to render progress the common heritage of all; not by communizing wealth but by synchronizing production and consumption, to synchronize man's economic life. This is the task of the political economist, sociologist and the statesman.

SIGN POSTS OF PROGRESS

By WILL H. HAYS

Median Pictures Productions and Distributors of America

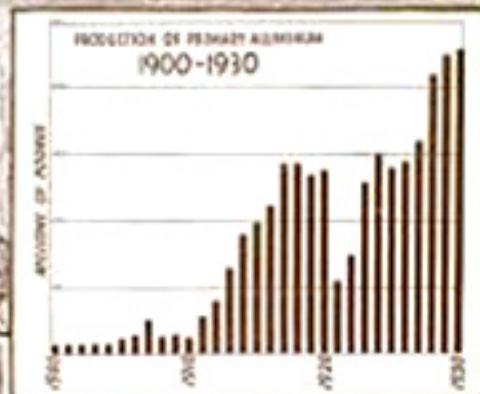
HAS scientific progress been too rapid for our powers of organization? Has technical achievement offered more problems than we can solve? Has education given us more theories than facts? There are those who feel that our present difficulties are due to the problems which rapid progress has raised.

To me such developments are the sign posts of advancing civilization. From the laboratory will come the technical solutions to the problems that technology has created; achievement will find the way, and education will light the road to further progress.

To all of these achievements **Popular Mechanics Magazine** has been and will be a definite contributing factor.



First Radio Set to Be Constructed for the Readers of **Popular Mechanics**; It Was Described for Former Years in the Magazine in 1918



Industrial Progress Can Almost Be Gauged by This Chart Which Shows the Production of Primary Aluminum for Thirty Years

This Car Bared us the Dirt on Some of the Early Trials to Give an Idea of the Speed Auto Made Achieve: It Is a Ford Model

"ON WHEELS AND WINGS"

By **EDWARD G. SEUBERT**

President, Standard Oil Company (Indiana)

THE thirty years since **Popular Mechanics** Magazine was founded have seen marvelous progress in the oil industry, resulting largely from application of science to all phases of its operations. Many of the steps in this advance have been described and pictured in the magazine as they developed.

We have only to contrast the United States production of 88,767,000 barrels of crude petroleum in 1902 with production which probably reached 853,000,000 barrels in 1931 to realize how science has aided the oil industry to march on.

In 1902 about ten per cent of the crude petroleum was unavoidably being made into gasoline, and refiners were wishing there were some use for it besides in gasoline stoves and lamps. Kerosene for lighting was nearly fifty per cent of the output. With development of the use of the automobile, engineers and chemists have made the oil refinery a complicated chemical plant which today has no trouble in converting kerosene and gas oil or fuel oil into gasoline, now in much greater demand, and a gasoline so different from the gasoline of thirty years ago that it is practically another product. Today the general yield from petroleum is about forty-two per cent gasoline, five per cent kerosene and the remainder, fuel oil, lubricants and other products.

In making motor fuels and lubricants available in abundance and at low prices, industrial science has put America on wheels and wings. Science was mainly responsible for creating both the demand for and supply of motor fuel and hundreds of other petroleum products. **Popular Mechanics** has aided this development like many others by broadening the public conception and understanding of the advanced facilities put at its disposal by science.

1902—1932—1962

By **HEBER D. CURTIS**

Director, the Observatory of the University of Michigan

IN 1902, only thirty years ago, we felt, and with some reason, that we were nearly at the apex of scientific progress. The electric light was here, with electric power; the telephone was fairly usable; the bicycle was a finished product. Education was almost universal. Transportation seemed amply rapid, though outside the larger cities there were but few roads over which it was possible to drive a mule at eight miles per hour. Chemistry appeared fairly settled; physics was practically a closed book, as finished and as complete as the indivisible atom which formed its ultimate element.

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We were a century, instead of thirty years, ahead of 1872, as progress is measured: science, transportation, government, all seemed to need only a few finishing touches. A few curiosities had appeared in the years just before 1902, but no prophet could have been so bold as to imagine them factors in changing the world. The X-ray was six years old; the first paid wireless message had been sent for a few miles in 1898; three years were to elapse before the first moving picture theater would be opened in Pittsburgh. True, 9,000 autos were produced in 1902, and a total of 23,000 were registered in the United States and Canada.

If, thirty years ago, we felt ourselves a full century ahead of 1872, we must now, in 1932, reckon ourselves a thousand years ahead of 1902. The auto, good roads, the celluloid films, airplanes, radio, have wrought more change in the life of man in these thirty years than did all the progress of the tens of thousands of years which preceded.

We are today living in the most wonderful age of history which has eventuated—yet. Chemistry is finding new worlds to conquer; physics has long since thrown away its old and final atom, and is starting afresh, with universes to subdue. Astronomy, formerly content with a cosmos perhaps thirty thousand light-years across, now talks of average Milky Ways at distances of hundreds of millions of years of light travel. Preventive medicine is constantly scoring wonderful triumphs, and many of the worst diseases are dying.

An even greater change may be noted between the scientific viewpoint of 1932, as compared with that of 1902—vital and far-reaching. The science of 1902 still felt that it was complete, inerrant, supreme. It was more than a little arrogant, autocratic, orthodox, intolerant. Today it is a more humble body of thought, as it has observed so many of its former inspired tenets go by the board, displaced by newer theories astounding in their wonder. Here and there it is even coming to admit that there may be more in this universe than mere matter and force. Science now feels itself just a youth—humble, receptive, eager for what the next few decades may bring.

And what of 1962 as it shall look back on 1932? Of one thing only can we be certain—that our present achievements will then seem as crude as those of 1902 now do to us. For 1962 will certainly be ten thousand years ahead of 1932 in scientific progress; no limit whatever can be set to that phase of man's development. Happy are those who are youngest among the back-numbers of 1932, in that they will live to see the wonders of 1962!

Will man continue to be fit to live in the new universe his brain is creating, or will he be crushed by his Frankenstein? We think and hope that man, who has been made by his tools, will continue to be their master. The pessimist, it is true, can point to the occurrence of the most destructive war of history

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Built and Tested



Camera Men with a
Photographer Making
a Picture for the
Magazine



Engraving Men
Where a Drawing
Is Being Photo-
graphed

