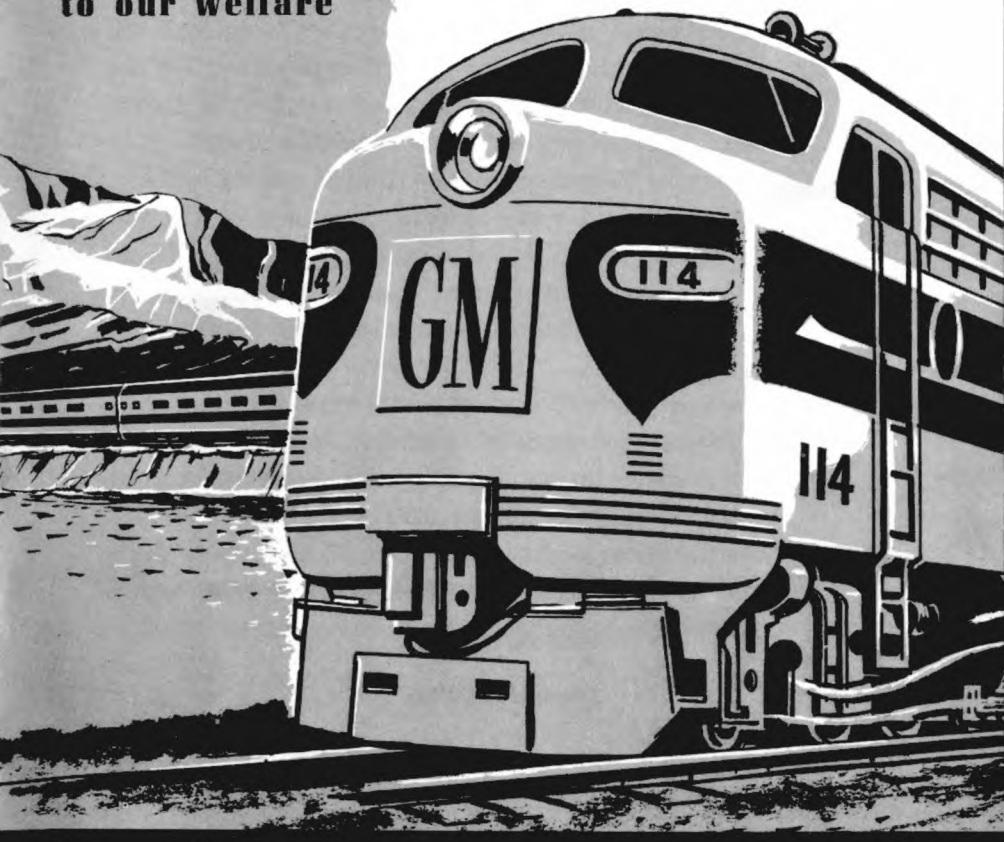
A dramatic example of the technological progress so important to our welfare

Story of the LOCOMOTIVE DIESEL



From a talk by Harlow H. Curtice, President, General Motors

PATTERN
for
TECHNOLOGICAL PROGRESS

delivered at the

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I hardly need say that I consider it a great honor to have the privilege of addressing the American Institute of Consulting Engineers.

The subject of my talk tonight is, "Pattern for Technological Progress." It may seem presumptuous for a business man to talk to engineers about technological progress. But I do hope that I shall be able to contribute a point of view that you will find useful.

All of us are agreed that technological progress is our key to economic progress—to a higher standard of living and a better way of life. It is also the key to a strong national defense. In these troublesome times our rate of technological progress is of crucial importance.

As you well know, there is no such thing as *guaranteed annual progress*. Advances in technology are by no means automatic. They vary importantly from year to year. More often than not, a particular forward stride is sparked by some dramatic development such as the one I propose to tell you about.

Such developments are the product of many forces,

all operating within the framework of our free competitive enterprise system.

Every American desires to improve his own standard of living. His wants are virtually insatiable. In total, these wants of individual customers set up compelling and cumulative pressures for more things and better things.

Errand Boy for Customers

I want to stress this point particularly because, curiously enough, in spite of its importance it often seems to be overlooked—even by engineers. You are all familiar with the man who designs or manufactures a product to suit himself and without reference to the use to which it is going to be put. On the other hand, the experienced business man who markets a product has to recognize the paramount importance of these customer pressures. As Mr. Kettering so well phrases it, the business man who makes a success of manufacturing goods or rendering a service never forgets that *his* job is to run errands for the customer.

Another requirement for technological progress is adequate capital. The usual sources for such capital are the successful and profitable businesses whose earnings are available for reinvestment or for distribution through dividends to the investing public. To attract such capital it is necessary that there be a reward—in other words, adequate incentives under our competitive system.

Continued technological progress also requires what

I like to call the attitude of the inquiring mind. This attitude of mind is never satisfied with things as they are. It assumes that anything and everything can be improved. It recognizes the inevitability of change. It is always seeking better ways to make things and better things to make.

Now I come to my story. It illustrates dramatically how the various forces I have mentioned can combine to bring about a forward stride in technological progress. It concerns both Ralph Budd and the organization with which I am associated.

In the early Thirties shortly after he became president of Burlington, Ralph Budd was seeking a way to reverse the precipitous drop in railroad revenues. The roads faced a difficult problem in the combination of a depression and a new competition provided by truck, bus and airplane.

Ralph Budd had an inquiring mind. The fact that certain types of equipment were traditional with railroads did not matter to him. He realized the desirability as well as the inevitability of change.

Mr. Budd began thinking in terms of utilizing a new technique for welding stainless steel to build a lightweight, streamlined train that would provide fast, de luxe mainline service at low operating cost. This was in the fall of 1932.

Meanwhile, Mr. Kettering, who was then in charge of our Research Laboratories, had been engaged in a long-range project to improve the efficiency of the internal combustion engine used in automobiles.

The Kettering approach to advancing the efficiency of the internal combustion engine was to refuse to stand in awe of any theory. He insisted on observing what actually happened inside an engine cylinder as combustion took place. This research led eventually to tetraethyl lead and to the higher compression automobile engines of today. But that is another story.

This research also caused Mr. Kettering to conclude that Diesel engines were being built according to theories that didn't coincide with what actually happened inside the engine. As he characteristically put it, no one had ever asked a Diesel engine how it wanted to be built. Mr. Kettering proceeded to do so in the General Motors Research Laboratories in 1928.

He also bought two four-cycle Diesel engines from the Winton Engine Company of Cleveland and installed them in his new yacht, the Olive K. The boat became a sort of floating laboratory.

Kettering's studies and experiments convinced him that the answer to the problem he had set for himself lay in a two-cycle Diesel engine with welded steel frame, unit injectors and a new method of forcing air into the cylinders. This was a revolutionary concept that necessitated blazing new trails in metallurgy. If successful, the new engines would weigh no more than 20 pounds per horsepower instead of 120 and do twice the work at half the cost.

By 1930 such definite progress had been made in the laboratory that the Corporation decided it was

time to consider the application of our new product to the specific needs of various kinds of customers. We turned to the Winton Company and its long years of practical production experience with very heavy four-cycle Diesel engines for marine and stationary application. Through Winton we became interested in the Electro-Motive Company. This small Cleveland firm, of which H. L. Hamilton was president, had built up a business with the railroads in the early Twenties designing and assembling gasoline engine, electric drive rail cars for branch line passenger service. Winton produced the gasoline engines used by Electro-Motive.

Railroads Need More Power

At this time, however, there were no longer any customers for the gas-electric rail cars sold by Electro-Motive. In fact, it was realized that the end of the road had been reached with this particular product. The railroads now wanted an engine with more power than could be successfully produced using gasoline. Furthermore, a rise in the price of gasoline had all but wiped out the cost differential favoring gas-electric power plants over steam.

What was needed was a prime mover that used low-cost fuel, developed more power than the gasoline engine and weighed less than the four-cycle Diesel engine. Neither Winton nor Electro-Motive could develop such an engine; nor did anyone in the industry have such an engine or any prospect for it.

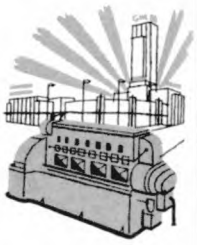
But it appeared evident that Mr. Kettering's two-cycle Diesel development might be the answer to the problem. On the other hand, it was evident too that no one had more experience than Hamilton and his engineers in successfully translating power at the crankshaft into effective tractive effort on the rails.

This was the situation when General Motors, Winton and Electro-Motive joined forces in 1930. Diesel development was now pushed ahead on two fronts—at the General Motors Research Laboratories and at the Winton plant in Cleveland. By 1932 a one-cylinder engine was running in Detroit and another in Cleveland. Winton was building to specifications of the Research Laboratories two eight-cylinder engines to furnish part of the power for the Chevrolet assembly line planned for the Chicago Century of Progress. However, it was recognized that the Diesel project was a long-range one. No one, not even Boss Kettering himself, expected much in the way of results for some years.

Budds Plan Stainless Steel Train

Now, to return to Ralph Budd and his light-weight train concept. Budd's first move was to visit the car builder, Edward G. Budd of Philadelphia. They were not relatives. Budd (Philadelphia) was the man who had developed the method for welding stainless steel. The two Budds agreed that this strong, light-weight structural material would be suitable for car bodies.

The next concern of Budd (Chicago) was motive power. It was natural for him to turn to Hamilton in Cleveland since he had bought a number of rail cars from Electro-Motive. Budd saw the eight-cylinder engines and immediately wanted one. Hamilton referred him to Kettering, so he stopped off in Detroit. Kettering said he wouldn't dare sell the engine; he wasn't even sure it would run. All the satisfaction he would give was, "Keep in touch."



This Ralph Budd did. In fact, when the Century of Progress opened for its first year in 1933, he frequently dropped in at the General Motors exhibit to inspect the new Diesels.

Finally, his persistence was rewarded. General Motors agreed reluctantly to build an engine for him —but with no guarantees as to performance. The order was placed on June 17, 1933. By February, 1934, the Pioneer Zephyr was completed.

Here was a revolutionary new concept in rail transportation that represented a tremendous advance in technology. Few, however, realized its far-reaching implications, and some railroad engineers even referred to it as a "tin train."

Mr. Budd realized the need for dramatic action. His first move was to send the Zephyr on tour—both to test its performance and to check public reaction. The train surpassed all expectations. Its performance was better than Mr. Budd had anticipated, even though General Motors engineers were not satisfied and had to nurse it like a baby to keep it running.

Everywhere it went people flocked to see the new marvel.

With only a few thousand miles "on" the train and with no one sure when a part would fail, Mr. Budd decided the time was ripe to startle the nation by making railroad history. He would do something that had never been done before.

A Dramatic Announcement

On May 26, 1934, the day the Century of Progress opened for its second year, the Pioneer Zephyr would make a dawn-to-dusk run, non-stop, from Denver to Chicago. That was a distance of over a thousand miles. Mr. Budd promised that the run would end on the open-air stage of the Fair and that the arrival would be timed to provide the grand finale to the opening of the great "Wings of a Century" pageant.

This was a highly dramatic announcement. It fired the imagination of the public and of railroad men everywhere. Up to then no locomotive had ever traveled more than 775 miles non-stop. Furthermore, the regular Denver-Chicago run then took 26 hours. To promise a dawn-to-dusk run meant that the run had to be made in 14 hours. When one considers that Budd was proposing to do all this with a virtually untried type of motive power and that he had committed himself to split-second timing at the finish, one marvels at his temerity. This undertaking required great courage and determination. Even more than was generally known at the time.

For instance, on the afternoon before the run, it was discovered that a bearing in one of the traction motors had cracked. A replacement was finally located in Omaha, 500 miles away. While it was being rushed to Denver by plane, the train was jacked up and the damaged motor disassembled.

This was the situation at 10 p.m. when Mr. Budd was scheduled to make a nation-wide radio broadcast. Despite the fact that he had no way of being sure, Mr. Budd told his radio audience that the Pioneer Zephyr *would* start its dash for Chicago at dawn the next morning. He did not mention the cracked bearing.

Then Mr. Budd returned to the shops to wait. As he surveyed the jacked-up train, a burro that a Denver paper was sending to the Fair via the Zephyr brayed insultingly. Mr. Budd turned to an assistant and remarked, so I am told: "I don't know which is the bigger jackass, Zeph there or me."

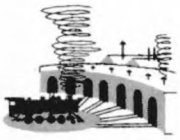
But, two hours later the bearing arrived, the repair was made, and the Pioneer Zephyr pulled out of Denver at dawn to insure that Zeph remained the No. 1 donkey.

At 7:10 p.m., Chicago time, the Pioneer Zephyr broke a tape across Halsted Street, completing the run of one thousand and fifteen miles in 13 hours and 5 minutes. An hour later it rolled on the stage of the Century of Progress right on cue.

I am perfectly sure that the courage and vision and determination of Ralph Budd advanced by many

years the age of Diesel on the railroads of America. Mr. Budd was the spark plug, so to speak, that fired the imagination of a group of great railroad men of that day.

However, even with the help of these men the going was not easy. General Motors was in the position of trying, during a depression, to sell an unproved product to an industry apparently headed toward bankruptcy. The railroads were desperately anxious to save money, but first the economy of the new locomotives had to be demonstrated. Many railroad men refused to believe that an engine that was "wrong in theory" could work. Some had had experience with Diesels—or thought they had. They had found that the heavy four-cycle Diesel had only limited use as a slow-moving, sluggish switching engine. Others were apparently wedded to the traditional form of motive power—steam—as were the historical builders of locomotives. This latter fact actually turned out to be a plus. As Mr. Kettering has remarked, the only advantage we had was that our competitors thought we were crazy.



"How much drawbar pull has this new-fangled tin locomotive of yours got?" one ardent proponent of steam asked Mr. Kettering. "I don't know exactly how much drawbar pull it has," Ket replied, "but," he added, "I do know we have enough to pull a lot of railroads out of the red."

There were, of course, many and continuing problems. Rings, bearings, pistons, cylinder heads and other

parts that now have a life of more than a million miles would fail after a scant forty thousand miles. Wheels would crack. Electric motors would burn up.

Ralph Budd remained optimistic. These problems did not provoke the criticism that might naturally have been expected from a customer—only words of encouragement. He even refused to admit he had taken a chance when he ordered his first engine. He said he knew that if he could get General Motors "on the hook" for one engine, we wouldn't stop until we "made the darn thing work."

We eventually did, although it took a lot of additional research and engineering and road experience. Many anxious hours and many millions of dollars were spent over a considerable period of time.

As a matter of fact, it was not until 1940, twelve years after the first experimental work got under way, that the losses of earlier years were fully recovered and General Motors' Diesel locomotive operations became profitable to shareholders.

Profitable to Customers from the Start

Of course, our Diesel locomotive operation was profitable to our customers from the start, and those customer "profits" have mounted year by year as more and more Diesel locomotives have been put in service. Today nine-tenths of all railroad traffic is handled by Diesel locomotives. Savings by the railroads in fuel and maintenance costs alone are estimated to total 750 million dollars annually.

Other benefits of Dieselization have been substantial—to the railroads' own customers, greatly improved service; to the public, elimination of smoke and soot, and to the economy as a whole, continued private operation of our rail network. In all of the world today the United States is the only country in which all of the railroads are privately owned, privately operated, tax paying services. For this I firmly believe that we can thank Ralph Budd and the Diesel locomotive.

I have told the Diesel story at some length because this epic in which Ralph Budd played a major role is such a dramatic example of the technological progress that is so important to our welfare. It contains all of the elements I mentioned as essential to the advance of technology. And its results are specifically measurable.

We need more such strides forward in our technology. We need more, right in the broad area of transportation. And we need more Ralph Budds to spark them.

A study just made public by the Railway Progress Institute discloses that our country's transportation bill for moving people and goods amounts to about 24 cents for each dollar of national income.

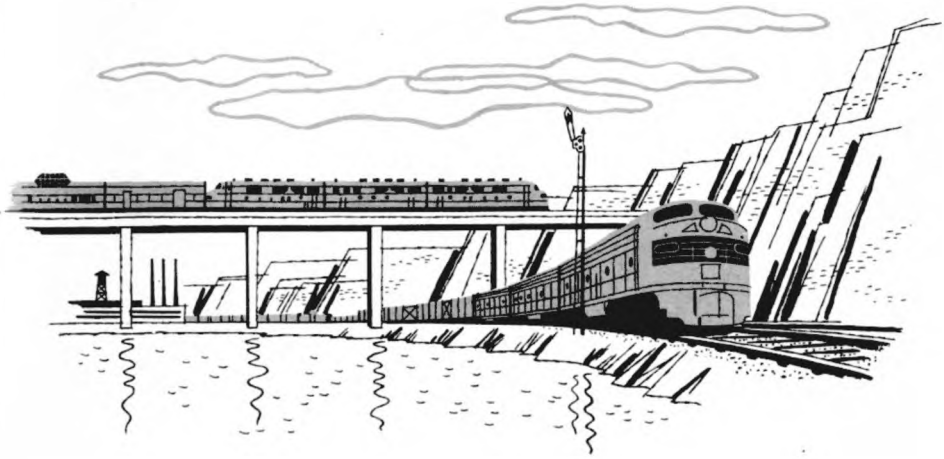
The Institute estimates that the amount of freight moved by all intercity transportation facilities to "supply" just one family or household will jump from an annual total of 27 thousand ton-miles in 1955 to 33 thousand ton-miles by 1965. This is an increase of

22 per cent just to keep pace with the normal growth of the economy.

Our freight must move faster too. And more safely. And it goes without saying that this is also true for our passenger traffic.

Who will deny that progress in technology of a high order is called for to meet this challenge.

No one of us can predict whose paths will cross to achieve such progress. But somewhere up ahead another Ralph Budd will find the support he needs from research and development, from investors and business men. Once again an inquiring mind will make contact with an imaginative flare for the dramatic. A spark will ignite, and once again our country will benefit from a major forward stride in technological progress.



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