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THE ARTICLES OF PROGRESS

By GARET GARRETT

IN THE artificial world the advent of a new mechanical species is a sign of change and progress. But a sign only. What will come of it is what people will do with it.

Such a sign has just now appeared. One day last May a prodigious, silvery, three-jointed worm, with one stalk eye, a hoofish nose, no visible means of locomotion, seeming either to be speeding on its belly or to be propelled by its own roar, crossed a third of the American continent, from Denver to Chicago, a distance of 1017 miles, in 785 minutes, without a stop. This was the Burlington Railroad's Zephyr, a Diesel-engined, electrically driven, streamline train, fabricated of stainless steel no thicker than the hide of a bull and yet as strong as a bridge.

The Burlington is one of the fine old railroads of the West. It rests upon agriculture. In the fields that come down to the right of way, the cattle, the sheep, the horses, the mules, the pigs, are so conditioned by familiarity to the snort of a locomotive and the rumble of traffic that a passing train does not move them. If they are dozing, they do not wake up; if they happen to look, it is with no curiosity. But at the sight and sound of the Zephyr, every kind of animal in the landscape uprose and fled.

Crowds Watching the Zephyr Pass

THE opposite effect upon people was extraordinary. For more than 1000 miles they occupied both sides of the right of way. On foot and in motor cars they had gathered at every crossing; and not at the crossings only, but in the fields, on the hillsides and hilltops, in the trees and along the embankments, wherever the view was good. In the towns and villages they were massed at the street ends, on platforms and on the tops of flat buildings. They were there at daylight in Eastern Colorado. They were there all day through Nebraska and Iowa. They were there in the evening through Illinois, the numbers increasing with the density of population, until, on the last 200 miles, the crowds were enormous.

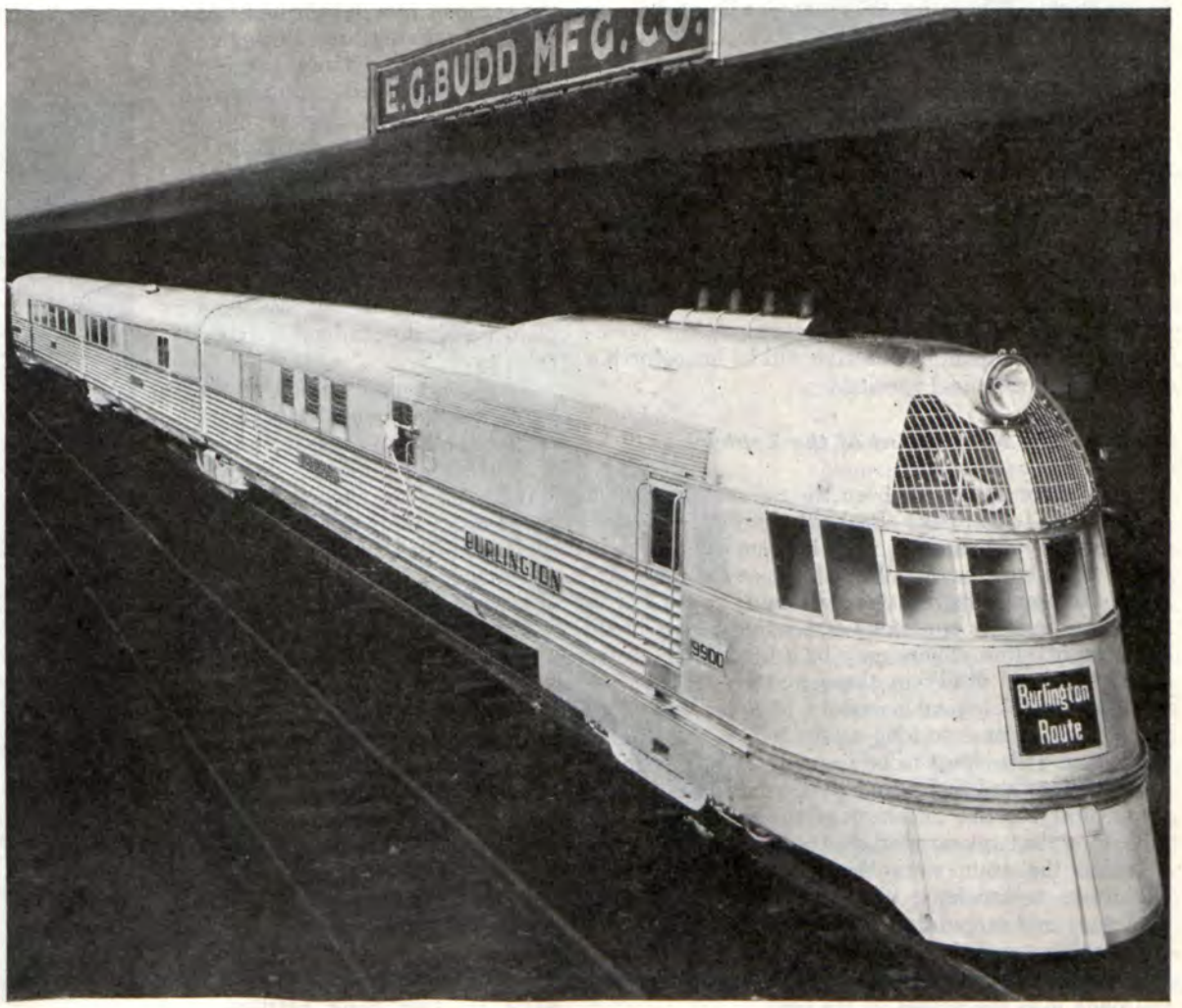
Provided a free and widely advertised sight, there need be no meaning in crowds. This was a free sight and it had been advertised. Yet it must have been something more. Parents held out their infants in arms, exhorting them to look. Women threw kisses wildly. Men leaped and waved their arms. Some who had come to make pictures saluted instead and forgot to turn their camera cranks. The enthusiasm was astonishing, even a little bewildering. And it was not for anything they could see with their eyes, for that, after all, was very little. A silver streak, a noisy blur, a technical apparition. The use of the eye was but to verify an excitement of the mind.

By certain marks of behavior you may distinguish between a crowd that rises to see a sight and one that gathers to behold a sign. The multitude that stood for more than 1000 miles along the Burlington's right of way from Denver to Chicago was not there to see a Diesel-engined, electrically driven, streamline train go by, nor to witness speed. A streamline object is no novelty, neither is any speed the Zephyr was likely to get up. There is more, overhead. As for a Diesel engine, not one in ten thousand could have said what the difference was between that and the spark-plug engine under the hood of the nearest motor car. So then, what was it this multitude went out to see, if not a sign? And what was the Zephyr a sign of? A sign of valorous enterprise on the part of an industry that, on the whole, has been and still is very sick—yes, that; but much more it was a portent of change and progress, and the first dramatized portent of the kind since the crash of prosperity five years ago.

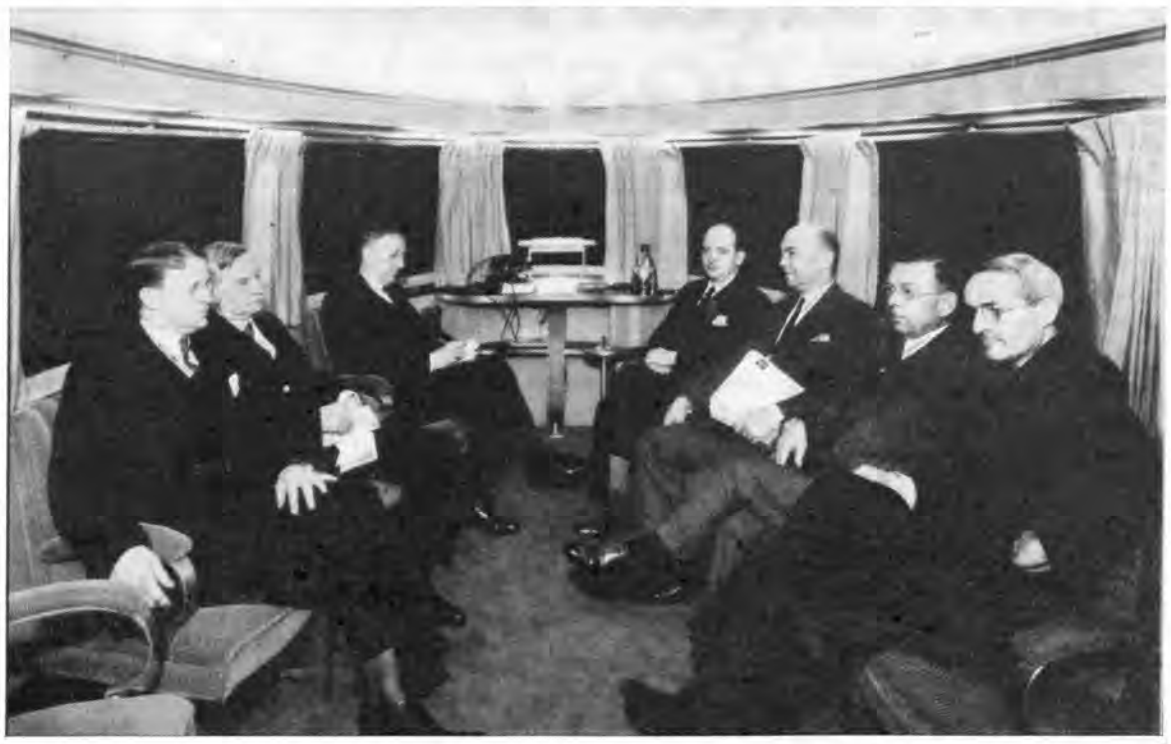
It would be strange, indeed, if after all this time we had not among us a kind of instinct for progress together with an intuition of its terms. The very first term of progress is surplus exertion, meaning all manner of human activity above the level of necessity. And whether it is material progress one speaks of or progress in civilization and culture, it is the same thing. Those great exercises of the mind that produce literature, science, music, art, religion and philosophy are not indispensable to life; neither is monumental architecture or any habitation better than a tent. To civilization they are indispensable.

The Spur of Surplus Exertion

SUDDENLY in the last century there was no absolute necessity for steamships and railroads. Human society without them might have gone on for thousands of years more, or, so far as we know, forever. Yet such progress as has occurred since in the economic well-being of the world had been utterly impossible without them. There was then no absolute necessity for telephones, electric light and power, the internal-combustion engine, motor cars, radio or aviation—all from the passion for surplus exertion. Even now life might dispense with any or all of



The World's Fastest Passenger Train, the Super-Streamlined Zephyr. It Consists of Three Cars, Articulated So as to Appear as One Unit



The Solarium on One of the New High-Speed Trains

them; that would mean to go back only forty or fifty years. It is progress that could not dispense with them.

The second term of progress is momentum. Not only is surplus exertion above the level of necessity indispensable to progress; the output must be continuous and cumulative. There is no standing still. People may say, "There is no summit, the ascent is endless; therefore, let us rest." True, there is no summit. But people who stop to rest will not stand still. They will go back; and there is momentum also in going back. It sometimes seems that people are obliged to stop for want of ideas. They have no new thing among them and, therefore, nothing to go on with. This means, of course, only that there is no surplus or unnecessary activity of mind among them.

No new thing arrives with a certificate of necessity in its hand. Where at this moment is there any warrant of need for more railroad transportation, old or new? Most people would say our existing railroad facilities are more than we require. That is true. The railroads are already equipped to produce much more service than they can sell. They have been tearing up tracks on which it is no longer possible to run paying trains. Their yards are full of idle cars. Their shops and roundhouses are crowded with cold locomotives. Suddenly through this scene of disuse, depression and obsolescence the Zephyr passes, leaving in its wake the suggestion of an appalling amount of further obsolescence, as, for example, the possibility that the steam locomotive will be henceforth a vanishing mechanical species.

The First Sprint of the Zephyr

BUT where had there been the necessity for such a thing to happen? Probably as little absolute necessity as for the steamship to happen when already there was a surplus of sailing ships, or for the automobile to appear before there were any roads to run it on, and nobody conscious of needing a new mode of transportation. There may be a kind of necessity we define very dimly in these matters, if at all—namely, the biological necessity of a new thing to bring itself to pass so long as the will to progress is unbroken. This is not to be proved. It is something one imagines and feels. And that would be a feeling to account for the behavior of the multitude 1000 miles long that appeared to see the first Zephyr go by.

Inside the train were the men who made it—engineers, technicians, observers, railroad people, credulous and incredulous, the crew, and, in the engine compartment, a specimen of the Rocky Mountain burro that carried the first transcontinental railroads into the passes on its back.

The windows were sealed. At front and rear were log keepers who filled sheets of white paper with figures. They were matching intervals of time with intervals of distance and calculating the speed. As fast as they made their findings they reported them to the passengers through microphones in the walls of the train.

Thus time was on everyone's mind. It was a time-conscious company. Would you suppose, in that case, the hands of the clock would seem to move slower or faster? Time was the measure of everything else. But what of the measure itself? After an experience in which we have been intensely interested, we say time has passed swiftly; or after having been bored, we say it has been endless. A unit of time in which sensory impressions are many and vivid seems shorter than one in which the impressions are dull and few. That deception is well known. But there is a point with speed at which one has definitely the sense of moving through space plus the stranger sense of moving also through time, and the time sense thereby is altered. Airplanes falling in with the Zephyr, flying low and keeping step until their ways parted, as they frequently did, intensified the notion of two time dimensions—the one outside, through which the train was passing, and the one inside, belonging to the train itself, determined by its velocity.

The topmost speed was 112½ miles an hour. The average for the distance was nearly seventy-eight miles an hour. The fuel was the cheapest low-grade oil, a kind of petroleum sludge, and the amount of it consumed was less than two quarts per mile.

These facts of speed and average time and fuel consumption are astonishing and break all records; nevertheless, they are comparable. The incomparable fact is that, having run at that speed twice as far as a steam locomotive goes without resting and ten times as far as a steam locomotive goes without stopping for coal and water, this lustrous worm was neither tired nor hot. There was nothing it needed but to have its fuel tank refilled. With that it might have been turned around and started back for an all-night run. The importance of this will appear.

Toward the end of the journey, a superintendent of railroad motive power, formerly a locomotive driver, who had been coming to it all day, leaned across the aisle to say: "I love the locomotive. God knows, I hate to see anything like this happen to it. But I'm a mechanic too. A machine is for what it will do. This thing skins the locomotive alive."

This thing—what is it? There is yet no familiar name for it, and for want of one there is some confusion. Two developments are in conjunction. One is the train and one is the power—the worm and what moves it. The Zephyr is not the only streamline motor train. The Union Pacific has one made of aluminum. Others are building, like and unlike the Zephyr. In any case, there are these two considerations—namely:

First, the radical application to railroad equipment of new technical knowledge touching the use of light-weight, high-tension materials, in order to reduce the weight of trains and streamline them for speed.

Second, substitution of the internal-combustion engine for the steam locomotive.

Taking Weight Off Railroad Equipment

TO ANYONE else, the idea of taking weight out of railroad equipment seems perfectly reasonable; to a railroad man it comes with a shock. He has been trained to believe in weight. In the typical case he gloats upon it. Since the designs and specifications that govern equipment of all kinds were crystallized, many years ago, metallurgy has discovered new alloys and technology has found new ways of handling light-weight materials of high tensile strength—electric welding of them, and so on—purposely in order to reduce the weight of a structure while at the same time increasing its actual strength. But a railroad man knew all the time what axles and wheels and cars and bumpers should weigh. All this welded and fabricated construction might do very well where it would do at all, but that was not on a railroad; for a railroad, weight was power, reliance, comfort, safety. So always heavier cars and heavier locomotives to pull them, and then heavier rails and bridges to keep them off the ground, until at last equipment had to be absurdly heavy if for no other reason than to withstand the shock of its own

The Zephyr in the Stable Door Before Starting on its Run of 1017 Miles in 785 Minutes

impacts, one piece with another. To say that the weight of passenger equipment might be reduced one-half, with all that would mean to the cost of operation, is to be conservative. The Zephyr, for example, is intended for regular service in a fast daily run from Kansas City to Omaha and back, where it will displace eight times its own weight of old equipment. The weight of the old equipment employed in that service—a train and two locomotives—is 1,618,000 pounds. The Zephyr weighs 200,000 pounds. Under pressure of many circumstances, the weight fetish here and there is beginning to break. Whatever else happens, there is indicated for the railroads a loss of weight, and it will be very good for them.

Substitution of the internal-combustion engine for the steam locomotive is another matter, with implications very much more startling. What was it moved the Zephyr 1017 miles in 785 minutes without a stop? A Diesel engine.

At sight, the Diesel engine—so named for an otherwise forgotten man who first declared its principles—differs from the engine under the hood of an automobile in respect, first, of having no carburetor and no spark plugs. The raw fuel is injected into the cylinder at very high pressure and in such a manner as to disarrange the molecules and enrage them. Compression then explodes them. Revenge of the molecules for what has happened to them, exerted on the top of the piston in the form of an explosion, is what makes the engine go. One of the merits of the Diesel engine is that it runs on very low-grade fuel. It would run, if it had to, on almost anything—on powdered coal, on molasses maybe, on the residue from mountains of oil-bearing shale that are yet untouched, and on alcohol, if everything else gave out—that is to say, on boiled cornstalks and cull potatoes. Beyond this, its three high qualities are doggedness, love of drudgery and a long life.

Since the Days of Water Wheels

THE Diesel engine is not geared to the wheels. That is to say, the drive is not direct, as in an automobile. The Diesel engine turns a generator, the current from the generator is delivered by wires to electric motors mounted on the wheel trucks below, and these electric motors turn the wheels by gear. This is the electric drive. What it amounts to simply is a velvet transmission, with infinite gradations of speed from zero to maximum, instead of three speeds and a shift of gears for each one when the drive is direct from the engine, as it is in an automobile. The further advantage of the electric drive is that the engine may run constantly at its optimum speed, so that you have your maximum power under all conditions, even at the moment of starting the load.

Call it a gas-electric locomotive. That defines it. And the first unlimited statement to be made about it is that it represents power at the highest point of mobility so far.

Ever since the inventive mind began to play with mechanical power, the problem of mobility has taunted it. The first steam engines were immobile. They were no more than substitutes for water wheels; much more powerful, of course, and yet, like water wheels, they were fixed. To get the power, you had to come to the engine. The limit of power transmission was a belt turning pulley wheels. Thus, at the beginning of machine industry, all work had to be performed near the engine; hence the massing of industrial labor in small areas and the rise and growth of industrial population within walking distance of the smokestacks.

Seven-League Boots for Power

PRESENTLY two problems were defined. One was how to take power from the engine, break it into sizable quantities and conduct it away, as water is conducted through mains and service pipes from a distant source to where the uses for it are. The other was how to impart to an engine the quality of locomotion—that is, how to make it get up and walk, carry its own fuel and water, and become a beast of burden.

The second problem seems much more difficult than the first. Intrinsically it was, undoubtedly. Nevertheless, the second was the first to be solved. The steam locomotive did it.

For many years more the steam engine, for all industrial purposes, was still like the water wheel. To get the power, you had to come to the engine, because there was no means whereby the power could be conducted away or made to act at a distance. That problem was not solved until electricity was conquered.

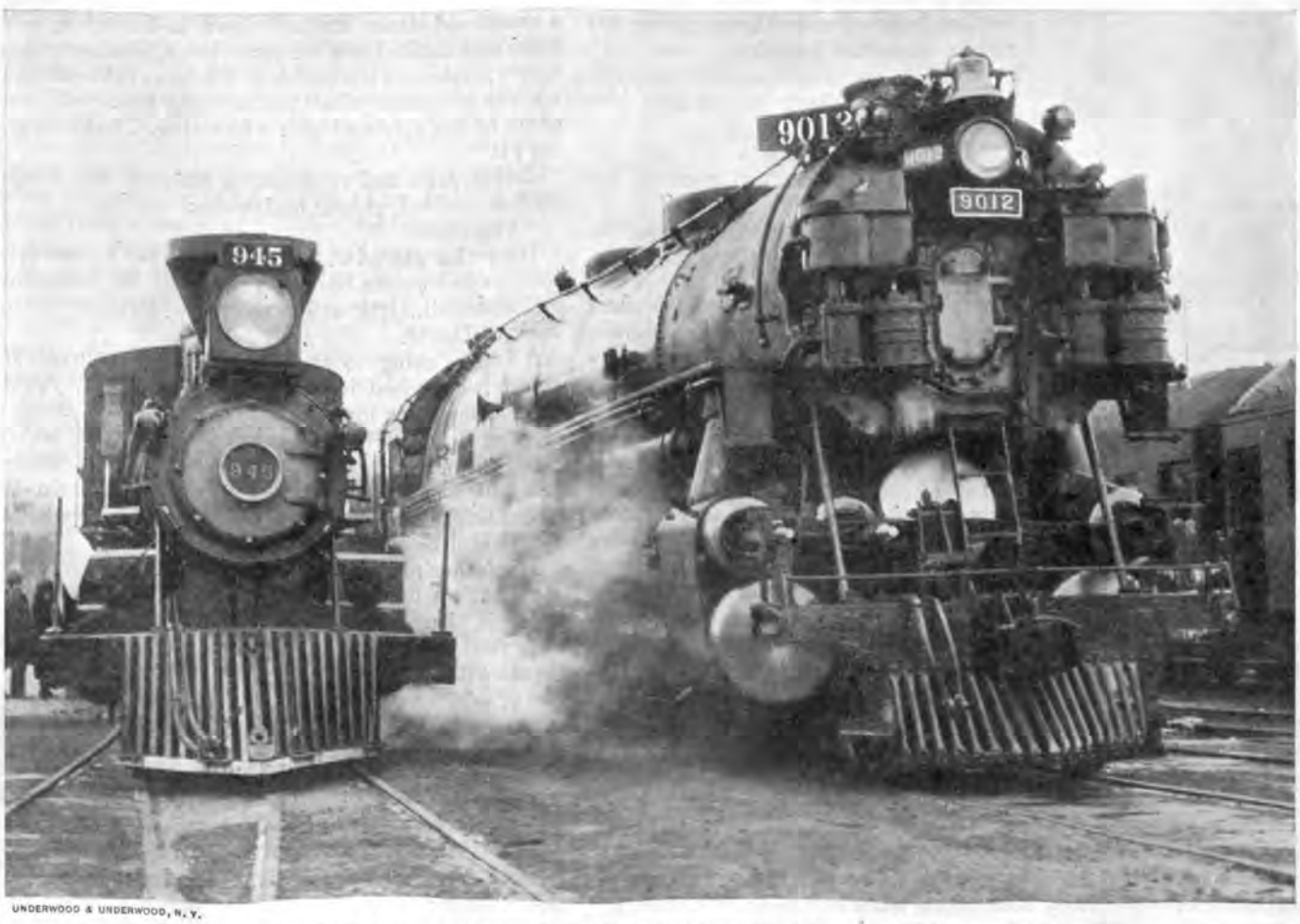
We speak of electric power. Strictly, there is no such thing. There is wild electric power, as in lightning, but that is no good because we cannot catch it and tame it. For our purposes, electricity must be tame, and tame electricity has to be made by turning a magnet inside a coil of wire. A magnet revolving in a coil of wire is called a generator; what it generates is electric current. But a generator cannot revolve itself, wherefore electric current cannot produce itself. There has to be an engine, called a prime mover, to revolve the generator. By that means the power of an engine is converted into electric current, and in the form of electric current power becomes mobile; it will flow through copper wires, and, therefore, by wires it may be conducted away from the engine to hundreds and thousands of electric motors at a distance of miles, up to hundreds of miles, just as water might be conducted from a dam through pipes to turn hundreds of little water wheels. Thus the problem of locomotion was solved; and then, instead

Individual Seats and Indirect Lighting as Well as Great Speed

of factories built around engines, each factory with its own smokestack, you began to see enormous electric-power stations and overhead high-tension transmission lines to distribute power in the form of electric current over the whole of an industrial area, and great factories with no stacks at all.

Next the gas engine was developed, sometimes as a stationary engine, or prime mover, in place of the steam engine, to revolve generators and produce electric current, but particularly in forms possessing the quality of locomotion, as in the automobile. When the gas engine had been made to get up and walk, carry its own fuel and become a beast of burden, its advantages over the steam locomotive for certain purposes were instantly apparent. It could be made small and it carried its fuel in the form of liquid gas very neatly. Therefore, the gas engine, not the steam engine, was for the automobile.

However, a gas engine delivering its power to the wheels of a vehicle by mechanical transmission, through a gear box, leaves much to *(Continued on Page 55)*



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More Than a Half Century of Progress in Locomotive Evolution. The One Was Built in 1867, the Other is One of the Latest Type Three-Cylinder Engines

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boat clusters and have the chief steward see that every cabin is lighted up! Don't lose that boat!"

With a whistle and sting of sleet, the squall shut down on the Arcturus like a blanket. Nobody spoke a word, nobody moved, for fear the crackle of a frozen oilskin might just shut out the sound of a faint hail out of the thick swirling to windward. Below, along the port rail, most of the crew hung over, cupped hand at ear.

"Where was Manly, now, just as the squall hit us?" asked Captain Clayborne. "Had he got clear of the Somaten?"

"No, sir," answered the navigator. "He'll probably stand by her until it clears. We could find the wreck again easily. That is, easier than we could find a boat."

"I think he was clear," said the officer of the watch. "I had the glass on him. They were well away."

Night shut down, so that all they could see in the searchlight beam was the driving snow. The wreck, the Arcturus and the lifeboat would, if they drifted long enough, eventually drift together. This was all Captain Clayborne had to hope for. If Manly tried to row to find the Arcturus, he would simply wear out his men, and perhaps wander so far they would never find him again.

Suddenly, out of the darkness, faint, but clear above the moaning of the stays, came a sound like water suddenly running into a bathtub, followed by a sinister crackling, then a splashing, as though some marine monster sported about. Then silence.

A murmur rose from the crew along the rail. On the bridge, not a word. Everyone knew the meaning of that clatter out there in the night. The Somaten had gone down.

Another hour passed in anxious waiting. Captain Clayborne went away into the wing by himself and let the storm stream into his ears. He should never have let that boat go out. He should have stood by until daybreak. He should have notified all the other ships around there that he had picked up the Somaten and asked them for help. Meanwhile the Somaten would have gone down anyway, but he would not have lost his boat. If the boat had still been fast to the wreck, then they had gone down with her. If they had got clear, they would have been sucked under just the same. He had allowed Manly to go with that boat when it was not his duty to do so. He had allowed his personal feelings to overcome his judgment. He was no longer worthy of command at sea.

"Light-o! Light-o! Broad on the port bow!"

To port, glittering, flashing like a diamond, a flare twinkled ghostily.

"Boat ahoy!" yelled fifty voices. The Arcturus' siren roared acknowledgment. Then the searchlights focused upon the boat.

She lay head on to the sea, riding to a sea anchor, her people aft, a white, hunch-shouldered mass. The Arcturus crept cautiously over to her, and half a dozen lines smacked into her at once. Then slowly they drew her up under the side, where men in cradles from the Arcturus made fast lines to the men in the boat, and then hoisted them, bundles of spray-incrusted clothing, into the warm depths above.

"All clear?" bellowed Captain Clayborne through the megaphone. "Releasing gear frozen? Never mind! Stave her in and cast off! To hell with her!" Then he went down to the hospital to see the survivors.

The first man he met was Captain Manly, blue-lipped, being chopped out of his frozen oilskins.

"Good work!" said Captain Clayborne, grasping the other's hand. "I'm glad you're back. I thought for sure you'd gone down with the other poor lads on the Somaten."

"I got 'em all off!" said Captain Manly. "There were only four. The others had been taken off by a windjammer. That's why she didn't give any more signals. The radio men had been taken off. The captain stayed behind with an injured man and another hand to help him. The windjammer lost them. A squall blew her away."

"Who was the fourth man?"

Captain Manly's blue lips parted in a ghastly grin. "O'Neill," said he. "The pilot. He'd taken her down the river, and the storm was so bad they couldn't get him off again."

Across the room, where a hospital steward was rubbing his frostbitten toes with ice, sat an elderly, weather-beaten man with a blanket about his shoulders.

"No, no grog," said the elderly man. "I've niver touched a drop, and niver the worse for it. Hot coffee is better." Here he dipped his monkeylike countenance into a steaming bowl. "What in the name of the siven divils are ye doin' here with the Arcturus, Clayborne? Are ye this far off course with all your newfangled fiddle-de-dees and your iron quartermaster?"

"What did you do with the Somaten, you old penguin?" demanded Clayborne, going over. "I should think that you would have sense enough to get him in out of trouble somewhere."

"Bah! His agents ordered him out. He had no more money for to pay wharfage. He was mad to get an offing, and what could I tell him to do? He took three seas over the bow that carried away his forward house, and his forehold was full of water in ten minutes. 'Tis a grandfather gale. If a big wagon like the Arcturus would be a hundred miles out of her course by it, what could you expect of a poor tramp?"

Captain Clayborne unbuttoned the two top buttons of his overcoat and sat down on one of the hospital chairs.

"Listen, Pelorus Jack, of Sandy Hook," he began. "Have you noticed the shoreward set of the current lately? We nearly shaved the stem off Block Island last night, it was so strong. But the one I have in mind is the one that nearly beached us both like a couple of old hulks. Don't worry though. You'll never run aground while Jack Clayborne can pass you a line."

"Are ye mad?" demanded O'Neill. "Or am I? Beached us? Beached who? I've niver put keel in mud in forty year!"

"The commission's ruling about pilots taking their turn!" hissed Captain Clayborne. "Wasn't that designed to put you ashore? But I sent a radio to the lines that I wouldn't have it. That O'Neill would take the Arcturus in, or I'd keep her out here until he did!"

"No! Did ye now?" said O'Neill dryly. Then to the hospital steward: "Rub the other foot awhile, will ye, young felly, like a good lad? Sure, ye'll be down to the copper on that one in another second." He buried his face in the bowl again.

"'Tis the first hot stuff I've had for forty-eight hours," he explained. "I'd have drunk the flames of hell, I was that cold at eight bells. Clayborne, you were ever a fine lad for mindin' other people's business. That ruling was my own idea. Sure, to give the lads all an equal chance to learn the profession with the big boats, as well as the little. I'm retirin' Choosday. 'Tis well I'd be out of it, there bein' too many pilots and I gettin' old. I have enough laid by. So you wouldn't take the pilot they give ye? Ye'll need no current to set ye ashore if ye keep on that way!"

"That ruling was your idea?" stammered Captain Clayborne. "It's lucky I didn't know it! If I had, I'd never have come banging down here all these miles, and you'd have gone to Davy a few years before your time." His face sobered. "O'Neill, I thought I'd lost that boat. Whenever it came into the beam of the searchlight, I went ten years younger!"

"'Tis no thanks to me," said O'Neill, having another go at the bowl. "There were four of us on the wreck, and the wind whistlin' out of the depths of her the way the bulkheads was collapsin'. Sure, I thought the race of the O'Neills would soon be extinct. Well, annyway, down comes the boat and gets a line aboard, and we over the side into it.

"'Cast off an' row for yer lives,' I says. 'There's a squall comin' and we mustn't lose the ship.'

"'Steady all!' says young Manly at the steerin' oar. 'I'm givin' orders here. You're on the high seas, O'Neill; ye've got no authority. No man,' says he, 'is in a bigger hurry than I to get away, fer I'm to be married the morn's morning, and I'll have to go right from the altar to the Casket if we're any later.'"

O'Neill cackled again at the joke. The Casquets are the first land one sees, Cherbourg-bound, after Sandy Hook.

"To be married! What do you mean? Married to who? Manly to be married?" gasped Captain Clayborne.

"Sure," said O'Neill sarcastically. "They stand up together, you know, an' say this an' that. That's marriage. It's safe to assume he's goin' to marry some young leddy. Says he to me, 'I've had nothin' else in my mind since I left New York. I was in that big a hurry to get home I nearly put the Arcturus ashore on Sankaty Head. When Clayborne said anything to me, there was a girl's face come between us an' I never heard him. But when I was off course beyont the lightship, he says to me, says he, "'Tis the man that's in a hurry at sea that goes to the eels before his time! See now, ye nearly had us on the beach with your rush!" So now we'll just heave over the lifeboat's sea anchor and ride to it until we're picked up. We can't make the Arcturus before the squall hits us, and Clayborne will ground on his own sardine cans before he'll leave us.'"

"Wants to be married!" repeated Captain Clayborne. "Why, I thought he was after my ship!"

"Divil a bit! He thinks you're a fine man. Men in an open boat in wintertime say what they mean to each other."

Captain Clayborne heaved himself to his feet and buttoned his overcoat.

"Well, I've got to be getting back to the bridge. Tell me, as long as you're aboard, I don't care who takes us up the river, but do you suppose I can get anyone to take me in at all this weather?"

"Give me a little calk," replied O'Neill, "and call me when you raise Fire Island, and I'll take you in. Sure, we don't want to disappoint the lad on his wedding. There'll be a shoreward set that will carry us in nicely."

Captain Clayborne crossed the deck to where Captain Manly was being rubbed with alcohol.

"Nice work, Manly," said he. "When you get ready, turn in, and don't think of anything until we dock. Just to give you courage, I'm retiring after the West Indies cruise, and I'm going to recommend they give you the Arcturus."

THE ARTICLES OF PROGRESS

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be desired. The power is not flexible enough. Fancy that an animal, or that you yourself, had only one speed backward and three speeds forward—one to start with, one to walk with, one to run with—and that to get from one to another, it was necessary to throw out a clutch, shift gears and let the clutch in again. That is how mechanical transmission works. With light vehicles and small loads it is tolerable enough. A donkey with mechanical transmission would be probably as efficient as a donkey is. But imagine an elephant with one speed backward and three speeds forward.

What is the solution here? It is quite simple. If the power of the engine is converted first into electric current and transmitted in that form to the driving wheels, then mechanical locomotion becomes suddenly as free and flexible as animal locomotion. That is what the gas-electric locomotive does. It combines the power of the machine with the locomotor qualities of an animal. Almost, it is an animal. Technically, it combines the advantages that may be possessed separately by the gas-engine locomotive, the steam-engine locomotive and the electric locomotive.

Compare it, for example, with the electric locomotive such as you may see running on electrified stretches of railroad. In that system you have, first, enormous power stations where fixed engines revolve generators to produce electric current, then a transmission line to conduct the current along the tracks, and, thirdly, the electric locomotive that is simply an electric motor like the one in your ice box, only bigger and not screwed fast but mounted on wheels, so that it moves itself instead of standing still and moving the wheel of something else. The electric locomotive takes the current, called also the

juice, by means of a sliding contact with a naked transmission wire overhead, or it may be from a naked transmission rail below; this current turns the motor and the motor turns the driving wheels. If anything happens to the juice, the electric locomotive is powerless. It cannot move. It has no power of its own to move with. And what is true of one is true of all. Every locomotive on the line is powerless if anything happens to the current or to the fixed engines at the power station that produce it. But a gas-electric locomotive makes its own juice and is self-contained in its own mobility. It is power station, transmission line and motor all in one. That is to say, it carries its own power station in the form of a gas engine, and its transmission line is six feet of copper cable from the generator through the floor down to the electric motor that turns its wheels. The electric locomotive is tethered to a distant power station. Beyond the end of the juice line it cannot move, nor to one side of it, whereas the gas-electric locomotive, making its own juice, is tethered to nothing and may run on two rails anywhere, like a steam locomotive.

The Romantic Steam Locomotive

Then compare it with the steam locomotive. At this point the senses are not to be trusted. Of all the mechanical species possessing the quality of locomotion, the steam locomotive is the most exciting, and so, if it should disappear, it would be remembered always. It has visible reciprocal parts. Its exertions are revealed. It is full of grunts and snorts and exulting sounds. It boasts of its power and is believed. Moreover, its background in pioneer American history is deeply romantic.

The gas-electric locomotive, in contrast, is a featureless, dumb, cased-up thing, with all action concealed and no personality. In the case of a featherweight speed train like the Zephyr, it is small enough to be incorporated in the streamline design without bulging it in the least at any point. From the outside there is no sign of its existence; inside, you may walk around it and see nothing. And when it appears in a much more powerful form, as a detached locomotive to be coupled to any train, like a steam locomotive, still there will be nothing to see. Everything about it will have to be imagined.

Yet for all its grandeur, or perhaps because of it, the steam locomotive has points of regrettable weakness. One of them is a gluttonous appetite. That is what the technician means when he says its thermal efficiency is low. In a week's work it will consume its own weight in coal and water. It was for some such reason, no doubt, that nature abandoned its mammoth creatures and let them perish. They ate too much for what they did. Only about one-twentieth, or 5 per cent, of the potential energy in what a steam locomotive devours is delivered to the wheels in the form of effective driving power. Its metabolism is bad. Of what a gas engine eats, more than 25 per cent of the potential energy arrives at the wheels. Another weakness of the steam locomotive is that for all its lusty magnificence, its nature is hypochondriac. Not that it is really delicate or chronically ailing, only that its health takes a lot of minding. At the end of every run it has to be cooled and rubbed and put to bed. Once a month it takes time out, under rules prescribed by the Interstate Commerce Commission, to have its boilers thoroughly physicked. Then at frequent intervals a trip to the sanitarium for a general overhauling. Technicians speak of the availability of a piece of locomotive equipment. How much of its lifetime is spent on duty? As such machines go, the availability of the steam locomotive is very low, maybe 35 per cent, whereas the availability of the gas-electric locomotive, owing to the mulishness of the Diesel engine, may be as high as 95 per cent, which means simply that it takes very little time off.

The gas-electric locomotive has yet to meet the steam locomotive on flat terms for decisive combat. That duel is soon to come. The run of the Zephyr was a challenge only. True, no steam locomotive could have done it; on the other hand, that was not a steam locomotive's job. But the gas-electric locomotive is not limited to that kind of job or that kind of train. The engine that moved the Zephyr was 600 horse power; the whole Zephyr train weighed 200,000 pounds. There is now building a gas-electric locomotive of the same Diesel-engine type to develop 3600 horse power; and its undertaking will be to put itself in the place of a steam locomotive at the head of a transcontinental train weighing, probably, 2,000,000 pounds—a train of full standard equipment—and pull it all the way from Chicago to the Pacific Coast. One engine!

Now the further implications begin to appear. It takes from eight to ten steam locomotives to haul a transcontinental passenger train from Chicago to the Pacific Coast. Suppose one engine could do it; and suppose that were an engine that would have to stop only once or twice to refill its fuel tank. What of all the water tanks and coaling stations and roundhouses and shops that now serve and service steam locomotives on the transcontinental-railroad routes? What of the people employed on the steam locomotives that are as ten to one against the gas-electric locomotive necessary to perform the same work, and of those employed at the water tanks and coaling stations and roundhouses and shops, and so on back to the coal mines that produce the coal the steam locomotives now devour?

But such questions as these have been asked and waived at every step of our way with progress during the last 150 years. The only point of doing with one engine the work of ten would be to cheapen the cost of transportation again; and never in the past has the cost of transportation been cheapened but in the end to increase, not to decrease, the total of human employment.

The Electric Interloper

However, whether we will or not, here are the materials of great change. We are looking at them. The railroads did not conjure them up. The gas-electric locomotive was evolved on the edge of the motor industry; the featherweight streamline train was produced by an outside manufacturing industry. The railroad industry, to speak of it generally, had been skeptical, timid, resistant and fearful. The gas-electric locomotive and the featherweight train both have had to be driven first through a railroad's executive department and then through its mechanical department; going the other way, or through the mechanical department first, they were certain to be wrecked. Here and there would be a railroad executive with the imagination to see it, but never—almost never—a mechanical department, with all its formulas based upon steam practice, all its faith in weight of equipment, and all its knowledge reduced to infallible rules.

So would any institution, wherein it is old and honorable and proud, resist the idea of sudden change. But even the executive who has the imagination to see, and all the more because he sees, will be uneasy and a little afraid. Why? Well, suppose it were true, as it may be. Suppose the steam locomotive were obsolete in fact as a mechanical species. Suppose railroad equipment, if you should look at it in a reasonable way, would appear to be archaic, in view of what might be put in place of it. Though he were willing to throw his mechanical department out of the window and tradition on top of it, what should he do then about the capital that represents all of that obsolete property?

The Changing Railroad World

The cruelties of obsoleseence are not to be taken lightly. They are unpredictable and remorseless. What can happen to the steam locomotive? There it stands on the track, as grand and as useful today as it was yesterday. But if a new and more capable locomotor mechanism has appeared in the world, out of the nowhere, the economic value of that steam locomotive is suddenly impaired, may even be destroyed, and there is no help for it. Thus, the railroad executive looks on the destructive side of change—on that side first—and cannot avoid a sense of dread. Yet he knows very well that one deep reason for the economic sickness of the railroad industry is that it has too much dreaded change and once, in a solemn and futile way, denied the power of change to touch it.

Forty years ago, to place it very roughly in time, the railroads took high cognizance of their estate and said: "This is the superb form of property, and it is permanent. Nothing can ever supersede it."

So everyone thought at the time. Having arrived at that conclusion, the railroads wiped out their sinking funds. All at once the sinking fund disappeared from railroad finance.

Now, a sinking fund is a sum regularly set aside out of profits to extinguish debt—specifically, in the case of the railroads, to pay off bonds as they came due. The assumption implicit in the sinking fund is that all forms of property are impermanent, wherefore borrowed capital—that is to say, debt—must be paid back out of profits before the property wears out or becomes obsolete. But if property has at last achieved a permanent form, never to be superseded by any competitive form, then of course there is no necessity to set up sinking funds out of the earnings to pay off debt. If the property is permanent, the debt is secure forever; it is more than secure, since if the property itself is permanent and cannot be superseded, it is bound to increase in value with the growth of the country. So the railroads believed, and believing it, they stopped paying off their debt out of earnings. As bonds matured they were not paid off; they were refunded. New bonds were exchanged for old ones, and the new ones were made longer and longer in term, up to ninety-nine years; for if the property was permanent, so might the debt be, and what was the sense of having to exchange new bonds for old ones every little while? It does not follow that railroad debt became static. It did not. It increased. Besides exchanging new bonds for old ones, the railroads sold new bonds for new capital to increase

their properties, always, of course, in the same superb form and always with the same assumption of its being permanent.

Forty years ago, hardly anybody could imagine a competitive mode of transportation. Hence the dread of railroad monopoly and the irresistible demand for Government regulation of the railroads, for laws to compel railroads to compete with one another, and, at last, for Government control of rates.

The power to control rates is the power to control profits; the power to control profits is a power of life and death over capital. When, through the Interstate Commerce Commission, the Government assumed that power, it assumed also an unlimited moral responsibility for the security of railroad capital. The Interstate Commerce Commission was loath to face this logic. Yet there was no avoiding it, and when it did face the truth, the result was inevitable. It declared that as a matter of public policy rates should be such as to return a reasonable profit on railroad capitalization as a whole. Thus, intending at first only to control rates, the Government was obliged to go on and say it would exercise that power both to limit profits and to guarantee them, as a matter of public policy. In this position the Government, too, assumed that the railroad represented property in its permanent form, beyond the reach of any competition that might be trusted in a natural economic way to limit its profits or divide its power.

Since then, what has happened?

The entire civilized world, since then, has been motorized. Since then in this country individual private transportation in the new form of the automobile has become a universal possession. A great system of concrete highways has been laid down. On these highways, day and night, run motor busses and motor trucks, competing with the railroads for passenger and freight carriage. Forty years ago, no frenzy of fancy could have entertained all this, and it is only what has happened on the ground. There is now, besides, a transportation system in the air, flying passengers, light freight and mail, in competition with the railroads.

The Government and the Railroads

There is no such thing as a permanent form of property, in a sense either physical or economic. If ever a delusion to the contrary could have seemed rational, it was at the beginning of this century, when the railroads embraced it as concerning themselves, the Government and all common opinion supporting it; and yet this was on the eve of change at a rate such as never before had been witnessed in the life of the world.

That is true of all popular delusions. They touch the extreme of plausibility just at the breaking point.

The Government could decree that railroad rates should be such as to return a reasonable profit on railroad capital as a whole; it could not forbid change to take place, nor could it forbid change to work its effects, one of them being to make a great deal of railroad property obsolete and unprofitable. As the earning power of railroad capital, for that reason among others, began to fall, the Government could, and the Government did, decree that rates should be raised, in order that railroad capital again as a whole should be reasonably profitable; the Government could not oblige people to pay those rates where cheaper means of transportation were available. What then? Having assumed unlimited moral liability for the railroad capital structure as a whole, what shall the Government do if the earning power of that capital continues to fall, higher rates notwithstanding? What it did do, beginning in 1932, was to employ public credit to save the capital structure as a whole, on the ground that as a matter of public policy it could not be permitted to collapse. Since then the Government has loaned to the railroads, roughly, $600,000,000, for various purposes, one being to enable them to pay off embarrassing debt.

The Toll of Obsolescence

An enormous amount of obsolescence now appears in the railroad capital structure as a whole, representing the impermanence and lost earning power of property that was deemed permanent, representing locomotives that are no longer intact, representing equipment that can no longer be run at a profit, representing 30,000 miles of track that the railroads would abandon if the Interstate Commerce Commission would permit them to do it, 20,000 stations that the railroads' old customers have abandoned without permission of the Interstate Commerce Commission, and so on. The fact of obsolescence is nobody's fault, since change does it; the liability consists in not writing it off and calling it lost. What is lost is lost, and all the Government's credit cannot save it.

The demand for transportation has not failed. All the time it has been rising. At the lowest point of railroad traffic during the depression the total demand for transportation was probably greater than when the railroads, a few years ago, were at the peak of their prosperity. Certainly, this would be true of travel. It has enormously increased. While passenger traffic on the railroads was decreasing three-fifths, travel by motor bus went from nothing to one-half of all the railroads had left, and travel by private motor cars increased more than tenfold. That is change.

To the suggestion that the railroads have stood aloof from change, or that they have let progress go by, a railroad man retorts with proper indignation. He offers the record to be examined, and he may be proud of it. After the war, the owners of the railroads having got them back in a used-up condition, there was carried through a program of rehabilitation and improvement that cost up to a billion of dollars annually over a series of years. The railroad machine was thereby raised to a point of effectiveness never before equaled here or anywhere. The benefits to business and industry in terms of service were extraordinary. The shortening of freight-train time schedules and making them trustworthy had, indeed, a notable effect upon the capital situation of the country, releasing funds that had been formerly tied up in large stocks of stored merchandise.

That was progress, certainly, as the railroads say; and yet it consisted only in doing better what they already knew how to do—not in doing a new thing. And the limitation of it all was that the cost of transportation was not cheapened. That becomes the crucial fact. For all the improvement in railroad service, traffic more and more took to the highways because highway transportation was either cheaper or more convenient, sometimes both. Moreover, in the face of competition, the cost of

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railroad transportation has been rising. Since 1900 the cost of moving an average ton of freight one mile by rail has increased one-third; in the same time, the average cost of travel per passenger per mile has increased, roughly, one-third. Which is to say not only that the finest railroad machine in the world failed during thirty years to cheapen cost of transportation; it is to say that when suddenly it came to meet competition where competition had been thought impossible, it was unable to keep its service from rising in cost.

The Railroad Riddle

If you ask a railroad man why this is so, your first sensation will be that of having touched a match to straw. In the ashes you will find, besides the comments that would not burn, some very earnest reflections on the difficulties of conducting an industry that is neither public nor private. The fields of activity are three. In one the railroads have but the responsibility to obey the Government's orders; in the second, matters are settled by friction and dispute; in the third, which is narrow, a railroad may do more or less as it will. On services that no longer pay, but which the railroads are forbidden to discontinue, there is a loss of maybe $250,000,000 a year. That has to be added to the cost of producing transportation. The Interstate Commerce Commission charged the railroads $145,000,000 as their share of the cost of finding their capital value. The only thing found was that the railroads are worth what they are worth. But there was $145,000,000 to be added to the cost of producing transportation. First the people demand Government regulation of the railroads. The cost of it to the railroads has to be added to the cost of transportation. To what else could it be added? As the regulation increases the cost of it increases, and it has all to be charged sooner or later to shippers and passengers in the form of rates.

Then suddenly if shippers and passengers take to the highways and patronize there an unregulated system of transportation only because it is cheaper, is it fair?

Having finished with the ashes, you may go to the Interstate Commerce Commission and ask the same question. Why, with the finest railroad machine in the world, has the cost of railroad transportation been rising? There you will have another kind of experience. Concerning railroads the Interstate Commerce Commission has accumulated an infinite amount of fact knowledge; owing to the profundity of its knowledge, simple questions are very difficult to answer. They may be, in truth, unanswerable. Here are men who have grown old and haggard thinking out the answers to questions A and B. And now you come, wanting all at once an answer to Question Z. Between the Interstate Commerce Commission and the railroads the relations are such as between a man and woman who have quarreled so long and bitterly that no simple questions are left and they quarrel about quarreling. The profit is for the lawyer.

Meanwhile there is traffic. If the railroads lose their traffic their troubles will be over and the Interstate Commerce Commission will have to find something else to regulate. It is not merely a question of how the railroads shall get back the traffic they have lost. If that were the question, much else would be hopeless. A struggle over how to divide what already exists belongs to no idea or theory of progress.

It is true that much traffic has left the railroads and gone to the highways because highway transportation was either cheaper or more convenient. But that is the superficial fact. There is much more traffic on the highways than the railroads have lost. What does that mean? It means that as the cost of transportation was cheapened traffic increased. There, then, is the problem: Not how to divide what traffic there is, or how to restore it to those who first had it, but how to create much more.

At a time when this problem becomes so acute that the Government does not know what to do with the railroads and even the advocates of Government ownership are weakening; when the railroads, on their part, would almost as soon sell out to the Government as to go on as they are—just then invention says it is ready with the mechanical means whereby the cost of producing railroad transportation may be greatly reduced. In the past at such a juncture any new means would have been embraced in a spirit of adventure. But at no time in the past was there so much luggage—and luggage is bad for adventure. Besides the luggage of inertia and tradition of which we seem to have more than ever before, there is the luggage of hindering laws, the luggage of obsolescence already existing in the railroad capital structure that the Government and the railroads are together defending, and the luggage of a habit on the part of the railroads to look to the Government for aid and relief, even now for capital. Not the Burlington but two other railroads are borrowing money out of the public treasury for purposes of a limited experiment with the gas-electric locomotive and speed trains.

Paying the Price of Progress

Greatly to reduce the cost of transportation and at the same time to open up fields of new service more belike the times would of course involve the destruction of much fine old railroad property, much displacement of labor, much loss and litter. This could not happen all at once. Such a process takes time. In the process, the railroads would be creating new property, new industries, new employment, new traffic, new profits.

What of the profit? Here is another obstacle. To compensate not only for the loss of old property but also for the risk of adventure, it is necessary that there shall be the expectation of profit in the new thing. But a railroad is no longer sure that in the event of success it would be permitted to have the profit. With the utmost protection, profit is a fragile, fabulous result, and very liable. Now, suddenly, profit as such, the principle of profit, is in jeopardy for political reasons, and the profit motive is slandered. It may be possible to dispense with that motive. There is a doctrine among us that says it shall be dispensed with. Yet we know that all our advance in material well-being until now has relied upon it. We know how it works and that it will work. We have no experience of anything that will work in place of it.

Progress is not inevitable. With all the materials thereto, still it is not inevitable. People may at any time stop, divide what there is, consume it and repent. That has happened again and again in the world. There is a price to pay for progress. Grim disappointments, great losses, crises, struggle, competition, insecurity, all the evils of economic and political liberty preferred over those of the planned and regimented life—such are the elements of the price. People who are weary of paying it will not progress; people who are persuaded that they may have progress without price are deluded. In so far as now we may be involved in that delusion, it is the only fact you can imagine that may arrest progress.

COACHING WITH CONNIE MACK

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never runs at the wrong time any more than Babe Ruth. Such fellows last longer in the big leagues because baseball is a game of wits as well as skill. That is the reason you will see Bucky Harris standing out on the coaching line at third base when the Red Sox are batting. He is there on the chance that some opportunity will reveal itself to his experienced eyes that might not, quickly enough to be seized, be seen by younger men.

Two Runs Scored on a Foul

I remember a game between the Athletics and the Yankees on a holiday in 1927, maybe the Fourth, maybe Decoration Day; I've forgotten. The score favored the Yankees 8 to 6. There was nobody out and we had the bases full, with Cobb at first and me at second and someone else on third. Then our man at bat popped up a high foul. Grabowski, the Yankee catcher, threw away his mask and with uplifted face ran close to the Athletics' dugout, which is guarded by a low iron railing. The ball, as a piece of iron to a magnet, smacked into his glove. It was a good catch and the batter was out at the instant it was made, but at that same instant the catcher vanished! His legs had carried him against that dugout railing, so that he had plunged over it, head foremost. For all we knew, he had been killed, because what he dropped into was the bottom of a concrete staircase giving access to a tunnel leading to the clubhouse. Philadelphia players rushed down to the assistance of what they feared was at best a badly injured man; so did our trainer. In the grand stands and bleachers horrified spectators had risen to their feet; but Cobb and I, accustomed all our days to keeping our eyes and minds on the ball, were running, each yelling at the man on third to light out for home, which he did.

You see, when that foul ball went up, each of us, naturally, had no thought of running. We had kept close to the sanctuary afforded by contact with the bases, but as soon as we realized that the ball had been caught, but that home plate was completely exposed, we started our journeys. The man who had been on third scored; then I scored, and Cobb had passed third and was on his way home before Grabowski came to life. As he emerged from the dugout steps, ready to throw to home to stop the play, there was nobody there to receive the ball. The Yankees had permitted their minds to be diverted from the ball game. But Miller Huggins was a smart guy, always, awake or sleeping. He simply had to do something. Cobb's run would have made the score 9 to 8 and given us the game.

Huggins began to squawk to Umpire Tommy Connolly. He conceded that our man on third had scored fairly. But Cobb and I, he insisted, should be sent back to the bases. Why? He said that so many Philadelphia players had gone to the rescue of Grabowski that they had impeded him; that in trying to help him, wittingly or no, they had held him down, almost kidnaped him! A fifteen-minute argument ensued and Umpire Connolly finally decided to let me score, but ruled that Cobb would have to stop on third. That made the score 8 to 8. The game went to extra innings and eventually the Yankees won. My satisfaction had to be taken later, when the rules were changed.

A Ground Rule on Umpires

Nowadays, if a fielder, after catching a fly ball, falls into a bench, dugout or stand at any point, the base runner or runners shall be entitled to advance one base and the ball shall be dead; but the rule provides that the fielder must fall; if he should step into difficulty of that kind deliberately, that would not count.

They monkey around with football every year trying to make a new game out of it, but in baseball the rules are not often disturbed; so I claim some kind of a record for having participated in plays that changed two of the rules. The other time was the result of a game the Athletics played at New York. This was in the days when Baker, Barry, McInnis and Collins were the $100,000 infield.

A ball was hit right through the pitcher's box and I stopped it so far back of second that I was out of position to throw directly to first base. A fellow on second was running on the hit. I couldn't put the ball on him, but I did see a chance to flip it to Barry, the shortstop. Bill Dineen, the umpire, was not expecting me to do that and got in the way; the ball hit him on the head and not a single New York player stopped running to ask if he was hurt.

We Athletics made a loud squawk then, contending that the play ought to be made over. Finally, when the umpires decided we were right, the New York man went back to bat to try it again. This time he hit a fly that was caught, retiring their side. Since then the rule has been changed and now if the umpire is hit by a thrown ball, it is just too bad and the play goes right on. I suppose you might call that one a perpetual ground rule on umpires.

This lively ball, now; it is one of the things that make it so difficult to make a comparison of players past and present that is anything more than one man's opinion. I am not hedging on anything I have said about Cobb or the