300 Miles to the Gallon!

By William G. Shepherd

Your automobile may run into a gasoline drought one of these days, according to the geologists. Does that bother your motor car manufacturer? Not at all! There's power for your engine in coal, charcoal, alcohol and even potato peelings

Illustrated by Harry Haenigsen

IF YOUR automobile engine purred as smoothly as that one you'd be the proudest driver in America. It stood on its block in the Detroit experimental laboratory, running like a clock.

"How'd you like that engine in your car?" Charles F. Kettering asked me the question. He's a General Motors man. By inventing among other things the self-starter, he widened the field of car ownership from big-muscle boys alone and made it possible for the frailest lady, in her daintiest frock, to start off in her car by the mere touch of her satin slipper on a small pedal.

Of course you'd like an engine like that, pulling your car.

"But look here," he said. He took a cork from a small bottle and moved it slowly under my nose. The damp cork had no distinctive odor. Then he moved the cork before a small aperture in the engine. It was like giving a human being a full sniff of pepper.

One whiff of that chemical made the engine sick. It slowed down. It began to knock as if it were pulling a ten-ton truck up a steep hill.

"What would you do if your engine knocked like that?" asked Mr. Kettering.

"I'd get out of the car and send for a repair man."

"Wait a minute." He pulled a cork out of another small bottle. My nose again failed to note any distinctive odor, as he passed it before my face.

He moved the cork, somewhat rapidly, before the aperture through which the engine was breathing.

Sledge hammers began to pound within the cylinders. The great room resounded to the noises of a boiler factory.

"What would you do if your engine started to knock like that?" shouted my guide above the tumult.

"I'd throw the family out of the car and we'd run for our lives."

"But everyone would tell you something was the matter with your engine, don't you think?"

"Not the slightest doubt," I roared.

"Some mechanic would pull it all apart for you, put it together again and charge you a pile of money, wouldn't he?" persisted the big-chested man.

"I'd expect to pay a lot to get an engine like that fixed."

The Reviving Sniff

"But you and I both know there's nothing wrong with the engine," insisted Mr. Kettering. "You heard it running noiselessly, a couple of minutes ago. Nothing has happened to the engine. Whatever *has* happened has happened to the fuel.

"Let me show you what a good engine this really is," he continued.

He permitted the engine to take a half-second sniff from a cork removed from a third diminutive bottle.

It was like turning off the power from a riveting machine. The knocking stopped almost instantly. Faster and faster moved the flywheel. Its sound became the soft hum of a top.

"It could barely turn itself before," said Mr. Kettering. "But now it's ready to take care of itself and do a big job besides.

"I've shown you this," he explained, "just to illustrate my point that we are only beginning to know gasoline as a motor fuel. The time is bound to come," he told me, as we walked out of the now almost silent room, "when we shall get more power out of gasoline. There's enough power in one gallon of gasoline, if you could utilize it all on mere car push, not taking into consideration engine friction and so forth, to drive a small car on a level paved road, at twenty miles an hour, from Chicago to Detroit. That's about three hundred miles.

"Today, a gallon of gasoline drives this same small car only twenty miles. We'll have to get that mileage up, and we'll do it too."

I had gone to Detroit to ask certain men who make our cars what they plan to do when comes that supposedly dread and dismal day which sees the last ounce of motor fuel taken from the oil wells.

I didn't find a single sign of panic in sight. Oil men of the nation, together with governors of various states, were preparing for the great June oil conservation congress in Denver, by which the companies hoped to get together to prevent unnecessary flowing of oil. President Hoover, only a few weeks before, had announced to a group of newspaper men in the White House offices that there would be no more drilling on government lands; that there would be "conservation of oil in this administration."

Not long before, experts had said we have only nine billion barrels of oil in the earth and that ten years will see the end of it, at the present rate of use.

There was enough for automobile makers to be panicky about, if there was reason for panic. But the first real fact I ran across in my search among the presidents of the great motor car manufacturing companies was this:

There isn't a motor car maker in this broad land who gives a whoop whether the squirting oil wells give out or not, that is, if they don't expire suddenly before other fuels can be prepared in sufficient quantities. The day of panic about a possible oil shortage has been wiped off the calendar of the future.

"What of it?" asks the car manufacturer, when you query him about the remote day of dry oil wells. "We're ready for it, when it does come.

"There'll be more cars running on the highways, after the last oil well has run dry, than there are now."

The motor car makers are going ahead complacently under the threat of a petroleumless world. This means that you and I, from this day forward, may step on the gas without a single fear that we may be selfishly ridding our children or our great-great-grandchildren of fuel for their land, air or water transport. Our present quota is an average of ten barrels of gasoline a year, per car. Use all you want.

Troubled Waters

This is not saying that there wasn't a day when the thought of dry oil wells and dry gasoline tanks at filling stations did make motor car makers sick at heart.

Just before the great war both the car manufacturers and the oil men got "jumpy" over the situation. Indeed, they held a conference to see what could be done.

What would be the use of car makers putting floods of gold into automobile plants for the future if the flood of oil were to cease and the gasoline would climb to a luxury height?

You and I—millions of us—would have been without cars today, both be-

cause of the high cost of cars and the high cost of fuel, if both the oil men and the car makers had not plunged blindly ahead, about fifteen years ago, determined to believe that somehow the problem would be solved by science, in their laboratories. They couldn't know what oil the Lord has stored away in the heart of the earth; but they had an almost childlike faith in the brains that He had stored away in human heads. Just like fool Americans they plunged ahead.

Whenever motor fuel goes too high in price the motor car factory must cut down production. Indeed in European countries, where motor fuel has been high in price, the motor car has never even had a good start, because of lack of mass production.

With gasoline some years ago at sixty-five cents a gallon in England—even while crude oil was right under her surface, ready to be taken out, as was proved by striking oil in ye one lone oil well of old England, known as Hardstoft No. 1—is it any wonder, what with high motor car taxes and a few other economic obstacles, that the automobile never got a fair start with the masses in that land?

Speed from Spuds

Similar conservatism, instead of American plunging, here in the United States just before the war, when people everywhere were talking about failing oil supplies, might have kept the automobile out of our reach.

As it is—here's our American motor car selling all over the world and American automobile plants being erected throughout the world. I talked with a man in Detroit the other day who has been erecting an American motor car assembly plant in Bombay! And as for worries about the oil supply, they have all passed away. I have talked with many oil men and many motor car makers on the subject. The solution of the "gas" problem is a new thing—but the ghosts of automobile-deserted highways and oilless oil wells have been laid. We can say good-by to our oil fields forever, if worst comes to worst, and ride away in motor cars driven by cheap fuel that never squirted through an earth-piercing pipe. In proof:

One of the busiest little worriers, some years ago, about the future oil supply was John N. Willys.

"I was named as head of a committee of our nation-wide association of automobile manufacturers to get at the truth about our oil supply," he told me. "I gave a dinner in one of the New York clubs, to which I invited both oil men and automobile makers. At my right sat one of the leading oil men of the nation; at my left sat another.

"I chatted with my right-hand neighbor, first.

"'What about the nation's oil supply? How long will it last?' I asked him.

"'Don't worry a minute about it,' he replied. 'My company owns great oil lands which it doesn't intend to touch for years. We won't take out the oil in those places until prices begin to rise considerably above the present rate. There's enough oil in the soil of America to last us for generations.'

"That was encouraging. Later in the evening I turned to my left-hand neighbor.

"'I don't want to go off half cocked on this oil proposition,' I explained to him. 'What do you think of the oil situation?'

"'Oh, it's very grave! Very grave!' he answered. 'We are likely to see the tapering off in the supply at almost any time. Something must be done.'

"There I had both sides of it.

"But now I have reached the stage, as a motor car maker, when my emotion regarding the oil supply is one of total unconcern. Automobile engineering is reaching such a high degree of exactness that I am persuaded that our streets and roads will abound in motor cars long after the petroleum supply runs out—if it ever does. We can trust our engineers for anything and everything.

"Why," he added, "our research men could make practical automobile engines that could run cars on alcohol distilled from potato peelings, if necessary to. They're always finding out something new about getting more power out of fuel."

Laboratory equipment for automobile engineers is improving as rapidly as are motor cars. We can do things today that we couldn't have hoped to do in 1920. For instance, we now have implements for measuring the intense heat within each engine cylinder. We knew that the three front cylinders in a six-cylinder engine were always cooler, and therefore yielded less power than the three rear cylinders. This was because the fan is placed at the front end of the car and also because the cooler water was taken from the radiator directly to the front cylinder which needed it least. Gasoline which would fire easily in a hot cylinder would not serve so well in the cooler ones. On a new model, therefore, we are taking the cold water into the engine back between the fifth and the sixth cylinders. This will give equal heat to all six cylinders. This is an example of how the less volatile gasoline than that of other days may be used because of better carburetion. It shows how engineers are helping motor car manufacturers to reach new refinements.

The Good Old Gas

Now Mr. Willys let no cat out of the bag when he mentioned the "less volatile gasoline of today."

It's perfectly true, and the oil men have made no secret of it, that gasoline isn't what it used to be. In this big job of making our petroleum supply stretch as far into the future as possible, the oil men have taken more gasoline out of a gallon of crude oil than they used to. They were forced to do this, both to keep the price of gasoline within the range of motor car users and to meet competition among themselves. To get one gallon of gasoline, say fifteen years ago, the oil men had to take almost eleven gallons of crude oil out of the earth; today they give you a gallon of gasoline which they have secured from only two-and-a-half gallons of crude oil.

The point of the matter is, however, that methods of building engines and of extracting engine fuels have been so improved that we get over four times more gasoline power out of one gallon of crude oil than we did fifteen years ago.

And I'm underestimating this calculation, because, as Roy D. Chapin, chairman of the Hudson Motor Car Company, told me, "The motor car industry every year has been giving the public more mileage per gallon of gas."

The chances are, indeed, that, on a basis of motor car fuel, science, both in the oil and in the automotive industries, has multiplied the motor car power of our oil wells by six or seven. Mr. Chapin told me of further laboratory study that has helped to achieve this.

"Automotive engineers, some years ago," explained Mr. Chapin, "decided that we had better study gasoline, as well as engines. It was a splendid decision. But money was needed as well as science.

"There is a great joint organization, known as the American Petroleum Institute, that serves the oil men with study and information. There is also a great joint organization known as the National Automobile Chamber of Commerce which serves the motor car maker in a similar fashion. Both of these great organizations were persuaded by the engineers to put up money on a fifty-fifty basis, for experimentation.

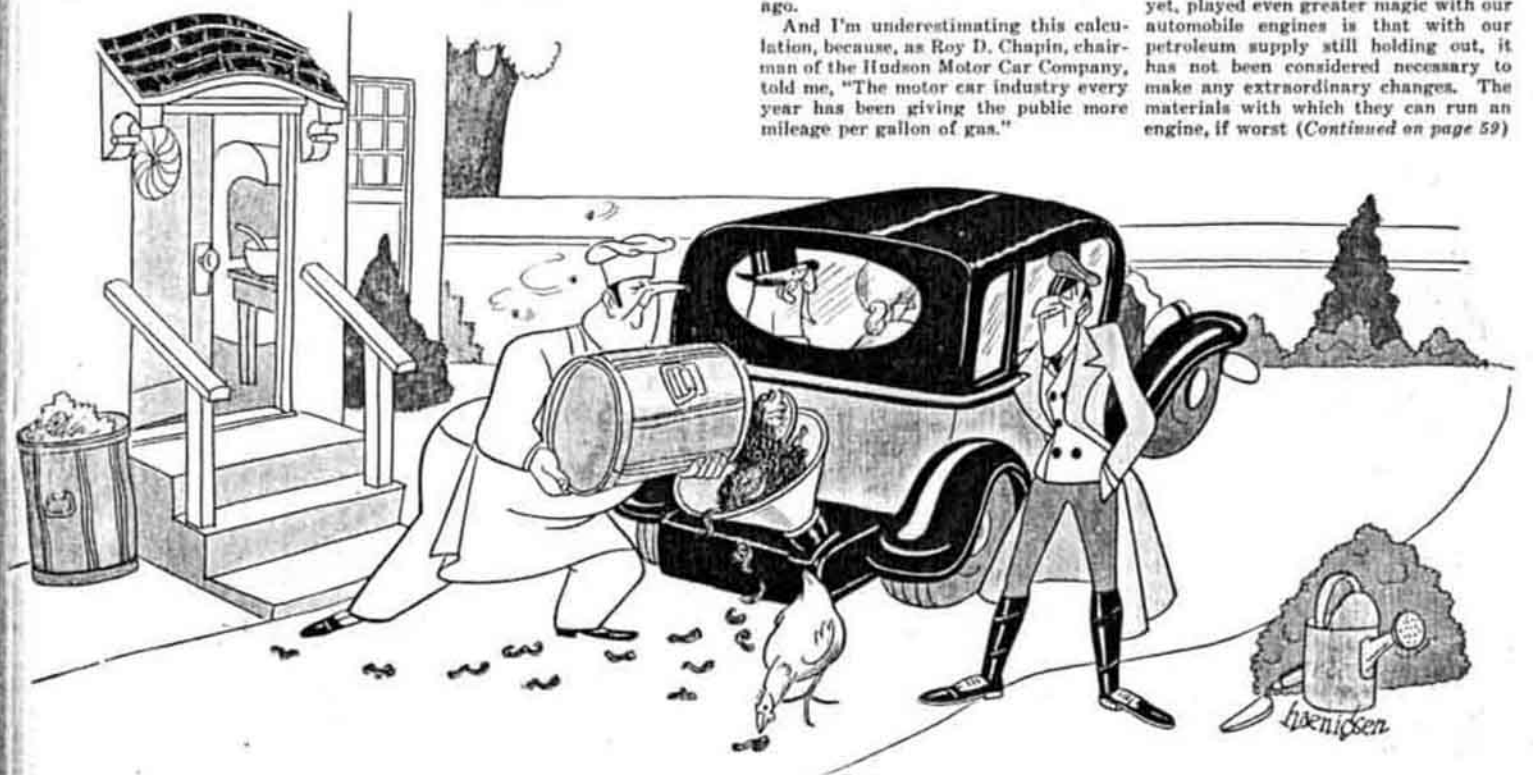
"The Bureau of Standards in Washington, one of the most effective departments of the government, made room in its Washington laboratories for the experimenters and lent us great aid.

"This study, in the Bureau of Standards, together with what we have learned about fuel and engines in research work in our own engineering departments has resulted in helping every motor car maker in America to give the public an engine that operates more efficiently, with the less explosive gasoline that is taken from oil today, than they operated ten years ago with more highly refined gasoline.

Making Each Drop Count

"We've changed the inlet of gasoline in our motors, changed the situation of our valves, changed our carburetors and even changed the location of our spark plugs, all with increased efficiency, because of new things we are constantly learning about gasoline and gasoline engines. We're going to make gas go a long way farther than it used to go."

As a matter of fact, the only reason that our automobile engineers haven't, as yet, played even greater magic with our automobile engines is that with our petroleum supply still holding out, it has not been considered necessary to make any extraordinary changes. The materials with which they can run an engine, if worst (*Continued on page 59*)



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comes to worst, are amazing in their variety.

Beyond oil wells, indeed even beyond any combustible material of any sort, passes the vision of H. H. Franklin, car maker and American developer of the air-cooled engine. Energy broadcast on ether waves or through the decomposition of atoms may drive our cars some day, he thinks. As for our present-day use of gasoline, he says, "At the present time approximately ninety per cent of the power of a motor car engine is consumed by wind resistance. Only ten per cent is required for overcoming inertia and friction. I believe that scientific stream-lining of bodies will encourage wider use of air-cooled engines, which will eliminate the broad-pointed areas necessary for radiators."

When Mr. Albert R. Erskine, president of the Studebaker company, blithely faced my questions concerning dry oil well days by turning me over to William S. James, Studebaker research engineer, the latter gentleman said, most reassuringly:

"Why, it's quite possible to produce automotive equipment suitable for the use of charcoal from small twigs and other refuse of this nature. During the World War gasoline was scarce in Egypt and they had their cotton crop to gather and transport.

"They developed cheap methods of producing charcoal from waste wood and twigs, with which they harvested the crop in charcoal-burning steam lorries."

One notable young car builder, E. L. Cord, president of the Auburn Automobile company, put the problem and its answer to me this way: "Why, nobody has ever yet built a fully effective internal-combustion engine that would consume the full power of its fuel. Other problems than 100 per cent fuel efficiency have entered into making of such engines. There are commercial problems, production problems, the ideas of the public as to what shape an engine and a motor car should have."

French trucks, fitted with ordinary gas engines, have been operated with gas obtained from a small gas producer, burning wood or charcoal, fitted on the running board. Engines have been operated on butter fats, on animal oils, on fish oils, on alcohol from sugar cane.

There's Some Oil Left

Of course we shall stick to the easy-flowing petroleum for a motor car supply as long as possible. It costs, at the refinery, from seven to eight cents a gallon; marketing and transportation costs add about ten cents a gallon to this price.

Twenty-cent gasoline will not only keep the motor car industry where it is today but will permit it to keep on growing. It is desirable, therefore, to draw our motor fuel from oil wells as long as possible.

One of the most notable of these optimists was an Illinois farmer boy who had learned in his early days to put his faith in the yield of this good old earth. His name is Charles W. Nash. He told me about his confidence in the oil supply:

"I remember very well, that when I first entered the motor car industry nearly twenty years ago, the Automobile Chamber of Commerce was beginning to worry about what we were going to do for fuel for the automobile. It was freely predicted by many that the gasoline supply would become exhausted within a very few years.

"My own opinion is that there is now deposited in the earth so much undiscovered crude oil that it will be several generations before there will be a noticeable shortage of petroleum motor fuel."

"If the oil business had gone ahead on the basis of 1913," Walter Teagle, president of the Standard Oil Company of New Jersey, told me, "both the oil industry and the motor car industry would have been far behind their present situation. Whether we could get enough fuel at reasonable prices for motor cars has been a serious problem at times. But it is a problem that is being rapidly solved."

Two and a half million barrels of oil a day is one big mess of oil. It's needed, however, to keep up the supply of eight or ten barrels of oil that you, an average car owner, must have every 365 days.

How to "Crack" Oil

There are 320,000 oil wells to draw upon. Sounds like a lot, but there's a joker in the picture. Over in Pennsylvania, every week or so, ancient wells, which ceased spurting forty years ago, are "put under pump" for a few hours and yield two or three barrels. In Kansas, Texas and Oklahoma, oil is coaxed in small but steady quantities from wells drilled years ago. Wells which yield oil without coaxing or pumping are few. Which means that new wells must be drilled all the time.

Back in 1913, we were inclined to lean solely on the gusher; today the gushing oil is only about fifty per cent of our supply.

The refiners, as we have already seen, are getting more gasoline out of oil than they used to. Prior to 1913—when the gasoline panic reached its height among oil and motor car men—refiners merely "cooked" the crude oil and by distillation changed a scant nine per cent of it into gasoline. That was all they could get, by mere boiling.

The "cracking system" changed all this. I don't suppose there's a motorist in America who has not wondered, at some time or other, what this snappily named process of "cracking" really is. Very simple. You simply throw away your old open-air cooker and boil your crude oil in an air-tight tank, under high pressure. Thus you'll be "cracking" molecules of crude oil, thereby releasing extra quantities of gasoline that you never could have broken down by ordinary cooking.

Under "pressure cooking," forty per cent of crude oil becomes motor gasoline.

"We can turn sixty per cent of crude oil into gasoline, if necessary," said E. M. Clark, eminent chemist, comfortingly, to this writer. "All we have to do is to regulate the pressure."

Now it's true, of course, that the distilled gasoline of 1913 had more power in it, quantity for quantity, than the "cracked" gasoline of today. It was, as the oil men say, more explosive. It's drug-store gasoline; the kind you are supposed to get in a small bottle for a dime. It's the kind that took Lindbergh to Paris.

John T. Casey, chief of the flying field at Red Bank, New Jersey, explains the difference thus:

"They call the very best gas we flyers can get by the name of '73-76.' That means by hydrometer test. We get it in drums. It costs about forty cents a gallon, retail. The next high test is '68-70;' the retail cost of that is about

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thirty-five cents. Then you come down to the ordinary automobile gasoline."

"What happens if you try to use the forty-cent gasoline in your automobile?" I asked him.

"I've tried it, in a pinch," he said. "You'd be surprised to know how little difference it makes. You get a quicker pickup and maybe a hotter explosion, but an ordinary driver in a good 1929 car wouldn't notice it." Casey had a boost for automobile engineers. "They've got these automobile engines down so fine these days," he said, "that they'll run almost as well on the cheapest honest gasoline as on our fancy '73-76'," he said. And then he handed a bouquet to the gasoline maker. "More than once," he added, "I've flown my planes, in a pinch, on ordinary gas right out of an automobile gas tank and it had plenty of power to get me where I was going.

"But, for the air, there's a margin of power, weight for weight, in the high test gasoline. It gives an aviator a percentage of advantage."

So much for that part of petroleum known as gasoline. But there are other parts of a gallon of oil beside gasoline that will drive an engine.

Think of a quart of crude oil as consisting of various layers. The top layer—almost the upper half—consists of your gasoline. We have engines for that. The second layer, a thin one, consists of kerosene. We also have engines for that. The third layer lying just above the thick lubricating greases is what is known as fuel oil; the sort that is used in heating houses. And now we have engines for that.

Opened up New Era

Not many weeks ago the newspapers excitedly told us that a Packard Diesel engine carried a plane from Detroit to New York, using as its sole fuel not gasoline but this third-layer fuel oil.

That flight opened up a new era for engine makers, for oil producers, for the art of aviation and, perhaps, ultimately for you and me, or our children as motor car users.

No batteries are used with a Diesel engine; compression itself explodes the charge of fuel that enters the cylinders. Heavy Diesel engines have been considered the height of luxury on rich men's yachts; now light-weight Diesel engines, as the Packard experiment shows, are showing signs of coming into the range of practical, everyday use.

How soon we'll have Diesel engines in our cars is a question. I talked with Alvan Macauley, president of the Packard Motor Car Company, about it. One thing seems sure and that is that we're not likely to have Diesel-engined motor cars right away. He told me:

"Those who expect to use the Diesel engine in their cars must wait at least five years, if not longer. Even then," he added, "we can't promise the new engine will be generally suitable for automobiles. In the present gasoline engine the compression pressure when the throttle is wide open is only ninety pounds per square inch, whereas, in the Diesel engine five hundred pounds pressure per square inch is required at all times.

"The fact that the very high compression necessary in the Diesel type engine is present whether the engine is idling, operating at cruising speed or at full speed, does not detract from its value in airplanes or boats, for in these uses the engine is practically always operated at a high percentage of its maximum output.

"On the other hand the automobile engine is operated at wide-open throttle at maximum speed for a very small percentage of the total time, and we consider that it would be probably objectionable in an automobile engine to have this very high compression required by a Diesel when driving a car about town under traffic conditions.

"One thing that seems to me epochal in this new engine is that we have added, in the automotive field, a third engine in the petroleum scale. This makes it possible to get more power out of a gallon of crude oil.

What to Expect from the Diesel

"Our Diesel engine is a fuel oil engine. We have been able to operate it, either on the thick crude oil, filtered after it comes directly from the well, or we can operate it on fuel oil after the gasoline, kerosene and even some of the lighter lubricating oils have been removed from the crude oil."

What this new engine means to aviation was pointed out to me, simply, by Capt. L. M. Woolson, aëronautic and research engineer, who had a guiding hand in its creation.

"Lindbergh, who flew about 3,200 miles to Paris, and still had some gasoline left for emergency, could, with the same weight of fuel, oil, and a Diesel engine, of power equal to that of the Spirit of St. Louis, have flown about twenty-five or thirty per cent farther than he did. He could have passed Paris with fuel, roughly speaking, for an additional 800 miles."

Twenty million gallons of gasoline, taken from soft coal, was used for operating motor cars in Germany last year. This is just another story of that touch of laboratory magic that has served to revolutionize human existence within the past twenty or twenty-five years.

I have beside me, as I write, a typewritten address of twenty-five pages. It was delivered by Dr. Krauch, a German scientist, before a group of American oil men. It sent the president of one of our greatest oil companies to Germany to pay several million dollars for American patent rights in the I. G. Farbenindustrie method of oil production from soft coal.

"Catalysis," runs the topic of the address, "applied to the Conversion of Hydrocarbons." It proved as clear to this layman as Einstein's famous five pages of arithmetic. But, buried away in it, were these very understandable words:

"With such knowledge we tackled the hydrogenation of coal and its products. . . . We managed to produce, without difficulty, the most diverse marketable products such as gasoline, kerosene, gas-oil, lubricating oils and so on. . . ."

E. M. Clark, Standard Oil chemist, most casually explained the new German powers to me:

"You see, the only difference between ordinary soft or bituminous coal and crude oil that comes from our wells is that the coal is deficient, chiefly, in hydrogen. All you have to do to turn coal into crude oil is to add hydrogen to it, and we've found out how to do that. To my mind, that settles the fuel oil problem for ages."

It is no longer a question of where we'll get our motor fuel. There's plenty of it in sight, as anyone can see.

"It may interest you to know," said Mr. Kettering, in our talk in his laboratory, "that, out of every twelve gallons of gasoline that you put into your tank, only one gallon goes for power. The other eleven gallons go into heating the water in your cooling system, the metal in your engine, and into the surrounding air.

"Only eight per cent of our gasoline is converted in automobiles into power for propulsion; the rest is wasted in heat and friction of the engine and automobile.

"We have been amazingly clumsy, in both the oil and automotive industries, about utilizing the full power of gasoline. For some reason or other, it hasn't been anybody's special business to work out this problem. The oil people got out the gasoline and the motor car makers got out the cars, and everyone, for a time, was content. The oil man stuck to his job, and the automotive engineer stuck to his.

"The problem of getting full power out of gasoline thus fell into a sort of No Man's Land of science. Just imagine," he continued, "what would have happened if oil drillers had struck crankshafts down in the earth, instead of oil. The automotive engineers, simply because crankshafts are machinery, would not have hesitated a moment to shorten or lengthen or change these crankshafts, produced by nature, to meet their own needs. Gasoline is just as much a part of an automobile as a crankshaft, and its molecules are of an identical nature with those of iron, steel, aluminum or any other element that goes into an automobile. But just because gasoline was not machinery the automotive industry has accepted gasoline, without attempting to make any change in it, or without attempting to adapt or rearrange its molecules, as they do those of iron and steel, to automotive purposes. It's time that we did this, and I can assure you that the job is well under way. Vastly more power is in sight for gasoline engines. Up to now, automotive engineers have been building their engines around a cracked and a highly variable fuel. You couldn't stand the variation in the materials in your car that automobile engineers have had to stand in fuel. They have been forced to build an engine that would run on almost any kind of gasoline. The engine today isn't the problem. The real problem is the adaptation of gasoline.

Taking the Knock Out of Gas

"It's the knock in the fuel that handicaps the engine maker. If we can take the knock out of fuel, we can, theoretically, get at least twice the number of miles per gallon, if not more, at ordinary speed that is obtainable now. You saw in the laboratory today that the knock is not a function of the engine, it is a function of the fuel. When the knock is taken out of gasoline fuel, we can make the gasoline engine at least equal in efficiency to the Diesel engine. The Diesel engine utilizes thirty-three per cent of the total energy in fuel, so you can see that we are only at the edge of the problem, which may be solved within the next few years, of getting far more power out of a gallon of gasoline than we have ever gotten before."

So you see that, whether our fuel comes from crude oil that spurts from the earth, or whether it comes from oil that is obtained by liquefying soft coal, or whether it comes from cooking the oil out of shale, the real problem that remains is how to get the most power out of whatever fuel we do use, at the lowest possible cost.