614-L

USE OF ALCOHOL FROM FARM PRODUCTS IN MOTOR FUEL

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE COMMITTEE ON FINANCE UNITED STATES SENATE

SEVENTY-SIXTH CONGRESS

FIRST SESSION

ON

S. 552

A BILL TO PROVIDE THAT GASOLINE MIXED WITH 7 PER CENTUM OF ETHYL ALCOHOL SHALL NOT BE SUBJECT TO THE TAX IMPOSED BY SECTION 617 OF THE REVENUE ACT OF 1932, AS AMENDED

AND

AN AMENDMENT INTENDED TO BE PROPOSED TO AN APPROPRIATE HOUSE REVENUE BILL TO PROVIDE THAT GASOLINE MIXED WITH 10 PER CENTUM OF ETHYL ALCOHOL SHALL NOT BE SUBJECT TO THE TAX IMPOSED BY LAW

MAY 23, 24, 25, AND 29, 1939

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CONTENTS

USE OF ALCOHOL FROM FARM PRODUCTS IN MOTOR FUEL

TUESDAY, MAY 23, 1939

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON FINANCE,
Washington, D. C.

The subcommittee met, pursuant to call, in the Finance Committee rooms, 312 Senate Office Building, Senator Clyde L. Herring (acting chairman) presiding. Also present, Senator Gurney, of South Dakota.

Senator HERRING. The committee will come to order. Senator Clark is detained at an important meeting. He asked me to preside until he could get here.

The subcommittee has before it a bill by Senator Gillette, S. 552, and a proposed amendment to an appropriate House revenue bill by Senator Gurney, both of which relate to an exemption from the Federal tax of gasoline mixed with a certain percentage of ethyl alcohol. S. 552 will be placed in the record at this point.

(The bill, S. 552, is as follows:)

[S. 552, 76th Cong., 1st sess.]

A BILL To provide that gasoline mixed with 7 per centum of ethyl alcohol shall not be subject to the tax imposed by section 617 of the Revenue Act of 1932, as amended

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That effective on the thirtieth day after the date of enactment of this Act, section 617 (c) (2) of the Revenue Act of 1932, as amended, is further amended to read as follows:

"(2) The term gasoline means (A) all products commonly or commercially known or sold as gasoline (including casinghead and natural gasoline), benzol, benzene, or naphtha, regardless of their classification or uses; and (B) any other liquid of a kind prepared, advertised, offered for sale, or sold for use as, or used as, a fuel for the propulsion of motor vehicles, motorboats, airplanes, or other automotive vehicles except that it does not include any of the foregoing liquids mixed with 7 per centum or more of anhydrous ethyl alcohol produced from annual agricultural crops grown in the continental United States or its organized Territories and so denatured as to exempt it from the tax imposed by law upon distilled spirits, and does not include any of the foregoing (other than products commonly or commercially known or sold as gasoline) sold for use otherwise than as a fuel for the propulsion of motor vehicles, motorboats, airplanes, or other automotive vehicles and otherwise than in the manufacture or production of such fuel."

Senator HERRING. As I understand, Senator Gurney intends to offer his amendment to an appropriate House bill. Perhaps it would be well if Senator Gurney would state the purposes of his amendment, and then we will hear any witnesses he may have to present as well as others who wish to testify. Senator Gurney.

STATEMENT OF HON. CHAN GURNEY, UNITED STATES SENATOR FROM THE STATE OF SOUTH DAKOTA

Senator GURNEY. First, I would like to offer for the record the proposed amendment that at first was proposed as an amendment to H. R. 3790. On the floor of the Seante it was agreed to conduct hearings before this committee, and the proposed amendment will be offered at a later date on some revenue measure that comes from the House, and, if the chairman will permit, I would like to start the hearing off by offering the amendment to appear in the record.

Senator HERRING. If there is no objection, it will appear in the record.

(The amendment to H. R. 3790 is as follows:)

[H. R. 3790, 76th Cong., 1st sess.]

AMENDMENT Intended to be proposed by Mr. GURNEY to the bill (H. R. 3790) relating to the taxation of the compensation of public officers and employees, viz: Add a new section to read as follows:

SEC. . That effective on the thirtieth day after the day of enactment of this Act section 3412 (c) (2) of the Internal Revenue Code is amended to read as follows:

"(2) The term 'gasoline' means (A) all products commonly or commercially known or sold as gasoline (including casinghead and natural gasoline), benzol, benzene, or naphtha, regardless of their classifications or uses; and (B) any other liquid of a kind prepared, advertised, offered for sale, or sold for use as, or used as, a fuel for the propulsion of motor vehicles, motorboats, or airplanes; except that it does not include any of the foregong mixed with 10 per centum or more of anhydrous ethyl alcohol produced from annual agricultural crops grown in the continental United States and so denatured as to exempt it from the tax imposed by law upon distilled spirits, does not include any of the foregoing (other than products commonly or commercially known or sold as gasoline) sold for use otherwise than as a fuel for the propulsion of motor vehicles, motorboats, or airplanes, and otherwise than in the manufacture or production of such fuel, and does not include kerosene, gas oil, or fuel oil."

Senator GURNEY. There will appear this morning as witnesses in favor of the bill Dr. William J. Hale, of the Dow Chemical Co., Midland, Mich.; Mr. William W. Buffum, of the National Farm Comergic Council; Mr. Carl H. Wilken, of the Raw Materials National Council, Sioux City, Iowa; and a little later Dr. Leo M. Christensen, of Miller, Nebr., formerly of the Atchison Argol Co. The testimony will be offered by those gentlemen, and I would just like to make a preliminary statement covering some of the reasons that I believe should be covered in the hearing, some of the information that should be covered in the testimony.

Beginning with the Hoover Farm Board on down through the various experiments of the triple A, it is estimated the Federal Government has paid in subsidies to the American farmers a total sum in round numbers of about $7,500,000,000 during the last 10 years. The average annual consumption of gasoline for motor fuel during this same interval has been about 18,000,000,000 gallons or 180,000,000,000 gallons for the 10-year period. If all this motor fuel had contained a 10-percent blend of anhydrous ethyl alcohol, 18,000,000,000 gallons of alcohol would have been required during the 10-year period.

Assuming that one-half of this alcohol had been made from corn and one-half from wheat, and based on an average yield of 2½ gallons of alcohol to the bushel, 3,500,000,000 bushels of corn and 3,500,000,000 bushels of wheat would necessarily have been diverted from

the food market to the industrial market. Assuming that this corn and wheat would have been available at "cost of production" prices namely, 60 cents per bushel for corn and $1 per bushel for wheat, the cost of the raw material would have been as follows:

3,500,000,000 bushels of corn, at 60 cents	$2,100,000,000
3,500,000,000 bushels of wheat, at $1	3,500,000,000
Total cost of raw material	5,600,000,000

The difference between the cost of farm subsidies and the cost of this raw material would have been as follows:

Estimated farm subsidies during 10-year period	$7,500,000,000
Cost of raw material	5,600,000,000
Difference	1,900,000,000

Assuming that the lifting of this surplus grain off the food market would have eliminated the payment of the above gross sum in farm subsidies, it is obvious that if the Federal Government had purchased the raw material for donation to the alcohol distilleries the United States Treasury and the taxpayers would have been $1,900,000,000 better off.

It is obvious that the absorption of these surpluses in grains by industry would in turn have influenced the open market price for all cereal crops much to the advantage of the American farmer and to the Nation as a whole, based on the simple fact that farm purchasing power would thus have been augmented on a sound instead of a fictitious basis and the expenditure of this purchasing power would have benefited every group of which our national economy is composed.

It is obvious that if the raw material for distilling the alcohol were made available without cost that the alcohol could be produced at a price per gallon to compete with gasoline without difficulty. The big advantage would be that such a policy would have given full employment to some 25,000,000 surplus acres.

Furthermore, the production of the raw material, its fermentation into alcohol, its blending and distribution would have given employment directly and indirectly to some 2,500,000 men, thus helping to relieve the unemployment problem. In making this estimate of the number of men thus employed it should be borne in mind that new purchasing power when earned (not given) by the American farmer has from a three-fold to a five-fold turn-over annually in our national economy and that all business and all citizens benefit accordingly.

Mr. Chairman, this amendment which is to be offered to the Internal Revenue Act is on the assumption of making motor fuel by blending gasoline with alcohol, and the alcohol to be made from domestic farm crops, not from any blackstrap molasses, or other material imported from outside the country. The main point is that the farmers need an additional market for that which they produce, in addition to the food market, and if a portion of what they raise can be turned into power, which they will in turn use in producing their own crops and tilling their own land, it will go a long way, and we believe all the way, in raising the price on the entire crop.

I believe that we should look into this thoroughly, not only from the standpoint of raising the farmer's income but also from the national defense angle of conserving the motor fuel that we are now

using, and that means gasoline. There are a lot of statements made as to the length of time our present reserve will last. It has been stated that the proven oil reserve and gasoline at the present time is some 14 or 15 years. So it is up to us, in my opinion, to conserve that supply, if at all possible.

The amendment does not seek a Federal appropriation of any kind. It is on the basis of making it possible for private capital to finance the production of this necessarily large amount of alcohol to be used for motor fuel.

I would like to suggest to the chairman that he now call on Mr. Carl H. Wilken of the Raw Materials National Council. He is from Sioux City, Iowa.

Senator CONNALLY. Senator, I would like to ask you a question.

Senator GURNEY. Go ahead, Senator Connally.

Senator CONNALLY. Why limit it to 7 percent of ethyl alcohol if it is a good thing? Why not require a larger percentage?

Senator GURNEY. My amendment reads 10 percent, Senator Connally.

Senator CONNALLY. The Gillette resolution is 7 percent.

Senator GURNEY. I think you may be looking at a different proposed amendment.

Senator CONNALLY. That is by Senator Gillette.

Senator GURNEY. The one I have is 10 percent.

Senator RADCLIFFE. This is Senator Gurney's amendment.

Senator CONNALLY. I thought we had the whole thing before us.

Senator GURNEY. As a starter 7 percent of alcohol would be a better proposition than my amendment, which says 10 percent. It would make it easier to get the industry started on a 7-percent basis than on a 10-percent basis.

Senator CONNALLY. Senator, do you have any estimate on the loss of revenue to the Government?

Senator GURNEY. That can be very easily figured out. If the entire 1-cent Federal tax on motor fuel was not forthcoming to the Government, that would be a total of $210,000,000, because we are using at the present time 21,000,000,000 gallons of motor fuel a year, but it will take years to be able to produce enough alcohol so that the entire motor fuel of the country would be a percentage of alcohol.

Senator RADCLIFFE. Mr. Wilken.

STATEMENT OF CARL H. WILKEN, SECRETARY, RAW MATERIALS NATIONAL COUNCIL, SIOUX CITY, IOWA

Mr. WILKEN. Mr. Chairman and members of the committee, my name is Carl H. Wilken, secretary of the Raw Materials National Council, an economic research organization at Sioux City, Iowa, and president of the Progressive Farmers of Iowa, a farm organization.

Senator CONNALLY. May I ask you a question right there? How is your research council financed?

Mr. WILKEN. The research council is finaced by voluntary contributions.

Senator CONNALLY. From what groups?

Mr. WILKEN. From farmers and from business men in that area. We have businessmen, farmers, professional men as members of the

Raw Materials National Council, and have a membership fee of $10 a year. I might say, Senator, that our research work is carried on on an impartial basis, independent from any group.

Now in my testimony I am going to combine S. 552 by Senator Gillette, which provides for 7 percent or more blend of alcohol, and Senator Gurney's amendment which provides for a 10-percent blend, and I am going to confine my testimony to the possible economic effect of the bill on the welfare of the Nation as a whole and the practical effect that it can have in solving our unemployment problem.

The value of alcohol as a supplement to gasoline for power purposes cannot be denied. Foreign nations have for many years used alcohol blends in their motors and have found them efficient and economical. I would like to call the committee's attention to the fact that all of the cars entered in the national auto races in 1938 used a blended fuel, most of which was obtained through the use of alcohol, the percentage depending on the amount best fitted for each driver's particular car.

Why did they use a blended fuel? They used a blended fuel because it gave them a cooler operation for their motor and it gave them more power and speed than they could obtain with regular types of fuel. Regardless of what the experts may say, it is impossible to get more power and speed unless the mixture does make a better fuel.

From the practical side of farm operation, during the year 1938, Fred Hawthorne, of Castana, Iowa, carried on extensive experiments with alcohol blends in the regular types of farm tractors. Mr. Hawthorne is an agricultural engineer and kept accurate records of his test. I will quote from a discussion on Power Alcohol Blends given by Mr. Hawthorne before the first congress of industry and raw materials at Sioux City, Iowa, on November 15, 1938.

Alcohol is a fuel of extremely high octane rating and, when added to ordinary gasoline in quantities of 10 to 15 percent, makes a fuel with antiknock qualities comparable to our leaded gasolines but with none of the objections just mentioned. In addition to keeping the motor free from gums, it also tends to keep the combustion head free from carbon deposits and, unlike lead, it is a fuel in itself.

My early dreams of corn-eating tractors have finally come true. Every working day this season, our two tractors have been eating around a bushel of corn a day—and they seem to like it.

We are required to keep a daily record on these experimental tractors showing hours run, gas and oil used, and mileage run as recorded by an instrument on the front wheel, from which acreage may be computed. These records indicated that we were getting around 7 percent more work per gallon from the Argol blends than from regular gasoline in these high-compression motors. In order to verify this, a careful test was made to accurately determine the relative fuel consumption on Standard Red Crown 70 octane gasoline as compared to a blend of Stanolind third-grade gasoline and 12½-percent Argol fluid. The test was run in a large level field with uniform soil. The load was a three 14-inch bottom plow set 6½ inches deep and with harrow attached. A 4-hour nonstop run was made with each fuel with absolutely no changes made in the adjustment of either plow or tractor. At the end of each test the fuel needed to refill to the filler cap was accurately measured. We will omit further details, for we are interested in the end results. Here they are: Fuel used per acre plowed and harrowed, Red Crown 70 octane gasoline, 1.65 gallons; Stanolind third-grade gasoline and 12½-percent Argol fluid, 1.54 gallons; a fuel saving in favor of the alcohol blend of 6.7 percent.

Regular gasoline cost me 12.8 cents, and the Argol blend 13.4 cents per gallon. Now, here is the figure that really interests us: Fuel cost per acre plowed and harrowed, regular gasoline, 20.8 cents, and Argol blend, 20.6 cents per acre.

MATTER OF SOUND ECONOMY

It was noted that the motor temperature was nearly 10° cooler when operating on Argol blend, with ease of starting, power, smoothness, and freedom from knocking all that could be desired. No water ever collected in the glass sediment bowl in the fuel line, as the alcohol readily takes up all the water that will normally be present in the gasoline. Tests of lubricating oil from the crankcase after over 100 hours of operation showed oil to be in excellent condition and fit for many hours more service. No valve or any other kind of motor trouble was experienced during the year's use of Argol blends in the two tractors.

MANUFACTURING COSTS

Some of the witnesses may testify that the manufacture of alcohol is uneconomic because of the cost factor. We are going to dismiss that phase of the question because it is not pertinent to the bill before the committee. If it is not profitable to manufacture alcohol with the advantage of the 1-cent exemption of the Federal fuel tax on blended fuels containing 7 percent or more of alcohol, the bill will become automatically inoperative, because private industry will not take advantage of the indirect subsidy. If it is possible to manufacture alcohol out of farm crops with the exemption, and our research indicates that it is, then we will have started an industry on its way which is destined to become one of the most important in the United States.

OTHER USES OF ALCOHOL

The development of the alcohol industry will mean lower costs for industrial alcohol. Alcohol in many ways is the king of industries. It is the base of acetic acid, which gives us the acetates to manufacture plastics, and it also is important in the production and use of cellulose, so that by starting off this industry on a large scale we will automatically lay the ground work for the expansion of many other industries.

THE ECONOMIC EFFECT

During the past 6 years we have been subsidizing the farmer not to produce new wealth. Such a program is an economic fallacy. It is an impossibility to have more wealth by producing less wealth. Of course, by creating a scarcity our economists say that we will have more dollars. If that is sound economic theory, then why go to the expense of producing the real wealth at all? Why not print the necessary money and eat it?

As a result of the research work of the Raw Materials Council, we have made the discovery that $1 of gross farm income, on the average, creates $1 of factory pay rolls and $7 of national income. And, further, that the $1 of gross farm income is the beginning of the primary flow of money through the channels of trade.

This 1–1–7 relationship of the farm dollar to our economy is not a theory but a historical fact based on the past 20 years of average farm income as compared to average national income. In order that you may realize its importance, I wish to point out that in 1928 and 1932 the farmers of the Nation produced approximately the same number of bushels of grain, pounds of meat, and bales of cotton, but because of the price drop and the 1–1–7 relationship farm income was $6,400,000,000 less in 1932 than in 1928. Factory pay rolls were approximately the same amount less, and the loss in national income in 1932

from the same number of units, approximately, of new wealth amounted to $45,000,000,000.

Therefore with each dollar of gross farm income translating into $7 of national income, the importance of maintaining the farm income is readily apparent.

If the bill which is before the committee were passed, it would make it possible, on the basis of a 10-percent blend of alcohol in our motor fuels, to use 1,000,000,000 bushels of grain annually.

In order to give the committee an idea of the tremendous market available for fuel, I wish to quote from a survey by the United States Department of Agriculture, entitled "Motor Fuels From Farm Products," Miscellaneous Publication No. 327, on page 42.

If the entire 1935 crop of carbohydrate crops, which from the table above are barley, corn, grain sorghums, rice, rye, wheat, Jerusalem artichokes, potatoes, sweetpotatoes, and sugar beets, were converted into alcohol, a total of 8,131,650,500 gallons might be obtained, equivalent to 47.4 percent of the gasoline used during that year. But this would leave the Nation without food.

Looking into the future it might be well for us to consider the necessity of conserving an irreplaceable raw material by the use of a raw material that can be grown every year from the soil. It might be of interest for the committee to know that 98 percent of our carbohydrous crops are nothing more than moist air and sunshine, of which the good Lord has given us a never-ending supply.

The Department of Agriculture admits in its survey that our present supply of farm crops is inadequate to produce a 10-percent blend of alcohol for our motor fuel in addition to food and other industrial requirements.

On the basis of their estimates, with which our research department concurs, it would require the additional production of 80,000,000 acres of farm crops to produce the raw materials for a 10-percent blend of alcohol in our motor fuels.

MONETARY RETURN

The monetary return from an additional 80,000,000 acres of production, on the basis of $20 an acre, which is conservative, would mean an additional $600,000,000 in gross farm income, $600,000,000 in factory pay rolls, and $4,200,000,000 in national income or business turn-over.

EMPLOYMENT

To produce, process, and distribute the additional production and the demand for other goods, would furnish approximately 2,000,000 new and permanent jobs.

CAPITAL

The building of plants would bring out of hiding approximately $350,000,000 of private capital. This bill does not require any expenditures from the Federal Treasury to build alcohol plants.

INDIRECT SUBSIDY

The exemption of the tax on motor fuels is of course an indirect subsidy, but what of it? The United States was developed to the point where we enjoy the highest standard of living of any nation

on the globe. All in the short space of 150 years as a democracy. How did we manage to obtain a higher standard of living than the rest of the world? Through subsidies which enabled us to develop our own resources.

Subsidies commenced with the third bill passed by the first session of Congress in 1789, our first tariff bill. Since that time we have and still are subsidizing domestic production and consumption of our own wealth. We subsidized the building of railroads, we have indirectly subsidize dthe automobile industry and the oil industry by the building of good roads with public funds, thereby increasing the demand for both more and better cars and more and better gasoline. Even our steel industry, one of our largest industrial groups, enjoyed the benefit of a tariff system in which it was allowed to benefit to the extent of $731,000,000 in just 1 year, 1937. This was on just crude and semifinished steel. This may be found in the Congressional Record of Tuesday, June 14, 1938, speech by Congressman Francis H. Case of South Dakota. Even the oil industry has enjoyed the benefit of a protective tariff against importations of foreign petroleum supplies, or an indirect subsidy.

EFFECT ON OIL INDUSTRY

I realize that Senators Capper and Connally come from States which are vitally interested in the production of petroleum, and if the leases that have been signed in northern Missouri and southern Iowa prove to cover oil territory, Senators Clark and Herring will also come from oil States, leaving the good Senator from Wisconsin as the only member of the committee from a State that doesn't have oil possibilities.

We have no way of knowing whether there is going to be opposition to this bill from the oil industry or not, but for the benefit of the Senators from those States which produce petroleum we would like to present the following argument:

The short-sighted view is, of course, to oppose, but that isn't always the best thing for all concerned. It is our opinion that the oil companies should cooperate in this program from the standpoint of the Nation as a whole and also from the selfish standpoint of financial return.

By creating 2,000,000 new and permanent jobs we will make it possible for 2,000,000 more automobiles to be driven each year. This, along with the power required to produce and transport the raw materials, will practically offset any loss of gallonage that they may suffer from displacement by alcohol.

We would also like to call the attention of the committee to the fact that it would require approximately 20,000,000 acres of farm crops to displace imports of petroleum each year on the basis of average imports for the years 1935, 1936, and 1937.

But that isn't all. With the exemption of the 1-cent-a-gallen tax blends for power alcohol, it will make it possible for the alcohol industry to use the excess of grains at parity prices. With parity prices

for the farmer our national income would be increased to at least 85 billion dollars. This increase would make it possible for us to produce and use 6,000,000 new automobiles each year, as compared to approximately 3,000,000 produced in 1938. These figures are based on the potential market of a car for each of the 42,000,000 farmers and laboring men in the United States and an average depreciation of a car every 7 years.

This additional number of cars sold annually, and the increased driving, resulting from a higher per capita income, would actually increase the demand for gasoline.

I wish to point out further that during the transition from horsepower to motorpower the oil industry has had all the benefit and the farmer has had all the loss through a lower price for his grain, resulting from the loss of markets that were destroyed when old dobbin was no longer required.

In this bill we ask the oil industry to cooperate with the farmer, one of his best customers, by using 10 percent of the farmer's products while the farmer uses 90 percent of the oil companies' products for power purposes, and help bring back the prosperity that has been hiding behind the corner for so many years.

THE BENEFITS TO THE NATION AS A WHOLE

The passage of this bill will help every industry in the United States and will also help the fiscal policies of the Government. On the basis of 25,000,000,000 gallons of motor fuel, and a full 10-percent blend, the Treasury receipts would be curtained by $250,000,000.

In return for this $250,000,000, the Federal Government would make it possible to increase our domestic production of farm crops and thus avoid the deficit of appropriations of approximately $750,000,000 for farm benefits to curtail production.

With an increase in national income of approximately 25 billion, the receipts of other taxes would be increased by a far greater amount than the loss in receipts due to the exemption in this bill. The additional employment resulting from the increase in national income would take the men off the relief rolls and we could once again balance the National Budget.

In closing, I wish to say that it is the opinion of the Raw Materials National Council that this short bill of only a few hundred words will do more to bring back permanet prosperity than all the legislation that we have passed during the last 6 years. I thank you, Mr. Chairman.

Senator RADCLIFFE. Are there any questions?

Senator LA FOLLETTE. Have you made any estimates on how big a development there would have to be in the production of this alcohol before you would bring the price down to the point where it would be any advantage to the manufacturer of motor fuels to make the blend and get the 1-cent exemption?

Mr. WILKEN. Of course, after you get up to the vanishing point you would not have any advantage, but at the present time we are consuming about 20 billion gallons of motor fuel a year.

Senator LA FOLLETTE. I am referring to these figures in the letter of the Acting Secretary of the Treasury. Have you seen that letter?

Mr. WILKEN. I have not.

Senator LA FOLLETTE. He indicates that it is clear that the 7 percent put into motor fuel in place of the 7 percent motor fuel removed would add a value on the gallonage basis of from 5.95 to 6.30 cents. Have you made any estimates, rough or otherwise, on the production of alcohol and the increased plants that would have to be built, and so forth, that would have to take place before the price of alcohol per gallon would get down to the point where the 1-cent tax exemption would be an inducement to the manufacturer to make the blend?

Mr. WILKEN. I think the 1-cent tax exemption would be an inducement at the present time. The cost records that we have made our survey of were prepared by the Atchison Argol Co., and on the basis of competitive prices for gasoline and the value of alcohol as a blend they could pay approximately a cent a pound for grain, if they get away from the marketing cost. Now, then, if the program is put on a national basis marketing costs would, of course, be very small. The trouble that we have had in getting the alcohol industry established in regard to power alcohol has been the educational work and the promotional work necessary to educate the public as to its value, and we feel that on the basis of a national program that expense would be eliminated, so that you would approximately start off at the point that you could pay about a cent a pound for corn. Now, then, in our research work on the farm problem we have used the alcohol industry as a sort of a dumping ground for any excess grains that we might have, and with the exemption of this 1 cent Federal tax on a 7 to 10 percent blend of alcohol the alcohol industry could pay approximately parity prices for all excess grains that we might produce above normal requirements for food and other industrial purposes at the present time.

Senator LA FOLLETTE. What are the prevailing prices per gallon for grain alcohol, for example?

Mr. WILKEN. Well, the alcohol blend at the present time, paying the price that they have been paying in that area for alcohol blended with the gasoline, the cost to the consumer is about 1 cent more than regular gasoline.

Senator LA FOLLETTE. Then you take the position that these quoted prices mentioned in the Assistant Secretary's letter are not accurate? Just read over the paragraph and tell me what, if any, answer you make to it.

Mr. WILKEN. He quotes the price of alcohol at 40 cents per gallon in carload lots. There is a lot of variation in those figures and the figures of the Atchison Argol Co., who have been making power alcohol. Now then, in regard to that phase of it, Dr. Leo Christensen will be a witness.

Senator LA FOLLETTE. Very well.

Mr. WILKEN. I think you could get the information that you want from him in detail.

Senator LA FOLLETTE. All right.

Senator RADCLIFFE. Are there any further questions? Is there anything in addition you want to say, Mr. Wilken?

Mr. WILKEN. No; that is all, Senator.

Senator RADCLIFFE. Thank you. Senator Gurney.

Senator GURNEY. Have you any of the other witnesses on the other side of the street to call?

Senator RADCLIFFE. There are a number listed here. Do you want Mr. Buffum to testify next?

Senator GURNEY. I will be glad to call him now, if the committee wishes.

Senator RADCLIFFE. Mr. William W. Buffum.

STATEMENT OF WILLIAM W. BUFFUM, THE CHEMICAL FOUNDATION, INC., NEW YORK, N. Y.

Mr. BUFFUM. Mr. Chairman, and members of the committee, I would like, if I may, to correct the statement of Senator Gurney as to whom I represent. Senator Gurney stated I would represent the National Farm Chemurgic Council. Instead, I represent the Chemical Foundation. That error was made by Senator Gurney by the fact, I think, that the Chemical Foundation formed the Farm Chemurgic Council, but about a year ago it was incorporated as a separate organization.

The Chemical Foundation has financed the research in the development of power alcohol from its inception to the present time. It has spent approximately a million dollars in its research and development work. It has applied for some 60 patents dealing with the manufacture of power alcohol and by-products. Those patents are held by the Foundation and are available for license to any American manufacturer. We have offered them to the Government at much less than they cost. We feel that the power-alcohol industry, as represented by our demonstration plant at Atchison, Kans., is at the point where it is ready for capital to develop it. There are, however, a number of problems yet unsolved.

Senator LA FOLLETTE. Before you go into that, has the Foundation secured what might be termed "basic" or controlling patents on this manufacture of power alcohol?

Mr. BUFFUM. Yes; I think it has.

Senator LA FOLLETTE. What are your license conditions?

Mr. BUFFUM. They have not been set as to these patents, but we have been licensing patents for some twenty-odd years at a nominal royalty rate to all industry.

Senator LA FOLLETTE. You make them available to everybody?

Mr. BUFFUM. To everybody. Anybody who is qualified to come in and take a license can get it. There are no restrictions whatsoever, so it is open to everyone. In other words, there is no monopoly under our patents.

Now we feel that these patents, this particular group, should go with this industry; particularly if it should be done by the Department of Agriculture they should have control of the patents, we are willing to turn them over to them. The reason for that is we believe there is a great deal more development to be done. In other words, it is an infant industry, a very infant industry.

We feel, referring to this amendment of Senator Gurney, that the encouragement of the Government is badly needed. The first thing that capital today wants to know is what is the Government's attitude. Well, the Government's attitude, I think, is represented by a report of Dr. Jacobs of the Department of Agriculture. I think that is a very fine report. To me it endorses the entire power alcohol program. Of course it points out the many things that are yet to be done, which is perfectly proper.

That research will have to go on over a period of years, and I understand the Department of Agriculture has available one of the new laboratories in which it is going to do further research in power alcohol. That will take a number of years, and should be done, but I do not think the industry should sit and wait for that additional research. I think it is developed to the point where it can be an industry. To us it is analogous to the development of the use of southern pine for the making of paper, which happened also to be one of our researches, and I think you gentlemen are all familiar with what has been done in the South and what it has meant to the southern farmer and southern industry. There is some $110,000,000 invested in new mills, and the first newsprint mill using southern pine will be dedicated on Saturday of this week at Lufkin, Tex., and a second newsprint mill has already been announced from Mississippi.

Now those two industries, the newsprint and kraft, from southern pine, indicated to us what could be done with farm products. That is how we became interested in power alcohol. The big cost, as Mr. Wilken stated a moment ago, is the educational and development cost that we have today. If it were not for that cost power alcohol could stand on its own.

Senator RADCLIFFE. You mean it could be made as cheaply as gasoline? You say "stand on its own."

Mr. BUFFUM. Senator, it does not have to be made as cheaply as the gasoline. The figures that I have here, and I think that Mr. Wilken read from the letter which the Senator handed him, is the cost of gasoline at the refinery. That gasoline has to be moved, in most cases, to the farm area. The cost is much higher when it arrives at the distributing point, or to the consumer.

Alcohol does not compete with gasoline; it competes with premium fuels. It raises the octane rating of the gasoline, to put it in a higher bracket class; therefore alcohol can get a higher price and still compete with the premium fuel, not straight gasoline.

We feel that this 1-cent Federal tax would just about make the difference between profit and loss on alcohol at present, the alcohol blends, because it costs just about 1 cent more to the customer; and, after all, he is the man who is paying the money. I think what is

more important would be the moral effect, the encouraging effect of the Government recognizing this as a great, new industry. In other words, as we see it, the products of the farm are the natural wealth of America. The more we can produce the more natural wealth we have. If the farmer can get a fair price, which pays him a profit for growing his products, he spends his money for products manufactured in plants in the urban sections of the country. Statistics show that the farmer's income and the factory pay roll of America for the past 30 years are almost identical; they go up and down with each other. If the factories are running full time, unemployment is going to be reduced greatly.

There has been a great deal of discussion as to whether or not this would curtail the business of oil companies by this 10 percent. I do not believe that would happen. I believe that 90 percent of the fuel business of a prosperous country will be greater than 100 percent of the fuel business of a country that is not prosperous.

It seems to me that this is as basic as the chemical industry was when it was being started in 1919 and 1920. As a matter of fact, this is a chemical industry, this agricultural industry. It is a part of our chemical industry, as we see it. We believe that the Government should offer it the same help that it offered the chemical industry when it was started, and I think it has proven that it was a very good investment on the Government's part, to help the chemical industry in its infant days, because that industry pays enormous taxes to the Government today.

In England, where alcohol blends are used quite extensively, alcohol was tax-free for the first 2 or 3 years. Last year they put on a tax. I was told the other day that the consumption has increased since the tax was put on. The evidence from the users is that it is a better motor fuel. That, I think, is something which cannot be questioned.

It is also the rule, I think, that in any new chemical industry the cost is always the highest at the start. As you progress and learn from experience your cost goes down. I was told recently that practically every product made in our chemical industry is made better and cheaper each year. History shows that. In other words, it is the advance of science. I think that this alcohol industry is probably the biggest opportunity for the advance of science in the agricultural industry that we have ever had.

Therefore we feel that this 1-cent Federal tax, as an indirect subsidy, would be a very small item to the Government, because it is impossible to produce enough alcohol for a 10-percent blend nationally for a long time to come, and the first few years it would amount to a very small sum. I believe there would then be enough progress made in the reduction of cost that the exemption of the tax could be eliminated. In other words, I have confidence enough in the development of science to believe that in a very few years this industry could be put on a basis that would require no subsidy, direct or indirect, of any kind. It would pay the farmer a profit for the products that he grows. It would help our unemployment situation. It would help our industry, and help our country in general. I thank you.

Senator LA FOLLETTE. Are there any questions you would like to ask?

Senator GURNEY. No questions.

Senator LA FOLLETTE. Mr. George Barton.

STATEMENT OF GEORGE BARTON, ENGINEER AND DIRECTOR, CHICAGO MOTOR CLUB, CHICAGO, ILL.

Senator LA FOLLETTE. Will you give your full name, address, and whom you represent, please, Mr. Barton?

Mr. BARTON. My name is George Barton. I am engineer for and a director of the Chicago Motor Club, which has a membership of about 85,000 motorists in Illinois and Indiana.

Senator LA FOLLETTE. You may proceed, in your own way, to make any comments you desire on S. 552 and Senator Gurney's amendment.

Mr. BARTON. As I indicated, we are an organization of motorists. As an organization serving the interest of motorists we have followed with some concern the various proposals made in recent years to force alcoholized motor fuels into use. It has been sought to bring about this use by placing penalties on present fuels, or subsidizing alcohol blends, or giving the blends preferential tax exemptions.

The purchasers of alcohol-gasoline will be, after all, the motorists. When I buy a commodity I consider two things: First, the intrinsic value of the commodity, and, second, its cost and value to me. Let me then, as a representative of the motorist, examine from the motorist's point of view the virtue of the commodity, alcohol blends, as a motor fuel.

As a first step in that examination let us evaluate the intrinsic value of alcohol blends and their cost as compared with straight gasoline. For this purpose let me introduce Mr. H. M. Jacklin, professor of automotive engineering at Purdue University, Lafayette, Ind. Professor Jacklin, by virtue of his experience and research, is well qualified to speak as an expert on this subject of alcohol blends. I would like to make a further statement after he has completed. Is that satisfactory to you?

Senator LA FOLLETTE. That is all right, if you desire to have it appear in the record that way. Professor Jacklin.

STATEMENT OF HAROLD M. JACKLIN, PROFESSOR OF AUTOMOTIVE ENGINEERING, PURDUE UNIVERSITY, LAFAYETTE, IND.

Senator LA FOLLETTE. Will you give your full name, please?

Mr. JACKLIN. Harold M. Jacklin. Nominally I am professor of automotive engineering at Purdue University. In the present instance, however, I am acting as a consulting engineer for the Chicago Motor Club.

I think the motoring public today is very much alive to the question of economy. One outstanding instance that has come to my attention

in the past 2 weeks is the new policy in advertising one of the new automobiles. It is quite different from that which we have had previously, particularly in bringing out a new model of the light type. That particular car happens to be built in Indiana, and on May 5, 2 weeks ago, they were 8,000 orders behind. The public seems to want this economy and are very much interested in having it.

Another slant on the public reaction toward extra or unnecessary expense is obtained from the fact that the Indiana Legislature, meeting in special session in the summer of 1938, repealed a 25-cent windshield-gadget law because of the continuous storm of protest from motorists all over the State.

I am aware of the fact that during the past 19 to 20 years there have been immense strides in the development of motor fuels. I recall that, in 1920, we were paying some 28 cents a gallon for fuel that we would consider akin to kerosene today. It was giving us a great deal of trouble from dilution in the crankcase and knocking and so on. In these 19 years the chemical engineers connected with the petroleum industry have succeeded, through research and development, in providing us, everyone of us, with a superior fuel and at the same time reducing that cost to about 14 cents a gallon retail. Of course, we have on the average about 5 cents per gallon to pay for State taxes throughout the country, which brings the total cost, including taxes, to around 19 cents.

They have cooperated with the engine manufacturers; that is, not only the automobile people but the builders of farm power engines and tractors. So today, we have a combination of fuel and engines that are very much superior in performance, in giving us the kick that we want in getting away in traffic, or climbing hills, or actual miles per gallon, very much superior to anything we had up to 1920, indeed, very superior to the vehicles and fuels we bought in 1933. That combination has developed through very excellent cooperation between the two groups.

Cooperation in the manufacture of fuels and engines enables all of us to travel almost anywhere in North America, from coast to coast and from northern Manitoba, if you please, to the lowest tip of Texas and into Mexico with very little difficulty from nonuniformity in fuels, providing we buy the corresponding grades.

As it stands today, gasoline of the regular variety ordinarily costs about 5 cents per gallon at the refinery. This is very cheap fuel. Distribution costs, and so on, and the necessary profits in the various transactions bring that fuel up to about the 14 cents that I have mentioned, and then the tax on top of that brings it to 19 cents, our retail price.

Throughout these years, from about 1925, I believe, or 1923, up to the present time, there has been a great increase in the reserve petroleum available. It appears that in, I believe, 1923 the apparent reserves were only 5,000,000,000 barrels, whereas today the apparent reserves are 17,000,000,000 barrels.

Some of that reserve has, of course, accrued from the discovery of new fields for oil or petroleum; however, not a little of it has accrued

because of the very great improvement in fuel performance. Whereas we used to be content with 8 and 10 miles per gallon, we take it as a matter of course today if we get 15 in many, many cases, and that has been due to the joint development by the engine manufacturer and the petroleum technologist himself.

So far as the technology of the situation is concerned, I think that most everyone will agree that alcohol is an excellent antiknock fuel. That has been a matter of record since about 1908, when there was a publication by the Bureau of Mines which sets forth that alcohol works best in an engine wherein the compression pressure is in the neighborhood of 200 to 205 pounds per square inch.

It was also set forth at that time that alcohol could be used in the ordinary gasoline engine without material change except in the mixer, or in the carbureter itself, where it was necessary to provide either larger orifices for the flow of the fuel, or to open such needle valves as were there used, so that the extra necessary quantity of fuel could be supplied to the engine.

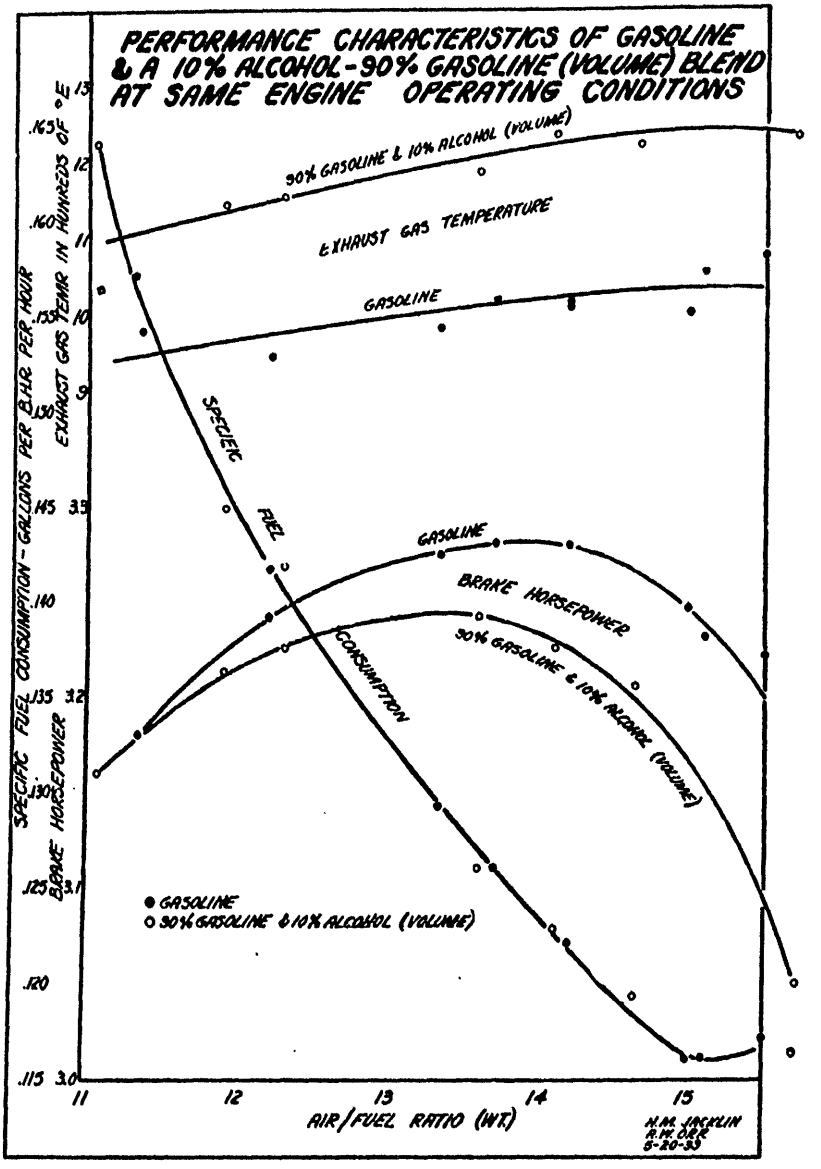
It is also admitted, I believe, that alcohol in such a test as the 500-mile race could be considered a rather suitable sort of fuel. Those fellows are after performance at any cost, so they build highly supercharged engines which have no provision for cooling the charge after it leaves the glower. To get around this weakness in design they use a fuel having a very high latent heat, namely, wood (not ethyl) alcohol (not made from grain) in large quantities which will help cool the charge by evaporating as it leaves the blower. Very low mileage is obtained and the fuel is far too costly for the average motorist to use. However, in 1938, no car using alcohol was able to finish the race.

The use of blends can be said to have certain minor features one way or the other. Some investigators have found a little in favor of using straight gasoline, and other investigators have found a little in favor of alcohol blends. In very few cases have I been able to find that they have tested such fuels or blends under identically the same conditions. There have been some numerous attempts and observations made of fuel consumption on the highway, and we find results that vary. In my own practice we do not accept single results, or the results of single tests, rather, in interpreting any such data, we generally make 16 test runs at any one speed, 4 in each direction of the compass, and on two sections of highways as level as possible, one section running north and south and the other east and west; so that we have four runs, say, with the west wind and four runs against the west wind, and four runs crosswise with the wind on either side of the car. The more such tests the more valid the results. I present this as a possible point of conduct in following up some various data that you may have to consider.

However, on last Friday I made a short test on a single-cylinder engine in our laboratory, wherein it is possible to hold the test results, or test conditions so closely that we have to calculate everything out in longhand to approach the accuracy of the data, the slide rule is not close enough.

If I may, I should like to discuss the curve results from that test, and present this copy, or more copies, if you wish.

(The graph referred to is as follows:)



This test was made on a 3 by 4-inch variable compression fuel-test engine in which we were able to measure the air supply very accurately, as well as the fuel supply, and to maintain the operating conditions very constant throughout all test runs.

You will note a curve in about the center of the page labeled "gasoline" and just below it the words "brake horsepower." That curve

delineates the brake horsepower realized from running this engine on regular gasoline with the different air-fuel ratios delineated on the Abscissa at the bottom of the page, running from just about 11.1 to about 15.7 pounds of air per pound of fuel. Immediately below that curve we see another one run on the same day, with exactly the same temperature of mixture entering the engine, exactly the same humidity and exactly the same pounds absolute pressure at the engine intake, using a 10-percent alcohol blend, with the same gasoline. We find that the gasoline delivered its maximum horsepower, or caused the engine to deliver its maximum horsepower with an air to fuel ratio of about 14 to 1, and that the horsepower was very slightly over 3.28; that the 10-percent blend of alcohol required an air-fuel ratio of 13.3 to deliver a horsepower of 3.243, a reduction of something in the neighborhood of 1.1 percent, as I recollect the figures. May I correct that figure later on to the actual one?

Senator LA FOLLETTE. Certainly.

Mr. JACKLIN. Going to the left from the peak of the alcohol blend curve directly to the gasoline curve, we find that if a carburetor was adjusted rich on gasoline to give the same power as on the blend it would have an air-fuel ratio of about 12.18 pounds air per pound of fuel, at which point the specific fuel consumption would be 0.142 gallon per brake-horsepower-hour, whereas the specific fuel consumption using the alcohol blend, at the 13.3 air-fuel ratio, is down to 0.128 gallon. This points out the fact that if a given vehicle were operated on a highway and had an adjustment of the carburetor that gave an excessively rich mixture such as this 12 to 1, that the substitution of an alcohol blend would result in apparent gain and economy, as shown here in the specific fuel consumption. It would drop from 0.142 to 0.128. On the other hand, if the gasoline carburetor were adjusted now toward the lean side, going to the right on the gasoline curve until the horsepower comes down to the maximum available with the alcohol blend, we find that the air-fuel ratio would be 15 to 1, 15 pounds of air to 1 pound of fuel, and the specific fuel consumption gallon. This points out the fact that if a given vehicle were operated then would drop down to 0.116 gallon per brake-horsepower-hour; a reduction of more than 9 percent in fuel consumption as compared with alcohol blend.

I think that this discussion accounts for the variations that we have in the results from various test authorities. We have it all delineated here from one engine.

Carrying it a little further, we follow the gasoline and the 10-percent alcohol horsepower curve to the left, and we note that they cross at an air-fuel ratio of approximately 11.3 to 1, and, of course, beyond that the fuel economy is very low in either case.

It is often stated that engines working with an alcohol blend run cooler than do engines with straight gasoline. It is well known among the experimenters with internal-combustion engines that you get so much out of fuels in actual useful work, and it approximates 20 to 25 percent of the fuel given to the engine, so far as heat recovered is concerned. Another 5 percent, approximately, goes to overcome the friction of the engine itself, accounting for a total of between 25 and 30 percent of heat supplied in the fuel. That leaves 70 percent to be divided between the exhaust gases and the cooling system. We can change engine adjustment so that 40 percent of the heat

goes out the exhaust and 30 percent of the heat goes to the water jackets, or we can so operate it that 40 or 45 percent goes into the water jacket and the balance, 25 to 30 percent, will go out the exhaust. In these test runs, with no change whatever in engine operating conditions, everything held right down, the exhaust temperatures on this alcohol blend went up about 175° to 200° above that which they attained with gasoline. The temperatures with the gasoline were approximately 1,000° Fahrenheit and with the alcohol, at the same air-fuel ratio, about 200° higher. Of course, if those exhaust gases are at a higher temperature they are carrying more heat away in the exhaust and there is probably less in the water jacket. We did not have a means at our disposal for measuring the water-jacket loss in this particular test; however, I believe my previous remark there will take care of that particular item. Now if the exhaust gas temperatures are higher, and they probably are in all the engines wherein the engine seems to run somewhat cooler, it would seem reasonable to suppose that the exhaust valves would give out earlier with the blend than with the straight gasoline. However, it is entirely possible, and technically feasible, to change the operating conditions with the blends so that these temperatures can be brought down to approximately the same point as with gasoline and at the same time probably improve the economy of the use of the blend. That was not attempted in these tests.

I made something of a survey of the costs of alcohol blends versus gasoline with tetraethyl lead, considering that they should have the same octane number. I should explain here that because two fuels have the same octane number it does not necessarily follow that those two fuels will perform the same in any given engine. They may, but they probably will not. It is one means, however, of measuring the value of fuels, and therefore we shall have to use it that way.

Taking material from Mr. Jacobs' bulletin on Motor Fuels From Farm Products (U. S. D. A., Miscellaneous Publication, No. 327), published in December 1938, we find, on page 56, an estimate of the cost of alcohol, providing that the grain, the corn, and so forth, yields 50 cents per bushel to the farmer. That estimate shows 30.8 cents as the net cost of 1 gallon of alcohol. Taking 0.93 of a gallon of gasoline at 5 cents and adding to it the 7 percent of a gallon of alcohol we have a fuel that costs 7.32 cents when an allowance of 0.5 cent is made for the extra cost of bringing thees two fuels together and mixing them; 0.7 cc. of tetraethyl lead costing only 0.175 cent will produce the same, or greater, increase in octane number, as will the 7 percent of a gallon of alcohol so the increased cost of the blend would be 2.145 cents since the gasoline with tetraethyl lead would cost 5.175 cents.

Senator La Follette. Is that the price at the refinery?

Mr. Jacklin. Yes; that is the price at the refinery, sir. The alcohol blend would cost 7.32 cents for the same octane value, from alcohol at the estimated cost by Mr. Jacobs of 31 cents from corn yielding 50 cents to the farmer.

Another basis, assuming corn is 25 cents a bushel, and on the same basis of computation, it seems that the alcohol would cost some 24 cents a gallon, to the best of my recollection at the moment, and that the increased cost of a gallon of blended fuel will be 1.67 cents over that of the equivalent gallon of ethylized or leaded fuel.

On that basis your 1 cent differential, your return of 1 cent for using the fuel, would not attract the motorists since there would still be 0.67 cent difference. I doubt very much that he would be interested in paying that much extra.

In 1938 there were some twenty-nine-million-two-hundred-thousand-odd cars, trucks, and busses registered in this country. They paid in State gasoline taxes and license fees an average of $38.98 per car per year. If we were to apply this 7-percent blend to the gasoline used that year, with corn priced at 50 cents per bushel each of those operators would have had to spend, if he drove as far, $16.04 in addition to that $38.98, which is a 41-percent increase over that expense. That, of course, is not a 41-percent increase in the cost of fuel, but he might, and I believe he would be justified in calling it an increase in his taxes. That applies to the farmer, as well as to all other motorists. It would apply to the fuel used by the farmer on his own farm and in many of his tractors.

It occurs to me that the motorist would have three alternatives if the amendment carrying the 7-percent blend and the 1-cent subsidy were carried through. First, he could pay that 1 cent and continue to use gasoline. As long as the alcohol blend costs more than the gasoline with the equivalent tetraethyl lead he is going to continue to use the gasoline.

The second alternative is for him to say, "Well, I will pay that extra $16.04 and forget about it." I think you will grant me that, being human, he is probably not going to do it. If you were minded to make it absolutely compulsory that the alcohol be used then he would have a third alternative, and that would be to cut down on the use of his vehicle, and on present-day average costs per gallon at retail each car would be driven approximately 1,200 miles less per year on that basis; 1,200 miles is approximately one-sixth of the average car mileage per year. If he adopts that alternative then he will operate his car one-sixth less than before. Presumably he will require one-sixth less service and service parts, fuels and lubricants during the year.

His car will last from 1 year to 1½ years longer, so that the car manufacturers will not have to make so many replacements; fewer tire makers will be necessary, because tires will be lasting one-sixth longer, and we might facetiously remark that fewer hot-dog stands will be required along the highway. So it might backfire into a condition where fewer people would be employed.

Senator LA FOLLETTE. As far as you know, there is no proposal to make the consumption of this particular type of blend compulsory?

Mr. JACKLIN. Not in this particular case, Senator. However, numerous compulsory laws have been proposed, in the past, and this third alternative will be operable, in any case, should the cost of fuels advance from any cause.

So he has these three alternatives. He either continues to use gasoline and says, "I won't buy the alcohol," or he buys the alcohol at increased cost, or he curtails the use of his vehicle, which might have repercussions of various sorts.

Now, further, there is an interesting set-up in this same bulletin by Mr. Jacobs wherein he points out that approximately 3½ boiler horsepower, are required to produce 1 gallon of alcohol. Now a boiler horsepower is approximately 33,500 B. t. u. per hour. He

further states that 1 boiler horsepower, applied over 24 hours, would produce (optimistically) 11 gallons of alcohol. If now we multiply 33,500 by 24 and divide by 11 we have approximately 73,000 B. t. u. necessary in the steam used in processing to manufacture 1 gallon of alcohol. There are few boilers that have an efficiency of over 70 percent, so we have to supply, in the firebox, the 73,000 divided by 0.7, which gives about 104,000 B. t. u. required from some fuel under the boilers to produce this gallon of alcohol. When you have that gallon of alcohol it contains only 80,600 B. t. u.

Three fuels most likely to be used are fuel oil, coal, and natural gas. If fuel oil is used they will have to use three-fourths gallon to produce 1 gallon of alcohol. If coal is used they will have to use between 10 and 14 pounds. If natural gas is used approximately 100 cubic feet will be required. All these fuels are natural resources and would be used up practically as rapidly in this scheme as they are being used up at the present time; in fact, with fuel oil, under present processes of refining, we would recover about 60 to 70 percent in useable gasoline. Why burn it under a boiler to produce alcohol with a lower heat content?

Now, if we carry this thing through—this may sound facetious, but if we exhaust our petroleum resources and finally come to the point where we have to use alcohol under these boilers in order to produce alcohol—it will require at least 1⅓ gallons of alcohol under the boiler to produce 1 gallon back out of the grain, which does not appeal to me. The whole program is not a real conservation program, so far as our natural resources are concerned.

I had some other material, sir, that is not immediately available.

Senator LA FOLLETTE. You may insert it in the record as part of this statement, Mr. Jacklin.

Mr. JACKLIN. Thank you.

(Subsequently Mr. Jacklin submitted the following supplementary statement:)

Alcohol gasoline blends are not superior motor fuels but in fact are inferior to gasoline in several ways.

There is a tendency for the alcohol to separate from the mixture if any water is present. It is estimated that but 14 to 26 teaspoonfuls of water in 10 gallons of a 10 percent blend of alcohol are necessary to start the separation process. This estimate is based on data presented by Bridgeman and Aldrich in the Journal of Research, volume 20, National Bureau of Standards, January 1938. A 7-percent blend would separate with the addition of less water (research paper RP 1059).

If alcohol may be so easily separated from the gasoline, it might easily present a difficult problem because of illegal diversion, as mentioned on pages 60 to 61 of the publication Motor Fuels from Farm Products, to which reference has been made previously.

Since the existing methods of storage and distribution of fuels do result in the accumulation of water in tanks, it would seem that some separation would result from large-scale (and therefore less controllable) use of blends.

I explained in my statement before the committee that it is possible to get an increase in mileage when substituting a blend for gasoline if the carburetor is set to give an excessively rich mixture, as is true in many older automobiles.

This is indicated by some of the data reported by R. A. Moyer and R. G. Paustian in the Iowa State College Progress Report No. VII—"Road Tests on Alcohol-Gasoline Mixtures," June 20, 1933, and by chassis dynamometer data on one 1936 model car contained in a paper Chassis Dynamometer and Road Tests of Alcohol-Gasoline Blends, by C. W. Phelps and L. C. Lichty, presented before an American Petroleum Institute meeting in New Orleans, May 18, 1939. However, the latter paper shows that the reverse was true in

cars (especially the later models) having properly adjusted carburetors for economical operation. In fact the former paper also shows data from two cars which obtained appreciably less mileage with a 10-percent blend than with gasoline.

These data further substantiate the data I presented and suggest that with any fuel, mileage may easily be increased in most road vehicles by careful adjustment of the carburetor. With proper adjustments on both gasoline and the blend, the mileage on gasoline will be greater since less fuel will be required to produce a given amount of power.

Since the blending of alcohol with gasoline produces a mixture with a higher vapor pressure and a lower average boiling point, blends will cause an increase in troubles from vapor lock and burbling. In many existing vehicles, it may be necessary to relocate the fuel line between the tank and the engine so that it will be exposed to lower temperatures than if left where it is, in order to reduce vapor lock. "Burbling" or boiling in the carburetor bowl and jets may also be increased with consequent faulty operation. It may be necessary to shield many carburetors from the heat of the exhaust pipe in order to procure regular operation with the blend.

On the other hand the high latent heat of alcohol in comparison to that of gasoline may result in less satisfactory starting and slower warm-up of the engine when a blend is used under severe winter weather conditions.

The proponents of blends have often stated that the use of blends will reduce the amount of carbon monoxide in the exhaust gases from engines. This is not true. The amount of carbon monoxide produced depends on the condition of the engine and the richness of the mixture being supplied that engine, not on the fuel being used. Carburetors can be set so lean that no carbon monoxide is found in the exhaust with any fuel. However, engines do not perform well with such lean mixtures so richer ones are used with the resulting production of carbon monoxide. L. C. Lichty and C. W. Phelps present data confirming this statement in their article Carbon Monoxide in Engine Exhaust Using Alcohol Blends, published in Industrial and Engineering Chemistry, volume 29, May 1937.

Broadly speaking, for engine conditions and adjustments giving comparable performance the carbon monoxide content of the exhaust gases will be about the same regardless of the fuel used.

The cost data from which I quoted in my statement to the committee are given in table I. Obviously, even with corn at 25 cents per bushel, the cost of the proposed 7-percent blend would be too high for the average motorist.

TABLE I.—*Increased cost of 7-percent alcohol blends over gasoline of equivalent octane rating when the alcohol is made from corn priced either 50, 75, or 25 cents per bushel*

	Using 31-cent alcohol made from 50-cent corn	Using 37.5-cent alcohol made from 75-cent corn	Using 24.2-cent alcohol made from 25-cent corn
	Cents	*Cents*	*Cents*
0.93 gallon of gasoline priced 5 cents per gallon f. o. b. refinery	4.650	4.650	4.650
0.07 gallon of alcohol f. o. b. distillery	2.170	2.625	1.694
Increased cost of distribution due to increased number of expensive short and cross hauls to bring alcohol and gasoline together, additional storage facilities, and added time and labor for blendings	.500	.500	.500
Cost of 7-percent alcohol blend	7.320	7.775	6.844
1 gallon of gasoline priced 5 cents at refinery plus 7/10 cubic centimeter of tetraethyl lead at 0.175 cent to assure the gasoline an antiknock rating equivalent to or exceeding the 7-percent alcohol blend	5.175	5.175	5.175
Increased cost of a gallon of 7-percent alcohol blend over gasoline or equivalent or higher octane rating	2.145	2.600	1.669
The Nation's increased motor-fuel bill if the 21,800,000,000 gallons used annually contained 7-percent of alcohol	$468,700,000	$566,800,000	$364,060,000
Increased cost per car-year	$10.04		
Motorists paid per car-year in State gasoline taxes and license fees in 1938	$38.93		
The increased cost per car-year over the 1938 taxes collected by the States (percent)	41		

Since the farmer will be concerned with both ends of the plan to use alcohol in motor fuels, because he will supply the corn and will also use the resulting blend, it may be well to examine into the net result to him.

Table II shows that the net return to the farmer on the basis of 50-cent corn and 31-cent alcohol is but 24.9 cents per bushel of corn.

TABLE II—*Estimate of farmer's net realization from 1 bushel of corn used for a 7-percent alcohol blend*

	Cents
Farmer receives for 1 bushel of corn, gross	50
But he has to buy back distillers' grains equivalent to about ¼ bushel, for which he must pay approximately	12.5
Apparent cash return	37.5
Out of the bushel of corn approximately 2.3 gallons of alcohol can be made, which in combination with gasoline in a 7-percent blend will result in 32.8 gallons of alcohol-gasoline.	
Since farmers consume about one-fourth of the total motor-fuel supply, the farmer will have to buy one-fourth of 32.8 gallons or 8.2 gallons of alcohol-gasoline. Because of the higher cost of alcohol, a 7-percent blend costs about 2.145 cents per gallon more than straight gasoline of equivalent quality. Therefore, the farmer will have to pay, or someone will have to pay for him, 8.2 times 2.145, or 17.6 cents for his share of the alcohol-gasoline made from his bushel of corn.	
Deduct from the above shown apparent cash return	17.6
Net realization by the farmer for ½ bushel of corn (since he has bought back the equivalent of ¼ bushel in the form of byproduct feed)	19.9
Convert into terms of 1 bushel (¾ times 19.9) for net return to farmer for 1 bushel of corn	24.9

On the foregoing basis, if the alcohol made from 1 bushel of corn is 2.3 gallons, 1 gallon will require the use of 1/2.3 of a bushel of corn. Therefore, in providing the corn for 1 gallon of alcohol, costing 31 cents, the farmer will receive 1/2.3 times 24.9 cents (the price he nets for his corn) or 10.8 cents, out of the entire price of the gallon of alcohol. The rest, or 20.2 cents, will go to others for processing, transportation, and blending costs.

Further, it would seem desirable to examine into at least one other possible way to dispose of the surplus corn, if any, now available for making motor alcohol.

Table III shows a comparison of the cost of using motor fuel from 1 bushel of corn with the net cost to the public, if the farmer could be subsidized to burn the same corn in his stove. This comparison is predicated on the fact that 60 to 65 bushels of corn are equivalent in heat value to 1 ton of coal, so that such use of corn might displace coal for farm-home heating or cooking.

TABLE III—*Comparison of cost of burning corn by using alcohol-gasoline with cost of burning in stoves and furnaces*

	Cents
Since 1 bushel of corn will produce 32.8 gallons of alcohol-gasoline and that product will cost about 2.145 cents more per gallon than straight gasoline, the cost to the motorist or the taxpayer (including the farmer) or using up 1 bushel of corn in motor fuel will be 32.8 times 2.145, equal to	70.4
As shown in table II, the farmer will net only about 24.9 cents a bushel from 50-cent corn under a 7-percent alcohol blend plan. Since the bushel of corn would replace at least 10 cents worth of coal (coal about $6.25 per ton) if burned in the farmer's stove or sold as fuel for domestic furnaces, the bushel of corn could be disposed of in that manner at a net cost of—by paying an outright subsidy to the farmer	14.9
Excess of cost by using the alcohol plan	55.5
Deduct the cost of 2.3 gallons of gasoline which the motorist would have to buy instead of the 2.3 gallons of alcohol which he would obtain if subsidizing the alcohol-gasoline plan (2.3 times 5 cents)	11.5
Net excess or cost of disposing of 1 bushel of corn by making into motor fuel	44.0

It is evident that it would be much less costly to motorists or taxpayers and to the farmer himself to impose a straightforward tax to pay for having surplus corn burned as stove and furnace fuel, without having to subsidize also the very expensive process of making corn into alcohol so that it could be burned in engines. The benefits to farmers would be exactly the same; the cost very much smaller.

Another item of expense that would be paid by the general public is the greatly increased cost of inspection and administration through the Treasury Department. It appears that their expense would be 8 to 10 times as great as at present.

CONCLUSIONS

First. There are no particular difficulties, except cost, in using alcohol blends in existing engines if proper adjustments and revisions are made for the use of such blend and if one is prepared to accept lowered power, lowered economy, or a combination of both.

Second. Alcohol blends are not superior in any technical characteristic to gasolines having equivalent antiknock ratings so their use in motor vehicles cannot be justified unless they can be produced more cheaply than these gasolines.

Third. The apparent benefits to the farmers from this plan seem to be much less than the penalties inflicted upon the whole populace.

Fourth. The cost of producing alcohol from corn is so high that the use of an alcohol blend instead of gasoline would result in an economic loss to all motorists including that large proportion of the farmers not supplying corn or other materials for the distillers. Indeed there is a great question that there will be any benefit for the farmer supplying the grains.

Fifth. The process of converting corn into alcohol by the most efficient large-scale method now known consumes more energy from exhaustible natural resources, such as coal, oil, or natural gas, than is contained in the alcohol produced.

Sixth. The manufacture of alcohol from corn or other farm products and the use thereof as a motor fuel is merely, in the last analysis, a complicated and expensive method of burning those products.

Seventh. The occasional surpluses of corn could be disposed of much more cheaply for all concerned by direct subsidy to the farmer of an amount sufficient to permit him to sell his surplus in competition with coal as a fuel for furnaces than to convert it into motor fuel by the costly process of alcohol manufacture.

Eighth. The provisions of Senate bill 552 regarding a 7-percent-alcohol blend are, to my mind, against the best interests of both the farmer and the motorist.

Senator LA FOLLETTE. Mr. Barton, you may resume.

STATEMENT OF GEORGE BARTON—Resumed

Mr. BARTON. Professor Jacklin has told you that, considering all factors, alcohol blends are slightly inferior to, or at least no better than, straight gasoline with equal antiknock properties, yet they cost more to produce. He has pointed out that it costs five to six times as much to produce alcohol as it does to produce an equal amount of gasoline. When mixed together the resulting blend is not superior to gasoline, and yet, of necessity must cost more.

The present proposal, Senate bill 552, would tend to encourage the use of alcohol blends by exempting them from the 1 cent Federal gasoline tax, and thereby reducing the price differential between the blends and straight gasoline.

If a 7 percent blend costs 1.8 to 2.6 cents a gallon more than straight gasoline, the proposed 1 cent Federal subsidy would not be enough to enable blends to compete with straight gasoline on an equal price basis.

As a representative of motorists I feel quite safe in predicting that the present bill would fail to accomplish its objective because

motorists would not be willing to pay a premium on an alcohol-gasoline blend when equal, if not better, performance could be obtained from a motor fuel that would cost 0.8 to 1.6 cents a gallon less. I feel quite confidently that this would be the case, knowing how violently the motorists oppose any increases in the cost of operating their vehicles. For example, the farm motorists for years opposed a driver's license law in Illinois, one of the reasons cited being that it would add a cost of 17 cents a year to the operation of the car.

We feel certain then that because blends are not superior as a motor fuel to gasoline of equal antiknock properties, and since the blends would have to be sold at a higher price, regardless of the 1 cent Federal subsidy, the proposal embodied in Senate bill 552 would be foredoomed to failure in that it would not create, as anticipated, a market for alcohol-gasoline blends.

At this point you may well be thinking, "Well, if you are so certain that Senate bill 552 will fall short of accomplishing its objective why, then, are you so concerned as to its possible passage?" I, as a representative of motorists, am disturbed about this bill not so much on account of its own immediate effects but because of the chain of events that it is likely to set in motion. If the proposal passes, the Government thereby has adopted a policy of subsidizing and encouraging the use of alcohol blends as motor fuels. As soon as that is done the proponents of the use of blends will undertake an enthusiastic promotion of the production and use of the blends. Before the blends can be offered to the motorists they must be produced. Here capital must be persuaded to provide alcohol plants and the other machinery for marketing the blends. Distribution and sales media undoubtedly will be set up in response to the glowing description of the potential market now made available. Bulk plants, blending stations, storage facilities, additional gasoline pumps and the like will be necessitated. National and local regulatons governing the sale and use of blends must be passed by legislative bodies. Inspection and administrative machinery must be set in motion. Then, after all this preparatory work has been completed and all the effort and money have been invested in the sale of blended fuels, the scheme will reach the point where the motorists will be asked to buy the blends. At this point, as we have predicted, the proponents of the use of blends will awaken to the realization that motorists will refuse to pay a premium on the blends. The next logical step by these proponents is for them to return to Washington and demand a greater governmental subsidy, or other action by Government, which will enable blends to compete with straight gasoline on an equal price basis. It is the likelihood of that development much more than the hazards in the immediate proposal that cause us, as representatives of the motorists, to be disturbed regarding Senate bill 552.

Because proposals have been so widely and enthusiastically pushed to penalize straight gasoline so heavily that it ceases to be used, and because we feel sure that Senate bill 552, if passed, would prove merely a first step in that ultimate direction we desire, as motorists, to examine some of the effects of these more drastic proposals.

If Government does not decide to increase its then-existing subsidy of 1 cent a gallon to 2 cents or more a gallon, then it is highly probable that the additional cost will be passed on in some form to the

consumer of the blends—the motorist. I realize that the motorist has been taken for an easy mark. He has been subjected to constantly increasing taxes for years. He paid last year an average total tax of $53.36 on the operation of his car. The motorist is not a rich man who can stand more and more tax burdens. He is on the average, instead, a man with an income of $20 to $30 a week. He is a worm that is just about ready to turn. The time has come when he is going to find some way to keep down his motoring costs, and the thing most to be feared is that the motorist may be forced to keep his cost down by buying less fuel and using his automobile less. That action probably would have effects on industry more far-reaching than the troubles now in the farm industry.

If the additional cost of blends is passed on to motorists in the form of enforced greater cost of motor fuel, we may find a decreased motor transportation and an impaired motor industry to be the result. If the additional cost of the blends is met by subsidy through diverting motor revenues, the eventual result will be the same. The highway system of the Nation is right now at a stage where extensive improvements are required to forestall a decrease in motor transport as a result of inadequate highway facilities.

The proponents of the alcohol-gasoline legislation have stated that its purpose is to help the farmer. They think he would benefit greatly by the use of his products for the manufacture of motor fuel—and so he would if the cost factor were more favorable. As things stand, however, the farmer himself would be required to bear additional costs from the forced use of blends. Farmers use about one-fourth of the motor fuel consumed in this country. If the price goes up they must pay; if the higher cost is met by tax exemptions or diversions they lose the benefits of roads and governmental services for which the diverted revenue had been paying. They may have, in addition, to meet new taxes to replace the funds which will have been applied to the subsidy.

Moreover, this alcohol-gasoline scheme is not one that would work out to the benefit of the farmer alone, or even in the greatest part. He would find a market for grain, to be sure, but right away he has to buy back the equivalent of one quarter of what he sells because the distilleries must get rid of the byproduct feed left over after the alcohol has been extracted or else the cost of alcohol becomes still higher. Experts on alcohol manufacture estimate (see appendix A) that out of 50 cents received for a bushel of corn, the farmer will net only about 28 cents after he has paid for the byproduct feed and met his own extra cost of motor fuel. Stated another way, out of 31 cents received by the distillery for a gallon of alcohol, the distilling and transportation agencies will net 18.8 cents, while the farmer will get only 12.2 cents. In other words, the farmer, after all, receives the small end of the benefits from the plan.

Theoretically, the use of blends is proposed to aid farmers in general. Actually it could be of benefit to only the favored few living within hauling distance of distilleries. Only they could get the new market for products. Other farmers would have increased fuel cost or increased tax burdens but no markets for their products. Some farmers would be unfavorably affected. It could mean only expense to cotton or dairy farmers, for example. It would mean a loss of part of their revenue to the farmers who at present receive an annual

revenue of $200,000,000 from leases and royalties on lands from which oil is produced. There is also some possibility that the drain on the fertility of the soil in order to produce new grains for alcohol could hardly be justified economically at a time when less expensive motor fuels are available abundantly.

Right here it seems pertinent to inquire where the alcohol for a 7 or a 10 percent blend would come from. The Department of Agriculture, in its miscellaneous publication, No. 327, has indicated in the first place that all surpluses and culls of all crops would not be sufficient to make enough alcohol to equal 7 percent of the present motor fuel consumption. And where would the alcohol be made? Present alcohol plants are not situated close enough to sources of farm materials or to all motor markets. Facilities are now lacking to make all the alcohol that would be needed. Therefore, obviously, more plants would be required. It is estimated that more than 400 plants of a capacity of 10,000 gallons a day would be needed, scattered throughout the country, to produce alcohol for even a 7 percent blend on a national basis. But it seems wholly unlikely that private capital would be put into anything so speculative on a scale so large.

Private investors would not likely put money into a business to produce a product which depends entirely on governmental subsidy or favor for its ability to meet competition. This is particularly true when we recognize that the alcohol business would depend, even for its raw material supplies, upon products which might be available in one year and not available in the next because of drought or other disaster—products which might be relatively cheap in one year and practically prohibitive in cost in another. The experience of the Atchison, Kans., alcohol plant has indicated that it is practically impossible for such plants to operate when prices of corn and other grains soar in drought years. Yet even in drought years overhead costs continue.

Where would the money come from even to get the alcohol plants built? There has been much talk of building power alcohol plants in the past 5 or 6 years, but actually the only one which has been built and operated is the Atchison plant. It is now shut down and, from the practical point of view, a failure.

Private investors would hesitate a long time before they would participate in a movement to try to force upon consumers a product in as little actual demand as alcohol-gasoline. True, a certain number of idealists think it would be a great thing and are ready to try it. But at Sioux City, Iowa, a year ago the demand soon failed after it had been whipped up by a great promotional campaign by the chamber of commerce and after blends had been put on a competitive basis through having jobbers and dealers absorb the extra cost. The jobbers and dealers lost their enthusiasm because they had to pay too dearly. Once the novelty of using the fuel wore off the motorists were not interested. They did not find it a better fuel. If they had wanted it there would be a large sale in Sioux City today instead of practically none.

By persons who are familiar with the problems that arise in the marketing of motor fuel it has been pointed out that forced use of alcohol blends would cause a chaotic situation from which motorists would be bound to suffer. Unscrupulous dealers would be practically

invited to make an extra cent or two or three per gallon by omitting the alcohol or by taking it out and substituting straight gasoline. Chances for a cent or two of extra profit per gallon make a great difference in the motor fuel business. There has already been sales difficulty because of attempts to evade motor fuel taxes on gasoline. If alcohol blends were in use, it would be easy for the dealer to substitute gasoline or even cheaper alcohol made from wood or even from petroleum. To prevent his doing so would take an army of inspectors. Even then the administration would not be easy because of such complications as this: A dealer might buy a legal blend of gasoline, but because of moisture in the gasoline tank the blend might separate. An inspector taking a sample might then find it deficient in alcohol and charge a violation of the law without the dealer being intentionally a violator at all. Such incidents have been reported from France and other foreign countries where alcohol blends have been used. There is the further problem of attempting to control the distribution and use of a tax-free alcohol and its relation to the beverage industry.

One of the arguments often advanced in favor of alcohol blends is that they will help to conserve our petroleum supplies. That argument must be advanced with the tongue in the cheek. A 7- or even a 10-percent blend could not possibly prolong the petroleum supply more than 7 to 10 years in a hundred. Much more is being accomplished in more practical ways to provide for the future. There is constant improvement in methods of discovering petroleum, of getting it out of the ground, of making it stretch, or of doing a larger amount of work. Technologists already know how to extract motor fuel from coal at less than the cost involved in making alcohol. Since there is enough coal in sight for at least the next 1,000 years, the motor-fuel supply is in no such immediate jeopardy that use of an expensive fuel like alcohol is called for.

As has been pointed out by Professor Jacklin, there is a decided fallacy in the argument that the use of alcohol as a motor fuel is a way to conserve irreplaceable resources. Actually, it is necessary to use up more heat units by burning coal, oil, gas, or other irreplaceable natural resources than are contained in the alcohol so produced. Thus the manufacture of alcohol actually wastes irreplaceable natural resources as measured by heat units. It would be more in the nature of real conservation to turn the coal, fuel oil, or gasoline into motor fuel directly and to forget all about making alcohol.

In advancing proposals to force the use of alcohol blends by outlawing straight gasoline or subsidizing blends it may be objected that they involve a new principle in this country, namely, that of telling the customer what he must buy whether he wants to or not. This principle is unsound, unfair, and un-American. It may establish a principle which might well open the door to endless bickering between competing industries and endless attempts by rival industries to gain advantages of subsidies or tax exemptions. Why not subsidize furs to enable them to compete with wool? Why not bring back the horse and buggy by putting a prohobitive tax on the automobile? The principle is about the same.

Fundamentally all alcohol-gasoline schemes are plans to make it possible to burn crop surpluses by the help of expensive methods of turning them into motor fuel so that they can be burned in engines. Ordinarily there is a tendency to reject with horror any thought

that farm products in use for present purposes should be burned as a fuel in home stoves and furnaces. But careful figuring by experts of the costs involved will show that if you take a given amount of surplus grain and burn it as a fuel in furnaces you can pay the farmer as much as he will get out of the alcohol-gasoline scheme. Still at the same time you get off more cheaply than if you have to manufacture gallons of alcohol and then pay the difference in cost between their value and the value of gasoline. For example, if we consider a 7-percent blend, even 1 bushel of corn will make about 32.8 gallons of blend costing around 2 cents more per gallon than gasoline. In other words, the motorists will have an extra fuel cost of 65 cents in helping to dispose of that bushel of corn on which the farmer will net about 28 cents.

If you must call upon motorists or taxpayers generally to pay for some way of getting the farmer 28 cents a bushel for surplus corn, why not impose the tax and pay it directly to the farmer on condition that he burn the bushel of corn in his cook stove or sell it to his town neighbors rather than compel motorists or taxpayers to pay 65 cents to accomplish the same thing in a very complicated and roundabout way? I refer you to appendix B.

In summary, may I emphasize the following points:

Alcohol-gasoline blends are slightly inferior to or at the most equal to a straight gasoline of equal antiknock properties in value as motor fuel.

Since alcohol at the distillery costs approximately six times as much as gasoline at the refinery, and with the cost of extra steps in the production of alcohol-gasoline, blends must cost more than straight gasoline.

Even a 7-percent alcohol blend though exempted from the 1-cent Federal gasoline tax would still cost a motorist more at the gasoline pump than would straight gasoline, provided the alcohol in the blend came from farmers' grains.

Since it is no better and would cost more the motorist would not purchase the tax-exempt 7-percent blend as proposed in Senate bill 552.

The great danger from the motorists' point of view in Senate bill 552 is that should the bill be passed, machinery would be set in motion which would continue until it had brought about the universal and compulsory use of alcohol-gasoline blends.

The compulsory use of blends as motor fuel should be avoided because—

(*a*) As additional fuel cost is created, it must be met by some source—motorists or general public.

(*b*) Such a small proportion of the additional cost of fuel finds its way back to the farmer for whose relief these costs are to be incurred.

(*c*) To enable the widespread use of blends serious adjustments would be necessary in the economic structure in order that adequate supplies of alcohol could be produced.

(*d*) Tremendous difficulties would be experienced in enforcing the actual sale of gasoline containing the rated percentage of alcohol.

(*e*) The use of alcohol made from grains for motor fuel fails as a measure to conserve irreplaceable natural resources.

(*f*) Surplus grains instead of being burned as alcohol in engines can be burned direct in furnaces with equal advantage to the farmers he wants to or not is unfair and un-American.

(*g*) The whole proposal to force the motorist to buy blends whether and less cost to society.

APPENDIX A

Estimate of farmer's net realization from one bushel of corn used for a 7 percent alcohol blend

Farmer receives for 1 bushel of corn, gross	$0.50
But he has to buy back distillers' grains equivalent to about one-fourth bushel, for which he must pay approximately	.125
Apparent cash return	.375
Out of the bushel of corn approximately 2.3 gallons of alcohol can be made, which in combination with gasoline in a 7-percent blend will result in 32.8 gallons of alcohol-gasoline. Since farmers consume about one-fourth of the total motor fuel supply, the farmer will have to buy one-fourth of 32.8 gallons or 8.2 gallons of alcohol-gasoline. Because of the higher cost of alcohol, a 7-percent blend costs about 2 cents per gallon more than straight gasoline of equivalent quality. Therefore, the farmer will have to pay, or someone will have to pay for him, 8.2 times 2, or 16.4 cents for his share of the alcohol-gasoline made from his bushel of corn.	
Deduct from the above shown amount	.164
Net realization by the farmer for three-fourths of a bushel of corn (since he has bought back the equivalent of one-fourth bushel in the form of byproduct feed)	.211
Convert into terms of one bushel (4/3 times 21.1) for net return to farmer for one bushel of corn	.281

On the foregoing basis, if the alcohol made from one bushel of corn is 2.3 gallons, one gallon will require use of 0.53 of a bushel of corn. Therefore, in providing the corn for 1 gallon of alcohol, costing 31 cents, the farmer will receive 0.53 times 28.1 cents (the price he nets for his corn) or 12.2 cents, out of the entire price of the gallon of alcohol. The rest, of 18.8 cents, will go to others for processing and transportation costs.

APPENDIX B

Comparison of cost of burning corn by using alcohol-gasoline with cost of burning in stoves and furnaces

Since 1 bushel of corn will produce 32.8 gallons of alcohol-gasoline and that product will cost about 2 cents more per gallon than straight gasoline, the cost to the motorist or the taxpayer of using up 1 bushel of corn in motor fuel will be 32.8 by 2, equal to	$0.656
As shown in appendix A the farmer will net about 28 cents a bushel for corn under a 7-percent alcohol blend plan. Since it can be assumed that the bushel of corn is worth at least 10 cents if burned in the farmer's stove or sold as fuel for domestic furnaces, the bushel of corn could be disposed of in that manner at a net cost of	.18
By paying an outright subsidy to the farmer; excess of cost by using the alcohol plan	.476
Deduct the cost of 2.3 gallons of gasoline which the motorist would have to buy instead of the 2.3 gallons of alcohol which he would obtain if subsidizing the alcohol-gasoline plan (2.3 by 5 cents)	.115
Net excess of cost of disposing of 1 bushel of corn by making into motor fuel	.361

It is evident that it would be much less costly to motorists or taxpayers to impose a straightforward tax to pay for having surplus corn burned as stove and furnace fuel, without having to subsidize also the very expensive process of making corn into alcohol so that it could be burned in engines. The benefits to farmers would be exactly the same; the cost very much smaller.

STATEMENT OF KIRK FOX, EDITOR, SUCCESSFUL FARMING, DES MOINES, IOWA

Senator LA FOLLETTE. Will you state your name, please?

Mr. Fox. My name is Kirk Fox. I am editor of Successful Farming, published at Des Moines, Iowa, with a circulation of 1,150,000, concentrated almost entirely in the Midwest. I am also chairman of the agricultural committee of the Des Moines Chamber of Commerce, and a member of the agricultural committee of the United States Chamber of Commerce. I speak, however, only as editor of Successful Farming.

Senator LA FOLLETTE. Will you please proceed, Mr. Fox, to make any statement you desire to make concerning this proposed legislation?

Mr. Fox. My interest in the matter of converting agricultural products into power alcohol goes back to the first suggestion of the idea in the State of Illinois. I have hoped during that entire period that something practical would develop from it. I remain to the present time open-minded on the subject.

In 1933 the State of Iowa was considering a bill making it compulsory to use a blend of power alcohol and gasoline. At that time I was active in opposition to the bill—first, because it was compulsory; second, because there was not a sufficient alcohol supply available, nor facilities for producing the alcohol at that time; third, there was no information as to costs, collection, supplies, blending, or anything else; fourth, my fear of promoters. My memory goes back sufficiently to recall the number of dead creameries throughout the State of Iowa which were built where there were no cows, hoping that cows would follow the creameries, which they did not do.

I am also aware of the recent development in Nebraska of Jerusalem artichokes, which proved to be entirely a promotional scheme. I am also aware of the attempts by Iowa and Minnesota to try hemp in recent years. So I appreciate the ease with which the proposition, once given indirect encouragement by the Government, is followed up by the promoter.

At that time it was difficult to oppose such legislation, because our corn was ridiculously low in price. However, in a very short time, I believe a year or slightly over, it was so high in price, because of the extended drought, that we were obliged to import corn from South America in order to save our livestock producers. Under such circumstances, where would the industrial alcohol plants, built to utilize farm products, have obtained their agricultural raw material? The price of alcohol would have skyrocketed to a point where it was impractical to manufacture it and even attempt to use it in motor fuel, with the result that alcohol plants would have been idle in 1934, 1935, 1936, and 1937, when corn was higher than the maximum raw-material price in the alcohol industry of 50 cents per bushel.

Again this past winter there was introduced a bill making compulsory the use of alcohol blends in Iowa. I played no part in that matter, as the bill did not come out of the sifting committee.

In 1933 there was a much smaller amount of dependable information in regard to the production of power alcohol. Since then considerable additional studies on various phases of the problem have been made, including the United States Department of Agriculture, Miscellaneous Publication No. 327, Motor Fuels From Farm Products. However, this information does not justify hopes for immediate general development of power alcohol. On the contrary it discloses numerous additional obstacles which previously were not so clearly outlined. The United States Government recognized this situation when it authorized building of the great research laboratory at Peoria, Ill. Certainly any legislative program undertaken at a time when so many basic problems remain unsolved would be premature.

Far from solution is the primary obstacle of an assured supply of farm raw materials at prices which do not make the cost of alcohol and of alcohol motor fuels prohibitive and yet which are attractive and profitable to farmers. A letter written by Milo Perkins, February 18, 1939, to Senator Reed, reaffirms this conclusion. [Reading:]

DEAR SENATOR REED: This is to explain to you why favorable action was not taken on requests made by the Atchison Agrol Co., Inc., Atchison, Kans., for assistance by way of supplying them with a quantity of corn or other materials as a source of alcohol, at prices below current market values, sufficient to enable them to operate their plant during the current crop year.

The Federal Surplus Commodities Corporation has no supply of corn or grain sorghums available which it could furnish to the Agrol Co., nor is it subsidizing the exportation of these commodities. Also from information available, as a result of careful studies which have been made of the subject in the Department over a long period, as well as from information furnished by Dr. Young and his associates, it is evident that the cost of production of industrial alcohol for power uses, under present conditions and at even the lowest probable cost of material required as a source of alcohol, is much higher than that of gasoline. There seems little probability, therefore, that such an industry, even under the most favorable conditions of plant facilities and efficient management, would be able to operate without a subsidy, at any time now predictable. If the Department should make an investment in the development of alcohol production from agricultural products, culls, and wastes for motor fuel, it would seem advisable that it be undertaken in connection with one of the experimental laboratories soon to be established.

At the time that Dr. Young, Dr. Christensen, and Mr. McKeen, of the Agrol Co., were in Washington, about November 1, a number of conferences were held with representatives of the Department and from statements obtained it appeared that under present operating and marketing conditions corn would have to be obtained at a price of about 28 cents per bushel f. o. b. Atchison, Kans., to enable the Atchison Agrol Co. to manufacture and market their product on a moderately profitable basis. Subsequent investigation by a representative of this Department has thrown considerable light on the financial and operating conditions of the plant, but it is not wholly clear that the plant could be operated profitably even if corn could be obtained at a cost of 28 cents at the plant when merchandising costs are considered. Although corn has at times been that low in price, it is not to be anticipated that such prices will exist with sufficient regularity to permit regular operations of the plant. The Department would not wish to continually subsidize such an operation though it might be willing to subsidize some form of research temporarily. It is doubtful, however, whether research conducted at the Atchison plant would yield results comparable to the necessary investment by the Government.

For these reasons it appeared inadvisable and of doubtful future benefit for the Department to undertake to subsidize the operation of the Agrol plant, especially because of the announced program of research on the subject.

(Signed) MILO PERKINS,
Associate Administrator.

To me this letter strongly emphasizes the myriad difficulties still ahead in making power alcohol a practical commercial proposition. Many other interests concerned with farm welfare apparently share my conviction.

To my knowledge, none of the editors of major farm publications, and probably few of those on leading newspapers in the Midwest, have indorsed this program. Furthermore, none of the major farm organizations, especially those having their membership largely in the Midwest, has seen fit to sponsor the conversion of farm products into alcohol for motor fuel. Such lack of enthusiasm in other quarters has been a signal to me to go slow and to examine with extreme care all factors in the plan.

We are considering today S. 552 which would waive the Federal tax for 1 cent on gasoline for all motor fuel containing 7 percent of alcohol made from agricultural products. In my opinion, such an exemption would of itself have little immediate effect, since the 5 to 6 times higher cost of alcohol at distillery over gasoline at refinery makes it certain the increased cost of 7 percent blends would be at least double the 1-cent tax exemption. The basis of this statement is the Department of Agriculture's careful estimate on page 56 of Miscellaneous Publication 327 of average costs of alcohol made from 50-cent corn, revealing that such alcohol f. o. b. distillery, exclusive of any profit, costs 30.8 cents per gallon, compared to the price of gasoline at refinery over the past several years of only 5 cents per gallon. In addition, the picture is made still darker by the statement in the third progress report of Iowa State College, issued in 1933, that it apparently would cost about one-half cent more per gallon to distribute alcohol blends due to the necessity for additional storage facilities, higher transportation costs in bringing the alcohol and gasoline together, and increased handling costs.

As I previously stated, I am a member of the agricultural committee of the Des Moines Chamber of Commerce. As a consequence I am interested in new agricultural industries. We have lots of ground around our city in which we would like to see more factories and we do not propose to let Sioux City or any other neighboring city get ahead of us. I have watched the Agrol situation at Sioux City with interest but felt that it was entirely too experimental for us to seek with enthusiasm. I do not wish to make offhand statements here whose inference might be derogatory to the proponents of the bill under discussion. I am away from home and do not have access to my files, so with your kind permission, Mr. Chairman, I would appreciate the opportunity of adding data I have obtained on the situation.

Senator La Follette. We will be very glad to have that, Mr. Fox, in the record as a part of your statement.

Mr. Fox. Thank you, sir.

Senator La Follette. To be furnished as soon as possible.

Mr. Fox. Yes, sir.

Because all the evidence must lead one to the conclusion that the subsidy proposed in the bill under consideration cannot possibly be effective, is it not reasonable to think that its proponents will in the near future ask for additional consideration? It is like the old story of the camel getting his head into a tent and before very long having

his whole body inside. Only a few concessions of this kind would be necessary to place alcohol blends on a basis where their use would be compulsory, and I do not like anyone telling me what I must eat, or wear, or use in my automobile tank. I can picture the enthusiasm of Pennsylvania and New York farmers at burning alcohol in their motors supposedly for the purpose of increasing the price of corn which they are obliged to buy in large quantities. Furthermore, if the principle of subsidies to give preference of one product over another is accepted, I would expect to see in a short while demands from the dairymen that cheese be given preference over pork chops and beef steak.

But let's assume for a moment that such a subsidy or tax exemption was on the statute books making it compulsory to use alcohol blends of 7 or 10 percent in motor fuels. In the light of costs already quoted, every user of motor equipment in the United States would have forced upon him at increased cost a fuel worth no more, or throw the cost on the Government. Through all the ramifications of our present complex Government machinery such taxes would necessarily filter, leaving great uncertainty as to who would eventually benefit and who would pay. Frankly, in the light of present costs of production of power alcohol the whole scheme seems a very expensive and ineffectual method of giving the farmer a subsidy. We are now granting vast subsidies to agriculture through the machinery of the A. A. A. There can be no question concerning the source of such money or to whom it is paid.

The biggest joker in the proposal which I can see is the fact that farmers themselves consume one-fourth of the motor fuel, even up to 50 percent in some farm States, and if the price was increased they would share generously in the job of digging up the money to pay their own benefits. And for the farmer, gasoline is largely a manufacturing expense. Regardless of farm prosperity or depression, his tractor must prepare the soil and harvest the crops—his truck must move them to market. Even his automobile is a necessary part of his farm equipment and most of its mileage is for business reasons. Farm gasoline consumption is inescapable and therefore stable. Should Uncle Sam be so kind as to absorb the increased cost, his money eventually comes from the people, and the farmer, being a consumer, pays his share of the general tax directly or indirectly.

Another Ethiopian in the woodpile is the charge between the farmer's corncrib and his fuel tank imposed by the vast number of agencies necessarily involved in converting his crop into alcohol. Certainly the distillers, the shipping agents, the banks, and a multitude of others would take their cut. It is an entirely different system than converting a bushel of corn into horsepower by dumping it into a feed box for old Dobbin.

Unfortunately the farmer who turns over 56 pounds of corn or its equivalent to the alcohol manufacture is not rid of that amount of surplus feed, for 12 to 16 pounds of byproducts will be left over after the most efficient distillation processes have done their best. And, of course, the city automobile driver is not going to help take up this byproduct. He converted his stable into a garage years ago—if he ever had a stable in town.

In Iowa I have watched the growing problem of soybean crushers in finding a market for their excellent byproduct, soybean oil meal.

On numerous occasions we have carried editorials at the suggestion of manufacturers who explained that inability to sell their byproduct readily was holding down the price they were able to pay farmers for raw soybeans. Distillers have always been plagued with the byproduct of their industry, many being forced to maintain their own feed-lots in which to dispose of their wastes. Being high protein feed the distiller's product would necessarily compete in the open market with cottonseed meal, linseed meal, and soybean meal. Certainly the fellow who produced these other crops would not be excited about helping out the corn grower by buying his byproduct.

While I frankly discount the possibility of this proposal accomplishing anything, let us again assume that we had such a statute and that it did work. Would not its success have a definite depressing effect on the farmer's returns from oil lands? I cannot forget that farmers in many States now profit from leases and royalties on oil to the extent of $200,000,000 a year.

And while we are assuming that such a law was operating, how would it affect grain prices? We have the proponents' answer because they argue that such an outlet for crops will increase prices. We have already seen in the statement by Milo Perkins that even at very low corn prices it is out of the question to produce alcohol profitably for motor fuels. Certainly if their use increased prices, would it not immediately make impracticable the conversion of corn into alcohol? The situation would be aggravated it seems to me by the fact that the distiller must draw supplies from a relatively small area in order to escape high transportation charges. Naturally, the local level of prices would quickly respond to such a market, but unfortunately the price of byproducts would necessarily be depressed because greater quantities would be dumped into a small area of consumers. Upon the rock of collection costs was wrecked our Midwest paper mills which at one time proposed with much ballyhoo to convert our straw and cornstalks into commercial products.

I have been on some good Iowa and Illinois farms whose owners once thought that there was no limit to the amount of corn they could raise. Mounting weed problems and increased threats from disease and insects clearly point to the need of changing that philosophy. And on its poorer more rolling lands evidences of excessive corn production may be found anywhere. Only last week I spent a day tramping over one of Iowa's midcounties viewing farm after farm completely ruined by the excessive growing of intertilled crops. Waiving aside all my other objections and granting that the plan succeeded, would it not stimulate increased production of corn at the very time the Government is paying the farmer enormous sums to reduce it? To tell the farmer he might go ahead and produce to the limit would defeat the present program which deserves a thorough trial before it is rejected for something different. Fertility removed by the crop alone is not the big loss about which I am concerned. It is fertility going down rivers in the form of soil dug up between the corn rows by raindrops. Already our leading farmers are swinging sharply to a grass economy, finding that by preserving green crops in the silo a high percentage of protein is obtained and only a minimum loss through soil erosion is suffered. Eminent authorities have stated that should the corn States operate their land with due regard to soil conservation no surplus corn would be avail-

able. Actually in 13 years (1915 to 1928) the excess corn carry-over was sufficient to maintain an alcohol-production program 1 year only. (See U. S. Department of Agriculture, Miscellaneous Publication No. 327, p. 23.)

I oppose this legislation because:

1. Method of the bill points eventually to compulsion.

2. There has not yet been demonstrated the commercial feasibility of producing alcohol from farm crops for blending with gasoline to produce motor fuel.

3. Research work so far has revealed as many handicaps as possibilities. It should continue under absolutely impartial direction.

4. Total agriculture production is insufficient to produce enough raw material for national consumption program of alcohol for motor fuel. Most locations are so lacking in raw materials as to make such a program economically unworkable.

5. The subsidy proposed is not sufficient to offset present production costs. However, it would be sufficient to set unscrupulous promoters upon businessmen and farmers alike.

6. Should the proposed bill lead to further Government subsidies sufficient to bring about the use of alcohol in motor fuels, the farmer would benefit to a very small degree as compared with distillers, and handlers. Furthermore, only a relatively few farmers could obtain a portion of the small benefits returning to agriculture while all farmers would help bear the bosts of the proposal.

Now, as I have put my notes together briefly and hastily, I would appreciate, sir, the opportunity of extending my remarks in the record.

Senator La Follette. You may have that privilege. The committee will stand in recess until 10:30 tomorrow morning.

(Subsequently Mr. Fox submitted the following material:)

Extension of Remarks on S. 552 by Kirk Fox

The most ambitious campaign for alcohol-gasoline ever staged in Iowa, possibly in any region of the United States, took place at Sioux City between December 1937 and May 1938. The Chamber of Commerce of Sioux City actively participated in the promotion of alcohol blends, on the promise that if Sioux City satisfied certain conditions a plant would be erected there similar to the one at Atchison, Kans. As a member of the agricultural committee of the Des Moines Chamber of Commerce, I naturally watched developments with deep interest. The facts as I was able to obtain them were substantially as follows:

The campaign failed and Sioux City has no power-alcohol plant. At its crest, in March 1938, alcohol blends were credited with constituting as high as 35 to 40 percent of total motor-fuel sales in Sioux City, and as high as 150 of the approximately 300 retail outlets in the area were reported as selling blends. In March 1938 about 1,800 gallons of alcohol, or "Agrol fluid," the product of the Atchison, Kans., power-alcohol plant, apparently were sold daily, admixed with gasoline in about a 10-percent ratio. Yet when the plant failed to materialize and the chamber of commerce abandoned its promotion efforts, demand for alcohol blends fell off rapidly, as partly demonstrated by published tax figures on imports into Iowa of Agrol fluid by the Atchison Agrol Co. for the first 7 months of 1938.

Month:	Gallons	Month:	Gallons
January	4,956	May	16,747
February	24,645	June	9,184
March	80,632	July	5,054
April	17,289		

Note.—These figures are exclusive of any Agrol Fluid or finished Agrol blended motor fuel which any jobber imported into Iowa and on which the jobber himself paid the State gasoline tax.

A survey published in National Petroleum News, September 28, 1938, indicated that retail outlets handling alcohol fuels had dwindled to 28, and estimated that alcohol-gasoline sales then constituted 5 percent of total motor-fuel sales of those jobbers who continued to handle blends.

The first announcement of the Chemical Foundation's intention to erect a plant at Sioux City similar to the one at Atchison, Kans., was made through an intermediary at the Sioux City Chamber of Commerce's annual dinner, December 14, 1937, and was reported as follows in the Sioux City Journal of December 15, 1938:

"Selection of Sioux City as the site for a half-million dollar plant to convert corn, kaffir, rye, and barley into power alcohol was announced Tuesday evening at the annual banquet of the chamber of commerce in the Martin Hotel. Plant construction is to begin in the spring.

"The announcement was made by O. L. Brownlee, Tribune editorial writer, on behalf of Leon E. Champer, of Atchison, Kans., where a plant now is in operation. Mr. Champer is assistant to Dr. Leo M. Christensen, inventor of the fuel.

"The concern will be known as the Sioux City Agrol Co., a subsidiary of Chemical Foundation, Inc., of New York.

"The product to be manufactured is a power alcohol which will be blended with gasoline for motor fuel. The blended fuel is said by Dr. Christensen, formerly of the Iowa State college faculty at Ames and now associated with the operation. Mr. Champer is assistant to Dr. Leo M. Christensen, inventor of the fuel.

"The Sioux City plant will consist of two units, one for making the alcohol and the other for making dry ice. The alcohol unit will cost $400,000 and the other $100,000. It is anticipated that between 50 and 60 persons will be employed directly by the company and between 1,000 and 1,500 indirectly. The plant will use about 1,500,000 bushels of grain a year.

"At Atchison that plant is manufacturing 10,000 gallons of the alcohol daily and paying 10 cents a bushel over the current market price for corn and the other grains.

"Blending plants are to be established in Iowa, South Dakota, and Nebraska.

"Mr. Brownlee will confer with the board of directors of the chamber of commerce at its meeting in the Martin Hotel today on the proposition. He said that the new business comes to Sioux City without strings, as the company has no stock to sell and wants no other concession from the city but its cooperation and goodwill.

"Businessmen welcomed the establishment of the plant here as a new outlet and good will.

"The Sioux City plant will consist of two units, one for making the alcohol by Dr. Leo M. Christensen, then vice president and general manager of the Atchison Agrol Co., a subsidiary of the Chemical Foundation.

"Dr. Leo M. Christensen, vice president and general manager of the Atchison Agrol Co., Wednesday explained to a group of business and professional men what Sioux City would have to do in order to get the power alcohol plant the Chemical Foundation, Inc., proposes to establish here.

"The requirements are as follows:

"1. Sioux City must satisfy the company that the surrounding territory will supply sufficient raw material to keep the proposed plant in operation.

"2. Sioux City must show a prospective demand for the blended product that will guarantee the consumption of at least 3,000 gallons of alcohol per day here and in nearby territory.

"In comment on the second requirement, O. L. Brownlee stated that already assurances had been received of a 400,000-gallon-per-month distribution of the blended product.

"I. W. Reck, head of the Sioux City Milk Producers' Association, said his organization would take 5,000 gallons a month.

"Dr. Christensen gave a half-hour talk, going into the history of power alcohol and forecasting possible future uses of that product. He predicted the coming of the time (in the somewhat distant future) when automobiles would be run wholly by alcohol power. That, he explained would necessitate the use of engines quite different from those now in use.

"The present popular blend of alcohol and gasoline is in proportions of 1 to 10, or thereabouts. The gasoline must be of high quality.

"Dr. Christensen suggested the possibility of one of the large oil companies running a pipe line into Sioux City in case this territory should become a large user of the gasoline-alcohol blend."

Subsequently it was announced that the Sioux City Chamber of Commerce had appointed an "Agrol" committee to aid and cooperate with the Atchison Agrol Co. in the test whether a demand for 3,000 gallons of alcohol in motor fuel could be demonstrated in and nearby Sioux City, and whether some form of contract could be negotiated with farmers to supply sufficient crop raw materials for the proposed plant's operations. It was estimated that 1,500,000 bushels of grain would be needed annually for the proposed plant of 10,000 gallons daily capacity. Various press reports indicated that the plant would be built by July 1, 1938. By March 9 chances that the plant would get built seemed bright, according to the following report in the Sioux City Journal of that date.

"The Sioux City Agrol plant will be in actual operation in time to handle the 1938 grain crop, the Agrol committee of the Sioux City Chamber of Commerce was told Tuesday. The assurance was given by Dr. Leo M. Christensen and Dr. Leon Champer of the Chemical Foundation at a meeting in the Martin Hotel at which final plans for the Sioux City plant were discussed.

"Bids are being asked this week for $250,000 worth of machinery for the Sioux City plant, Dr. Christensen said, and only the physical labor of making the drawings remains before the plans for the factory are submitted to the Federal alcohol-tax unit.

"All financial arrangements for the Agrol plant have been completed, the scientist told the Sioux City group, and will be handled entirely by the foundation. The quarter of a million dollars will buy the tanks, boiler, stills, and a feed-recovery unit, and will be exclusive of the cost of installation and the expense of the ground and building. Total cost of the plant will be around $500,000, it was said.

"The procedure from now on is definite, the chemist continued. Reminding the group of the two conditions under which the foundation agreed to build the Agrol plant here, Dr. Christensen said the first was as good as done. Referring to the daily distribution in this area of 3,000 gallons of Agrol from the Atchison factory, which had been asked by the foundation, he said that volume was nearly reached now and with warmer weather and the starting of farm work, was assured. Calling that a mere formality, the doctor then spoke of an adequate supply of raw materials.

"Mass meetings are being held by the Agrol committee throughout the territory to acquaint farmers with the nature of the farm contract, and it was emphasized that 1,500,000 bushels of grain will be needed annually by the Agrol plant here. Since the contract in use at the Atchison plant is not entirely suited to the Sioux City territory, farmers are being asked what they want included in the local contract.

"Fifty-six cents a bushel for corn and an equivalent price for other grains will be paid, it was said, with such clauses to protect the producer from crop failures as are asked by farmers. In general, the foundation representative said, it was considered advisable to contract only 10 percent of each farmer's crop, or the percentage of alcohol used in motor fuel.

"When these things are accomplished, which will be in the next few weeks, the shovels will be put to work. Building of the plant, installation of machinery, and a short trial run will require about 4 months, the group was told."

My reason for the foregoing detailed citation of the background of the Sioux City project is that it was regarded by many people in the Middle West as more or less of a test case. It will be seen that the project was well publicized and received strong backing by important local and outside organizations. It therefore seems to me that the ultimate failure of the project should be regarded as doubly significant.

As regards the acceptance of the blended fuels by the motoring public in Sioux City and vicinity, I have little direct information. However, it is my understanding that blends containing approximately 10 percent of alcohol were sold to the public at the price of regular gasoline, the distributors absorbing the extra cost of approximately 1.42 cents per gallon of blend. This added cost was, of course, based on the price of 25 cents per gallon of alcohol, f. o. b. Atchison, at which the Atchison Agrol Co. supplied the alcohol for this experiment. Since the blend was supplied at the price of regular gasoline, it may be assumed that the previously mentioned figures, showing the rapid decrease in consumption of the blend in Sioux City, are a fair criterion of the motoring public's acceptance thereof. In other words, it is no indication that the public was sufficiently enthusiastic to continue purchases after the novelty had worn off.

Little public information is available on how many farmers were contracted in the vicinity of Sioux City to supply raw materials for the proposed alcohol plant. Contracts proffered farmers by the Sioux City Agrol Co. included the following terms. Farmers might contract for corn, sorghum grains, barley, or rye for the crop years 1938 to 1948, with provisions for cancelation by farmer on any January and to the extent of 50 percent or more of the amount of crops contracted for in any given year in which a crop failure occurred. The price scale for corn was 56 cents per bushel, f. o. b. plant; 58 cents per bushel if the farmer chose to take half cash and half coupons good for protein supplement feed at $30 per ton, f. o. b. plant, and Agrol (alcohol) blends wherever they would be offered for sale; 60 cents per bushel, f. o. b. plant, if the farmer chose payments entirely in coupons. The contracts specified 200 bushels of corn, barley, or rye, or 10,000 pounds of grain sorghum, as the minimum quantities per grower, while growers with more than 200 acres might contract to deliver as many bushels as he had acres. Deliveries might be called for by the proposed plant upon giving the grower 15 days' written notice. Delivery dates were to be rotated year to year to each grower.

A copy of the Sioux City Agrol Co.'s grower contract form is attached. It may be of interest as indicating the complexity of the practical requirements of any such projects. How much greater the complexities would be on any national scale can only be imagined. It will be seen that while there was no compulsion on the grower to repurchase the distiller's grain ("protein supplement feed") it was nevertheless necessary to try to make it attractive to him to do so. The price of $40 per ton, however, is definitely higher, according to the Department of Agriculture figures, than the equivalent value of the feed based on 56-cent corn. The question, therefore, arises as to whether the growers would have repurchased the feed at this price, particularly if existing grain price levels were below the levels set forth in the contract.

Generally speaking, however, it is felt that these proposed contracts were as liberal to the grower as would be possible in any project of this kind. There has been no official statement as to the number of contracts which were executed, but one publication has reported that from 200 to 300 agreements were negotiated with farmers but were not completely signed, pending construction of the Sioux City Agrol plant.

All in all, it seems that the Sioux City experiment was undertaken under the best possible auspices and that its failure must be taken as significant as regards the actual acceptance of the proposal, in its ultimate practical aspects, by both farmers and motorists.

[Copy of Sioux City Agrol Co. contract form]

GROWER'S AGREEMENT, SIOUX CITY AGROL CO.

For and in consideration of the payments hereinafter provided and of the mutual benefits to the parties to this agreement, the Sioux City Agrol Company, party of the first part, hereinafter called the "Company," and

---------- of ----------
Name Address

party of the second part, hereinafter called the "Grower," covenant and agree that said Company will buy from said Grower, crops raised by him on lands hereinafter described, during the crop years of 1938 to 1948, inclusive, and said Company agrees to make payment for said crops in the manner hereinafter provided:

The Company agrees that the Grower shall have the right and privilege of cancellation of this agrement when notice of said cancellation is made in writing and sent by registered mail to the company during any month of January for the ensuing and unused remainder.

The crop shall be delivered by the Grower to the Company at its plant, in Sioux City. Grains containing moisture in excess of 14½ percent will be discounted ½c per bushel or 1c per cwt., whichever applies to option, for each ½ percent. of excess moisture. Deductions will not be made for foreign seeds of approved crops, but deductions will be made for inert material.

Compliance with this agreement calls for the delivery of a minimum of 200 bushels of corn, barley, or rye, or 10,000 pounds of sorghum grain. A Grower having more than 200 tillable acres may contract to deliver not more than the same number of bushels of corn, barley, or rye, or the same number of cwt. of sorghum grains as there are tillable acres contained in the farm operated by him.

In event of crop failure to the extent of fifty percent or more, from any cause, Grower may be released from compliance with this agreement for the growing season in which the crop failure occured. Determination will be made on the basis of the average yield for each county for each crop as reported by the State Department of Agriculture. Grower may ask for relief in writing and Company shall have the privilege of appraisal for determination of the facts and must render its decision in writing within thirty days.

TERMS OF COMPLIANCE

---------- Compliance Term No.----------
Amount Grain

(Refer to the reverse side of the agreement and insert, in pen and ink, or by typewriter, the amount and kind of grain and number of one of the several forms of compliance.)

The Grower will produce the crop as (tenant) (landlord) on the_____ Section ----------Township----------Range----------County State----------

(If you change farms during the life of this agreement, notify the Company, giving new legal description, and request transfer of agreement.)

The Company will give the Grower fifteen days' notice, in writing, of the date the crop is to be delivered to the plant. Such notification will be mailed each year and the Grower covenants to deliver the grains raised and sold to the Company under the terms of this agreement at the time designated by the Company. Delivery dates will be rotated from year to year, to give each grower delivery instructions for the several months of the year during the lifetime of this contract.

For good and sufficient reasons, such as based upon a settlement of an estate, dissolving a partnership, or to assist the tenant at moving time, Grower may apply to the Company, in writing, for the privilege of delivery of the grain at a time other than set forth in this Company's delivery schedule. In such an eventuality the Company will render its decision in writing.

Because of the superior quality of certain sorghum grains for the manufacture of Agrol, the Company will not accept delivery unless the sorghum grains are of the varieties known as pink, red, western blackhull, sooner milo, grohoma, early Kalo, and sweet stalk sargo.

(You are advised to consult your County Agent or State Agricultural school with reference to selection of sorghum grain seed and cultivation practices.)

The Grower herewith covenants with all other growers and the Company, in the spirit of full compliance with the high intent and purpose of this agreement, to use Agrol blended motor fuels in every and all possible manner and to advocate its use among friends and neighbors.

Grower hereby vests legal title to said crops in Company, admitting that Company shall be irreparably damaged by his failure to carry out fully the terms of this instrument. Grower agrees to pay all taxes and assessments which may accrue against or be levied on said crops, and further agrees that he will in no wise dispose of or encumber any of said crops to or in favor of parties other than Company, without Company's consent previously obtained in writing.

It is mutually agreed that the purpose of this agreement is to comply with one of the conditions procedent to the erection of a power alcohol plant in Sioux City by said Company. The other condition being the consumption of at least 3,000 gallons of alcohol per day by Sioux City and trade territory. Therefore, this agreement is not binding upon the Company unless these conditions precedent have been complied with, in the opinion of the Company; and in the further event the Company's plant is rendered inoperative through fire, strikes, or other causes beyond Company's control, in which eventuality Company shall not be compelled to pay for or receive any of said crop.

This agreement shall be binding upon the respective heirs, executors, administrators, successors, and assigns of Grower and of Company. Company reserves the right to assign this contract; but in such event it shall guarantee performance of the contract by such assignee.

IN WITNESS WHEREOF, the parties have on this _____ day of _____, 19____; executed this agreement in duplicate, the Company through its agent duly authorized so to act for it.

---------- SIOUX CITY AGROL COMPANY,
(Grower)

Witness---------- By ----------
Authorized Agent.

WAIVER OF LANDLORD'S LIEN, CHATTEL MORTGAGE, OR OTHER INTEREST

I hereby waive all claim as landlord, mortgagee, or otherwise, upon the crops referred to in the attached and foregoing Agreement.

Dated---------- ----------
Landlord—Mortgagee—Claimant

[On reverse side of contract]

INSTRUCTIONS

(The Grower may be either landlord or tenant, but must actually grow the crops or receive a share of crops for land rent. A Grower's Agreement may be entered into by both landlord and tenant for crops to be grown on the same land. Fill out the agreement in duplicate. In submitting the following agreement you are merely making a proposal subject to the acceptance of the Com-

pany and the official signature of the Company is necessary to make it an operative contract. When the Company has accepted your proposal it will sign your copy and return the same by mail. The Company reserves the right to reject all proposals submitted after the quota of one and one-half million bushels of grain have been contracted.)

TERMS OF COMPLIANCE

Select the form of compliance best suited to your individual needs and write it into the space provided in the agreement.

The Company grants permission to the Grower to change form of compliance during any succeeding month of January. The request must be directed to the Company in writing and the Company will give its decision in writing.

If you agree to accept coupons in lieu of cash in any of the following forms of compliance, you will receive a coupon book, issued by the Company. These coupons will be good for protein supplement feed at $30.00 per ton (Minimum sale one ton) f. o. b. the plant, and for Agrol blends at the place of business of any and all agents and merchants offering the blends for sale.

Compliance No. A—Corn at 56¢ per bushel, cash, f. o. b. plant.

Compliance No. B—Corn at 58¢ per bushel, one-half cash and one-half coupons, f. o. b. plant.

Compliance No. C—Corn at 60¢ per bushel, all coupons, f. o. b. plant.

Compliance No. D—Sorghum grains at 80¢ cwt., cash, f. o. b. plant.

Compliance No. E—Sorghum grains at 82¢ cwt., one-half cash and one-half coupons, f. o. b. plant.

Compliance No. F—Sorghum grains at 84¢ cwt., all coupons, f. o. b. plant.

Compliance No. G—Barley at 42¢ per bushel, cash, f. o. b. plant.

Compliance No. H—Barley at 44¢ per bushel, one-half cash and one-half coupons, f. o. b. plant.

Compliance No. I—Barley at 46¢ per bushel, all coupons, f. o. b. plant.

Rye, being the same weight as corn, may be substituted for corn in compliance Nos. A, B, and C, but Company reserves the right to limit its purchases of rye to 10 percent of the total grains contracted.

The latest or 20th edition of Feeds and Feeding, by Morrison, page 399, on Distillers' grain protein foods, says:

"Distillers' corn dried grains are considerably higher in value than the rye grains, and usually have 28 percent or more of protein, averaging 30.6 percent. In addition, they are rich in fat, usually containing 9 to 11 percent or even more, and they have only 10.8 percent of fiber, on the average. Distillers' corn grains are about as bulky as wheat bran, but they rank high in total digestible nutrients. They furnish 85.0 pounds of total digestible nutrients per 100 pounds, which is even more than is supplied by such feeds as corn grain, corn gluten feed, linseed meal, and cottonseed meal. Some of the distillers' grains sold as distillers' corn dried grains are of distinctly lower value than the usual grade, being lower in both protein and fat.

"Distillers' corn grains are deservedly a popular food for dairy cattle, and are chiefly used for this purpose. The high opinion dairymen have of them is due not only to the richness in nutrients, but also to the bulky nature. Though they are not especially well liked by stock when fed alone there is no difficulty from this when they are fed in suitable mixtures. Indeed, distillers' corn grains are a common ingredient in mixtures for feeding dairy cows on official test. As is pointed out in Chapter XXV, distillers' corn grains are slightly superior to corn gluten feed for dairy cows. This would be expected from their composition and content of digestible nutrients."

(Whereupon, at the hour of 12:05 p. m., the committee recessed until 10:30 a. m. of the following day, Wednesday, May 24, 1939.)

USE OF ALCOHOL FROM FARM PRODUCTS IN MOTOR FUEL

WEDNESDAY, MAY 24, 1939.

SUBCOMMITTEE OF THE COMMITTEE ON FINANCE
OF THE UNITED STATES SENATE,
Washington, D. C.

The subcommittee met, pursuant to recess, at 10:30 a. m., in the Finance Committee room, 312 Senate Office Building, Senator Clyde L. Herring, presiding. Also present Senator Gurney, of South Dakota.

Senator HERRING. The hearing will be in order. Our first witness this morning will be Congressman Vincent F. Harrington, of Iowa.

STATEMENT OF HON. VINCENT F. HARRINGTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF IOWA

Senator HERRING. You have a statement, Congressman, that you would like to make?

Mr. HARRINGTON. I have a statement I would like to make, Senator.

Senator CONNALLY. Senator, I have got to leave in a minute. I have a question or two that I would like to ask. I do not know whether the Congressman will try to answer it or not, but I will ask it, so if anyone else appears who can answer it you may ask him.

Senator HERRING. You have no objection to him answering it personally?

Senator CONNALLY. No, I have no objection.

Mr. HARRINGTON. Dr. Hale is here. He can answer any questions of a technical nature that I probably would not be able to answer.

Senator CONNALLY. Do you know anything about the plant of the Chemical Foundation that started in Atchison, Kans., that dealt with the production of ethyl alcohol?

Mr. HARRINGTON. I know something about the plant; yes, sir.

Senator CONNALLY. Can you state whether or not it has gone out of business?

Mr. HARRINGTON. It has temporarily closed, as I understand it. I do not know whether it is completely out of business or not.

Senator CONNALLY. You do not know anything about the prices at which it was able to sell this alcohol that it produced? I am merely asking these questions, Congressman, so that the committee can ask them of anybody else that comes on in case you are not able to answer them.

Senator GURNEY. I can answer that, Senator. The man who ran the plant will be a witness here a little later on and will make a complete statement on it.

Senator CONNALLY. That will be satisfactory, if somebody will ask him these question when he comes on. That is all. Pardon me for interrupting you.

Mr. HARRINGTON. I think the questions you have in mind will be covered by some other witnesses who have had direct dealing with the plant, and I think the man who ran the plant is here.

Senator CONNALLY. All right. Thank you.

Mr. HARRINGTON. Mr. Chairman, in coming before this committee to urge the favorable recommendation of S. 552, a companion bill to which I have introduced in the House, I do so as one of the pioneer advocates of legislation to encourage the development and use of power alcohol as a solution of the ever-pressing problem of what to do with our farm surpluses.

Six years ago and four years ago I sponsored "corn alcohol" legislation in the Iowa State Senate. Two years ago and again this year I introduced the bill now under consideration by your committee.

Six years ago corn was selling for 6 cents a bushel in the State of Iowa and the idea of compelling its use in the carburetors of Iowa motor cars instead of in the stoves of Iowa farm homes was born of that emergency. Today an emergency of a similar nature exists, the emergency of overproduction and underconsumption, of farm surpluses, of unemployment and in the not distant future, we fear, the emergency of depleted oil resources. All of this, but without any compulsion whatever, we seek to help solve with this legislation. In this bill we merely ask that gasoline containing a 10 percent blend of alcohol made from the products of American farms be exempted from the Federal tax of 1 cent a gallon.

In the past few years great strides have been made in the science of farm chemurgy which seeks the coordination of chemistry and agriculture for the purpose of developing industrial uses from what formerly were solely food and fiber crops. In the Southern States some 300 commercial uses have been found for the lowly peanut, commercial starch is being manufactured from sweetpotatoes, cloth from sweetpotato starch, composition board from sawmill waste, paints and varnish from the oil of the tung tree, paper pulp from pine, and many other new uses have been evolved to absorb the surpluses and by-products of agricultural commodities.

Agricultural colleges and experiment stations likewise have concentrated on the problem of finding industrial uses for farm products, and at the last session of Congress funds were provided for the establishment of four huge laboratories to carry on this research.

As a result of experiments by private, as well as public agencies, agricultural alcohol as a motor fuel also has become a reality surpassing in its potentialities for economic benefit any and all of the other branches of farm chemurgy now in operation. Last year a blend made from corn was successfully used in gasoline in the Middle West, and it was demonstrated that a similar blend can be made from wheat, rye, barley, sorghum, artichokes, sweetpotatoes, sugar beets, white potatoes, fruits, and many other agricultural product. A plant manufacturing this power alcohol from corn was in operation at Atchison, Kans., for a considerable period, and while financial difficulties recently have been encountered, nevertheless, it was demonstrated over quite a period that fuel alcohol can be produced from products of the soil, that it can be used to operate motor cars, that it

can be commercially sold, and that its manufacture and sale help to use up farm surpluses, help to make employment, help to create new wealth, and tend to relieve the danger of exhausting our present petroleum reserves.

On the basis of this one experiment it is estimated that to supply the motors of American users with a 10-percent blend of alcohol would require at least 800 units such as the one at Atchison. Construction of 800 such units would involve a capital outlay of between 320 and 400 million dollars. They would consume annually approximately 1,200,000,000 bushels of grain or the equivalent of that much grain in the form of tuber crops, sweet potatoes, and so forth. These factory units would employ about 50,000 men and permanent work would be created for a minimum of another million men on the farms and in affiliated industries.

It goes without saying that an industry of such magnitude soon would be able to put our idle acres and our idle men to work, and to consume the surpluses that now depress the market for farm products. Without question agricultural alcohol looms as the most potential big new industry on the American economic horizon today, and a little push in the way of Government subsidy may send it on its way to accomplish much more than any other phase of the farm chemurgic movement.

What we propose in this bill—the remission of the 1-cent tax on gasoline blended with this important new product of the farm—is an inducement to private enterprise to go ahead and foster and develop this new industry. In effect it is a reward offered for the so ution of our farm surplus problem. If it works the cost to the Government will be insignificant as compared with the general and widespread benefits. If it fails it costs the Government nothing.

As I mentioned before, the Atchison plant is temporarily shut down, so that the passage of this bill would not benefit any existing manufacturer. On the other hand, I am told that the enactment of this bill would immediately stimulate new interest and activity in the fuel alcohol field and start the ball rolling again. In my opinion, it is too big a chance to pass up, too important not to show every possible government cooperation, particularly when that cooperation is made contingent on private enterprise investing its own money and getting results for the general good of the Nation.

In closing, let me emphasize that fuel alcohol potentialities are not confined to any particular area, that the industry can operate in any area where there is agriculture, that its sources are not limited to any particular crop, but that if it works at all it can be made to work in any section and on any crop. Therefore, let us remit the Federal tax on this blended fuel, as I have suggested, and thereby assist the farmers, encourage a new American industry, create employment for men, land, and capital. Thank you very much.

Senator CLARK. Congressman, let me ask you a question about that. The justification for all suggested measures of this sort is to help American agriculture, is it not?

Mr. HARRINGTON. Yes, sir.

Senator CLARK. I introduced a bill myself the first year I was in the Senate to that effect. How do you get over this hump, though, as to the introduction of alcohol as a motor fuel, that blackstrap

molasses from Cuba is liable to come in and run all the American agricultural products out of the market?

Mr. HARRINGTON. Senator, this is only one phase of our program.

Senator CLARK. That was the consideration that gave me pause when we got into my own bill in 1933. I did not know how I was going to keep blackstrap molasses from Cuba from coming in and dominating the alcohol field, which I was not anxious to do.

Mr. HARRINGTON. Senator, I think if we could enact not only this bill but the parity-price bill, which provides for parity tariff as well as parity prices, that might answer it.

Senator CLARK. You are getting in pretty deep water, I am afraid.

Mr. HARRINGTON. I think that is the answer to it, Senator, as far as I am personally concerned, but I want to call your attention also to the provisions of our bill which remits the tax on alcohol derived from crops grown on American soil only.

Senator CLARK. Thank you, Congressman.

Senator HERRING. Mr. Tarleau, legislative counsel, Treasury Department.

STATEMENT OF THOMAS TARLEAU, LEGISLATIVE COUNSEL, TREASURY DEPARTMENT

Senator HERRING. You have a statement you wish to put into the record, have you, Mr. Tarleau?

Mr. TARLEAU. No, Mr. Chairman. The Secretary has already reported to you unfavorably on the Gillette bill, as well as the amendment intended to be offered by Senator Gurney.

Senator HERRING. Unfavorably?

Mr. TARLEAU. Unfavorably on the proposals, and I am here just to speak very briefly about two features which may not have been sufficiently covered in the letters reporting on the bills. I also have available, for whatever questions the committee cares to ask, representatives of both the Alcohol Tax Unit, who concern themselves with the collection and enforcement of alcohol taxes and regulations, and a representative of the Miscellaneous Tax Unit, which will be entrusted with the collection and enforcement of the gasoline provisions of the act.

Now we have reported unfavorably, as I have said, for several reasons: In the first place, because of the potential loss of revenue.

Senator CLARK. What do you estimate the loss of revenue to be? This letter might be included in the record.

Mr. TARLEAU. Yes. Senator, at present there seems to be little incentive for much employment of the exemption provision. The 1-cent gasoline tax saving is too expensive because of the cost of the anhydrous ethyl alcohol that would have to be added. Our chemists show that the cost of anhydrous ethyl alcohol will run about 6 cents. It is not anticipated that they will spend 6 cents in order to save 1 cent. There has been other evidence introduced, I believe, before the committee indicating that the 6 cents, or 5 cents, is too high, that it may be only 2 cents or a cent and a half. At any rate, it seems at the moment, that the cost of anhydrous ethyl alcohol is higher than the 1 cent they would save.

If the bill does become successful to the extent that the bill does away with the gasoline tax because of the introduction of anhydrous

ethyl alcohol we would lose about $235,000,000 a year, based on our fiscal 1938 figures.

Senator CLARK. That objection would not apply to such a proposition as was contained in the bill which I referred to a moment ago. If you put the shoe on the other foot, so to speak, and instead of remitting the tax where alcohol was used put an additional tax on gasoline where less alcohol or no alcohol was used.

Mr. TARLEAU. Yes. Of course that would create an entirely different revenue picture.

Now there are two matters that I would like to talk about very briefly, if I may. One is the increased cost of supervision. Of course one of the elements we always have to consider in the whole matter of alcohol supervision and alcohol tax collection is the cost of supervision, the number of people we have to have at the distilleries, and the matter of checking and being sure that bootleggers do not come in.

The total quantity of anhydrous ethyl alcohol that is now to be produced if 7 percent thereof is to be added to gasoline, based on our 1938 tax collections on gasoline, is about a billion and a half standard wine gallons. Now if it is to be 10 percent—I believe Senator Gurney's bill is 10 percent and Senator Gillette's bill 7 percent—if it is to be 10 percent of anhydrous ethyl alcohol the requirement will be about 2,000,000,000 wine gallons. Putting that into proof gallon figures, that means that we would need about 3,000,000,000 proof gallons of anhydrous ethyl alcohol on the 7-percent bill, if I may so phrase that bill, and over 4,000,000,000 on the 10-percent bill, that is, on Senator Gurney's bill.

At present the amount of alcohol that is being produced in proof gallons is about 350,000,000 proof gallons per year. You can see that would mean an increase in production of about ten-fold, if this bill goes completely into effect. I do admit that is the utmost case, the most extreme case, but that is the only way we can adequately judge it. If that is true, if we have to increase tenfold the number of distilleries and the amount of alcohol produced, naturally our cost of supervision will be enormously increased.

At the present time our costs of supervising the production, denaturization and distribution of that quantity of distilled spirits mentioned, 350,000,000 gallons, is approximately 4½ million dollars, and of course we feel our costs will rise enormously. That is a fact which should be taken into account, because we will have no compensating source of revenue therefrom. In other words, it is purely a supervision of production and does not assure us any revenue, because if that amount of alcohol is produced it will be produced, of course, to go into the blend with gasoline.

The other factor is the hazard to revenue. Attention is called to the fact that alcohol may be separated from gasoline by the simple addition of water. That has been one of the peculiar difficulties. The alcohol and water will separate at the bottom of a container and may easily and readily be drawn off from the gasoline layer which collects on the top. The alcohol thus separated, unless well denatured, can be converted into potable alcohol by simple distillation, and if it is well denatured can be cleaned or rendered potable by a number of processes that the bootleggers are now using to remove the denaturization from completely denatured alcohol. It will be a tremendous task to watch

and check the distribution of this large amount of anyhdrous ethyl alcohol-gasoline when the alcohol may be separated by simply adding water. It would mean that every gas station and automobile gas tank in the United States would be a potential source of alcohol supply for the bootlegger. The gasoline separated from the motor fuel blend may still be sold for motor-fuel purposes, while the alcohol could be turned over for distribution to the bootleggers, who could render it potable by processes now known to them, and thus both the gasoline and distilled spirits taxes could be avoided and the Government defrauded.

Senator GURNEY. Have you had any difficulty with the 10,000,000 gallons of anhydrous ethyl alcohol that has already been manufactured at Atchison and throughout the Middle West? Have you had any trouble with the bootleggers taking the denaturization out of the alcohol and using it that way?

Mr. TARLEAU. I prefer, Senator, if I may, to ask one of the men from the Miscellaneous Tax Unit or the Alcohol Tax Unit to answer that.

Mr. LINDER (Mr. W. W. Linder, Alcohol Tax Unit, Bureau of Internal Revenue). We have had no trouble so far that I know of in the Alcohol Tax Unit.

Senator GURNEY. The Alcohol Tax Unit has approved the denatured product and it was acceptable to the trade?

Mr. LINDER. Yes, sir; acceptable to the Bayler Manufacturing Co., at least they accepted the formula we suggested.

Senator HERRING. How much did you say you sold out there?

Senator GURNEY. More than 10,000,000 gallons.

Senator HERRING. Without any difficulty?

Senator GURNEY. Without any difficulty.

Mr. TARLEAU. Now, Senator, we have available for further questioning, of course, these gentlemen. They can talk to you after I have finished.

Now I would like to for a moment, if I may, dwell upon the administrative difficulties with respect to the supervision of the sales of gasoline. Under the present statute a producer of gasoline is defined as including "a refiner, compounder, or blender, and a dealer selling gasoline exclusively to producers of gasoline, as well as a producer."

It is further provided that under regulations to be prescribed no tax shall be imposed on the sale of gasoline to a producer of gasoline.

From the above, it can be seen that any person who blends gasoline with other ingredients to produce a motor fuel, qualifies as a producer of gasoline, and if such person gives bond and registers as required by the law and regulations, he can purchase all of his gasoline supply tax free.

This means that if this proposed bill is enacted every roadside filling station might qualify as a producer of gasoline by becoming a blender of gasoline and anhydrous ethyl alcohol, and could then purchase both of these products tax free from the producers thereof.

Senator GURNEY. I have had some experience in the gasoline business. I find that the cost of the bond is pretty high.

Mr. TARLEAU. $2,000.

Senator GURNEY. Therefore only the large producers of motor fuel would request a bond. Is that information of mine incorrect?

Mr. TARLEAU. You certainly have experience, Senator, and I haven't. All I know is from hearsay, so of course I defer to your experience.

Senator GURNEY. There is a possibility they might ask for a bond, but the cost of the bond would prohibit any but the large producers of motor fuel from complying with the provision.

Mr. TARLEAU. Certainly it is evident, Senator, that the number of taxpayers would be greatly increased and it would require a large force of additional investigating officers to police the industry to enforce the law. Such investigating officers would necessarily have to be experts or make chemical analysis in order to determine whether the necessary percentage of alcohol is contained in the blended product.

It is understood that this blending operation is a very simple method of mixing the two products without requiring any particular equipment except the storage tanks normally used.

If it is the intention of Congress to grant the exemption provided in this bill, it should be limited to the products actually blended at the refinery of the actual producer of the gasoline content thereof. We believe that such an amendment would tend greatly to aid the enforcement and cut down the cost of supervision or collection of gasoline taxes.

I believe that in other respects the letter of the Secretary adequately covers our objections, and, as I have already said, the representatives of both the Alcohol Tax Unit and the Miscellaneous Tax Unit are here for any questions which you care to ask them.

Senator HERRING. Would you like to have these letters placed in the record?

Mr. TARLEAU. The letters of the Secretary?

Senator HERRING. Yes.

Mr. TARLEAU. Yes.

Senator HERRING. Without objection the letters of March 10 and May 23 from the Treasury Department will be placed in the record. Also, at this point the letters concerning Senator Gillette's bill and Senator Gurney's amendment from the Secretary of Agriculture will be placed in the record.

(The letters referred to are as follows:)

TREASURY DEPARTMENT,
Washington, May 23, 1939.

Hon. PAT HARRISON,
Chairman, Committee on Finance,
United States Senate.

MY DEAR MR. CHAIRMAN: Further reference is made to your letter of April 26, 1939, enclosing a copy of an amendment "intended to be proposed by Mr. Gurney to the bill (H. R. ——) to provide revenue, and so forth," and requesting a statement of this Department's views on this proposed legislation.

The bill proposes to further amend section 3412 (c) (2) of the Internal Revenue Code to read as follows:

"(2) The term 'gasoline' means (A) all products commonly or commercially known or sold as gasoline (including casinghead and natural gasoline), benzol, benzene, or naphtha, regardless of their classifications or uses; and (B) any other liquid of a kind prepared, advertised, offered for sale, or sold for use as, or used as, a fuel for the propulsion of motor vehicles, motorboats, or airplanes; except that it does not include any of the foregoing mixed with 10 per centum or more of anhydrous ethyl alcohol produced from annual agricultural crops grown in the continental United States and so denatured as to exempt it from the tax imposed by law upon distilled spirits, does not include any of the foregoing (other than products commonly or commercially known or sold as gasoline) sold for use otherwise than as a fuel for the propulsion of motor vehicles, motorboats, or airplanes,

and otherwise than in the manufacture or production of such fuel, and does not include kerosene, gas oil, or fuel oil."

Under the present provisions of section 3412 (c) (2) of the Internal Revenue Code, all products commonly or commercially known or sold as gasoline, including casinghead and natural gasoline, are subject to the tax imposed thereunder regardless of the purposes for which sold or used. If the bill is enacted into law, it will have the effect of depriving the Government of revenue derived from the tax on motor fuels imposed by section 3412 (a) of the Internal Revenue Code to the extent that producers of gasoline, in order to be relieved from the payment of the Federal tax, blend their product with 10 percent or more of anhydrous ethyl alcohol. Therein lies the highly important economic aspect of the bill.

It appears from the Oil, Paint and Drug Reporter of April 11, 1938, that anhydrous alcohol produced from molasses is quoted (without tax) at 40 cents per gallon in carload lots, 42 cents per gallon in 10-drum lots, and 45 cents per gallon in 1- to 18-drum lots. Anhydrous alcohol made from grain is quoted at 45 cents per gallon higher than the molasses anhydrous alcohol. On this basis anhydrous grain alcohol is quoted at 85 cents, 87 cents, and 90 cents per gallon in carload, 10-drum, and 1- to 18-drum lots, respectively. The same publication quotes gasoline (refinery) at prices ranging from 2½ cents to 7¼ cents per gallon.

Any manufacturer of gasoline desiring to avail himself of the tax exemption offered by the bill must substitute 10 percent of anhydrous alcohol for 10 percent of gasoline. The value of the gasoline for which alcohol was substituted would range, on the gallon basis, from $0.0025 in the case of 2½-cent gasoline to $0.00725 in the case of 7¼-cent gasoline. It is not known, of course, from which of the agricultural products the anhydrous alcohol will be produced, but since grain is an important agricultural product, it is fair to assume that much of the anhydrous alcohol intended for use in motor fuels will be produced from grain. Since grain anhydrous alcohol is quoted at 85 cents, 87 cents, and 90 cents per gallon, it is clear that the 10 percent thereof put into motor fuel in place of the 10 percent of motor fuel removed will have a value, on the gallon basis, of from 8½ cents to 9 cents. In other words, the gasoline producer will save a tax of 1 cent per gallon on gasoline of his production if he substitutes for gasoline valued at $0.0025 to $0.00725, anhydrous alcohol valued at from 8½ cents to 9 cents.

It is fair to assume that no motor fuel manufacturer would substitute expensive alcohol for cheap gasoline and thereby lose approximately 8 cents per gallon. If, however, it is found to be possible to develop cheaper methods of producing alcohol, thereby making it economically feasible to substitute it for gasoline, it is not at all improbable that motor-fuel manufacturers will find it profitable to make the substitution of alcohol for gasoline and save the amount of the motor-fuel tax. The balance of this report is predicted on the widespread substitution of alcohol for gasoline when and if such substitution becomes economically feasible.

While the administration and collection of the tax on gasoline, as imposed by section 3412 of the Internal Revenue Code, has presented no unusual difficulties, it is believed that if the proposed amendment is enacted into law it will tend to create many administrative difficulties not heretofore encountered, one of the most important of which will be determining whether or not a certain shipment of gasoline contains the percentage of anhydrous ethyl alcohol specified. In each case a chemical analysis will have to be made of the product so shipped in order to determine its contents. This will apparently require the detailing of a chemist or an expert representative of the Department at the place of business of each person qualifying as a producer of gasoline to prevent tax-free sales of the product being made under conditions not warranted under the proposed amendment.

The extent of the probable loss of revenue if the bill is enacted is best presented by a reference to, and a study of, the figures showing gasoline consumption in the United States. The statement appearing on pages 70 and 71 of the report of the Commissioner of Internal Revenue for the fiscal year ended June 30, 1938, discloses that during that fiscal year there was collected in internal-revenue taxes on gasoline, at the rate of 1 cent per gallon, the sum of $203,648,079.78. Since each penny of that tax represented a gallon of gasoline, it follows that there must have been sold during that fiscal year a total of 20,364,807,978 gallons of gasoline. If during that fiscal year the gasoline sold had contained 10 percent of alcohol, as contemplated by the bill, it is apparent that 2,036,480,797.8 standard gallons of alcohol would have been used in the manufatcure of the gasoline.

The quantity of alcohol just referred to is in terms of the standard or liquid gallon, referred to by statutes and usage in the distilled-spirits field as a "wine gallon." Since the bill requires, as a condition precedent to the exemption from tax, that 10 percent of anhydrous alcohol be used, it is proper here to explain the

term and note its effect upon the computation of the number of proof gallons of alcohol which would have been required if all blenders and producers of motor fuel had availed themselves of the privilege. Anhydrous alcohol is absolute alcohol containing no water.

Proof spirits are defined by section 2809 (c) of the Internal Revenue Code as follows:

"Proof spirits shall be held to be that alcoholic liquor which contains one-half its volume of alcohol of a specific gravity of seven thousand nine hundred and thirty-nine ten-thousandths (.7939) at sixty degrees Fahrenheit."

A gallon of spirits is defined by section 2809 (d) of the Internal Revenue Code as follows:

"In all sales of spirits a gallon shall be held to be a gallon of proof spirit, according to the standard prescribed in the preceding subsection, set forth and declared for the inspection and gauging of spirits throughout the United States."

The simple way to compute the proof of a liquid is to mulfiply by 2 the percentage, by volume, of the alcohol therein. Thus figured, a wine gallon of liquid composed of 50 percent (½) water and 50 percent (½) alcohol, would be a gallon of proof spirits. A wine gallon of liquid containing (by volume) 40 percent water and 60 percent alcohol, would be a gallon of 120 proof spirit; or stated decimally for computation of the tax on the proof gallon, it would be 1.20 proof gallon. A wine gallon of liquid containing by volume 100 percent of alcohol and no water would be actually 2 proof gallons of spirit (100 proof by 2 gallons).

Assuming then that during the fiscal year 1938 anhydrous alcohol had been used in the compounding of gasoline, it would appear that 4,072,961,595.6 proof gallons (2,036,480,797.8 wine gallons × 2.00) of alcohol would have been used.

The production of 4,072,961,595.6 proof gallons of alcohol, or any like quantity, from any and all types of raw material (most of the alcohol is now produced from molasses), presents a practical problem which should not be overlooked. Neither the industrial alcohol plants nor the whisky, rum, gin, and fruit distilleries now operating are equipped to produce high-proof ethyl alcohol from agricultural products generally. Even if so equipped, they would be unable to produce the vast quantities of anhydrous alcohol which would be needed if the bill became law and the blenders and manufacturers of motor fuel should generally seek to avail themselves of the privilege extended by the bill.

It is at once apparent that if, in order to supply the alcohol which may be needed under the act, a sufficient number of plants are erected to produce it, the expenses of the Bureau of Internal Revenue incident to the supervision and control of the production of such alcohol will be increased. Since the alcohol produced for use under the act will be denatured and therefore free of the distilled spirits tax, the Government will lose not only the tax on the gasoline and the alcohol, but costs of supervision of production, denaturation, control, and distribution.

This Department is not in favor of the enactment of the proposed legislation.

In the event that further correspondence relative to this matter is necessary, please refer to the symbols IR:MT:ST.

The Director, Bureau of the Budget, has advised the Treasury Department that there is no objection to the presentation of this report.

Very truly yours,

JOHN W. HANES,
Acting Secretary of the Treasury.

MARCH 10, 1939.

Hon. PAT HARRISON,
Chairman, Committee on Finance,
United States Senate.

MY DEAR MR. CHAIRMAN: Further reference is made to your letter of January 13, 1939, enclosing a copy of bill, S. 552 (76th Cong., 1st sess.), "To provide that gasoline mixed with 7 percent of ethyl alcohol shall not be subject to the tax imposed by section 617 of the Revenue Act of 1932, as amended," and requesting a statement of this Department's views on the proposed legislation.

The bill proposes to further amend section 617 (c) (2) of the Revenue Act of 1932, as amended, to read as follows:

"(2) The term gasoline means (A) all products commonly or commercially known or sold as gasoline (including casinghead and natural gasoline), benzol, benzene, or naphtha, regardless of their classifications or uses; and (B) any other liquid of a kind prepared, advertised, offered for sale, or sold for use as, or used as, a fuel for the propulsion of motor vehicles, motorboats, airplanes, or other

automotive vehicles except that it does not include any of the foregoing liquids mixed with 7 per centum or more of anhydrous ethyl alcohol produced from annual agricultural crops grown in the continental United States or its organized Territories and so denatured as to exempt it from the tax imposed by law upon distilled spirits, and does not include any of the foregoing (other than products commonly or commercially known or sold as gasoline) sold for use otherwise than as a fuel for the propulsion of motor vehicles, motorboats, airplanes, or other automotive vehicles and otherwise than in the manufacture or production of such fuel."

Under the present provisions of section 617 (c) (2) of the Revenue Act of 1932, as amended, all products commonly or commercially known or sold as gasoline, including casinghead and natural gasoline, are subject to the tax imposed thereunder regardless of the purposes for which sold or used. If the bill is enacted into law, it will have the effect of depriving the Government of revenue derived from the tax on motor fuels imposed by section 617 (a) of the Revenue Act of 1932 to the extent that producers of gasoline, in order to be relieved from the payment of the Federal tax, blend their product with 7 percent or more of anhydrous ethyl alcohol. Therein lies the highly important economic aspect of the bill.

It appears from the Oil, Paint, and Drug Reporter of April 11, 1938, that anhydrous alcohol produced from molasses is quoted (without tax) at 40 cents per gallon in carload lots, 42 cents per gallon in 19-drum lots, and 45 cents per gallon in 1- to 18-drum lots. Anhydrous alcohol made from grain is quoted at 45 cents per gallon higher than the molasses anhydrous alcohol. On this basis anhydrous grain alcohol is quoted at 85 cents, 87 cents, and 90 cents per gallon in carload, 19-drum, and 1-to 18-drum lots, respectively. The same publication quotes gasoline (refinery) at prices ranging from 2½ cents to 7¼ cents per gallon.

Any manufacturer of gasoline desiring to avail himself of the tax exemption offered by the bill must substitute 7 percent of anhydrous alcohol for 7 percent of gasoline. The value of the gasoline for which alcohol was substituted would range, on the gallon basis, from $0.00175 in the case of 2½-cent gasoline to $0.005075 in the case of 7¼-cent gasoline. It is not known, of course, from which of the agricultural products the anhydrous alcohol will be produced, but since grain is an important agricultural product, it is fair to assume that much of the anhydrous alcohol intended for use in motor fuel will be produced from grain. Since grain anhydrous alcohol is quoted at 85 cents, 87 cents, and 90 cents per gallon, it is clear that the 7 percent thereof put into motor fuel in place of the 7 percent of motor fuel removed will have a value, on the gallon basis, of from 5.95 cents to 6.30 cents. In other words, the gasoline producer will save a tax of 1 cent per gallon on gasoline of his production if he substitutes for gasoline valued at $0.00175 to $0.005075, anhydrous alcohol valued at from 5.95 cents to 6.30 cents.

It is fair to assume that no motor-fuel manufacturer would substitute expensive alcohol for cheap gasoline and thereby lose approximately 5 cents per gallon. If, however, it is found to be possible to develop cheaper methods of producing alcohol, thereby making it economically feasible to substitute it for gasoline, it is not at all improbable that motor-fuel manufacturers will find it profitable to make the substitution of alcohol for gasoline and save the amount of the motor-fuel tax. The balance of this report is predicated on the widespread substitution of alcohol for gasoline when and if such substitution becomes economically feasible.

While the administration and collection of the tax on gasoline, as imposed by section 617 of the Revenue Act of 1932, as amended, has presented no unusual difficulties, it is believed that if the proposed amendment is enacted into law it will tend to create many administrative difficulties not heretofore encountered, one of the most important of which will be determining whether or not a certain shipment of gasoline contains the percentage of anhydrous ethyl alcohol specified. In each case a chemical analysis will have to be made of the product so shipped in order to determine its contents. This will apparently require the detailing of a chemist or an expert representative of the Department at the place of business of each person qualifying as a producer of gasoline to prevent tax-free sales of the product being made under conditions not warranted under the proposed amendment.

The extent of the probable loss of revenue if the bill is enacted is best presented by a reference to, and a study of, the figures showing gasoline consumption in the United States. The statement appearing on pages 70 and 71 of the report of the Commissioner of Internal Revenue for the fiscal year ended June 30, 1938, discloses that during that fiscal year there was collected in internal revenue taxes on gasoline, at the rate of 1 cent per gallon, a sum of $203,648,079.78. Since each penny of that tax represented a gallon of gasoline, it follows that there must have been sold during that fiscal year a total of 20,364,807,978 gallons of gasoline.

If during that fiscal year the gasoline sold had contained 7 percent of alcohol, as contemplated by the bill, it is apparent that 1,425,636,658.46 standard gallons of alcohol would have been used in the manufacture of the gasoline.

The quantity of alcohol just referred to is in terms of the standard or liquid gallon, referred to by statutes and usage in the distilled spirits field as a "wine gallon." Since the bill requires, as a condition precedent to the exemption from tax, that 7 percent of anhydrous alcohol be used, it is proper here to explain the term and note its effect upon the computation of the number of proof gallons of alcohol which would have been required if all blenders and producers of motor fuel had availed themselves of the privilege. Anhydrous alcohol is absolute alcohol containing no water.

Proof spirits are defined by statute (sec. 3259, Rev. Stat., U. S. C., title 26, sec. 1158 (e)) as follows:

"Proof spirits shall be held to be that alcoholic liquor which contains one-half its volume of alcohol of a specific gravity of seven thousand nine hundred and thirty-nine ten-thousandths (0.7939) at sixty degrees Fahrenheit."

A gallon of spirits is defined by statute (sec. 3250, Rev. Stat., U. S. C., title 28, sec. 1158 (d)) as follows:

"In all sales of spirits a gallon shall be held to be a gallon of proof spirit, according to the standard prescribed in the preceding subsection, set forth and declared for the inspection and gaging of spirits throughout the United States."

The simple way to compute the proof of a liquid is to mulitply by 2 the percentage, by volume, of the alcohol therein. Thus figured, a wine gallon of liquid composed of 50 percent water and 50 percent alcohol, would be a gallon of proof spirits. A wine gallon of liquid containing (by volume) 40 percent water and 40 percent alcohol, would be a gallon of 120 proof spirit; or stated decimally for computation of the tax on the proof gallon, it would be 1.20 proof gallon. A wine gallon of liquid containing by volume 100 percent of alcohol and no water would be actually 2 proof gallons of spirit (100 proof by 2 gallons).

Assuming then that during the fiscal year 1938 anhydrous alcohol had been used in the compounding of gasoline, it would appear that 2,851,073,116.92 proof gallons (1,425,536,588.46 wine gallons by 2) of alcohol would have been used.

The production of 2,851,073,116.92 proof gallons of alcohol, or any like quantity, from any and all types of raw material (most of the alcohol is now produced from molasses), presents a practical problem which should not be overlooked. Neither the industrial alcohol plants nor the whisky, rum, gin, and fruit distilleries now operating are equipped to produce high-proof ethyl alcohol from agricultural products generally. Even if so equipped, they would be unable to produce the vast quantities of anhydrous alcohol which would be needed if the bill becomes law and the blenders and manufacturers of motor fuel should generally seek to avail themselves of the privilege extended by the bill.

It is at once apparent that if, in order to supply the alcohol which may be needed under the act, a sufficient number of plants are erected to produce it, the expenses of the Bureau of Internal Revenue incident to the supervision and control of the production of such alcohol will be increased. Since the alcohol produced for use under the act will be denatured and therefore free of the distilled-spirits tax, the Government will lose not only the tax on the gasoline and the alcohol but costs of supervision of production, denaturation, control, and distribution.

This Department is not in favor of the enactment of S. 552.

In the event that further correspondence relative to this matter is necessary, please refer to the symbols IR:MT:ST.

The Acting Director, Bureau of the Budget, has advised the Treasury Department that there is no objection to the presentation of this report.

Very truly yours,

JOHN W. HANES,
Acting Secretary of the Treasury.

MARCH 15, 1939.

Hon. PAT HARRISON,
United States Senate.

MY DEAR SENATOR HARRISON: I have your transmittal under date of January 13, 1939, of a bill (S. 552) which has been submitted by Senator Gillette, of Iowa, to provide that gasoline mixed with 7 percent of ethyl alcohol shall not be subject to the tax imposed by section 617 of the Revenue Act of 1932, as amended.

This bill is designed to artificially stimulate industrial use of farm crops through indirect subsidy. Although ostensibly such stimulation is to be accomplished by

removal of an existing tax, the Federal Government may ultimately have to make up from other sources any revenue deficits thus incurred. The amounts of money involved through this legislation within the next 2 years or so may not be so great because of present limitations as to producing capacity, although there may be possible increases in the future, as shown below.

This Department has recently issued a bulletin discussing the manufacture of motor fuels from farm products, (Misc. Cir. 327, December 1938), a copy of which is attached hereto. On pages 58–60 of this report the present unused manufacturing capacity of the existing industrial alcohol industry due to lack of markets is estimated at 478,450 gallons per day, equivalent to about 145,000,000 gallons per year. Perhaps an additional 145,000,000 gallons production capacity is to be found at present in the beverage spirits industry, which now has large manufactured stocks on hand. If this entire inactive processing capacity were brought into use to make alcohol for motor fuel, the 290,000,000 gallons of alcohol which might be manufactured (equivalent to 126,000,000 bushels of corn) would make annually about 4,140,000,000 gallons of motor fuel (at 7 percent alcohol concentration), representing a revenue loss of about $41,400,000 for each year.

If the proposed subsidation were to be continued indefinitely, perhaps additional alcohol-producing plants might be built, thereby increasing the potential amount of revenue deficit. Certainly the growth of an agricultural motor-fuel industry might be stimulated by the means offered in the proposed legislation, although this statement is subject to the arguments advanced on pages 38–41 of the attached report, concerning economics of cost.

At prices which can now be obtained for alcohol for use as a motor fuel, and with present processing costs, manufacturers cannot afford to pay prevailing market prices for farm products used as raw materials, such as corn and wheat (Bulletin, pp. 80–84). If the 1-cent existing Federal tax on gasoline were removed on a 7-percent alcohol-gasoline blend, the sales value of the alcohol used in the blend would be increased, and the prices that manufacturers could pay for the raw materials would be greatly augmented. It is estimated that for corn the increased amount which could be paid would be about 33.7 cents per bushel, for wheat about 37 cents, and for grain sorghum about 32 cents. Use of a 10-percent blend would amount to about 23 cents a bushel on corn, and similarly change the prices which could be paid for other materials.

Even with such increases in the amounts which could be paid for the raw materials used in alcohol manufacture, however, these prices presumably might still be lower than market prices now prevailing, or which may be expected to prevail during the next few years. Thus the elimination of the 1-cent tax on such blended gasoline might not result in any large increase in the utilization of farm products for the manufacture of alcohol. It is quite possible, however, that existing plant facilities would be used to manufacture alcohol from local surpluses or low-quality products for which there is now no available market, or for which low prices prevail. This would be beneficial to producers of the affected commodities, and would correspondingly increase farm income. There would also be increased employment resulting from the operation of these facilities, which would be offset only partly by decreased activity and employment in the petroleum industry.

Manufacturers may not feel justified in investing large sums in additional plant equipment to utilize materials of this kind in the manufacture of alcohol, partly because of the relatively erratic changes in supplies of such materials which occur as a result of changing weather and market conditions, and partly because of the limited quantities which might be available within areas from which any given plant would have to draw its supplies. It would appear that in order to stimulate the production of alcohol on any very large scale, and thereby materially increase the industrial consumption of and raise the market prices of farm products, a larger subsidy than that proposed in this bill would be necessary.

It might also be noted that the possible benefits to farmers resulting from the operation of this bill, as outlined above, are conditioned by the fact that farmers themselves may constitute as high as 50 percent of the users of gasoline in some States.

The effect of alcohol in raising the octane rating of gasoline will vary. This is discussed on pages 91 to 93 of the bulletin. Much of the ordinary (nonpremium) gasoline sold today contains some tetra ethyl lead in lesser amounts than premium gasoline. Some gasolines respond better with alcohol than with lead compounds, but the reverse may be true in other instances. Alcohol added to lead compounds effects antiknock increases which are greater than those obtainable by further similar additions of alcohol to alcohol or lead to lead in the respective instances.

This effect varies for different gasolines, therefore no exact general statement can be formulated as to the predictable gasoline blend price for any given raw material. Much experimentation will be required on this one point alone, and extensive research on the entire problem will be required to reach a final evaluation of power alcohol as a real aid to agriculture. Such research is likely to be stimulated through the bringing into existence of an active industry. The necessity for exhaustive study of the entire problem must be emphasized.

If the present Federal tax on gasoline were to be repealed within a few years, some other form of subsidization might have to be accomplished to continue the motor-fuel-blend industry brought into existence through this proposed legislation. Such uncertainty is undesirable. It might be preferable to devise some more permanent means of accomplishing the intent of this legislation.

The bill as now drawn fails to include alcohol fuels which might be used for stationary engines or power devices, since only automotive and propulsion fields are included. It seems also that the setting up of a 7-percent blend as a standard may act as a limitation on the amount of crop material which might find use under this plan, owing to present manufacturing and cost difficulties. It is stated in the attached bulletin that blends approaching 10-percent alcohol concentration are the most likely to be economical and effective, and while it is admitted that low concentration blends have little relative value (pp. 95–96), it might be desirable to set up a 10-percent blend as the standard basis for tax removal, allowing, however, a proportionate removal of tax for blends of lower concentration, down to perhaps 2 percent as a minimum. This would create a more flexible basis to cover the initial period of fluctuating production and cost which will be encountered in the early stages of the industry. At present, sales costs may be excessive, as has been demonstrated in trial operations in the Midwest, and mere removal of the tax may be insufficient to bring about easy sales under present distribution difficulties.

This Department does not oppose the proposed legislation. From the standpoint of conservation of national and irreplaceable petroleum resources, the establishing of an industry which might create a replacement fuel annually from the land is of sufficient national importance to justify the employment of means such as are proposed. This Department is now contemplating studies on technical problems which are certain to arise in the development of such an industry.

Upon reference of this matter to the Bureau of the Budget, as required by Budget Circular 344, the Acting Director thereof advised the Department of Agriculture under date of March 8, 1939, that there would be no objection on the part of that office to the submission to Congress of this proposed report.

Sincerely,

H. A. WALLACE, *Secretary.*

MAY 12, 1939.

Hon. PAT HARRISON,
United States Senate.

MY DEAR SENATOR HARRISON: I have your letter of April 26, 1939, enclosing a copy of a proposed amendment submitted by Senator Gurney, of South Dakota, to House bill 3790, which was pending in the House of Representatives on the date of your letter, in which amendment the removal of the existing 1 cent Federal gasoline tax on motor fuels containing 10 percent of ethyl alcohol was provided.

It is my understanding that since the date of your letter the revenue bill in question has been passed by Congress without the inclusion of this amendment. However, for purposes of record, I am pleased to express an opinion on the proposed legislation.

The position of this Department in regard to removal of the existing Federal gasoline tax on motor fuels containing alcohol produced from farm products has been set forth at length in our letter to you of March 15, 1939, in reference to the Gillette bill (S. 552). In the case of this Gurney amendment there are only minor differences in text, and no difference in intent, as expressed in the Gillette bill. The principal difference is that Senator Gurney proposes that a 10-percent blend be made the basis for tax removal, whereas the Gillette bill had specified only 7 percent. In my letter of the above date on the Gillette bill, I stated that if legislation of this character were to be enacted "it might be desirable to set up a 10-percent blend as the standard basis for tax removal, allowing, however, a proportionate removal of tax for blends of lower concentration, down to perhaps

2 percent as a minimum." This phrase, in entirety, might be suggested for consideration in the Gurney amendment because of the flexibility which would be created, whereby the indeterminate amounts of alcohol which might be immediately available for motor-fuel blending could be used in low-percentage mixtures and benefit from the legislation, pending such time as an alcohol industry could be created which could produce the quantities of alcohol which would be eventually required.

It should also be pointed out that, as shown in my previous letter, the amounts by which the relative values that the alcohol plants might pay for farm products would be increased, when used for alcohol production, would be approximately 23 cents a bushel for the 10-percent blend rather than the 33.7 cents per bushel for the 7-percent blend, for corn, as is indicated in the letter. It may be further noted that the Gurney bill, like the Gillette bill, also fails to specifically exempt alcohol fuels which might be used for stationary engines or power devices, under our interpretation of the existing law. Reference to the new Internal Revenue Code, Seventy-sixth Congress, indicates some possible ambiguity as to the exact interpretation of the word "Propulsion" appearing in the statute as used in connection with motor vehicles. It would seem that under existing wording the intent of the law concerns vehicles that are moved or propelled from one place to another by the action of the fuel. This interpretation, of course, would eliminate the taxing of fuel for stationary engines. If, however, the use of the word propulsion implies a meaning of the self-rotation of an internal-combustion motor, by a fuel, so as to produce power without the implication of forward motion, then this particular exemption would be pertinent.

I am attaching a copy of our previous opinion on the Gillette legislation for the use of your office. However, because of the current interest in alcohol motor fuels, I would like to amplify the previous statement, so as to bring out some further points for your consideration.

As I view the matter, the proponents of alcohol fuels thus far have not indicated any unity of objective or purpose for the initiation of such a program. There have been various suggestions concerning the use of alcohol fuel as a means of utilizing farm wastes and occasional surpluses. Conceding the desirability of such an accomplishment, it is, however, obvious that the creation of an alcohol fuel-blending industry, merely as a scavenger operation, will expose such industry to considerable hazards as to permanence and economic operation. Amounts and qualities of raw materials will fluctuate widely, as well as prices thereof, with resultant variations in the cost of producing the alcohol. All this will have to be equalized in some manner. In addition, basically the cost of producing alcohol from such diverse materials as corn or sorghum, sugar beets, white or sweet potatoes, and sugarcane will vary for each material and each location. Assuming that sufficient plants were built to adequately cover the country and use all the wastes which might be available, the inevitable competition in sale of fuel blends, or in feed by products, would necessitate some form of equalization of inequalities in production costs. There has been no expression that has come to my attention, as to how these obvious facts are to be successfully dealt with in creating an industry. As a further fact, much of the cull and waste material will be of a nature unsuitable for collection or transportation to alcohol plants, if location is at any great distance from the material source. If, in accordance with other suggestions, the power-alcohol idea is to be merely a crop price-raising device, some limitation would be necessary or the eventual price advances will raise the alcohol cost, from any material, to impractical levels. Many other obvious resultants might be indicated. Suffice it to say, if this Government intends to subsidize a power-alcohol industry in some manner, then certainly a previous clear understanding of objectives and methods should be formulated. I am enclosing a copy of a recent talk presented by a Department representative on this subject, in which this point is especially emphasized.

Furthermore, if the object of the subsidy is to directly aid agriculture, specifically by placing an adequate cash return into the hands of the grower of the material, then provision should be made that the benefits derivable under the proposed legislation are not completely absorbed by the alcohol-processing industry, but are passed on to the farmer, at least in part. Furthermore, this Department would view with apprehension a development of stock selling or promotional schemes involving erection of alcohol processing plants indiscriminately and without regard to economic factors of location, as might be visualized if there was a rush of self-interested individuals to turn the benefits of the proposed legislation to their personal advantage. Without some control a debacle of promotion schemes might eventually bring great losses to private investors, many of whom

would doubtless be farmers, and destroy whatever real value the basic agricultural motor fuel idea may possess.

As I indicated in my previous letter, I do not oppose the legislation. However, I do think that any legislation favoring the establishment of an agricultural motor-fuel industry should be so shaped as to provide safeguards and definite means of adjustment and control. I still am of the opinion that adequate research should precede much investment of capital into proposals of the nature of power alcohol. All the comments which I have outlined are of course equally applicable and pertinent to the Gillette or similar proposals.

Very truly yours,

H. A. WALLACE,
Secretary.

Senator HERRING. Do you have anything further?

Mr. TARLEAU. That is all, sir.

Senator HERRING. Thank you. Dr. Jacobs, Bureau of Chemistry and Soils, Department of Agriculture. You have a statement you want to place in the record in connection with this proposal?

Dr. JACOBS. I would like to make certain things clear, Senator. I am here at the suggestion of the Department, to be at the service of the committee, to give technical information, and as such I will be happy to answer any questions.

I would like to also bring out that yesterday in the hearing my bulletin on motor fuels was repeatedly referred to as a sort of an authority. I would like to suggest, therefore, that actually the entire bulletin should be a part of the record, since it more or less covers the entire field. I will be happy to answer any specific questions that may be asked.

Senator HERRING. I was not present yesterday when that was referred to and I am not familiar with the trend that the hearing took. Do you have something, Senator Gurney?

Senator GURNEY. In that connection, I might say that this126-page booklet has been delivered to every Member of the Senate. If the committee cares to incorporate it all in the record, that would be all right. I do not think it is necessary to incorporate it in the record. You can incorporate in the record possibly the conclusions.

Senator HERRING. We will suggest that to the committee and let the committee determine whether or not it shall go into the record.

Dr. JACOBS. Otherwise I have not prepared any particular statement, because I really felt that I would be probably called at the end, after this testimony is all in. I will be glad later, at any time, to prepare an opinion.

Senator HERRING. Perhaps that might be better. We will be glad to receive any observations which you might care to make in connection with this legislation.

Dr. JACOBS. I think that would be more satisfactory.

Senator HERRING. Mr. Hubert Holloway of the American Automobile Association.

STATEMENT OF HUBERT HOLLOWAY, AMERICAN AUTOMOBILE ASSOCIATION, WASHINGTON, D. C.

Mr. HOLLOWAY. Mr. Chairman, I did not have in mind to go into any technical discussion of this subject. The American Automobile Association, as you probably know, is a federation of some 750 clubs, motor clubs, and branches throughout the country, representing approximately a million motorists.

We are very much concerned, of course, with anything that may affect the cost of motor fuels, or affect travel, and I would like to call the attention of the committee to a policy resolution adopted by our annual convention in June 1933. It is as follows:

Recently there has developed widespread agitation for the blending of alcohol made from surplus farm products with gasoline as a dubious means of aiding the farmer.

Several bills to make the use of the blended motor fuel mandatory have been introduced in State legislatures and the Congress of the United States.

Tests and studies conducted by the American Automobile Association, under the supervision of its contest board, have conclusively demonstrated that the additional cost of blended fuel to the users of highway transport would amount to hundreds of millions of dollars a year, depending upon the percentage of alcohol in the blend. This would simply constitute another supertax on motor transportation.

There is a surplus of cheap and efficient motor fuel available at wholesale prices of less than 5 cents a gallon, while alcohol from agricultural products would cost a minimum of 30 cents a gallon.

I will mention here, as I said, this is a 1933 resolution.

Under these conditions, the American Automobile Association, as a matter of good economics and sound public policy, is strenuously opposed to legislation of any kind or character making use of alcohol-blended fuel compulsory.

Since that time we have continued to watch technical studies on the subject, studies made by the Department of Agriculture, the conclusions of the Treasury as to tax evasion, and other conditions, which and we have found, during the passage of the last 6 years, no reason to amend that resolution. It now stands as the policy of the American Automobile Association.

There was an inference left, perhaps, with the committee yesterday as regards the use of alcohol-blended fuels at Indianapolis. I have asked our contest board, which has supervision of the Indianapolis races and enforces the technical requirements, to give me a brief statement on this subject. The statement follows:

The use of alcohol as an automobile racing fuel is confined almost exclusively to the foreign type of racing engines and particularly the highly specialized engines employing extreme manifold pressures such as the current German and Italian designs.

The great majority of cars participating in the 1938 Indianapolis 500-mile race used an aviation type gasoline without alcohol content. In the 1937 race, which was an eminently successful event, the rules required that all cars should use a strictly stock gasoline, as available to consumers. In the 1938 race the records indicate that of more than 40 cars entered only two foreign and two American cars, each equipped with foreign-type superchargers, used an alcohol blend of any appreciable percent.

Where fuel economy is relatively unimportant, where the highest possible power output is desired from the lightest or smallest possible engine, and where normal cooling equipment is in itself insufficient, an alcohol blended fuel then has desirable characteristics and is frequently employed.

The fifth (1939) edition of Automobile Racing by Ray F. Kuns, in reviewing the 1938 Indianapolis race, states:

"Most of the cars to qualify used aviation gasoline of about 80 octane rating blended with 15 to 40 percent chemical benzol. Ethyl fluid was added in quantities up to 24 cc. per gallon. The amount of benzol and ethyl fluid depends upon the compression ratio, which ranges between 8:1 and 14:1 (the normal American pleasure car has a compression ratio not generally exceeding 6½ to 1).

"The two foreign cars reportedly used as much as 90-percent alcohol and benzol or gasoline with ethyl fluid. There are several reasons back of this. First, national policy demands the use of home-produced fuels, and alcohol and benzol come from farm products and coal, respectively. Both are available in most foreign countries. Second, these fuels, although having very much less fuel value than gasoline, do have extremely good antiknock values. Third, the object in

foreign racing does not necessarily include economy, and fuel consumption of five or six times that of American cars is not considered objectionable."

In conclusion I would like to make one point, perhaps a bit facetiously, and that is that this proposal would eliminate the alcohol tax from a tax which expires in about 30 days, and I believe the records of this committee show that almost without exception there has been a general agreement from year to year that a continuance of this tax would not be recommended.

Senator HERRING. Thank you. Are there any questions, Senator Gurney?

Senator GURNEY. The American Automobile Association is composed of a group of people who are scattered all over the United States, who are generally patriotic, like all the rest of the people. They like to see the country get along, and most of them are in business. Have you ever gone into the proposition, as an association, as to what benefit the use of alcohol motor fuel would be to the farmers, and therefore to the businessmen who are members of your association, in finding a better market for those things that they produce, around the Chicago area, if you please, or any other place in the United States?

Mr. HOLLOWAY. I will answer, Senator, by saying, as I stated at the outset, I am not qualified as a technical expert on the respective qualities of fuels.

Senator GURNEY. Your only research has been in the cost price to the ultimate consumer?

Mr. HOLLOWAY. The cost price to the ultimate consumer; recognizing, of course, that virtually one-fifth of the automobiles used in this country are owned by farmers. Thus it is reasonable to assume that they demand 20 percent of the fuel. So on its face it would look like, while we are entirely sympathetic to anything that will help any group of farmers, you will benefit your corn growers but at the same time will you not saddle an extra burden on your cotton growers?

Senator GURNEY. As I say, you haven't given any time to research along that line?

Mr. HOLLOWAY. Not in the last 2 or 3 years. We gave quite a bit of research to it when we made our studies under the contest board in 1933, as pointed out in this policy resolution.

Senator HERRING. Mr. Thomas J. Keefe, general manager, American Motorists Association.

STATEMENT OF THOMAS J. KEEFE, GENERAL MANAGER, AMERICAN MOTORISTS ASSOCIATION, WASHINGTON, D. C.

Mr. KEEFE. Mr. Chairman, I represent the American Motorists Association, a national organization embracing more than 250,000 automobile owners in the United States. Since 1935 the American Motorists Association has observed the introduction of more than 30 bills in State legislatures and before the Congress, which bills propose to compel the mixing of 10 percent of agricultural alcohol by volume with gasoline as a motor fuel. The avowed intent of these measures has been to aid the farmers by giving him industrial outlets for his crops. The current measure (S. 552) proposes to exempt from the Federal gasoline tax motor fuel containing 7 percent of alcohol made from domestically grown farm produce.

MOTORISTS NOT RESPONSIBLE FOR FARMERS' PLIGHT

The proponents of this plan have advanced the argument that because the automobile displaced the horses and mules and thus deprived the farmer of a market for his produce, then the automobile owner is primarily responsible for the present plight of agriculture. Personally, I have never been convinced that the displacement of draft animals has been a disrupting factor in our national life and I have looked for the facts in support of this conviction as a matter of self-reassurrance. In December 1938 the Federal Government issued a study of Changes in Farm Power and Equipment—Tractors, Trucks, and Automobiles. One phase of this study was devoted to the question of loss of farm markets upon the displacement of horses and automotive power. The study found that "The combined acreage of wheat, oats, and hay harvested represents a slightly smaller proportion of total acreage harvested in the period 1931–35 than the years 1907–17."

This study also found that the adoption of farm automotive equipment—including tractors—in 1935 had more than compensated for the resulting reduction in shift of farm man-hours of labor attributable to animal displacement. Actually, a net difference of 390,000,000 additional man-hours of labor was created by the farm automotive industry. I should like to call your attention to this report so that you may see how fair were the bases for its contentions.

INVENTION OF THE AUTOMOBILE INEVITABLE

I believe it is significant to point out that, if the internal-combustion engine now universally used in automobiles had not been invented, some form of mechanical power would have been applied to highway vehicles in any event. The National Resources Committee in its study of "technical trends" points out that "one of the greatest sales obstacles which the gasoline-powered car had to overcome was the widespread conviction that Edison would invent a superior and cheaper automobile."

I submit, therefore, that it is unjust to charge automobile owners with responsibility for the plight of the farmers and suggest that these people, many of whom are farmers themselves, pay damages on the basis of such an accusation in the form of a tax subsidy.

On the basis of 1938 motor-fuel consumption of 21,800,000,000 gallons, blending of 7 percent alcohol with gasoline would increase the fuel bill of the motorists by a figure in excess of $500,000,000 annually. Since the income of the average automobile owner as shown in recent studies by the Department of Commerce is between $20 and $30 per week, the average motorist should not be asked to donate what amounts to the best part of a week's wages to a scheme of this kind.

ARE BLENDS WORTH THEIR HIGHER COST

It is the consensus of qualified automotive engineers that 10-percent alcohol blends definitely are not worth more than gasoline of equivalent octane rating, and that in the net of their technical properties they are somewhat inferior. These findings have been repeatedly verified by exhaustive tests under scientifically controlled conditions.

Alcohol's one advantage is that it improves the antiknock qualities of gasoline. But identical improvement can be obtained at one-twelfth to one-seventeenth the cost (about one-fourth cent per gallon) by the addition of tetraethyl lead, an anti-knock agent now used in "regular" and premium grade gasolines.

There are various disadvantages to alcohol which are not encountered when the tetraethyl lead is used as the antiknock agent in gasoline. Ten percent of alcohol adversely affects the starting characteristics of a gasoline, and increases its susceptibility to vapor lock.

When carburetor settings are comparable for both fuels, 10-percent blends give less mileage than gasoline due to their lower heat energy content. If the carburetor setting is such that blends give mileage equivalent to gasoline, power output and acceleration are inferior.

A constant hazard with blends is absorption by the alcohol of sufficient moisture from the atmosphere and sides of storage tanks to cause it to separate from gasoline, which does not mix with water. Depending on the degree of separation occurring, partial or complete stoppage of the engine results under these conditions.

Alcohol is a solvent which attacks paints and lacquers used on automobile bodies. In the course of refueling cars numerous times motor fuel unavoidably is spilled on fuel tanks and fenders. The finish on these parts of the body on which motor fuel is unavoidably spilled would be destroyed by the alcohol.

Ten-percent blends clearly are not worth more than gasoline of equivalent octane rating, and in many respects are somewhat inferior.

MAJORITY OF FARMERS ACTUALLY WOULD BE LOSERS

Even if all gasoline sold in America were to contain 10 percent of alcohol, less than 15 percent of the Nation's farm lands would be near enough to alcohol plants to participate in supplying the market for fermentable crops. The vast majority of farmers would receive no income from sale of crops to distilleries, and would actually be out of pocket the amount of their increased motor fuel bill.

Only one of the many defects of the power alcohol scheme is that there is not enough fertile land distributed throughout the country in which to locate power alcohol plants so that crops for processing wouldn't have to be collected farther than 10 miles away, which is about the average maximum distance which it is economic to haul crop to alcohol plants. The Department of Agriculture has shown that actual production of fermentable crops is insufficient to meet the Nation's food requirements and the raw material needs for even a 7-percent blend on a national scale at the same time. It is obvious that any extensive use of alcohol in motor fuel would require the location of distilleries in regions where costs of crop collection would be exorbitant, enormously boosting the theoretical costs of alcohol manufacture and of alcohol blends.

How would the small minority of farmers in a position to supply corn or equivalent grains to alcohol plants fare? Their return as compensation for the cost of growing the corn would be less than half the price paid motorists to distilleries, after farmers had paid the increased cost of the motor fuel which they consume and had repurchased from distilleries by-product feed from alcohol processing equivalent to about

one-fourth of the corn initially delivered to the alcohol plant. If farmers failed to repurchase byproduct feed the theoretical cost of alcohol and of alcohol-gasoline would be increased still more.

WOULD ONLY AID SMALL GROUP OF FARMERS

I take the liberty of pointing to the obvious fact that this proposal would not aid the tobacco farmer, the cotton planter, the stock breeder the poultry raiser, or the average man engaged in mixed farming, many of whom have to buy feed. Yet all of these groups operate automobiles, tractors, and kindred motorized farm equipment for which they have to buy motor fuel. These groups are no better off than the corn farmers whom the scheme is intended to benefit and it seems to me both unjust and uneconomic to force the groups to whom I have just referred to shoulder a large share of the costs of an untried scheme for benefiting the farmers who have a surplus of corn.

SCHEME VIRTUALLY UNENFORCEABLE

I would like to refer briefly to a book entitled "Motor Fuel Taxation in the United States" by Dr. Finla G. Crawford, professor of political science at Syracuse University. Speaking of tax administrative problems on pages 106–7 of that book, Dr. Crawford says:

A major problem of administration is to guarantee that all blends sold contain the required amount of alcohol. Under present conditions of the production of alcohol from corn or other agricultural products grown upon American soil, the price of alcohol is greater than the price of gasoline. Any unscrupulous dealer could very easily increase the amount of gasoline or substitute a cheaper-priced gasoline. This would give him a price advantage and greatly increase his profits.

In those cases where tax exemptions or tax preferentials are granted blends, reduction of the alcohol content below the specified legal limits would defraud the State of tax collections and the unscrupulous would profit by tax exemptions to which they had no claim.

In order to provide suitable facilities for blending and to reduce the costs of transportation of both alcohol and gasoline, it would be necessary to establish a number of blending plants. This very fact would add to the problem of tax administration.

If alcohol-gasoline blends were widely sold under tax preference, inspection would be required. The frequency of the sampling would determine the size of the staff. There are more than 200,000 service stations in the country and the number of inspectors would be considerable. In addition, laboratory expenses would have to be met. Whenever an individual was apprehended, further expenditures would be required in order to enforce the law. Under certain conditions, alcohol and gasoline separate, and the sample taken by an inspector might be deficient in alcohol even though no attempt had been made to evade payment of the tax. At least, this defense could be used by those accused of violation.

In the legislation proposed in various States and in Congress, provision has been made that the alcohol should be made from "agricultural products grown upon American soil." This in itself creates a difficulty to prevent the use of alcohol for blending which has been produced from blackstrap molasses or from petroleum gases. This type of evasion would be almost impossible to trace, for there is no chemical test to determine the raw materials from which ethyl alcohol has been made. In fact honest blenders could be fooled as to the source of the alcohol.

A final problem not related to gasoline tax administration might well eventuate. Alcohol to be used for blending might well be diverted for beverage purposes. Proposed laws have imposed requirements for denaturants but not in all cases. A bill was introduced in Congress in 1938 which sought to make a 10-percent blend mandatory throughout the Nation, providing that alcohol for motor fuel could be withdrawn from bond tax-free without the necessity of denaturing. The Bureau of Internal Revenue would be faced with the gigantic task of tracing the

movements of large quantities of alcohol to prevent any portion from entering beverage channels.

The failure of prohibition enforcement furnishes a clue to the difficulties which would be encountered. Yet the quantities of alcohol involved in prohibition were inconsequential compared to the amounts which would be involved if even a small percentage of alcohol were mixed with gasoline as motor fuel. The resulting widespread abuse of tax exemption could not, in my opinion, be prevented, no matter what costly and elaborate methods of enforcement were devised. Farmers would be cheated out of part of the market which the schemers intend to provide, motorists would have extra costs, and the quality of fuel sold would be distinctly unreliable.

TAX EXEMPTION ONLY SHIFTS COST

If the Federal Government should exempt alcohol blends from the Federal gasoline tax of 1 cent it would, to whatever extent such blends were used, lose the motor fuel tax revenue therefrom. If States should help to bring blends into use by exempting them from State gasoline taxes they would lose revenue in proportion as the sales of alcohol-gasoline blends increased. It is conceivable that through this process of removing taxes from alcohol-gasoline blends the price to the consumer could be reduced so that he could buy a 7 percent blend as cheaply as he could buy gasoline which would still be taxed. The fuel would be no better, but on the whole slightly worse than gasoline. If sales materialized on any large scale, however, the governments concerned in exempting alcohol blends from tax would lose most or all of their gasoline tax revenues. These lost revenues would have to be replaced either by increases in other types of taxes paid by motorists or by a new general levy of some kind on taxpayers at large. Since most taxpayers are motorists they would find themselves paying the extra cost of alcohol in the end just the same as if they had been forced to pay it directly to the person selling them alcohol blends.

THE BURDEN ON THE MOTORIST

It is quite conceivable that if the Federal Government with its unbalanced budget found itself losing revenue from motorists' taxes, it might abandon its Federal highway aid to the States. Many States are in dire need of this revenue in order to complete their Federal-aid highway programs, and they need the revenue from their own State gasoline taxes for maintenance and construction costs on their State highways and for the payment of the principal and interest on outstanding highway bonds. In several States the financial situation of the highway program is so finely balanced that any disruption would inevitably require an immediate increase in motorists' taxes by the State.

As was pointed out in the recent study of superhighways by the United States Bureau of Public Roads, the average motorist has an income of about $1,500 a year. He reckons his out-of-pocket expenses for operating his car at about 1 cent per mile. That report goes on to show that these automobile owners must budget their expenses very carefully and that any added costs mean the forced curtailment of their car use.

That this would be the effect is shown by a recent Nation-wide consumers' survey completed by the General Motors Corporation. This survey has been conducted annually for several years. Some years ago the consumers demanded reliability as the number one quality in a car. Later, and for some years, safety was the predominant quality sought. Now the demand is for economy.

This proposal would do more than any other suggestion of which I have heard to increase the cost of operation of automobiles and it would do it in direct opposition to the expressed wishes of 29½ million American automobile owners and their families. The ultimate effect would be to force the American public to the use of smaller and smaller cars, just as the high costs of these alcohol blends and other high taxes on motorists forced the average Europen automobile driver to the use of the small, uncomfortable, and inconvenient cars which economic necessity compels them to use today.

May I say, that the object sought to be accomplished by the proposal is one in which a majority of the Members of both the Senate and House are interested—that is, some practical and effective manner to aid the farmers of our country. There is hardly a person in the United States who is not in sympathy with any move, legislative or executive, which can be made with reasonable certainty to raise the income of this great part of the population of our Nation.

From the discussion of this subject in other Congresses and on March 23 of this year when Senator Gurney's proposal was offered as an amendment on the floor of the Senate, many Senators from substantially agricultural States evidenced serious doubt as to the practicability of aiding the farmers by legislation of this sort. Admittedly, exempting from taxation motor fuel mixed with alcohol is merely a step toward making mandatory the blending of alcohol with gasoline. Other proposals have been made to directly require such blending, while others seek to require blending by means of "penalty" taxes.

I shall not attempt at this time to burden the committee with involved statistics and cost figures as I believe that these at best can only be approximated and are not generally a reliable basis upon which this committee can afford to formulate any recommendation. It is my purpose, however, to comment upon clear fundamental principles which appear to be involved.

In substance and effect isn't the proposal to exempt from taxation motor fuel blended with a percentage of alcohol an indirect form of subsidy to the farmer at the expense of a particular property-owning group—not a general levy? In other words, will not the 29,500,000 automotive vehicle owners of our country be called upon to make up the tax deficiency either by paying more for alcohol or by new taxes on gasoline? It is well known that the Federal Government is obligated to bear a proportionate share with the States of direct benefits to automobile-owner taxpayers—namely, the construction of Federal-aid highways. If the State and Federal taxes collected are not sufficient to meet this necessary obligation, obviously other taxes must be levied on the motorists (or on others) to make up the deficiency.

The motorist is already faced with serious threat—that threat is diversion of present tax revenue. Diversion can be of two kinds: the actual transfer of funds, or exemption from taxation for the benefit of others as in the present case. In either situation the revenue is not available for the purpose needed. And this revenue is required, gen-

tlemen, for road building. There are 2,000,000 miles of mud roads in the United States; 5,000,000 farms of our country are still on mud roads, and it is estimated that there are between 6,000,000 and 8,000,000 or about 25 percent of all motor vehicles on these farms; school busses and mail routes traverse nearly 1,000,000 miles of roads that are in an unimproved condition. Thus it is that nearly all the revenue derived from automobile owners is required for road improvement and for maintenance.

If the principal here advocated is sound—namely, exempting from taxation motor fuel containing alcohol or levying increased taxes on gasoline alone to force the use of alcohol as an indirect subsidy to the farmer—the Congress of the United States is certain to be faced with a proposition to exempt gasoline blended with other ingredients to help or subsidize other needy groups.

It is well known that benzol, a product of coal, is used to some extent at the present time in many grades of gasoline for motor fuel (better than 100,000,000 gallons annually). The Department of Agriculture states that benzol mixes well with gasoline and increases the efficiency of poorer grades of gasoline. Its use on many occasions has been argued to benefit the coal miners. There are other coal products which could be made adaptable for the same purpose. Coal hydrogenation gives promise of motor-fuel cost somewhere double the present market price of petroleum fuels (alcohol five to six times the present cost of gasoline). In fact, alcohol can be manufactured from coal. Therefore, it would be just as logical, just as equitable, just as fair to exempt from taxation any motor fuel blended with coal-alcohol or benzol; for, gentlemen, our coal miners' plight is believed by many to be equally as troublesome as that of the farmers. In all justification such plea should be given equal consideration with that of the farmers. And rest assured such demands will be made if the principle being considered by this committee is enacted into law. Proposals are already before Congress to tax oil for the benefit of coal. How could you equitably exclude alcohol made from coal?

But the plight of the farmer and of the coal miner is not the only problem that will arise. If the principle of indirect tax penalty or exemption here advocated is to be equitably applied, what of the great pine forests which extend practically from Pennsylvania to the Mexican border along our Southeastern coastal plain? I gave no complete chemical facts, but I understand that it is possible to make great quantities of alcohol from wood or cellulose at prices less than from agricultural surplus, as grain. These pine trees are crops that can be grown, maturing every 7 years. These pine lands will produce no other profitable crop. Much submarginal agricultural land can effectively be used for tree growths. This source of chemical raw material for alcohol production would be difficult to ignore. The land is available and everything needed is foreseen. The Department of Agriculture anticipates a campaign that would necessitate the inclusion of this source of supply. Would it not be just as reasonable to exempt motor fuel blended with alcohol made from pine wood to help the southeastern coastal region? The residents of this section have every right to come before Congress and demand tax exemption or special privilege the same as the farmer from the richer agricultural districts.

The Department of Agriculture states that ethyl alcohol may be derived from four classes of raw materials: (1) Saccharine materials (sugar beets, molasses, sugarcane, etc.); (2) starchy materials such as grains, potatoes, etc.; (3) cellulose materials such as wood, wood product wastes, etc.; (4) gases, natural and artificial, including that made from coal. The alcohol is manufactured either by process of fermentation or synthetically. Chemical synthesis as from coal and wood has attained considerable commercial importance in recent years.

The Department of Agriculture further reports that certain "higher" alchols make better motor fuels than etyhl or grain alcohol, because of their higher fuel value. This fact is also proven by the Bureau of Standards who report that "it would appear preferable to employ one of the higher alcohols rather than ethyl alcohol, for blends with the higher alcohols have a higher water tolerance and a higher heat value (therefore power) than have the ethyl alcohol blends."

The ability of these compounds to blend with gasoline is generally considered superior to that of grain alcohol. Since these materials also may be produced from carbohydrates by fermentation, or synthetically, consideration ought to be given to the possibility of producing these higher alcohols and requiring their use of rpoer purposes rather than the inferior grain or ethyl alcohol. At the same time the production of the nonpotable alcohols would safeguard possible diversion to beverage purposes.

But let us not lose sight of the main principle which is certain to evoke more problems—not only problems for Congress as to whether other groups will be given equal consideration, but the problem of making up the tax loss either by additional taxes on gasoline, or by taxes from other sources.

What of the consumer? His troubles will have only begun. He will be faced with increased prices. Higher costs are ultimately certain, for alcohol blends cannot compete with gasoline at present prices. Reduced efficiency of motor fuel is sure in the case of grain alcohol alone. Where such alcohol is used, even proponents admit that less mileage per gallon is likely; during cold weather separation of the oil content may occur; during damp cloudy weather where the atmosphere is humid, alcohol will absorb water and separate from the gasoline, unless a more expensive "blending agent" is used, thereby further increasing the cost.

The United States Bureau of Standards in their last investigation reported that blends containing ethyl alcohol have no material advantage over gasoline as motor fuel. Blends cannot be directly competitive with gasoline. It is for this reason that taxation exemption must be sought, or in other words, one commodity must be penalized to force the use of another. Gasoline must be penalized so as to require motorists to buy alcohol. If this were not true, no action by Congress would be needed.

If 29,500,000 automobile owners are required to buy alcohol to reduce the farm surplus, it has been estimated by competent authorities that 10-percent blend would increase their bill for motor fuel approximately two-thirds of a billion dollars annually. This appears to be a very expensive subsidy.

For this reason, if the advocated step is taken, it will be only a question of time when other forms of duress or a direct mandatory requirement will be made to force all motor-vehicle consumers to use

alcohol blends. The 29,500,000 motor-vehicle owners in this country will be forced to buy at higher costs a motor fuel which at best has not been shown to be equal in quality to that capable of being produced from petroleum.

The Treasury Department, I understand, in a letter to Senator Harrison has fully expressed its views, and upon analysis, it goes on record against the proposal now being considered by this subcommittee. The Department of Agriculture has made quite a study of the subject, and the Secretary of Agriculture has written the chairman of the Senate Finance Committee to the effect that alcohol blends are not certain to benefit the farmer; that so many problems are apparent that more time should be allowed for solution before attempting to endorse any legislative action in connection with alcohol as a relief to farm surpluses.

May I summarize the matter briefly:

(1) The principle of tax exemption inuring to the benefit of one group must of necessity be extended to others similarly situated;

(2) If tax exemption is given to special groups either considered as a subsidy or encouragement, the loss in revenue now available for building farm-to-market roads, Federal-aid highways, betterments, improvements, and so forth, will have to be curtailed or financed from increased taxes on gasoline, or from other sources;

(3) Alcohol blends of motor fuel have not been shown to be capable of competition with the better grades of gasoline motor fuel now available at reasonable cost, and the efficiency of alcohol is generally considered to be inferior;

(4) It is very questionable whether the farm surplus would be decreased without more than mere tax exemption. If required, certainly the farmer could not be benefited to the extent of the penalty imposed on a large property-owning group—the 29,500,000 automotive-vehicle owners of the United States.

In view of all the facts, gentlemen, it is most uneconomic—certainly not a sound precedent to establish—to require the public to buy any product. If the forces conducive to healthy economic growth in our country are to have free play, the Federal Government cannot afford to handicap one product for the benefit of another; one property owner for the benefit of others; or, one industry for the theoretical advantage of another.

Therefore, I trust this subcommittee will report unfavorably Senate bill 552, proposing a 10 percent blend, and the amendment to the Revenue Act proposed by Senator Gurney, exempting a 7 percent blend of alcohol motor fuel from the Federal excise tax on gasoline.

Now, Mr. Chairman, I would like to present some facts as rebuttal testimony to the points brought out by the proponents of the plan yesterday. Of course I have in mind S. 552 and the proposed amendment by Senator Gurney.

Senator Gurney, in his remarks yesterday morning, pointed out that the American farmer has received subsidies totaling $7,000,000,000 since the days of the Hoover Farm Board, more than 8 years ago. That is a tremendous sum and it amounts to nearly a billion dollars a year. On the other hand, it went to aid nearly 50,000,000 of our population. In other words, $20 per head per year. Under the

present proposal, 29,500,000 automobile owners, nearly a quarter of whom are farmers, would be asked to pay a higher price for their motor fuel to subsidize not all the farmers but to subsidize the farmers who have a surplus of corn for sale. I, for one, fail to see where one plan is any better than the other. Senator Gurney asked that very careful study be given to the proposal. May I be permitted, as a representative of the consumers group, which is expected to pay the bill, to endorse the sentiment expressed by the Senator.

My understanding is that only about 600,000 gallons of alcohol have been manufactured in this country from farm produce in the last 2½ years. In short, that is about 60 days' production from an alcohol plant having a rated capacity of 10,000 gallons per day. I do not think that that is a sufficient basis of experience upon which to ask the investing public for capital with which to build farm alcohol distilleries. It is a matter of public record that the Department of Agriculture will shortly open an experimental laboratory at Peoria, Ill., and it is my humble opinion that further experiments should be carried out at this plant before legislation is passed designed to foster this or any other industry with such a limited background of practical experience.

I do not believe that the American public should be induced to invest money in a scheme, the success of which depends upon the repeal or modification of a Federal tax law. This program depends for its success upon the continuance of the Federal gasoline tax, a measure which originated in the Senate Finance Committee, a subcommittee of which is now considering this measure. It was conceived as a temporary measure or budget-balancing expedient under the Revenue Act of 1932, and the same committee went on record on May 10, 1933, as follows:

> Your committee is of the opinion that the gasoline tax should be reserved for the States after June 30, 1934.

Chairman Doughton, of the House Ways and Means Committee, said:

> The tax of 1 cent a gallon was imposed by the last Congress as emergency legislation to balance the budget. I do not think it was the intention to make it permanent.

It is by no means assured that the Federal gasoline tax is a permanent measure and, as I have said, I do not believe that the construction of alcohol plants would be justified upon such a shaky premise.

I might add, parenthetically, that the Department of Agriculture's findings in Miscellaneous Publication No. 327 show that it will cost $516,000 to construct a plant with a capacity of 10,000 gallons of alcohol per day.

The witness, Mr. Wilken from Sioux City, Iowa, who appeared upon behalf of the National Council for Raw Materials Research, spoke of the fact that the automobiles entered in the 500-mile Memorial Day automobile race at Indianapolis, Ind., used blended fuels. There were 33 cars entered in this race. Only four cars, all of which were of European design, used alcohol an an ingredient in their motor fuel. These cars had exceptional compression ratios, ranging as high as 14 to 1, as against the normal American passenger car ratio of 5½ to 1. Four cars used alcohol. But what kind of alcohol? Certainly it wasn't agricultural alcohol. And, furthermore, it might be of interest to state that not one of these cars traveled the full 500 miles; not one

of the cars using alcohol fuel finished the race. The man who won the race won $30,000. He used about 50 gallons of motor fuel. It is rather obvious that when a car is built especially at a cost of $10,000 or $15,000 to win one race that any type of fuel, even fuel costing $1 per gallon, would be a nugatory item.

That is not the case with the average automobile owner. He makes $20 to $30 a week, according to Department of Commerce studies, and a cent or two added to the cost of a gallon of motor fuel may very well mean a half week's wages to such a man in the course of a year—a man who is compelled to use his car in making his living.

Mr. Wilken dealt at length with the added employment which an alcohol-gasoline program would furnish. He failed to take into consideration that added fuel costs would reduce automobile operation. Studies show that a 1 cent increase in gasoline taxes decreases the consumption of motor fuel 5 percent. The lesser use of automobile which might be expected would, of course, increase the life of the cars, and thus affect the automobile industry, the tire industry, battery manufacturers, replacement parts manufacturers, service-station operators, garage owners, and every other interest which directly or indirectly relies upon highway travel for its livelihood.

Mr. Wilken stated that the motorist had been subsidized through the construction of highways. I wish to point out emphatically that we had no highways in this country worthy of the name until the gasoline tax was introduced. Highways have been built through revenue provided by the taxation of gasoline, through automobile registration fees, and through Federal taxes on automobiles, trucks, parts, batteries, accessories, and through the Federal gasoline tax, and the like. The motorist has not only paid for the roads and the use he has made of them, but he has provided roads which are of tremendous value in our scheme of national defense, and he has provided roads which have expedited the delivery of the mails. These roads have speeded up commerce and they have aided automobile owners and nonautomobile owners alike by reducing the cost of transportation and making merchandise available to the entire population at lower prices.

Mr. Wilken was asked what loss this measure might mean to the Federal Treasury. He stated that this would amount to $210,000,000 if the plan became completely successful. What would this loss of revenue mean to our highway system? Only 3 weeks ago the President sent to the Congress a plan for an interregional highway system of 28,000 miles. Certainly this plan could not be carried through without Federal highway aid, and the loss of Federal revenue would certainly retard this program which has every prospect of furnishing far more employment than would ever be provided by alcohol distilleries.

Senator La Follette mentioned a letter from the Acting Secretary, Mr. John W. Hanes, relative to the tax on gasoline, to Hon. Pat Harrison, chairman of the full committee of the Committee on Finance under date of March 10, 1939. I happen to have come across a copy of that letter. I have it here and I ask that it be inserted in the record, together with a further letter to Senator Harrison from the Secretary of Agriculture, Mr. Henry A. Wallace, and a further letter upon the same subject between the same parties, bearing the date of May 12, 1939.

(The letters referred to by Mr. Keefe appear at the close of Mr. Tarleau's testimony.)

The witness, Mr. William W. Buffum, introduced himself as head of the Chemical Foundation, Inc., and stated that the Chemical Foundation had advanced a million dollars to the agricultural alcohol plant at Atchison, Kans. He said that the Chemical Foundation had more than 60 patents upon the manufacture of agricultural alcohol and that they were willing to grant licenses under these patents to anyone who wished to manufacture agricultural alcohol. He did not state for what sums these patents would be available, presumably on a royalty basis of so much per gallon. Obviously, Mr. Buffum was in the position of a man with something to sell. He stated that the agricultural alcohol industry is in its infancy, and with that we agree. In fact, the industry is so young and so ineffectual that it has succeeded in producing only a little more than 600,000 gallons of alcohol in the 2 years and a half since the plant at Atchison, Kans., was first put into operation.

From this and other facts, it would appear that this industry is much too young to ask that the laws of this country be changed until such time as it can present a sounder case than it has done to date.

Mr. Buffum spoke of the fact that alcohol fuels were used in England. He admitted that the alcohol was tax free, that recently a tax was also placed on the alcohol content of the fuel. He did not mention that this tax was much less than the 18 cents per gallon tax now borne by gasoline, which is much more expensive in England than it is in this country. In other words, alcohol can be added to gasoline if the price of the gasoline is high enough, and that is just the situation in England. The price of motor fuel is very high—twice as high as it is here. Automobiles are more expensive, too. And what is the result? There is 1 car for every 30 people in the British Isles against 1 car for every 5 people in the United States. The most of these cars are not automobiles as we know them. They are baby cars—little better than toys. Is that what Mr. Buffum would like to have us use here?

He spoke of agricultural alcohol in Europe, and in this connection I would like to call attention to a pamphlet issued in 1933 by the association which I represent. This pamphlet is entitled "What French Motorists Say About Alcohol-Gasoline Motor Fuel Blends." I ask the permission of the chairman that this pamphlet be embraced in the record.

Senator HERRING. I will submit that for the consideration of the committee.

Mr. KEEFE. It consists of 40 letters from constituted authorities in France.

Then at the same time I would like to incorporate, without asking the committee to concern itself with the diagrams or the photographs, a short pamphlet by Gustav Egloff, Universal Oil Products Co., Chicago, Ill., reprint from Industrial and Engineering Chemistry under date of October 1938; and a clipped article from the New York World-Telegram under date of Tuesday, May 23, 1939, with the headline "New French car gets 53 miles to gallon; seats five, and will go 93 miles per hour."

Senator HERRING. You may submit those to the committee.

Mr. KEEFE. At the same time I would respectfully ask the chairman and the committee to extend me the courtesy of offering, in the way of rebuttal, an extension of my remarks, as I am more or less at a disadvantage, not having heard all of the proponents for the adoption of these two measures, and because additional proponent witnesses are still to be heard.

Senator HERRING. You may submit that later on.

Mr. KEEFE. Thank you.

Senator HERRING. Your principal objection is you believe this will result in increased cost to the consumer?

Mr. KEEFE. Yes, Mr. Chairman.

Senator HERRING. And, secondly, you believe it will produce a loss of revenue to the Government?

Mr. KEEFE. Yes.

Senator HERRING. If it can be shown that this can be prepared without increased cost to the consumer and that we could change the system so that there would be no loss of revenue to the Government, your principal objection would be removed, or would you still be opposed to the proposal?

Mr. KEEFE. Yes; I would. Mr. Chairman, I respectfully submit that there are other objections. There is the question of the separation of the alcohol from the gasoline; there is the question of redesigning carburetors, cylinder heads, tappets, valve stems, and the many other reasons I have herein cited.

I wish to thank the committee for your indulgence. I also thank you for the privilege of extending my remarks.

(The material submitted by Mr. Keefe is as follows:)

WHAT FRENCH MOTORISTS SAY ABOUT ALCOHOL-GASOLINE MOTOR FUEL BLENDS

FOREWORD

Proponents of legislation designed to compel American motorists to use as motor fuel a blend of gasoline and alcohol have stated that such fuels are used with consumer satisfaction in other countries, particularly France.

In its July 10, 1933, issue, the "L'OFFICIEL DE L'AUTOMOBILE, DU CYCLE, DE LA MOTOCYCLETTE," official organ of the "French National Federation of Automobile, Bicycle, Aeronautical, and Related Trades," published an editorial setting forth the need of collecting truthful information concerning alcohol-blend motor fuels based upon the experience of users. It asked its readers—motorists, engineers, technologists, mechanics, motor vehicle and motor fuel dealers, and others—frankly and fully to answer these questions:

1. *"Is this motor fuel giving satisfaction?"*
2. *"What are the inconveniences?"*

In its October 8, 1933, issue, "L'OFFICIEL" reprinted 40 letters answering the questions. A few approved blended fuels, provided motor equipment could be rebuilt or adjusted to meet new requirements, and the blend itself altered. The vast majority emphatically disapproved.

The one advantage of blending was reported to be a slight increase in the anti-knock value of motor fuel. Generally, however, it was reported that consumers of blended fuels were dissatisfied and complaining. They said they had starting difficulties, increased fuel consumption, faulty motor operation, damaged motors, increased repair and service bills, corrosion of metal parts, destruction of body finishes, increased danger from fire, reduced power, speed, and pick-up, and difficulties arising from separation of alcohol and gasoline, water in fuel tank and lines, and obnoxious odors.

The 40 letters herewith are reprinted verbatim for the information and enlightenment of American legislators, who are asked to judge the merits of blended fuel legislation, and of American motorists, who would be forced to use the more expensive and less efficient blended fuels.

The letters, in French, may be found in "L'OFFICIEL," volume 38, No. 41, October 8, 1933, pages 17 to 33.

J. BORTON WEEKS,
President, American Motorists Association, Washington, D. C.

DECEMBER 15, 1933.

AFFIDAVIT

RIDGEWOOD, N. J.,
November 18, 1933.

Following is a full and complete translation of all letters appearing in the October 8, 1933, issue of "L'OFFICIEL (JOURNAL) DE L'AUTOMOBILE, DU CYCLE, DE LA MOTOCYCLE" (Organe Officiel de la Federation Nationale) in answer to a questionnaire sent out by the editor of the official journal.

(Signed) O. W. WILLCOX, Ph. D.

Appeared before me this 18th day of November 1933, the above named O. W. Willcox, Ph. D., who is known to me and did take oath that the above is a full and complete statement of the facts.

(Signed) CHARLES DYKSTRA,
Notary Public of New Jersey.

My Commission Expires June 28, 1935.

ARMS, T. S. F.
SEWING MACHINES
AND BICYCLES

ARTHUR BAR
11 RUE DES BOUCHERS
NOGENT-LE-ROTROU

JULY 18, 1933.

Mr. President: In No. 9 of "L'OFFICIEL DE L'AUTO, DU CYCLE, DE LA MOTOCYCLETTE" you propound two clearly defined questions on the subject of the new motor fuel.

I have a numerous clientele of automobile drivers, and I am one myself. Now, here is the general opinion:

Question 1. Is this motor fuel giving satisfaction?

Answer. No; and this is unanimous.

Question 2. What are the inconveniences?

Answer 1. Bad, very bad efficiency. During hot weather starting is more than difficult and the motor stops almost at once if you don't step immediately on the accelerator.

2. Almost impossible to get going with the starter and the motor dies almost immediately, hence the impossibility of maneuvering.

3. Slow pick-up, and the necessity of going into first gear in order to enable the motor to negotiate a seven or eight percent slope.

4. Continual necessity for taking the carburetor apart, hence loss of time and of fuel, which is already very dear.

Conclusion: A dirty trick of the Government, resulting from the purchase of alcohol made from potatoes, of this and of that at exorbitant prices, slow sales, dead stock, ending in liquidation at a loss, just as we have in the present case of wheat at 115 francs.

Yours devotedly,

ARTHUR BAR.

L. BONNY
SAINT-ANTOINE-DE-BREUILH
(DORDOGNE)

SEPTEMBER 2, 1933.

SIR: I am a little late in answering the alcohol-gasoline question, but I have plenty of time to tell you that there is nothing to it because all the customers are kicking. Bad performance of the motor; at a certain adjustment it heats up too much and everybody is demanding that they give us back our old reliable gasoline. I hope that there will be no delay about it.

Receive, Sir, my most distinguished salutations.

L. BONNY.

GARAGE DUPLEIX
4, RUE DUPLEIX
PARIS

PARIS, *September 2, 1933.*

Mrs. Felix Laine,
59, Avenue de la Grande-Armee
Paris.

SIR: As a constant reader of "L'OFFICIEL," I promised to advise you of my findings on my return from a circuit of more than 3,000 kilometers as a reply to your inquiry on the alcohol-gasoline mixture.

During this trip I was able to interview a certain number of colleagues on the subject, and everywhere I got the same answers and a story of the same annoyances. The motors pull less, jangle more. There are even some vehicles that are completely intractable to the mixture. I have three of that kind, all of the same make, in my garage.

There is noted a lack of homogeneity in the mixture, which results in chokes. There is a certain deterioration of the carburetor cups and the feed pumps, on the walls of which one notices at first a little whitish froth. When cleaning off this froth, metal is detached. It appears to be rather friable, it obstructs the calibrated orifices, and is the cause of frequent disorders in consequence of the deterioration of the cups. The Grand Marque de Neuilly can confirm what I say.

A fact of somewhat less importance: the odor of this mixture is very disagreeable. On the other hand, the customers think themselves forced to more and more reject this fuel in favor of superfuel, to such a degree that we have quincupled our sales of this latter product during the month of July.

I am persuaded that it would be wise not to urge this solution for alcohol consumption, and I think that the automobilist is under the pressure of sufficient taxes to be relieved of all other cares.

An action similar to that of our National Chamber against new taxes this spring would be in order against the new alcohol-gasoline mixture when Parliament meets again.

Hoping for a favorable solution, I pray you to believe, Mr. Manager, in the assurance of my perfect consideration.

The Manager, M. MARION.

GENERAL AUTOMOBILE MECHANIC
CENTRAL GARAGE
EMILE ROGER
MASTER MECHANIC
ALTKIRCH (HAUT RHINE)

ALTKIRCH, *May 18, 1933.*

Mr. Felix Laine,
Manager of L'Official de L'Automobile,
du Cycle, de la Motorcyclette,
59 Avenue de la Grande-Armee,
Paris.

I have just received "L'OFFICIEL" for July 10. On the first page I find an extremely interesting article: "What do you think of the new motor fuel?"

I myself shall write to the manufacturers of "Solex" and "Zenith" carburetors, asking the same question, and ask them if it is necessary to change the regulation of the carburetors and modify the level of the alcohol-gasoline.

The inconveniences of the new fuel are numerous. Its solvent power, due to the addition of alcohol, creates a great number of difficulties. In the carburetors, rust and deposits of all sorts are rapidly dissolved. On account of this it is not rare to find in the carburetor a thick red liquid. It is unnecessary to add that in this case trouble is inevitable.

Hermetic can no longer be used for the aspiration joints. The only packing which from now on can be permitted must be made from thick paper and "Certus" water glue.

It has also been noted that the motors rapidly heat up with the alcohol-gasoline mixture, but this can not be blamed on the mixture. The heating may be due to the fact that the carburetor cannot assimilate the new fuel. This means a new regulation.

Among the inconveniences attending the use of the alcohol-gasoline fuel, its solvent action on the cellulose paints should not be forgotten. For this reason great precautions must be taken when filling a car.

With the new fuel a goodly number of cars have difficulty in starting. This may come down to a question of regulating the carburetor.

To return to the carburetor, it is to be noted that the alcohol-gasoline mixture disintegrates the carburetor cups made of "Aluvac," a metal which is not very

homogeneous and has an irregular grain. (One of my customers has been obliged to replace the entire cup of his "Solex" carburetor).

I have found several Renaults where the regulating chamber had been attacked. The best means of using the alcohol-gasoline now on the market is to add a little "Fire Point," "Catrollo," or other analogous brand of oil. Aside from all these disadvantages there is one advantage—the cars have more speed.

Now, let us attach another point of view, that of the national economy. I believe that this new trade will result in a deficit to the government treasury, since the price of alcohol is nearly double that of gasoline. How is it possible to sell the new fuel at a price less than that of pure gasoline? Who will pay the difference, unless it is the taxpayer?

Please accept, Mr. Manager, my distinguished salutations.

EMILE ROGER.

GRAND-GARAGE
DE VILLE D'AVRAY
CH. COURCIER
II BIS, 33 & 34
RUE DE SAINT-CLOUD
VILLE D'AVRAY

VILLE D'AVRAY, *July 20, 1933.*

Monsieur Felix Laine,
Manager of L'Officiel Auto,
Paris.

It is with great pleasure that I give you my opinion concerning the fuel mixture that is now being sold. From the first appearance of this mixture the motors have had spells of sickness, convulsions, somersaults. Many give out along the road, and others come limping up to my garage. All have the same diseases (in series)—choking of the carburetor with a sort of mud, paste, and fine sand. All this comes from scaling of the gasoline tanks and the carburetor cups.

Second phase. The mixture continues its destructive work by attacking the joints of the gasoline valves, the exhauster, the Durit tubes connected with the gasoline pipes, the membranes of the S. E. V. and A. C. gasoline pumps, the cork float (covered with a coat of gum lac), which controls the gasoline indicators.

Third phase. The cylinders and the rods of the valves dry out, the motors stick on starting. Not having had occasion to dismount a new motor, I do not know the cause of this effect. If it is due to the same disintegration that takes place in the gasoline tanks and in the carburetor cups, it will be damaging to the life of the motor and to the pocketbook of the owner. Or, the explosion being slower and occurring along a longer traject of the piston, may not this alcohol-gasoline mixture dry off the film of oil? In any case, and as a preventive, I advise my customers to add a little oil to the gasoline.

Fourth phase. The carburetors flood on stopping the car. The cause is the difference of density between the new fuel and the normal tourist gasoline for which the levels were regulated. The present mixture is much heavier. Please recommend to the motorists to shut off the gasoline valves at every stop to avoid the risk of fire.

This "Melo-fuel" doesn't give anything but trouble. From morning to night I get nothing but complaints from my customers, even ignoring the chronic grouch who grumbles at the fuel for its low mileage even after he has been shown a dead spark plug or a dragging brake (really). So much for the motors.

The same trouble affects the filling station man. The pumps are put out of order and corroded. Before long the stations will have apparatus that is a lot of junk and will get into trouble with the weights and measures inspectors.

In the near future I will write you on this burning subject.

Please, Mr. Manager, accept my hearty salutations.

CH. COURCIER.

AUTOS, MOTOS, VELOS
RENE DERAISON
ROMESCAMPS (OISE)

Mr. Felix Laine.

I take advantage of this courier to address to you my personal opinion on the new motor fuel.

1. In my personal auto, an 8 Citroen CV type A, I find no difference. The starting is good and the travel normal on moderate runs.

2. On a motorcycle 2 CV Terrot, which I frequently use, at the start all goes well, but after seven or eight kilometers my motor begins to balk, depending on what gasoline is used (I get it from different pumps) and it heats up very much.

3. It is with a gasoline blast that I meet with the greatest annoyance (it is a "Gazlik" from Chaleur & Light, Rue de Colisee, Paris). Depending on the content of alcohol, I get a red instead of a blue flame. There is a continual sputtering as though there were drops of water present, there is a smearing of the gasoline pipe that reaches the top of the burner, and I have to dismount it for cleaning every 15 days. This did not happen with the old gasoline, because it is two years since I used it.

I hope that these few lines will be of assistance to you in your inquiry on the alcohol-gasoline mixture.

In my opinion, the smearing of the pipe of a blast should occur in the same manner on the valves, although these latter are not at the same temperature.

RENE DERAISON.

GENERAL MECHANIC
ANDRE JAMIN
CREULLY (CALVADOS)

AUGUST 28, 1933.

Mr. Manager,
of L'Officiel de l'Automobile et du Cycle,
Paris

SIR: On the subject of your inquiry regarding alcohol-gasoline, I may be allowed to enumerate the inconveniences which I have observed:

1. When the alcohol is not sufficiently close to 100 degrees of strength, it mixes with the water contained in the tanks of the filling stations.
2. Fouls the reservoirs and the piping (hence frequent cleaning of the carburetor)
3. The motor heats more.
4. Starting is more difficult; the motor coughs until it has got up to its temperature.
5. The valves frequently burn.
6. A greater consumption. In fact, a motor having been adjusted to gasoline, for this mixture the number of the carburetor jet has to be larger.
7. As concerning cars with old motors—bad odor for the occupants of the car which greatly irritates the eyes.

Therefore, up to the present, this mixture is not to be recommended.

I pray you to accept, Mr. Manager, the expression of my distinguished sentiments.

A. JAMIN.

AUTOMOBILES
MODERN GARAGE
MARCEL BOUTET
NOGENT-LE-ROTROU

JULY 20, 1933.

L'Officiel du Cycle, et de l'Automobile,
Mr. Laine, Director,
59, Avenue de la Grande-Armee,
Paris

GENTLEMEN: I am now getting around to answer your question about the new motor fuel and to impart to you my observations since they filled my five stations with "Moto-Naphtha" alcohol-gasoline.

I must tell you that, having been advised of its coming, I refused to let it be put in until the company sent some one to empty and carefully clean out my underground tanks. These tanks are covered internally with three sorts of coatings. Two of these only needed brushing with alcohol to effect their removal. In the case of third it is necessary to fill the entire tank with alcohol and let it stand 48 hours in order to loosen the paint.

Having taken these precautions I had only clean essence to furnish my customers, and there are no kicks on that score. But in the majority of the vehicles that have been in use for several years, the deposit that has accumulated in the fuel tanks and the piping has become loosened and these parts have had to be cleaned.

At the beginning I have had to repeat these cleanings without knowing the reason; now I clean these parts with pure alcohol and do not have to repeat the cleaning more than two or three times.

In fact, not being able to learn from the refiners the exact percentage of alcohol (experimental period), I filled the first time with eight per cent, the second with 16 percent, and a third with 20 percent, and having three cleanings to do, it would be better, in my opinion, to clean thoroughly the first time.

But these are not the only faults of the alcohol fuel. The following objections can undoubtedly be made to it:

1. *Greater consumption*, especially on account of evaporation. For us distributors this evaporation shows itself in my plants during hot weather as a perceptible loss, which is the more painful because the margin of profit is very close. This evaporation is especially marked when the tank wagons come to supply us with their uninsulated steel tanks heated to 50 degrees by the sun. How much will the shortage be in the cool of the next morning?

2. *Instability of the mixture.*—During hot spells the mixture does not separate, but in humid weather the water in suspension in the mixture is rather rapidly precipitated. On account of its high absorbing power, the alcohol absorbs moisture from the air aspired during filling and from the air that gets into our underground tanks. Now, I believe that in a mixture with 16 percent of alcohol the rest of the fuel precipitates its moisture when this exceeds 2/000. The experiment is easy to make with a liter of this mixture and water from a dropper. In moist weather this decomposition causes plenty of inconvenience, to mention only scaling, plugged carburetor jets, carburetor overflows, backfiring, fouled spark plus, etc.

3. *Difficulties of starting.*—In hot weather, nothing to say. After installing a somewhat larger carburetor jet for the gasification the starting is good; but in cold and damp weather, it is often necessary to run down the battery and then get out and crank for half an hour.

4. *Difficult pick-up.*—In hot weather and for about the first 10 kilometers, during which there is a little trouble with the acceleration, the rate of travel becomes normal. But in wet and cold weather the unsatisfactory acceleration becomes more pronounced and is continual.

5. *Scaling of the varnish.*—If, during filling, some drops are unluckily spilled on the painted surfaces, the paint rapidly disappears. To convince yourself of this, plunge into a glass filled with alcohol fuel several pieces of sheet metal painted with various products, including "Duco," and examine them after several hours. Who will pay for damage caused in this way when the customer complains?

After having set forth my observations regarding the faults of the alcohol fuel, I allow myself to make a few suggestions which may be useful if you begin a campaign against this mixture:

1. The ministerial decree obliges the importers to take from the Government a quantity of alcohol proportional to their imports, but it *does not oblige* the same refiners to force us to consume it. Why should not these refiners ship this alcohol to America, which is no longer "dry"? In using their tank steamers for this purpose, they could send them back loaded instead of going to the high cost of returning them empty, and the freight charge on the gasoline would be less burdensome?

2. But (since the above is too much to expect) if they are not able to get rid of it in any other way than by dumping it on an industry which pays the highest taxes in France, couldn't they have the honesty to label their distributions to show the exact content of the product? The public would not be fooled and would certainly choose the product with the least alcohol.

3. And, finally, why do most of them balk at the suggestion to incorporate benzol with the alcohol? In my opinion, this ternary mixture, when well proportioned—that is to say, mixed in direct proportion to their densities—is very stable and avoids nearly all the faults of alcohol.

The constructors would then know once for all where they stand, and could regulate our vehicles accordingly. And please note: benzol is a French product, and if we distill coal at the mouth of our pits that are shut down, our factories would begin to hum in the very near future, we would be importing less American gasoline, and we would not be importing all the byproducts of benzol from Germany, which now rolls almost exclusively on pure benzol.

Will you please excuse me, my dear President, for these long suggestions which you may print or not. It is only because I have the courage freely to express my opinions, especially on this question of fuel, which I would willingly see increased by 1.25 francs per can, if the tax on power were suppressed. This is the main thing, for having nothing further to fear from the American industry, our constructors should be quite willing.

Will you please accept, my dear President, my distinguished salutations.

M. BOUTET.

AUTOMOBILE REPAIRS
H. J. TURRIN
30, QUAY DE SERIN
LYON

LYON, *September 2, 1933.*

Mr. Felix Laine,
59 Avenue de la Grande-Armee,
Paris

At the request of the journal "L'OFFICIEL"
soliciting the opinion of the motorists:

At the moment I have noted nothing but annoyances; attack on the valves, destruction of the gasoline gauges, troubles with the carburetor, and heating of the motor to an abnormal degree.

I enclose herewith an article from the "Documentation Automobile de Lyon" of August 18. After verification of the figures given, it might possibly be useful for the corporation to insert this article in our Journal in order to apprise the readers of the importance of bringing pressure to bear on our deputies, like the alcohol manufacturers are doing.

Receive, Mr. Felix Laine, the assurance of my perfect consideration.

J. TURRIN.

CONSTRUCTION SHOPS
CYCLES, MOTOS, AUTOS
SEWING MACHINES, ARMS
GILBERT CASSE
ETAULIERS (GIRONDE)

AUGUST 16, 1933.

Mr. Felix Laine,
Paris.

Here is my opinion on the mixture alcohol-gasoline:

In a certain proportion, and if the mixture is perfect, the efficiency of the motor will be undoubtedly increased. But there is an enormous inconvenience in the variations of percentage, a variation which is inadmissible. It is not possible to obtain a good regulation unless the mixture is definite and uniform.

What is the reason for the latitude allowed to the refiners for changing the proportion of alcohol, and what is the reason for these immense posters on the premises of certain distributors carrying the inscription, "PURE TOURIST GASOLINE GUARANTEED WITHOUT ALCOHOL"?

Is the alcohol obligatory or not? If yes, then everybody should be held to the same obligations; if not, why this disorderly experiment?

Personally, in a Packard type 3E truck I use a heavy fuel called "Dynalco." The efficiency of this fuel is absolutely superior to that of any other, including the super-fuels, both from the point of motor efficiency and from the point of view of consumption.

In making my explanations, which are perhaps a little long, I will add that not seldom there are encountered mixtures that have been "loupes"—mixtures without mixture, as we might say—and which give trouble to the poor devils of automobilists who have put it in their tanks. And our technicians have not yet improved their stuff.

I ask you to accept, Mr. Laine, my hearty salutations.

GILBERT CASSE.

AUTOMOBILES RENAULT
GENERAL MECHANICS
ETABLISSEMENTS LALAURIE
DE MONTAUGE, SUCCESSOR
PORTE D'AGEN
VILLENEUVE-SUR-LOT

L'Officiel de l'Automobile, du Cycle,
59, Avenue de la Grande-Armee,
Paris.

DEAR MR. LAINE: I respond with pleasure to your inquiry regarding alcohol mixed with gasoline. Having personally studied the question, I have arrived at the following conclusions:

The experiments were made at a normal temperature. In this case there is practically no difference from the old fuel. But, as a consequence of the present hot wave, the use of the mixture gives rise to various troubles. Not a day passes but that some owner comes to me crying for help on account of bad performance or even complete stoppage of carburetion.

In most cases, pockets of air form in the reservoir and the carburetor, and the mixture does not get through. The mixture passes through certain capillary passages less easily than gasoline, which will filter through nearly anything. It is therefore necessary to avoid short turns or spiral tubes. Also, all filters of metal cloth which are of too fine mesh should be removed.

Extraordinary as it may appear, there are certain carburetors which it is practically impossible to use with the mixture. Although the simple carburetors with two jets and of classic construction accommodate themselves well to it, certain carburetors of complicated construction designed to give high efficiency fall down completely with alcohol.

With an inspector of the "Zenith" firm we worked three days on a carburetor with multiple jets and acceleration pump which we could not make to work with the mixture. This carburetor was furnished with an economizing calibrator acting through the acceleration pump and controlling the outflow from the jets. It only needed the removal of this calibrator for the car to travel in a very satisfactory manner with the mixture. It therefore may be concluded that a complex carburetor, the regulation of which with gasoline is pushed to the extreme limit, should be calibrated somewhat larger with the mixture.

The membrane feed pumps are also subject to trouble on account of heat and the mixture. Those pumps especially which are regulated to deliver the minimum, do not furnish enough of the mixture. In this case it is simply necessary to weaken the tension or even remove the small springs which keep the flap valves of these pumps in their seats.

The conclusion from all this is plain. The mixture passes less readily than pure gasoline; in that case one suppresses or removes the difficult passages.

Please believe, dear Mr. Laine, in my devoted sentiments.

MECHANICS-BUILDERS
CLOVIS LARDY
MECHANIC BUILDER
SAINT-SAVINIEN (CH. INF.)

SAINT-SAVINIEN, *August 1, 1933.*

Monsieur Felix Laine

Mr. MANAGER: For some time I have been observing with a great deal of attention the effects of the mixture of alcohol-gasoline on various motors which I see every day, and I do not fail to ask the personal opinion of those who are using it. In my humble opinion, this is what I have found:

1. *Question of utility.*—It is well settled that when the misture is too high in alcohol, starting is much more difficult. Until the motor has been thoroughly warmed up the loss of power is quite apparent. I think that up to a proportion of eight to 10 percent for current use the inconveniences are absolutely negligible, but with more than this it at once becomes necessary to readjust the motor.

But this regulation becomes very much of a gamble, because when on the road you very rarely find gasolines of the same quality, the proportions running from simple to extreme, which results in great inconvenience.

For the power input there is very often a loss of power parallel to the amount of alcohol. As regards consumption the opinions vary, because some consume more and other consume the same.

2. *Results.*—I may state at once that the alcohol-gasoline mixture employed alone attacks the internal parts of the motor, and the wear on the cylinders becomes exaggerated within a short time.

In résumé, I think that the mixture may be accepted up to a maximum of eight to 10 percent, but on the condition that care be taken with lubrication of the upper parts of the cylinders by mixing oil with the fuel such as it now exists in the trade.

You may publish or do what you please with my letter.

Receive, my dear Manager, the assurance of my most distinguished salutations.

CLOVIS LARDY.

SOCIETE ANONYME
DES ANCIENS ETABLISSEMENTS
LOTARD BROTHERS
22, RUE DE LORRAINE
PARIS

PARIS, *July 31, 1933.*

L'Officiel de l'Automobile
et du Cycle,
59, Avenue de la Grande-Armee,
Paris.

GENTLEMEN: We hope that your future articles on the "alcohol-gasoline mixture" will tell us by what process this mixture has been obtained, because there is no doubt but that some acid product has been incorporated in this mixture which oxidizes, sometimes in a very disconcerting manner.

It has happened that on removing the brass cap of a tank that has contained the alcoholized mixture, this cap has oxidized under our eyes in a few seconds.

Please accept, gentlemen, our distinguished salutations.

For the Manager.

"AT THE UNITED SPORTS"
C. BAILLY
ARMORER
REMIREMONT (VOSGES)

REMIREMONT, *September 4, 1933.*

Mr. F. Laine,
Paris.

It is with pleasure that I give you my modest understanding of the alcohol-gasoline mixture.

According to observations on customers' engines and on my personal car (a new one), the consumption is sensibly the same, but I have observed a greater heating of the motor, resulting in a more rapid wear of the same. This mixture could be improved.

Please accept, Mr. Laine, my very respectful salutations.

C. BAILLY.

CYCLES AND MOTOCYCLES
PIERRE PORTAL
55, RUE SAINT-LOUIS LONGWY
(MEUTER-ET-MOSELLE)

LONGWY, *September 5, 1933.*

MR. LAINE: Here are my ideas on the subject of your inquiry on the motor fuel; I shall be very glad to be controverted, because it is good to know and to recognize the truth.

In my opinion this decision was a pebble in the puddle. This mixture should have been introduced progressively, with a durable and stable percentage, three grand qualities.

The customer is always surprised when he is informed that there is alcohol in the gasoline. Being ignorant, he has not changed his carburetor. He sees that this motor which previously had behaved well begins to heat up in an abnormal manner and he blames the lubrication, the valves, the engine, the constructors, the dealer who sold him the outfit and I do not know what else. It would be better for him to enlarge his carburetor jet as you have indicated and to see that it functions correctly. He generally goes away satisfied, unless he fails to understand and wants to find a remedy himself.

It is true that the alcohol-gasoline mixture allows of increasing the compression, but as a provincial dealer, I am not equipped to do this and do not wish to undertake it. The introduction of the fuel should have been gradual so that our constructors would have time to do their work, and then to fix a definite proportion. The mixture destroys the calamine, but we are there to take care of it. Aside from this it attacks the exhaust valves and rusts the tanks that are not well coated. At the present we have no defense against these two inconveniences.

If wine does not sell, it is because it is expensive. It is all right to aid the wine growers, but who will aid the motorists?

Not being able to lower the price of gasoline, which has now become an adulterated product, couldn't the treasury recoup itself on the manufacturers of alcohol, reopen the matter of the tax on circulation, and replace it by a tax on consumption?

My response is a rustic one. The trouble is not a great one, but the nervous haste of this decision has caused a lot of inconvenience. I could have wished for a more precise method and a more sure application of it.

I should be glad to have been of use to you, and in this hope will you please accept, Sir, my respectful salutations.

PIERRE PORTAL.

"ALSACE AND VOSGES"
L. BRAUN, AGENT
14 RUE KUSS
STRASSBURG

STRASSBURG, *July 24, 1933.*

Monsieur Felix Laine,
59 Avenue de la Grande-Armee,
Paris.

DEAR SIR: Concerning your article on the gasoline-alcohol motor fuel, I have the pleasure to inform you that since April 1 of this year I have been using it with 15 vehicles, autocars, and trucks.

However, we have found ourselves obliged to add to this mixture one liter of oil per hundred liters in order to maintain the same lubricating properties as gasoline.

We have not had any occasion to complain of the road work of this fuel, which is as good as with gasoline, provided that the motor is first slowly warmed up.

From the standpoint of driving, the chauffeurs prefer this mixture because on the hills the valves do not rattle so much, meaning that the mixture is somewhat antiknock.

From the standpoint of maintenance, however, we have observed that the valves are attacked more rapidly by this mixture than by gasoline, and if on further use this wear tends to become worse we shall be obliged to reject this fuel.

There is, however, a possible way of palliating this corrosion by adding to the engine an apparatus for the superlubrication of the upper parts. Before rejecting the fuel it seems advisable to make the experiment, which we would continue even with gasoline.

We know of a transport firm which uses this fuel without addition of oil or using superlubrication. They use Panhard trucks, and do not have these excessive repairs.

In conclusion, we are in an experimental period, and experience will teach us how we should operate, because we can foresee that the Government will make us use more alcohol than ever in the gasoline.

Like yourselves, I should like to know the opinions of other users in the matter.

Please accept, dear sir, the expression of my best sentiments.

L. BRAUN.

AUTOMOBILES AND CYCLES
L. MAUCHAUSSE, MECHANIC
ARNAY-LE-DUC (COTE D'OR)

ARNAY-LE-DUC, *September 8, 1933.*

Cycle & Automobile
59, Avenue de la Grande-Armee,
Paris.

Mr. MANAGER: From the beginning I have followed your inquiry on the alcohol-gasoline mixture, and I will give you my opinion:

Since March I have been burning for my personal use a tourist gasoline containing 20 percent of alcohol. I am very satisfied with this motor fuel, and since that time I have used it without other mixture in a Rochet-Schneider truck and a Citroen 5 CV and I have several clients who use only this mixture in C4 and 201 to their great satisfaction. I have made no change with the carburetor, so that it is a matter of indifference whether the pure or the mixed gasoline is put in.

One inconvenience with the 15 percent mixture is that the alcohol does not tolerate water and the tanks must be in a good state of cleanliness, something that does not occur with gasoline. Since there are certain brands that are not mixed, and because pure gasoline is sold, and since there is no inspection to see whether the water which may be in a tank gets into an auto which has been served with gasoline mixed with alcohol and afterwards without the mixture, it may happen that a few drops of water that have been mixed in the tank still containing alcohol will quickly form a condensation and water in the tank without anyone knowing where it comes from. I have seen several cases of the sort with passenger automobiles.

It is necessary that all the gasolines have the same quantity of alcohol, and I believe that under those conditions no automobile will refuse to go.

Certain individuals complain of and fear wear on the motor. Since I have been using the mixture I have inspected the motor several times and have not found any noticeable wear beyond that found with gasoline.

I have noted, and so have some other automobilists that this mixture suppresses the jingling of certain motors.

There will probably be some inconvenience in winter when starting and it will be necessary to idle the motor a bit longer before going on the road.

In March I tried out a 20 percent alcohol mixture, which is somewhat heavy, but had to abandon it because it was not possible to make good starts. This inconvenience disappeared when I began to employ the mixture which I am now using.

Receive, Mr. Manager, my hearty salutations.

L. MAUCHAUSSE.

GARAGE
HENRI TARDIEU
PLACE KLEBER
BELLEGARDE (AIN)

BELLEGARDE, *August 30, 1933.*

MR. MANAGER: You have asked our opinion on the alcohol-gasoline mixture which is now being used by all the owners on this route.

One fact is certain—aside from the tales of woe which the customers relate to me every day—I have had the following experience which is conclusive:

I was on a trip in Switzerland with three cars, and on returning in the evening I had occasion to put into one of my cars only the gasoline used in Switzerland:

(without alcohol). I have observed that this car, although less speedy as a rule than the other two, got up the Faucille hill much easier than the others. This dispenses with all commentary.

In all cases the results of my observations, extending over a number of weeks, is that the motors run irregularly, have less pull, sometimes heat up, and even jangle, not to mention a greater consumption.

Please accept, Mr. Manager, my very sincere salutations.

HENRI TARDIEU.

AUTOMOBILES
R. TISSANDIER
8, PLACE DE LA CORDERIE
COGNAC

COGNAC, *July 31, 1933.*

Mr. Felix Laine,
59, *Avenue de la Grande-Armee,*
Paris.

MY DEAR MANAGER: I have the honor to send you herewith enclosed the list of motorists and motorcyclists of the Cognac district. I also send you the sum of 20 francs for my subscription to the "Autocatalog 1934."

Replying to your article which appeared in "L'OFFICIEL" on the subject of the alcohol-gasoline mixture, I may say that in connection with the B. M. A. motors I have observed a very pronounced heating. For the most part, the customers have found themselves obliged to put in a carburetor jet of a higher number. This facilitates starting, but does not suppress the heating. I have even had customers whose motors stopped after a few kilometers, and after starting again the trouble recommenced. I have also had customers who were obliged to travel with the air throttled, and this with engines that, before the alcohol was added, traveled normally.

For the trucks, the starting is more difficult. A large number of customers have turned to using super-fuel, saying they could not use the ordinary gasoline. I have had results clearly better with ordinary gasoline instead of with super-fuel, and in other cases absolutely the reverse. In order to get exact figures it would be necessary to make an experiment with the same car and with the same regulation of the carburetor, using a certain type of mixture and neutral gasoline. The variation between trucks and gasolines used, the limited observations reported by the customers, do not permit us to give a precise opinion. I know that the question is arising from the complaints of the customer.

R. RISSANDIER.

ALL AUTOMOBILE EQUIPMENT
ESTABLISHMENT MILLERET
34, RUE DE L'UNION
CLAMART

CLAMART, *September 2, 1933.*

Mr. MANAGER: In response to your editorial of July 30, concerning the alcohol-gasoline mixture, after 2,000 kilometers I have noticed a much larger consumption (which means increased expense), poorer pick-up, rubber joints deteriorated, carburetor cup disintegrated. My two representatives make the same observations.

In our opinion there is no advantage but rather annoyance, except, *bien entendu*, those which (------) in this affair.

Please accept, Mr. Manager, the assurance of my distinguished consideration.

MILLERET.

P. S. Why is it that a number of garage men post "GASOLINE GUARANTEED WITHOUT ALCOHOL"? Is it true, and how far can they go with such a guarantee?

CELLULOSE STATION
R. DENAIX
128, RUE DE LA MARIETTE
LE MANS

LE MANS, *September 1, 1933.*

Mr. PRESIDENT: Replying to your inquiry on the question alcohol-gasoline, I give you some information collected from among my customers.

Many customers have had fires, due to rubbing, loosening of joints, scaling of the tanks leading to stoppage of the piping.

Partial increase of power due to frequent stops, coughing, bad starting, especially in rainy weather. Finally, increased consumption and an intolerable situation in the car—the gas burns your eyes.

I make about 500 kilometers a day, and I serve a little group of customers who are worth having.

I pray you, Mr. President, to please accept my respectful salutations.

R. DENAIX.

AUTOMOBILES "PEUGEOT"
"FORD", "UNIC"
LOUIS BEZILLE, SUCCESSOR
MOULINS-ENGILBERT [NIEVRE]

AUGUST 1, 1933.

Mr. LAINE: I have read with interest your editorial relative to the alcoholized gasoline. I have not yet been furnished with this new product, and for the next 15 days I shall still be furnishing pure gasoline.

On the other hand, I have already used the national fuel (Eco) of 50 percent, on different vehicles, including an X, with which the travel was good, and the efficiency good. On the other hand, with other vehicles (Rosengart, Citroen B) no travel is possible even by changing the carburetor jet, advancing the spark, etc., as much as 50 percent.

The travel of vehicles that have been regulated to the exact degree of carburetion, that is to say, for maximum economy, will be impossible even with 20 percent alcohol, especially with old cars with low compression and antiquated ignition. I have learned this from customers who have bought alcoholized gasoline elsewhere.

Moreover, I have observed corroding at the bottom of the carburetor cups, which went to the point of obstructing the carburetor jets with the products of corrosion.

The only small advantage that I have noticed is that when added to tourist gasoline in small quantity, one liter of 50 percent to 10 liters of gasoline, the 50 percent fuel increases the flexibility and suppresses autoignition. Used in the pure state, I have observed pitted escape valves.

While awaiting more complete experience, my opinion is as follows:

One can travel with a mixture containing 10 percent of alcohol, but absolutely on these conditions: first, to use 99.5 percent alcohol, that is to say, with no water; and second, to find some other denaturant than acetone, which corrodes the valves and the carburetors.

Please accept, gentlemen, my sincere salutations.

LOUIS BEZILLE.

BICYCLES
AND
MOTORCYCLES
LOUIS CARRE
SANGERGUES [CHER.]

AUGUST 11, 1933.

Mr. F. Laine,
Paris.

Mr. PRESIDENT: This is my response to your inquiry regarding the motor fuel.

So far as I am interested—motors—I have observed the following inconveniences, which are also well known to others: bad starting, excessive heating, lack of power and, particularly with two-cylinder motors, the action of the mixture seems to show itself in a decrease in the lubricating power of the oil used; on certain motors it produces an almost complete drying to the top of the cylinder. In my opinion this is a very serious inconvenience, especially with the velo-motor.

On the other hand, I have noted that the mixture of alcohol with gasoline is not made as easily as the mixture of gasoline and oil; during mixing there appears to be a bubbling which seems to liberate the alcohol, entraining to the surface a film of oil which floats and does not mix.

I should be very glad to know if this fact has been noted by others. It should not be peculiar to the oil I use.

I am also manager of a gasoline pump, and I have found that the automobilists are nearly all hostile to the alcohol-gasoline mixture. Same griefs—heating up, bad starting, lack of power, increase of consumption.

If this product has qualities and if the economic safety of France depends on its use (???) why shouldn't they give us at least a fuel of uniform proportions, so that when a motor has been once regulated it will function equally well no matter where it has been served?

Receive, Mr. President, my sincere salutations.

LOUIS CARRE.

AUTOMOBILES, CYCLES
SEWING MACHINES

OF ALL MAKES
CAMILLE HERBIN
MECHANIC-BUILDER
MONTIER-EN-DER
(HAUTE-MARNE)

MONTIER-ON-DER, *August 28, 1933.*

L'Officiel de l'Automobile et du Cycle,
59, Avenue de la Grande-Armee,
Paris.

Mr. MANAGER: Please excuse me for my tardy answer to your question regarding alcohol-gasoline. I have wished to take some notes myself and get the opinions of a number of my gasoline customers on the subject. Today I can tell you that nobody is satisfied with the mixture, that the motors do not give as much mileage as before, with a consumption a little higher, and that the difference from the old gasoline is noted by everybody.

We want them to sell us a gasoline of quality, charging us a little more, if necessary, but not the alcohol mixture.

Receive, Mr. Manager, my hearty salutations.

CAMILLE HERBIN.

AUTOMOBILES, CYCLE CARS
AMERICAN MOTORS
VELOCIPEDES OF ALL MAKES
F. DECOMBREDET
21, PLACE DES VOSGES
PARIS

PARIS, *August 19, 1933.*

Mr. F. LAINE: In reply to your referendum: After using the alcohol gasoline I have been obliged to change the gauge of the carburetor jet, which certainly means an increase in consumption.

There is a drying of the upper parts of the cyclinders, which makes it necessary to add to the present fuel either oil or various other products for replacement.

This fuel evidently disintegrates the gas tanks or the piping, because the driver frequently finds his carburetor jet plugged.

The variations of percentage certainly do us no good.

Tho result is certainly an increase of expense, which is quite clearly felt by the owner.

And as in the case of the green bulletin, we are always waiting for the suppression of "laissez-passer."

Believe me, I pray you, yours devotedly,

F. DECOMBREDET.

AUTOMOBILES
PAUL FILHON GARAGE
REGISTERED MECHANIC
CROIX-DE-VIE (VENDEE)

CROIX-DE-VIE, *August 16, 1933.*
Mr. Felix Laine, Manager.

What do you think of the alcohol-gasoline mixture?

In my opinion, all fuels, whether solid, liquid, or gaseous, are excellent, provided they are used in a suitable machine.

If the measures undertaken by the Government are to extend over some little time the following should be attended to:

1. Absolute obligation on the refiners to incorporate the same quantity of alcohol with their gasoline.
2. The builders should provide, at a reasonable price, a modified feeding system that will allow of getting a mixture which will give the best efficiency.
3. The manufacturers of carburetors should show the owners the new regulation of the carburetor jets to use to obtain the best mixture corresponding to each type of vehicle.

With the correct compression and the right carburetor, starting in the cold should not be more difficult than with normal gasoline, because for my part I have observed that in spite of the different improvements that have been made on the present carburetors, the starting on a cold winter morning is still difficult for most vehicles.

I have the impression that a chemical mixture added to the new motor fuel could not but increase the rapid destruction of the organs of the motor.

Please accept, Mr. Manager, the assurance of my sincere salutations.

PAUL FILHON.

CYCLES, MOTOCYCLES
AUTOMOBILES
DONNEAU-MATHIEU
GENILLE (INDRE & LOIRE)

AUGUST 28, 1933.

L'Officiel de la Automobile,
59, *Avenue de la Grande-Armee,*
Paris.

SIR:

I have already acquainted you with the opinions of my customers regarding the alcohol-gasoline mixture; now I shall tell you what I have noted and what think on the Subject:

Like all laws, this law is unjust and has been poorly applied from the beginning. I am in favor of a strictly maintained proportion. As regards the application of the law, we have only to take a walk on our beautiful roads or in the cities to be edified on the subject.

In fact, there are already a number of dealers who display in big letters a sign "GASOLINE GUARANTEED PURE," and others who announce nothing. The customer is inveigled to the sign "PURE GASOLINE," and imagines that some dealers are "dishonest mixers."

We have already seen the "premium king," and soon we shall see the "pure gasoline king." In my opinion, this should be prohibited.

I have a gasoline distributor. The firm that supplies me assures me that there is no alcohol in the gasoline. Why two weights, two measures? Because of this bad mixture.

Thank you for stirring up this question. All the motorists should answer you.

Please accept, Sir, my sincere salutations.

DONNEAU-MATHIEU.

S. E. A.
SAN APPROPRIO 7
MADRID

MADRID, *September 2, 1933.*

Mr. Felix Laine.

SIR:

I am aware of the inquiry you are making on the alcohol-gasoline fuel and I believe I am able to give you certain observations.

I have made numerous experiments with this mixture, which I have found *dangerous* to the life of the motor. This composition, at the end of a few months of service, destroys the valves by corrosion; the edges of the valve seats look as though they had been subjected to the action of an oxy-hydrogen blow pipe. The same phenomenon is shown by everything that has a direct contact with this mixture, the spark plugs, for example, in the breach, the exhaust openings, etc.

These experiments were made on six trucks, Aries, R. 6 and R. 66, Ballot and Aster motors, and have led to the result which I have just stated to you. Our firm has resolved not to make further use of this liquid, the sales price of which is a little lower than that of gasoline, but is much more burdensome from the point of view of maintenance.

I hope that these few lines will have set forth my modest experience in the cause which interests you.

Please believe, Mr. Laine, in my best sentiments.

CENTRAL GARAGE
AUTOS, MOTOS
J. BOUVIER
LIEUSAINT (SEINE & MARNE)

AUGUST 15, 1933.

Mr. MANAGER: The alcohol-gasoline mixture which they furnish me gives a good result and if many automobilists complain of this mixture it is because it has not been imposed on all the refiners. This permits certain pump men to compete unfairly with their colleagues by placing on their pumps, in big letters, the words, "WITHOUT ALCOHOL."

The Government should speed up the standardization and put a stop to these signs.

I have nothing to complain of in the use of the mixture of 12 liters of alcohol in 100 liters of gasoline that has been furnished to me. My C–4 stands it well, and my old Panhard 1914 still better. I have rapid pick-ups and get up the hills more easily. It is not the same with a heavier fuel.

In the hope of having met your expectations, I present to you, Mr. Manager, my very sincere salutations.

J. BOUVIER.

MANUFACTURF OF BICYCLES
AND VELOMOTORS
GUILLER BROTHERS
PLACE DU PUY-LA-VAU
FONTENAY-LE-COMPTE (VENDEE)

AUGUST 24, 1933.

Mr. Felix Laine,
59, Avenue de la Grande-Armee,
Paris.

Mr. MANAGER: We have read your articles concerning the alcohol-gasoline or gasoline-alcohol, the distribution of which has now begun in France. We take occasion to give you our opinion concerning this fuel.

One of us who was traveling last week had occasion to fill up with gasoline on the road and immediately had trouble with his motor. At first, he thought that, on account of the hot weather, the motor was binding for lack of lubrication or lack of water. Having convinced himself of the good performance of the motor by turning the crank, he had to seek some other reason for the bad behavior of the car.

A garage man dismounted the carburetor and remarked that there was alcohol in the gasoline that remained in the cup of the carburetor. After cleaning the carburetor the car had the same trouble, lost its speed and came nearly to a dead stop, as though the fuel was at fault. Results: Important loss of time and average speed greatly reduced. As we go out on business our time is valuable and we should make speed on our travels.

The next morning, having got fuel from our usual supplier, the car performed as in the past and the incidents of the preceding day were not repeated. As far as we are concerned we are not satisfied with this motor fuel, and it is probable that you will receive plenty of complaints like ours.

Please accept, Mr. Manager, our hearty salutations.

GUILLER BROTHERS.

MOTOS, CYCLES, AUTOS
SEWING MACHINES
M. PROUTEAU
VIVY (MAINE-ET-LOIRE)

VIVY, *August 8, 1933.*

L'Officiel de l'Automobile, du Cycle,
et de la Motocycle,
59, Avenue de la Grande-Armee,
Paris.

Mr. MANAGER: I may tell you that the addition of alcohol to the gasoline has no other result than complaints raised on all sides, and the cause of these complaints is that certain dealers have proclaimed in big letters: "TOURIST GASOLINE WITHOUT ALCOHOL." This is not a criticism of the 15 percent alcoholized mixture, I find that very good. But the fact is that the firms that sell these fuels are all obliged to have the same percentage of alcohol in the gasoline, for this is a law that is made for everybody without exception. It is this that draws the criticisms from the owners.

Now, the gasoline that is not alcoholized in a proportion higher than 10 to 15 percent does not give bad results; quite the contrary, provided you add a little superfuel of a paraffin base in order to lubricate the upper part of the cylinders. Because the alcohol has a drying tendency, the result is premature wearing of the cylinders, which causes trouble.

This is my viewpoint; it is up to you to draw your own conclusions.

For the present please accept my sincere salutations.

M. PROUTEAU.

SEWING MACHINES, PERAMBULATORS, TRUCKS
CYCLES, MOTOCYCLETTES
FOUGART-CARON, SON-IN-LAW
AND SUCCESSOR
RUE DE LA REPUBLIC
FOUILLOY-LES-CORBIE (SOMME)

FOUILLOY, *August 14, 1933.*

Mr. MANAGER: In response to your inquiry on the subject of retroviseurs, I had several in stock during the month of June which have been sold. On June 15 I sent an order to a wholesaler who replied, "We have no retroviseurs." On addressing myself to the other usual wholesalers I got every where the same response; I am still waiting and my colleagues of the neighborhood are in the same fix as me.

On the subject of the alcohol-gasoline mixture, many of the clients are not satisfied. The motor gives less mileage, the consumption is higher, the percentage should be the same at all the filling stations, and also the price should be standardized, as there is too much difference—from 0.5 to 0.75 francs—according to locality.

Always devoted to your orders.

Please accept, Mr. Manager, the homage of my profound respect.

FOUGART-CARON.

PEUGOT AUTOMOBILE AGENCY
LOUISE SOULIER
11 & 13
BOULEVARD DE LA MEYNE
ORANGE (VAUCLUSE)

AUGUST 21, 1933.
L'Officiel de la Automobile, du Cycle, et de la Motocycle,
59, Avenue de la Grande-Armee,
Paris.

In response to your inquiry, my point of view is that the use of the new tourist gasoline to which alcohol has been added (decrede of March 22, 1933) is bad for the motors.

The most serious of the inconveniences that have come to light is, in my opinion, the drying of the cylinders by solvent action of the alcohol on the film of oil. The principal danger is that of a separation of the alcohol-gasoline mixture.

The customer, if he wishes to preserve his motor in good condition and remedy the phenomenon, is obliged to increase the quantity of oil by mixing with the fuel some special lubricant.

On the other hand, a large number of the customers complain of obstruction of the carburetor jets and the piping for the fuel by dirt from the tank which has been loosened by the alcohol, and also of a larger consumption of gasoline.

The only good property of this mixture is that it is anti-knock.

In truth, I am not a partisan of the new fuel.

Please accept, Gentlemen, my hearty salutations.

Your editorial correspondent,

LOUIS SOLIER.

AUTO AVIATION
P. REMES
4. RUE ST. DENIS AND
3. ALLES BOSSERVILLE
MONTPELLIER

SEPTEMBER 11, 1933.
Journal l'Officiel,
59, Avenue de la Grande-Armee,
Paris.

SIR: In response to your inquiry concerning the alcohol-gasoline mixture I can tell you that for the good performance of the motors it will be necessary that all the brands of fuel should have the same percentage in the mixture, because now when the customers fill up at different places the regulation of the carburetor must be changed.

On the other hand, I have customers who at frequent intervals and even on the same day have had the same trouble (carburetor full of water), the alcohol having become dissociated from the gasoline (on account of the hot weather) and has evaporated, leaving the water.

I have also noted that the carburetor cups have been perforated on account of acids contained in the fuel.

And this winter we shall know about starting.

Having thus given you some idea about the annoyances due to the alcohol-gasoline mixture I pray you to accept, Sir, my distinguished salutations.

P. REMES.

CYCLES, AUTOMOBILES
SEWING MACHINES
VIEUX SON
MECHANIC-BUILDER
AVENUE-CLEMENT-DESORMES
CHATILLON-SUR-CHALARONNE
(AIN)

CHATILLON, *July 23, 1933.*

"L'Officiel"

"What do you think of the new motor fuel?"

I have a station of l'Economique. On the first delivery of this alcohol mixture the crusts on the tank were disintegrated; the fuel measured out looked like the yellow water of muddy brooks. After giving out a few liters I shut down the station, because the whole afternoon I had nothing to do but unstop carburetors and even to empty the tanks.

Near me is an autobus station where they had a Latil that would not budge. On giving it pure gasoline it went very well. Consequently they wanted to be served with Roumanian gasoline, or at least they wanted gasoline without alcohol. Also, as soon as the motorists got wise to it they passed up the stations with alcohol, and fell back on carrying with them cases of cans in which there is no alcohol, so you can imagine what this means to us.

I enclose a clipping from the "Journal du Dombiste," a paper published near Trevous, from which you may obtain some tips for the motorists.

Please accept my sincere salutations.

VIEUX.

DONNEAU-MATHIEU
GARAGE-MECHANIC
GENILLE (I.-ET-L.)

AUGUST 16, 1933.

L'Officiel de l'Automobile,
59, Avenue de la Grande-Armede,
Paris.

DEAR SIR: You are right to insist on having the opinions of the motorists on the subject of the alcohol-gasoline mixture. Here is what I have to say:

1. *For the serious customers who do not complain about nothing:*

If you do not say anything to the customer you will not notice any change. If, on the other hand, you begin to talk about the alcohol-gasoline mixture, he will know, in fact, that the motor starts less easily, or has less pull, etc. But he only believes it.

2. *For the customers who are maniacs by disposition:*

It is not the same; the alcohol-gasoline mixture is simply the death of the motor, without knowing why and without proof.

3. *For the gabby ones who are pleased to demonstrate everything:*

They find it an excellent occasion to accuse the alcohol of plugging the carburetor jets, or of fouling the spark plugs.

On the whole, I have never been called on to change the regulation of an automobile motor except in one case, an industrial motor which functioned normally with gasoline. Thanks to the advice of "L'OFFICIEL," I widened the carburetor jet, and everything was in order again.

The result of your referendum interests all the motorists.

Please accept, Sir, my sincere salutations.

MASSENA GARAGE
M. LEBOUTEILLER, ENGINEER
A. M. DIRECTEUR
1, RUE CHAUVAIN. NICE

SEPTEMBER 7, 1933.

Monsieur Felix Laine,
Manager of L'Officiel de l'Automobile,
59, Avenue de la Grande-Armee,
Paris.

DEAR MR. LAINE: Compliments on your nice radio broadcast of Monday, August 17.

Why should not the furnishing of alcohol-gasoline have been begun in the wine growing and "sugar beet" departments? They should have been the ones to clean the paint while the great centers, Paris, Lyon, Marseille, and the big tourist regions, were left one side for the time being. After things had been adjusted in this experimental region there would be nothing to do but extend the system to the rest of France and give the mass of the people the benefit of the experience acquired by those who are the most interested in the first place.

Please accept, Mr. Laine, my heart salutations.

LEBOUTEILLER.

MOTOS & CYCLES
ALL MAKES
EMILE GARANS
PEYREHORADE (LANDES)

PEYREHORADE, *September 10, 1933.*

L'Officiel de l'Auto, etc.

The use of the present motor fuel in two-cylinder motors does not correspond in any sense to the purpose intended. The alcohol drys the walls of the cylinders, plugs the carburetor jets frequently, and brings about stoppage of the motor because of heating.

In gasoline torches without pressure its use is disastrous. The heat produced by the burner is not strong enough, a fatty body is produced and plugs the jet, it is impossible to use these blasts with the present fuel. The case is not the same with the brazing lamps where the heat perfectly entrains the mixture.

I give you my opinion on the engines and tools which I have tried out, and I believe that it is true.

Receive, Mr. Manager, my best salutations.

EMILE GARANS.

[Reprinted from Industrial and Engineering Chemistry, vol. 30, p. 1091, October 1938]

MOTOR FUEL ECONOMY OF EUROPE

By Gustav Egloff, Universal Oil Products Co., Chicago, Ill.

Self-sufficiency strikes the keynote for the desires of most European nations. The production of substitute motor fuels derived from their own resources, such as coal, wood, oil shale, and agricultural products, is one of the goals. The economics involved is not the primary factor.

Coal is converted into liquid motor fuel by carbonization, hydrogenation, and the water-gas reaction. Alcohols from farm products and methanol from hydrogenation of carbon monoxide, and wood distillation are also used.

Methane, ethane, propane, and butanes, or city gas, are used in compressed form in steel cylinders (3,000 to 4,000 pounds per square inch pressure) in gas-driven motor vehicles. These gases are derived from coal carbonization, coal hydrogenation, and from hydrogenation of carbon monoxide, and natural gas. There are about 26,000 of this type of motor vehicle in use. Other types of gas-driven vehicles manufacture their own combustible gas en route from wood and charcoal. There are about 9,000 such wood-burning motor vehicles in Europe consuming about 450,000,000 pounds of wood yearly. These vehicles are heavily subsidized by governments through direct payments, elimination of taxes on the wood and vehicle, and taxes on imported gasoline.

Total consumption of power alcohol in Europe in 1937 amounted to 510,000 tons compared with 646,000 tons during 1936. The 510,000 tons of ethanol (some methanol) represented 4.3 percent of the total 11,882,600 metric tons of motor fuel consumed during 1937 in Europe. It is estimated that the 510,000 tons of alcohol used in Europe cost the consumer and state in additional expenditures on the order of about $100,000,000 in subsidies, tax losses, and higher operating costs of vehicles.

The increasing tendency of nations to become autonomic in both thinking and action has been strongly felt by the author during the past 10 years of European visits. As part of this nationalism, substitute motor fuels play an increasingly important role.

Countries such as Germany, England, France, and Italy have no material petroleum resources and are conducting research feverishly to utilize their own potential motor-fuel supplies from coal, vegetables, cereals, wood, natural gas, and oil shale. This research is not directed solely toward producing fuel for motor vehicles such as airplanes, pleasure cars, busses, trucks, and boats, but also toward the desire to become nationally self-sufficient, to keep people employed, and to utilize their own resources. The cost of producing substitute motor fuels is not specifically involved, since gasoline produced from crude oil is markedly less in cost that any of the sources enumerated comparing over-all motor-vehicle performance.

A number of European nations directly and indirectly subsidize indigenous motor fuels through taxes on imported motor fuels, partial elimination of taxes on the fuels and on the vehicles using nationally produced fuels, and, in some cases, direct part payment on the vehicles using substitute fuels.

Table I gives a bird's-eye view of European crude oil production, motor-fuel consumption, motor vehicles, alcohols (methanol, ethanol), coal, and forest

resources, and indicates the interplay of economic forces that motivate nations in their self-sufficiency programs.

The primary source of motor fuel in the world today is crude oil. Over 2,000,000,000 barrels of petroleum were produced during 1937, from which about 775,000,000 barrels of motor fuel were derived by distillation and cracking. Substitute motor fuels consist of compressed gases, liquids, and solids from coal, alcohols (methanol and ethanol), producer gas from wood and coal generators on motor cars, compressed natural gas, and oil shale. Acetylene, cracking of ammonia, and hydrogen have been used in an experimental way.

COAL

The primary substitute motor fuel in Europe is derived from the hydrogenation of coal and carbon monoxide. The synthetic liquid motor-fuel production in Germany will be at the rate of about 17,000,000 barrels a year from the units of the two processes now operating or under design and construction. In England the rate of direct coal hydrogenation to gasoline is about 1,300,000 barrels a year. France is operating a 110,000-barrel-a-year catalytic unit to convert water gas to motor fuel. No other European countries are using these processes at present. For European conditions the various sources indicate that the cost per United States gallon of motor fuel produced by either coal or carbon-monoxide hydrogenation is about 18 cents.

TABLE I. *Crude oil, coal, and alcohol production, motor-fuel consumption, forest area, and motor-vehicle use in Europe during 1937*

Country	Motor-car registration (2)	Motor-fuel consumption (21)	Crude-oil production (21)	Coal production (23)	Alcohol used as motor fuel (10)	Total forest area (18)
	1,000 cars	*1,000 barrels*	*1,000 barrels*	*1,000 metric tons*	*1,000 metric tons*	*1,000 square miles*
United Kingdom	2,411.3	44,200	0	228,990	16	4.7
France	2,200.0	25,000	532	46,146	153	34.0
Germany	1,445.7	20,000	3,077	208,045	210	54.6
Russia	514.4	24,000	199,636	81,000	----------	3,014.5
Italy	429.7	5,200	150	988	37	4.7
Belgium	220.4	4,600	0	27,876	----------	----------
Sweden	192.7	4,000	0	424	15	100.4
Netherlands	147.8	3,500	0	12,893	----------	----------
Spain	125.0	2,900	0	7,320	----------	----------
Czechoslovakia	95.0	1,820	185	28,432	50	18.8
Norway	76.4	1,600	0	----------	----------	27.0
Austria	47.4	970	33(9)	3,141	2	7
Finland	44.4	800	0	----------	----------	84.2
Poland	34.3	600	3,870	29,768	8	31.0
Rumania	26.5	700	63,533	1,928	----------	29.3
Hungary	21.2	590	----------	7,932	10	2.1
Yugoslavia	14.6	----------	0	4,476	4	47.8

DIRECT HYDROGENATION OF COAL

The hydrogenation of coal and carbon monoxide derived from coal are two processes developed in Germany. The hydrogenation of coal is carried out at pressures of the order of 4,000 pounds and temperatures of about 850° F. in the presence of catalysts (fig. 1). The hydrogenation of carbon monoxide (Fischer-Tropsch process) is carried out at atmospheric or superatmospheric pressure in the presence of catalysts and temperatures of the order of 350° F. (figs. 2 and 3).

It is difficult to obtain precise figures on the cost of producing a gallon of motor fuel from the hydrogenation of coal or from carbon monoxide. However, from a number of European sources it has been learned that the cost of motor fuel production by the two processes ranged between 17 and 19 cents per United States gallon. These figures are fortified by the conclusions in important reports issued by the Committee of Imperial Defense of Great Britain and by the Labor Party of England (7). The Imperial Defense committee reports:

The Billingham plant was originally intended to deal with coal only and to have a rated output capacity of 100,000 tons (30,000,000 Imperial gallons or 36,000,000 United States gallons) of motor spirit. It was subsequently decided to include provision for the treatment of coal tars to the extent of 50,000 tons of petrol per annum, thus making the capacity 150,000 tons (45,000,000 Imperial gallons or 54,000,000 United States gallons) of petrol per annum.

The quantity of coal which was then expected would be required for the plant when in full operation is stated to be as follows:

	Tons
Coal hydrogenation:	
For processing [1]	150–200, 000
For all other purposes (steam, power, hydrogen production, etc.)	300–350, 000
	500, 000
Tar oil hydrogenation [2] for steam, power, hydrogen production, etc	100, 000
Total	600, 000

[1] The exact quantity depends, among other things, on the ash and moisture content of the coal.
[2] In addition, about 60,000 tons of tar oils are required.

This gives for the coal hydrogenation 1 ton of petrol for each 1.5 to 2 tons processed, or for each 5 tons of total coal used.

The spirit produced by the plant is of a high grade and during the last few months an octane rating of 75 has been achieved. This is a high standard for a straight or undoped petrol.

If a new hydrogenation plant were to be built, it would have to be designed to use coal only, as there are not available supplies of creosote or low-temperature tar in sufficient quantities to provide for another mixed coal and tar plant. The plant would have a capacity of 150,000 tons of petrol, as Imperial Chemical Industries, Ltd., regard this size as the minimum from an economic point of view.

The capital cost of such a plant (to include land, offices, site development, and design charges, research charges essential for this new plant, working capital, interest during construction, and fees payable to the International Hydrogenation Patents, Ltd.) is estimated by Imperial Chemical Industries, Ltd., at 8,000,000 pounds ($40,000,000), made up approximately as follows:

	Pounds	Dollars
Capital cost (plant, materials, etc.):		
General services and workshops	1, 035, 000	5, 175, 000
Boilers and power plant	1, 570, 000	7, 850, 000
Gas making, purification, and compression	1, 762, 000	8, 810, 000
Hydrogenation plant and refinery	2, 880, 000	14, 400, 000
	7, 247, 000	36, 235, 000
Sundry charges (research during construction, interest during construction, working capital, International Hydrogenation Patents fee)	750, 000	3, 750, 000
Total	7, 997, 000	39, 985, 000

The estimated results of operations on a new plant thus calculated are shown below. The figures are set in two groups; the first deal with a calculation for depreciation of the plant on the basis of 20-year life (i. e., with no provision for obsolescence), and the second group is based on a charge for depreciation and obsolescence combined which is sufficient to write off the plant within 10 years.

	20-year life		10-year life	
	Pence per imperial gallon	Cents per United States gallon	Pence per imperial gallon	Cents per United States gallon
Assumed average realization price at works (assuming existing rate of preference of 8d. (16 cents) per gallon)	12.00	20	12.00	20
Deduct:				
Works costs (including works overhead)	7.20	12	7.20	12
Works profit before providing for depreciation and obsolescence	4.8	8	4.8	8
Provision for depreciation at 5 percent	2.13	3.63	.....	.....
Provision for depreciation and obsolescence at 10 percent	.....	.....	4.27	7.1
Profit after charging depreciation	2.67	4.45	.....	.....
Profit after charging depreciation and obsolescence	.....	.....	.53	.967

On the basis of a new plant to hydrogenate coal costing $40,000,000 for the production of 150,000 tons a year of motor fuel, the production cost per United States gallon would be about 15.6 cents on the basis of plant life of 20 years (no obsolescence charges included). On the basis of writing off the plant in 10 years, including depreciation and obsolescence, the cost per gallon of motor fuel would be 19 cents.

The British Labor Party, working independently of the Imperial Defence Committee, came to the conclusion that gasoline from hydrogenation of coal "at the present time" costs about 11d. (22 cents) per imperial gallon or 18 cents per United States gallon. The following is taken from the British Labor Party's report:

"On the basis of their experimental work, I. C. I. (Imperial Chemical Industries, Ltd.) were led to believe that petrol could be produced by hydrogenation at a cost of 7 to 9d. (14 to 18 cents an imperial gallon, or 11.67 to 15 cents per United States gallon), of which about 2d. (4 cents) would be due to the cost of coal. The figure realized in practice has not been disclosed, but there is some reason to think that with a reasonable allowance for interest on capital and amortization the price stands in the region of 11d. (22 cents) an imperial gallon. The I. G. Farbenindustrie has been similarly reticent, but it is learned from an authoritative source that their cost of producing petrol (from brown coal) has been 25 pfennigs a kilogram which is about 11d. (22 cents) an imperial gallon (18.3 cents per United States gallon) at par.

"The chairman of Imperial Chemical Industries, Lord McGowan, has twice referred recently to the high cost of producing petrol at Billingham. In his speech at the company's annual meeting on April 29, 1937, he said:

"'For general commercial reasons it is not the practice of the company to disclose the financial results of any particular activity. All that I can say, therefore, in regard to the hydrogenation plant is that up to date it has not shown results which would justify its description as a good commercial proposition, even with the advantages of the existing customs duty, and without that protection, of course, the enterprise would be uneconomic.'

"In the House of Lords on July 14, 1937, Lord McGowan said: 'Although the process is today in successful operation it does not, even with the protection afforded by the British Hydrocarbon Oils Production Act, present a favorable opportunity for the investment of large sums of private capital. * * * Success from a commercial point of view in the synthetic production of petrol depends largely, as far as the future is concerned, upon the policy of the government of the day.'

"Although the company has not disclosed its accounts, it is not difficult to form a rough idea of the principal items in the running costs of a hydrogenation plant similar to that at Billingham. The men employed on the plant are largely skilled workers, and their wages will average about £3 15s. ($19) a week. On this basis the wages bill for 2,000 men will be £300,000 ($1,950,000) a year; spread over an annual production of 45,000,000 imperial gallons (54,000,000 United States gallons) of motor spirit, this is equivalent to 2.1d. (4.2 cents) an imperial gallon (3.5 cents per United States gallon). The cost of the raw materials—600,000 tons of coal, 50,000 tons of creosote, and 12,000 tons of low-temperature tar—can hardly be put, at current market values, at less than £500,000 ($2,500,000), equivalent to 2.7d. (5.4 cents) an imperial gallon (4.5 cents per United States gallon).

"Imperial Chemical Industries provided the Billingham plant out of reserves, but in a calculation of the running costs of the hydrogenation process it is necessary to allow interest on the capital expenditure. With a rate of 3.5 percent, at which the money could be raised with a governmental guarantee, the interest on £5,500,000 ($27,500,000) would amount to £192,500 ($962,500) a year or 1d. (2 cents) an imperial gallon (1.67 cents per United States gallon).

"It is difficult to know at what figure amortization of the plant should be reckoned. Imperial Chemical Industries suggest amortization in 10 years, with compound interest at 2½ percent on the reserves provided. German authorities take the view that 10 years is an unnecessarily short period, and amortization in 15 years, with compound interest at 2½ percent on reserves, seems reasonable; on a capital of £5,500,000 ($27,500,000) this would absorb about £300,000 ($1,500,000) a year or 1.6d. (3.2 cents) an imperial gallon (2.67 cents per United States gallon).

"The total of these costs—wages, raw materials, interest on capital, and amortization—is £1,382,500 ($6,912,500) a year or 7.4d. (14.8 cents) an imperial gallon (12.3 cents per United States gallon).

"These estimates may be checked by the reports made by Sir David Rivett personally, and by a committee of which he was chairman, to the Australian Government. Sir David Rivett's estimates are based on figures supplied to him by Imperial Chemical Industries and by German firms. His final calculations are made in terms of Australian currency, costs, and wages, but by using his own multipliers as dividers it is possible to reverse the procedure and reach the European figures on which he ultimately relies, figures that have not otherwise been made generally available. By this means it may be calculated that the cost of a hydrogenation plant to produce 150,000 tons of petrol annually from coal (not, as at Billingham, from coal and other materials) is £7,500,000 ($37,500,000). If amortization takes place in 15 years and interest on capital is charged at 3.5 percent, the cost of petrol works out at 10.5d. (21 cents) an imperial gallon (17.5 cents per United States gallon); if amortization takes place in 10 years and interest on capital is charged at 6 percent, the cost of petrol will be 12.75d. (25.5 cents) an imperial gallon (21.25 cents per United States gallon).

"With a reasonable allowance for amortization and interest on capital it seems fair, therefore, to say that petrol can be produced by hydrogenation (directly from coal) at the present time for about 11d. (22 cents) an imperial gallon (18.3 cents per United States gallon)."

HYDROGENATION OF CARBON MONOXIDE FROM COAL

The Fischer-Tropsch process of producing motor fuel from the hydrogenation of coal was developed in Germany. Motor fuel, kerosene, Diesel oil, and paraffin wax are produced; the mixture is called Kogasin oil. The motor-fuel production from this process in Germany will be at the rate of 530,000 tons yearly when the units now operating and those under design and construction are functioning. There is one unit in operation in France producing motor fuel at the rate of 13,000 tons a year.

The Imperial Defence Committee studied the Fischer-Tropsch hydrogenation of carbon monoxide process and reported:

"Statements were furnished to the committee setting out particulars relating to the recommended size of plant, estimates of the capital and operating costs, the type and yield of products it is claimed can be produced, and estimated realization value of the products, etc. * * * The following are examples of the sizes of plants and estimates of capital cost submitted to the committee:

Kogasin oil yearly plant capcity costs

20,000-ton plant (including coke ovens)	£1,000,000 to £1,500,000 ($5,000,000 to $7,500,000).
35,000-ton plant:	
Including coke ovens	£1,901,000 ($9,505,000).
Direct gasification of coal in water gas plant	£1,717,000 ($8,585,000).
60,000-ton plant (including coke ovens and distillation plant)	£3,100,000 ($15,500,000).

"The estimates of cost have been prepared at different dates, based on information supplied by Ruhrchemie.

"Until more information is available as to the most suitable methods of treating the primary product in this country, and of the resulting products which will give the best economic return, it is obviously impossible to obtain any reliable data as to costs of production. One witness gave estimated figures of the average costs of production of marketable products from a 35,000-ton per annum plant which ranged from 12¾ to 15d. an imperial gallon (21.2 to 25 cents per United States gallon), according to the period allowed for amortization of the capital. The average realization price taken was 13d. (21.7 cents per United States gallon). Another stated that, on the basis of the best yields of products which he could at present accept, the over-all cost of the primary product would not have to exceed 10½d. (17.5 cents), and finished products an average of 12¾d. per imperial gallon (21.25 cents per United States gallon), if proceeds were to equal costs. He had not sufficient data to say whether such results were practicable. Generally the evidence appears to indicate that the costs of production in the case of this process are not likely to be less than those of the hydrogenation process."

The following is reported from the British Labor Party's report (7):

"The synthetic process (i. e., catalytic water gas reaction), unlike hydrogenation, can be worked in relatively small units. The economic unit is said to be a plant producing about 35,000 tons of primary products annually, or, if it includes its own catalyst plant, about 60,000 tons of primary products annually.

"The committee were given estimates for synthetic plants of two types: Plant A is a self-contained plant, with its own coke ovens, designed to produce annually 35,000 tons (11,077,500 gallons) of primary products from bituminous coal. If the Diesel oil fraction were "cracked", it would yield 28,350 tons of motor spirit annually, apart from subsidiary products. Plant B is a plant without coke ovens, designed to work in conjunction with a coal distillation unit and to produce from the low-temperature coke 10,000 tons of synthetic products annually.

"It is difficult to assess the cost of a British plant from German experience, especially in view of recent wide fluctuations in the price of steel, and all estimates must be accepted with caution.

"Plant A, it is stated, would cost about £1,900,000 ($9,500,000) to build, which spread over the 35,000 tons of synthetic products made annually, works out at £54 ($270) per ton of annual production. (It is not possible to give so confidently the cost of a plant designed to make water gas directly from black coal, as such a plant has not yet been worked on the commercial scale, but it would probably be about £200,000 ($1,000,000) cheaper.)

"Plant B, it is stated, would cost 4,500,000 marks in Germany, which is equivalent to £225,000 ($1,125,000) at par—that is, £22.5 ($122.50) per ton of annual production. When allowance is made for the omission of coke ovens, this is in substantial agreement with the estimate for plant A. To make a fair comparison, a portion of the capital costs of the accompanying coal-distillation plant should be added to the capital costs of plant B.

"Estimates of the over-all cost of finished petrol depend to a great extent on interest charges and the period required for amortization. With coal supplied to the coke ovens at 18s. 6d. ($4.62) per ton and amortization in 15 years, interest at 3 percent and depreciation on three-quarters of the capital would amount to not less than 21 percent of the cost of production.

"For a plant similar to plant A, Sir David Rivett made two estimates for the Australian Government of the cost of finished petrol. With amortization in 10 years, compound interest at 2.5 percent on accumulated reserves, and a return of 3.5 percent on capital, he estimated the cost at 15.8d. (31.6 cents) an imperial gallon; with amortization in 15 years, compound interest at 3 percent on accumulated reserves, and a return of 3.5 percent on capital, he estimated the cost at 13.0d. (26 cents) an imperial gallon (21.67 cents per United States gallon). These figures are in terms of Australian currency and conditions. The comparable British figures would be about 12.1d. (24.2 cents) an imperial gallon (20.17 cents per United States gallon) and 10.0d. (20 cents) an imperial gallon (16.7 cents per United States gallon). These are of the same order as the estimated costs of hydrogenation.

"For plant B, the over-all cost of the finished motor spirit is given as 20.21 pfennigs a kilogram, which works out at about 8d. (16 cents) an imperial gallon (13.3 cents per United States gallon) at par. The lower estimate for plant B compared with plant A results from the lower capital cost, which in turn is due to the absence of coke ovens, and for this, as already explained, some allowance should be made. When allowance is made, the estimates are in substantial agreement.

"With reasonable provision for amortization and interest on capital, the cost of synthetic petrol at the present time may therefore be taken at 10.5d. (21 cents) an imperial gallon."

The Falmouth committee offers the following conclusion:

"The limitations which have been referred to in the cases already dealt with do not arise with these processes (hydrogenation of carbon monoxide); for the main product is oil, and there is no residual solid fuel to be disposed of in competition with coal. The successful operation on a large scale of these processes would, therefore, produce an entirely new demand for coal, and offer greater opportunities for the creation of employment in the mining industry, as well as directly at the plants. Since, however, the development of these processes cannot be achieved on a strictly economic basis, it becomes necessary to consider at what cost the additional employment could be provided in present circumstances.

"The information supplied to the committee indicates that for this hydrogenation process a plant with a production capacity of 150,000 tons per annum of motor spirit would afford direct employment to some 2,000 persons in the

plant, and a further 4,000 in the mining and secondary industries, giving a total employment figure of 6,000. Unfortunately the cost of erecting such a plant is very great, amounting, on the basis of the present cost of wages and materials, to about £8,000,000 ($40,000,000). This would work out at a capital cost of £1333 ($6,665) per man employed. In addition, on the basis of the present preference of 8d. (16 cents) per imperial gallon (13.3 cents per United States gallon), there would be a loss of revenue to the Exchequer which would represent at least £250 ($1,250) per annum per run. The cost of providing work by this means would therefore be very high. It would represent from the revenue point of view alone a continuing assistance amounting to about £5 ($25) per week per person employed.

"Though reliable figures are not available for these processes (hydrogenation of carbon monoxide), the information furnished to the committee indicates that they are not likely to be very different from those given for the hydrogenation process.

"The committee, therefore, find themselves driven to the conclusion that, viewed solely from the point of view of providing a large measure of employment, the hydrogenation and synthetic processes do not at present offer a very hopeful prospect, in relation to the cost which would be involved. In this view they are supported by one important witness, who, while advocating the development of these processes for other reasons, used the following words as regards their effect on employment: 'Any idea that oil from coal can provide sudden salvation for the coal industry is clearly foolish.'"

The foregoing cost figures and related data are interesting and instructuve from the standpoint of present-day conditions in Europe. Secured from a number of wholly independent sources abroad, they conform surprisingly with figures from foreign coal hydrogenation operations translated to United States conditions of today by authorities close in touch with foreign operations. These latter data from American sources indicate 14 to 16 cents per United States gallon of motor fuel as the cost which would be obtained in hydrogenating coal in the United States today, with present coal prices and freight rates.

However, this cost must not be considered conclusive as regards future conditions in the United States. Abundant oil supplies make prospects rather remote that coal or other substitute motor fuels will be utilized for many years in the United States. When that distant time arrives, lower hydrogenation costs for America can well be anticipated. Since European plants were the first constructed, they have doubtless suffered from much higher capital costs than would be expected for new installations. Further, the thorough application of American engineering technic, particularly petroleum refining technology, would reduce capital and operating costs of gasoline from the hydrogenation of coal in the United States to a price materially below 16 cents a gallon.

BENZENE MOTOR FUEL

The high-temperature carbonization of coal has been the primary source of benzene motor fuel for years. The products of high-temperature treatment of coal are gas, coal tar, and metallurgical coke. The gas is scrubbed with oil or activated carbon and the coal tar is distilled to recover the benzene motor fuel content. Benzene is produced in the gasification of coal with a maximum yield of 3 gallons per ton of coal gasified. This type of motor fuel has an octane rating of over 90 and is used as a blending agent for lower grade fuels to raise their antiknock value.

Benzene and toluene, which are present in benzene motor fuel, are diverted in wartime largely toward explosive use. The Mining and Power Commission of the French Chamber of Deputies recently reported (*11*): "Benzene would also have to be reserved in time of war for the manufacture of explosives. Its production, moreover, is limited by the activity of coke ovens and gasworks and is therefore capable only of slight expansion. The domestic output of benzene last year at 75,144 tons (64,794 tons from coke ovens and 10,350 tons from gasworks) showed only a small advance over 1936, and was well below the 1929 peak of 79,200 tons."

The production of benzene motor fuel in the different countries of Europe is as follows (*13*) in metric tons:

Germany	480,000	Austria	8,200
Czechoslovakia	12,000	Sweden	500
Hungary	3,100	Holland	10,800
Poland	10,000	Finland	200
Belgium	36,700	Switzerland	3,000
France	80,000		
United Kingdom	230,000	Total	824,500

The cost to consumers of Europe was $49,463,000 more for benzene motor fuel than it would have been for gasoline, as a result of loss of taxes, governmental subsidies, and benzene production costs. Expressed another way, it was 20 cents more for each gallon of benzene fuel consumed.

COMPRESSED GAS

The sources of substitute motor fuels in Europe which are increasing are combustible gases from coal carbonization, coal hydrogenation, Fischer-Tropsch hydrogenation of carbon monoxide to hydrocarbons, natural gas, and the cracking process. Although during the World War, England used balloons filled with city gas as motor fuel because of an "impending shortage of gasoline," its use did not increase materially. The development in Germany turned toward the light-weight alloy cylinders attached to the motor vehicle to store the combustible gas under pressure. The gases used for motor fuel are coal gas, methane, ethane, propane, and butane; they are compressed, depending on the type, up to 4,000 pounds per square inch.

Motor vehicles are converted into the compressed gas type at a cost of $150 to about $300, depending on the size (*3*, *16*). The primary changes are as follows: (*a*) Racks are installed to hold the steel cylinders. (Each weighs about 115 pounds empty; when filled with propane-butanes at a pressure of 150 pounds per square inch, one weights 215 pounds or more of 100 pounds of compressed gas (*3*), equivalent to 18 gallons of gasoline.) Some of the larger trucks carry eight cylinders and some passenger busses use trailers to carry the cylinder. When methane at 3,000 pounds per square inch is used, the cylinder weights 155 pounds; it holds 28 pounds of methane, equivalent to 4.6 gallons of gasoline (*3*). When compressed city gas is used, the cylinder content in terms of gasoline equivalent is about 1.8 gallons (*5*). (*b*) The heart of the operation is the control of the pressure reduction by means of a regulating valve, so that a steady flow of gas passes to the motor. (*c*) A special gas-air mixer is used instead of the gasoline carburetor.

The greatest development in the use of compressed gas has been in Germany where it is estimated, over 150,000 tons (*16*, *17*) of gasoline during 1938 will be replaced by compressed gas, which is available at many stations (*19*) similar to gasoline filling stations.

Filling stations (*6*) dot Germany in a network which supply city gas, methane, or propane-butanes direct by filling the cylinders on the motor vehicle or replacing the empty ones. Depending upon the type of compressed gas (city, methane, or propane-butane), the distances traveled by a given vehicle when using two cylinder storage tanks are about 25, 55, and 225 miles, respectively, before they have to be refilled (*3*). It is estimated (*17*) that over 25,000 German motor vehicles are using about 250,000 cylinders as storage tanks for the compressed gas.

Italy has developed a natural gas field near Milan made up largely of methane. This gas is compressed at 3,000 pounds per square inch into steel cylinders and is distributed at eight filling stations which supply about five hundred busses and trucks in the Milan and Florence areas (*3*). At present (July 1, 1938), in Italy, natural gas is replacing petroleum gasoline as a motor fuel at the rate of about 40,000 tons a year. It is expected that within 2 years the use of methane from natural gas and coal carbonization will be fourfold greater than it is now.

The use of motor vehicles burning compressed gases is subsidized by governments of Germany and Italy by reduction of taxes (*4*, *16*). The tax on a United States gallon of gasoline shipped into Italy is 51 cents; Germany charges 36 cents. On the basis of 59.6 cents a gallon for motor fuel in Germany, of which 36 cents is a tax on imported gasoline (10 land via Hamburg at 11 cents an imperial gallon or 9 cents per United States gallon from the United States), the cost of city gas, motor methane, and propane-butanes in Germany compared on a gallon of gasoline basis is 43, 41, and 61 cents (*4*).

It is estimated that in all Europe compressed gas will replace about 250,000 tons of gasoline during 1938.

ALCOHOL MOTOR FUELS

The increased use of power alcohol was demanded in central Europe from 1930 to 1937 through enactment of laws. Power alcohol iss upported by heavy governmental subsidies. Alcohol replaces imported motor fuel and is fostered by the national self-sufficiency programs. Power alcohol consumption increased in Europe during 1930 to 1936 from 59,000 to 648,000 tons. However, a sharp decline took place in 1937 with the use of only 510,000 tons, a drop of 25 percent. A more drastic drop is indicated for 1938. Alcohol may be eliminated as a source

of power as a result of the staggering economic losses involved, its diversion to other uses, and its encroachment upon food supplies.

The economic strain upon the governments of Europe due to power alcohol use has been heavy. A loss of income of about $105,000,000 (*12*) was incurred during 1937 alone, based upon subsidizing the producers, tax losses, and higher fuel costs. These losses resulted from the marketing of 510,300 tons of alcohol out of a total 11,882,600 tons or 4.3 percent of the motor fuel used in Europe.

Germany and France (*21*) have been the heaviest consumers of power alcohol in Europe, and their supply was derived primarily from sugar beets and potatoes. Germany required a 10-percent blend of alcohol with gasoline but, 4 years after the legal requirement, it was found that there was insufficient alcohol produced in the country to fulfill the law. In order to meet government specifications, it was necessary to import alcohol to cover the deficiency. During 1937 synthetic methanol was used in Germany to the extent of 70,000 tons to make up the 10 percent alcohol quota, but it was not sufficient to stop the drain on basic foodstuffs entailed by so drastic a requirement in motor fuel. The percentage of alcohol required in motor fuel was reduced from 10 to 8.5 percent in October 1937, and to 6.9 percent in April 1938.

In France the sugar beet is grown primarily for the purpose of furnishing power alcohol, so that there is no excessive drain on foodstuffs to furnish motor fuel. The laws requiring from 10 to 35 percent alcohol in motor fuels were for the purpose of absorbing the products of the vineyards and beet farms; but as a result of drought neither group was able to produce the legal amount of alcohol required for blending.

The German subsidy to the potato alcohol producers is about $130 per ton of power alcohol or about 39 cents per gallon. In order to increase alcohol production 100,000 tons a year from farm products, France legislated in June 1938 to the effect of paying $12,500,000 for this amount of alcohol which figures about 36 cents a gallon subsidy.

Power alcohol consumption reached a peak of 321,300 tons in France, in 1935, dropping to 153,400 during 1937, a shrinkgae of over 52 percent. During 1935 France used over 55 percent of the total power alcohol of Europe and about 33 percent during 1937; an estimate is given for 1938 of less than 25 percent of the total. The power alcohol goal set by law has not been reached (the percentage alcohol blend during 1937 was 5.4 percent) as a result of natural causes and to diversion of alcohol to other uses such as munitions manufacture.

In Germany the use of alcohol from agricultural products has fallen off sharply—i. e., 20,000 tons during 1937 compared to 1936. Of the 210,000 tons of alcohol used during 1937, methanol represented 70,000 tons, leaving 140,000 tons of ethanol derived from potatoes, etc. This alcohol tonnage of 140,000 is about the same quantity as was used in Germany 5 years ago.

Power alcohol consumption for Germany and France has been as follows:

Year	Germany	France	European total	Year	Germany	France	European total
	Metric tons	*Metric tons*	*Metric tons*		*Metric tons*	*Metric tons*	*Metric tons*
1930	(?)	28,000	59,000	1934	170,000	203,000	445,000
1931	50,000	52,100	121,000	1935	170,000	321,300	576,000
1932	95,000	69,100	182,000	1936	[1] 207,000	303,900	646,000
1933	135,000	180,000	362'000	1937	[1] 210,000	153,400	510,000

[1] Includes methanol: 47,000 tons in 1936, 70,000 tons in 1937.

The data showing the power alcohol consumption and percentages of the total motor fuel consumed during 1937 in European countries are as follows; the alcohol used in motor fuel ranged from 0.3 percent for the United Kingdom to 23.0 for Czechoslovakia:

Country	Power alcohol consumption	Total light motor fuel consumption	Alcohol
	Metric tons	*Metric tons*	*Percent*
Germany	210,000	2,640,000	8.0
France	153,400	2,827,000	5.4
Czechoslovakia	50,600	220,000	23.0
Italy	37,000	483,500	7.6
United Kingdom	16,000	4,840,000	.3
Sweden	15,200	503,200	3.0
Hungary	10,500	69,100	15.2
Poland	8,000	98,200	8.1
Yugoslavia	3,800	30,200	12.6
Austria	2,300	146,300	1.6
Latvia	2,200	19,400	11.1
Lithuania	1,300	5,700	22.7
Total	510,300	11,882,600	4.3

Great Britain has never compelled the use of power alcohol for blending purposes in order to subsidize the agricultural industries. This is probably due largely to the fact that the raw material, molasses, must be imported.

The British Government further encourages alcohol motor-fuel blends by exempting both their alcohol and benzene content from the import duty on motor fuel, which for years was 8d. per imperial gallon (about 16 cents per United States gallon). Recently the tax on imported motor fuel was increased to 9d. (18 cents) per imperial gallon or 15 cents per United States gallon. The principal alcohol blends sold in England have been able, by reason of tax exemptions, to compensate for the higher alcohol cost of about 7.6 cents per imperial gallon of blend due to the governmental subsidy granted alcohol itself to the limit of 17.5 cents per imperial gallon (14.6 cents per United States gallon). Alcohol blends have not occupied a significant position in British motor-fuel markets in competition with gasoline, as shown by the fact that alcohol in the United Kingdom represents only 0.3 percent of the total motor fuel consumed.

Governmental pressure has been exerted this year to force the power-alcohol producers to pay the tax of 18 cents per imperial gallon (15 cents per United States gallon) as do importers of gasoline or gasoline produced from imported oil, on the basis that the alcohol is derived from imported molasses and hence is not entitled to preferential treatment However, loss of the 18-cents-per-gallon tax advantage for alcohol still leaves a preferential of approximately 5 cents per gallon in favor of alcohol motor fuel.

During 1937 a changed attitude regarding the use of power alcohol was noted in various European countries. In Germany the use of foodstuffs for alcohol production was out of favor, and in Italy and Latvia the legal regulations regarding alcohol blends have been suspended for the time being because of a shortage of crops and the increased fear of war, which has diverted motor-fuel alcohol to munitions manufacture.

Increased gasoline taxes have formed only a part of the encouragement given to power alcohol. In most European countries alcohol is heavily subsidized—i. e., Germany 39 cents per gallon and France 36 cents per gallon; the government monopolies pay higher prices to distilleries than to distributing companies. The monetary losses entailed due to power alcohol use in the countries of Europe during 1937 was $104,060,500.

The following table (*13*) shows alcohol tax losses, subsidies, and extra cost to consumer above tax-paid gasoline:

Germany	$53,738,000	Sweden	849,000
France	36,634,000	Poland	584,000
United Kingdom	1,538,000	Latvia	367,000
Italy	4,145,500	Austria	383,500
Czechoslovakia	3,032,500	Lithuania	181,500
Hungary	1,677,500		
Yugoslavia	930,000	Total	104,060,500

Europe's power alcohol policies have made difficulties for motorists which have been little recognized in the United States. The instability of alcohol supplies has caused repeated changes in the octane ratings of fuel sold the public. No sooner do car operators and automobile manufacturers adjust engines to run on fuels of a given antiknock value than an increase or decrease in the supply of power alcohol

results in the raising or lowering of the antiknock value of fuels and in making readjustments necessary.

On June 17, 1938, the French Government was confronted with a surplus of wheat and imposed an additional tax of 20 centimes per liter (2.1 cents per United States gallon) on gasoline to subsidize the manufacture of power alcohol primarily from wheat to the amount of 1,250,000 hectoliters (32,875,000 United States gallons) annually, with the result that alcohol again must be blended in essence tourisme and a further change in octane rating is made necessary.

ARMAMENTS ON ALCOHOL POLICIES

Recent events have confirmed previous analyses showing that the primary reason for compulsory use of alcohol in motor fuel in Europe is the desire of the countries to develop and maintain their alcohol industries for the purpose of national defense; this is done not merely as a protection against failure of petroleum supplies in wartime due to blockades but particularly to assure adequate capacity in wartime for manufacture of a prime raw material in making munitions—namely, alcohol (*1*). Significantly, the war scare which gripped all Europe during 1937 was accompanied by a sharp decline of alcohol used in motor fuel. This decrease was far too great to be explainable solely by crop shortages in sugar beets, the main source of alcohol in France and Italy, and must be attributed to the large quantities of alcohol consumed for armament purposes. Classified as confidential military information, diversion of alcohol from motor-fuel channels to use in making munitions has seldom been publicly mentioned. In at least one instance, however, it has been reported as a cause for the decline in France of alcohol for motor-fuel purposes during 1937 (*10*). Numerous informed sources abroad privately acknowledge that similar diversion of alcohol is also an important factor for the decline of alcohol for use in motor fuel in Italy and probably in Germany.

Because of the natural inclination of foreign nations to avoid this sensitive topic, it is likely that the desire to maintain a vital wartime industry in a continuous condition which permits operations at peak capacity has been greatly understressed as a cause of Europe's compulsory use of alcohol in motor fuel. A realistic appraisal of the situation compels the conclusion that this consideration has been a basic incentive for Europe's power alcohol policies, possibly outweighing even the desire to overcome vulnerability to wartime failure of petroleum supplies due to blockade. At times incapable of meeting all peacetime requirements as in 1937, most European nations clearly do not have alcohol industries of sufficient capacities to meet motor-fuel needs and wartime scale of munitions manufacture simultaneously. Indications are that at least one major European nation does not contemplate the use of any alcohol in motor fuel in the event of war. Reports are that it has rejected pleas of automobile manufacturers and others to advance the octane ratings of various fuels on the grounds that in wartime no alcohol would be available for that purpose, that the country's limited supply of tetraethyl lead would be used up in military fuels, and that commercial vehicles consequently should not be adapted to fuels of high antiknock value in face of the probability they would have to run on straight gasoline of relatively low antiknock value in time of war.

The Mining and Power Commission of the French Chamber of Deputies recently reported (*11*): "So far as alcohol is concerned, wartime requirements for the explosives industry, for solvents, and for medicinal purposes would be so great that they would far exceed domestic production. This is borne out by the experience of the Great War, when French consumption amounted to between five and six million hectoliters, of which domestic output was able to supply 1,000,000 hectoliters only. In time of national emergency alcohol would be far too valuable to be used as a motor fuel."

PRODUCER GAS FROM WOOD

Wood and coal as gas producers are not primary sources of motor fuel even in those countries urging their wider adoption. Despite drastic laws and government subsidies, the number of wood-burning motor vehicles is relatively small. The total number in Europe is estimated to be about 9,000. These motor cars are made up of specifically designed wood-burning (producer gas) stoves and motors, or gasoline engines converted to wood-burning motors. Passenger busses, trucks (up to 20 tons), pleasure cars, and two taxicabs in Paris are using wood as the motor-fuel source.

France has about 4,500 wood-burning vehicles, Germany 2,200, and Italy about 2,200. Many wood filling stations dot France, Germany, and Italy, where the wood is sold in packages varying from about 30 to 60 pounds. In Germany there are over 1,000 wood filling stations at distances between 20 to 25 miles apart.

At Holten, Germany (May 1938), the cost of dried wood (at a filling station) was at the rate of 51 cents for a sack of 82 pounds. In order to start the motor readily, charcoal costing 70 cents for 33 pounds is used at the beginning of producer-gas production. It has been estimated that 25 pounds of wood, costing 16 cents, will give the same distance performance as 1 gallon of gasoline. This comparison gives the effect of a cheap fuel source when compared to Berlin prices of motor fuel of 59 cents per gallon (filling station price, June 1938). However, this gives but part of the picture; we must take into consideration the high gasoline tax (36 cents per gallon), absence of taxes on wood, one-half tax rate on wood-burning vehicles, governmental subsidy in converting the vehicle from a gasoline burner to wood burner, and the greater labor, repair, and depreciation costs involved in using wood-burning vehicles compared to gasoline.

Wood as a power substitute for motor transport is a factor in those countries where the natural resources encourage it. The use of wood is desired primarily in France, Germany, and Italy to replace imported petroleum. It is estimated that 450,000,000 pounds of wood were substituted for the equivalent of 18,000,000 gallons or 53,000 tons of gasoline.

A number of motor-vehicle manufacturers fabricate equipment directly for the purpose of using producer gas from wood. The vehicles are more expensive in initial cost compared to gasoline type. Many of the wood burners have been converted from gasoline types at costs ranging from $300 to over $500, depending upon the size and work required. The additional parts of wood-burning vehicles over those using gasoline are: Stove to burn the wood; cooling pipes to reduce the producer-gas temperature; tank to collect condensed water, tar, and acids; filtering agent to extract solid particles from the producer gas; blower in some units to draw the producer gas from the source and then inject it into the motor.

The flow diagram of a gas producer, called in Europe "Gasogene," is illustrated in figure 4. It consists of a light steel cylinder 2 feet in diameter and 8 feet high, and may or may not be lined with a ceramic material for insulation. It has openings at top and bottom, through which wood, wood charcoal, coal, briquets, or mixtures of them may be charged into the gas generator. Air flows into the solid fuel bed to ignite the producer-gas-forming material. A torch dipped in oil may be used to start the fire (actually observed by the author). Air is admitted into the bottom of the generator, and combustion takes place at about 1,400° C.; the producer gas leaves the bottom of the generator at about 800° C. as the gas passes through a series of air-cooling pipes connected to a knockout cylinder to collect water, tar, acids, and a solid-particle catcher, then into a filtering chamber to take out the colloidal particles of dust in the gas stream as it passes through a solid filtering material such as activated char and filtering cloth. The purified producer gas mixed with air is then discharged by means of a blower into the motor.

Green wood is not as suitable for producer gas production as wood which has been air-dried in order to remove excess moisture. The drying period may take from 7 to 18 months. Beech, oak, and birch with a moisture content of 20 percent are used. Part of the wood is converted into charcoal for "quick" starting of the motor on a cold morning. From 10 to 20 minutes may be required, and in some cases gasoline is used first to warm the motor. Depending upon the duty that the motor vehicle has to perform, the wood is cut into sizes of 0.5 by 0.5 by 0.5 inch to about 2 by 2 by 3.5 inches. Some waste (sawdust) is briquetted with wood tar or coal tar and pitches.

In addition to the fact that the initial cost of the Gasogene vehicles is higher than that of gasoline vehicles, other economic factors have to be considered. One lies in the bulk and weight of the generator equipment. The transporting capacity is reduced about 20 percent in comparison with gasoline motors on trucks. A wood gas generator capable of operating a 90-horsepower 5-ton truck weighs 1,850 pounds. When a charcoal gas generator is used, the weight is 1,575 pounds but the price of charcoal is about $2.18 higher per 100 miles of operation than wood which nullifies the excess loading possible in that type of truck. The general over-all performance of the engine using charcoal is considerably better than that using wood because fewer cleanings are necessary and less water is produced.

The loss of power output based upon the heat content of wood gas in comparison to gasoline is about 30 percent. The combustible constituents of the wood gas are 30 percent carbon monoxide and 1 percent methane.

The inconvenience and delay in starting are other objections; when combined with the delays necessitated by cleaning and reduced efficiency, the over-all picture of wood as a motor fuel compared to gasoline does not appear favorable except as necessity demands its use.

If all the wood produced in France yearly were used as a motor fuel, it would displace about 500,000 tons of oil or 10 percent of the Nation's requirement. Should this ever go into effect, there would be no wood left over for other purposes. This conclusion holds in general for other European countries as well.

PRODUCER GAS FROM CHARCOAL AND ANTHRACITE

The gas-producer motor vehicle may operate on brown coal, lignite, anthracite coal, and peat coke alone or mixed with wood or wood charcoal. One taxicab in Paris operates on producer gas from a mixture of 20 percent charcoal and 80 percent anthracite coal. Gasoline was used to warm the motor, and the charcoal-anthracite mixture was ignited from a torch dipped in oil. It actually took about 5 minutes before the taxi was in smooth running order. In general, it has been found that the use of coal gives somewhat more difficulty in operation than dried wood or wood char.

PRODUCER GAS FROM BROWN COAL, LIGNITE, AND LIGNITE BRIQUETS

On account of the high-water content of brown coal and lignite fuels, they should be converted to coke. The resultant cokes are similar to wood charcoal in activity but have considerable ash which gives rise to clinkers. In forming brown coal briquets, tar decomposition is accomplished by precarbonization in order to remove volatile matter.

Coal in general has not met with favor as a producer gas fuel because of its high gasification temperature. Nevertheless, Belgium favors as 80 to 20 mixture of anthracite and charcoal; a lower fuel expense is claimed than when city gas is used. The disadvantages which have halted the use of coal are slag formation, leading to sintering of the ceramic lining of the generators, and discharge of high percentages of sulfur dioxide in the exhaust gases. It was impossible to obtain information as to the number of coal-burning vehicles in Europe.

OIL-SHALE MOTOR FUELS

Oil shale in Europe is found in the following countries: Great Britain, Estonia, Finland, France, Latvia, Sweden, Spain, and Czechoslovakia. The latter countries have little or no commercial production at present. Since these countries have practically no crude oil, the exploitation of the shale deposits has become increasingly important from the economic standpoint. The following table shows the metric tons of shale-motor fuel produced in Europe during 1937:

United Kingdom	26,000
Estonia	7,300
Finland	2,700
France	1,500
Latvia	1,300
Total	38,800

The Scottish oil industry started about 90 years ago to yield products such as motor fuel, kerosene, Diesel oil, wax, and ammonium sulfate. The reserves are estimated at 280,000,000 tons or a potential 6,160,000,000 gallons of oil, assuming 22 gallons of oil per ton of shale. The shale-oil industry antedates the petroleum, and many of the processes developed in this industry were subsequently applied to crude oil. The output of oil shale annually (1937) is approximately 1,400,000 tons from which 100,000 tons of marketable products were obtained. The shale motor fuel industry is protected by an 18-cent tax per Imperial gallon (15 cents per United States gallon) against imported gasoline, but even this protection has not served to stabilize the industry.

Because of the more efficient motors of today, the fuel produced from shale oil has required increased blending with higher octane fuels or cracking to raise the octane rating which in turn increases the cost of production. The motor-fuel yield is at the rate of about 26,000 tons a year. It is estimated that the cost of producing motor fuel from oil shale is about 15 cents per United States gallon.

The Estonian oil shale deposits have been exploited commercially since about 1922 when a fuel shortage made extensive developments desirable. The deposit has a total average thickness of 10 feet and an area of about 965 square miles. The oil shale reserve is estimated at 3,500,000,000 tons with a potential oil production of about 675,000,000 tons. During 1937 about 112,000 tons of shale oil (*8*) were produced from which 14,000 tons of motor fuel were derived. It is estimated that 18,000 tons of motor fuel will be produced during 1938 from 150,000 tons of shale oil.

The oil shale deposits of France are estimated at 21,000,000 tons of workable shale in the Autun region. The shale mined per year is about 120,000 tons with a yield of about 9,000 tons of oil a year. The motor fuel production during 1937 was about 1,500 tons.

Semiscale tests have been carried out in Italy on the shale oil production from the deposits in Ragusa, Frosinone, and Abruzzi. The 1,800,000 estimated tons of shale of this area would probably produce over 100,000 tons of motor fuel; however, to date there has been no commercial production of shale motor fuel.

Sweden has oil shale deposits to the extent of about 5,000,000,000 tons. It is estimated that of this quantity 630,000,000 tons can be mined cheaply in open cuts and converted into 32,000,000 tons of oil. A retorting unit is in operation which processes 75 tons of oil shale a day, producing 3 tons of oil.

At present, competition with petroleum products has made oil shale motor fuel a nationalistic problem.

The following table shows the extra costs of shale gasoline above imported gasoline, in losses in taxes, government subsidies, and production costs for the countries where it was marketed during 1937.

Country	Cost above imported gasoline	Extra cost per metric ton of motor fuel
United Kingdom	$1,309,000	$50.00
Estonia	282,500	37.00
Finland	98,000	36.30
France	105,500	70.00
Latvia	53,500	41.00
Total	1,848,500	

The production and use of shale motor fuel have cost the consumer and governments about 15 cents per United States gallon above that of imported gasoline, owing to losses in taxes.

AMMONIA, HYDROGEN, AND ACETYLENE AS MOTOR FUELS

The desperate desire of nations to make themselves self-sufficient in substitute motor fuels is reflected in the experimental work going on with such substances as ammonia, hydrogen, and acetylene.

Synthetic ammonia has been used in Italy as a motor fuel substitute. The ammonia is cracked into hydrogen and nitrogen by means of a so-called disintegrator (probably catalytic). Vaporization of the liquefied ammonia is accomplished by releasing the pressure in the storage tank and counteracting the refrigerating effect thus encountered, by means of a disintegrator which utilizes the heat from the motor exhaust. In Cherso, Italy, a test using a Fiat passenger car developed 31 miles per hour in a road test. As a motor fuel the low heating value of ammonia (4.450 kilocalories per kilogram) does not lend itself to wide use. The high cost involved in the use of ammonia is another factor retarding its use.

Experiments on acetylene as a fuel indicated that acetylene cannot do the full work of a gasoline engine and that thermal efficiency is highest with dilute air-gas mixtures.

Hydrogen as motor fuel in the form of compressed gas has also been tried. The results so far do not look very promising.

TABLE II.—*European proportions of substitute fuels in 1937* [1]

[Metric tons]

Country	Alcohol	Benzene	Oil from coal and synthetic gasoline	Low-temperature-carbonization gasoline	Shale spirit	Total substitutes	Total light motor fuel consumption	Percent substitutes
Germany	210,000	430,000	800,000	(2)	.....	1,440,000	2,640,000	54.5
Estonia	.....	.....	.....	.....	7,300	7,300	14,300	51.9
Czechoslovakia	50,600	12,000	.....	.....	.....	62,600	220,000	28.5
Lithuania	1,294	.....	.....	.....	.....	1,294	5,700	22.7
Hungary	10,516	3,100	.....	.....	.....	13,616	69,100	19.7
Poland	7,955	10,000	.....	.....	.....	17,955	98,200	18.3
Latvia	2,154	.....	.....	.....	1,300	3,454	19,400	17.8
Yugoslavia	3,806	.....	.....	.....	.....	3,806	30,200	12.6
Belgium	.....	36,700	.....	.....	.....	36,700	408,800	9.0
France	163,400	80,000	13,000	.....	1,500	247,900	2,827,000	8.8
United Kingdom	10,000	230,000	116,000	4,000	20,000	392,000	4,840,000	8.1
Italy	37,000	.....	.....	.....	.....	37,000	483,500	7.7
Austria	2,300	8,200	.....	.....	.....	10,500	146,300	7.2
Sweden	15,247	500	.....	.....	.....	15,747	503,200	3.1
Holland	.....	10,800	.....	.....	.....	10,800	392,600	2.8
Finland	.....	200	.....	.....	2,700	2,900	112,500	2.6
Switzerland	50	3,000	.....	.....	.....	3,050	203,990	1.5
Total	510,322	824,500	929,000	4,000	38,800	2,306,622	12,014,700	17.7

[1] Total European light motor fuel consumption, including countries not enumerated, 14,344,000 metric tons.
[2] Included under synthetic gasoline.

TABLE III.—*Retail prices, import duty, and taxes on motor fuel (22)*

[Cents per United States gallon]

Country	City	Gasoline price	Import duty	Import duty and tax
Italy	Rome	73	49	51
Germany	Berlin	59.6	31	36
Lithuania	Kaunas	63.1	23.2	23.2
Bulgaria	Sofia	50	28	39
Czechoslovakia	Prague	42.4	5	16.1
Palestine	Jerusalem	41.4	20.7	20.7
Yugoslavia	Belgrade	40.9	6.7	23.5
Switzerland	Zurich	28.2	19.2	19.2
Hungary	Budapest	38	8	26
Estonia	Tallinn	38	8.1	1112
Latvia	Riga	37.8	14.4	.2.2
Greece	Athens	37.5	19.9	12.6
United Kingdom	London	36.2	15	15
Blegium	Antwerp	36	20	[1] 20
France	Paris	31.8	18.5	19.5
Norway	Oslo	27.5	None	9.5
Denmark	Copenhagen	26.4	None	11

[1] Plus 9 percent ad valorem.

100 OCTANE FUELS

There are no units operating in Europe at present on substitute fuels to produce 100-octane motor fuel. While there is one plant producing such fuel and several others are under way, the source material is petroleum. However, 100-octane fuel can be produced from Europe's substitutes, providing some of the catalytic processes developed and introduced in the United States are employed. This may be done in one of the following ways:

1. Isomerize the normal butane which they produce from hydrogenation of coal and the water-gas reaction, dehydrogenate and polymerize to isoöctenes and hydrogenate to isoöctanes.

2. Isomerize their normal pentane to isopentane which has an octane rating of 90, whereas the normal has 64. The isopentane, because of its boiling point, will be blended with the isoöctanes and then leaded to 100 octane.

3. Alkylation of normal or isobutylene with isobutane or isopentane.

4. Catalytic cracking process, which is highly selective in the production of high-octane gasoline.

5. Catalytic isomerization and cyclization of gasoline made by Fischer-Tropsch water-gas reaction and hydrogenation of coal.

There is nothing at present to indicate that 100-octane fuel, which has become practically necessary in the operation of military aircraft, can be made from these Ersatz materials by any other methods.

SUMMARY OF SUBSTITUTE MOTOR FUELS *(13)*

The substitutes for petroleum gasoline in Europe in 1937 composed of synthetic gasoline and benzene from coal, alcohol, and oil shale amounted to 203,306,622 tons or 15,250,000 barrels, or about 18 percent of the total gasoline consumption. The tonnage of substitute fuels for each country is shown in table II.

In addition to the liquid substitutes given, two other types are produced from the gases of coal and wood. It is estimated for 1938 that compressed and producer gas from coal and wood will substitute for 243,000 tons of petroleum gasoline or 1,823,000 barrels.

For the year 1938 about 25 percent of the total European requirements for motor fuel will come from substitutes.

IMPORT DUTY, TAXES, AND PRICES

The highest gasoline prices in Europe are in Italy, Germany, and Lithuania and are 76, 63, and 59.6 cents per United States gallon, respectively. The import duty and tax per gallon of gasoline in Italy is 51 cents and for Germany 36 cents. Detailed data are shown in table III.

As a matter of contrast, the average retail price for regular grade gasoline in the United States was 19.5 cents a gallon, of which 5 cents was tax (June 1938).

EXCESS COSTS OF SUBSTITUTE FUELS OVER GASOLINE

For 1937 the extra cost to the consumer and State above the cost of imported gasoline (*24*) and losses in taxes amounted to about $235,000,000, or 32 cents for every gallon of substitute fuel consumed. The monetary losses involved in European countries are given in table IV.

TABLE IV.—*Cost of European substitute fuels at average rates of exchange during 1937 (14)*

Country	Alcohol tax, losses, subsidies, and extra cost to consumer above tax-paid gasoline	Benzene	Synthetic and low-temperature-carbonization gasoline	Shale spirit	Total
Germany	$53,738,000	$33,238,500	$70,952,000	----------	$157,928,500
France	36,634,000	6,564,500	2,523,500	$105,500	45,827,500
United Kingdom	1,538,000	9,660,000	6,039,000	1,309,000	18,546,000
Italy	4,145,500	----------	----------	----------	4,145,500
Czechoslovakia	3,032,500	(1)	----------	----------	3,032,500
Hungary	1,677,500	(1)	----------	----------	1,677,500
Yugoslavia	930,000	----------	----------	----------	930,000
Sweden	829,000	(1)	----------	----------	829,000
Poland	584,000	(1)	----------	----------	584,000
Latvia	367,000	----------	----------	53,500	420,500
Austria	383,500	(1)	----------	----------	383,500
Estonia	----------	----------	----------	282,500	282,500
Lithuania	181,500	----------	----------	----------	181,500
Finland	----------	(1)	----------	98,000	98,000
Total	104,040,500	49,463,000	79,514,500	1,848,500	234,866,500

[1] Not calculated.

There will be an estimated loss of $300,000,000 due to the use of substitute fuels over petroleum gasoline costs (during 1938) to the consumers and governments of Europe.

ACKNOWLEDGMENT

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[From the New York World-Telegram, Tuesday, May 23, 1939]

New French Car Gets 53 Miles to Gallon, Seats Five, and Will Go 93 Miles per Hour

France now has a lightweight motorcar that can do 53 miles to the gallon of gasoline when running at 30 miles per hour, it was reported to the World Automotive Engineering Congress here by French Engineers J. Andreau and Charles B. Brull.

At 50 miles an hour it will get 49 miles to the gallon of fuel and 39 miles to the gallon at 70 miles per hour. Even at speeds of 90 miles an hour it obtains 27 miles to the gallon of fuel.

This car, a streamlined version of the popular Citroen, seats five persons and has a top speed of 93.5 miles an hour. Compared with a stock car having the same motor, the streamliner's performance showed half the gasoline consumption coupled with a 45-percent increase in speed.

Andreau is the designer who turned out the body of the famous "Thunderbolt" of Captain Eyston which holds the world's land speed record of 357.5 miles an hour.

In cars with the new Andreau body the hissing of the wind against the body is completely suppressed, said Mr. Brull, and the driver loses this criterion of speed.

So efficient is the streamlining that the windshield remains completely clear. There is no frontal air pressure upon it to stick mud or insects to the glass panels. Raindrops run from the bottom to the top of the windshield and are instantly scattered so that no wiper is needed.

With this streamlining there is no sidesway due to lateral wind, and the stability is so great that the steering wheel has true fingertip control.

The economies achieved with such streamlining, even at ordinary driving speeds, are the engineer's answer in Europe to the severe taxes on motor fuel and the cars.

The tax collector, Mr. Andreau indicated, is in fact the "chief engineer" of all motor cars in European countries. In France there are 15 taxes to worry the motorcar owner and driver.

Senator HERRING. Thank you. Dr. Christensen, of Miller, Nebr.

STATEMENT OF DR. LEO M. CHRISTENSEN, MILLER, NEBR.

Senator GURNEY. Mr. Chairman, may I make the suggestion to Dr. Christensen that he start off his testimony by letting the committee know what experience he has had in this field, how many years he has been working with it, and his background as an authority?

Senator HERRING. Yes; you may qualify yourself in any way you wish, Doctor.

Dr. CHRISTENSEN. Following Senator Gurney's suggestion I will say that I am associate research director for the National Farm Chemurgic Council at the present time. I have been acquainted with and have followed carefully the developments in the use of power alcohol in all countries of the world during the past 15 years or more, and I became definitely active in finding a sound method for the development of a power alcohol industry in America in 1932, for reasons which are perfectly familiar to everyone, namely, corn selling at 15 cents a bushel and less.

While I was Professor of Chemistry at Iowa State College during 1932, 1933, and 1934, I worked on power alcohol production and utilization. The work which we did, and which others subsequently did, is covered in a series of seven progress reports issued by the Committee on Use of Alcohol in Motor Fuel of Iowa State College. I think perhaps you are familiar with those reports.

The interest in power alcohol became so great all over the Middle West—that is, throughout the agricultural region—by 1935, that it was impossible for us at Ames to keep up with the flow of inquiries for information, and I took advantage of a very fine opportunity to become identified with the Chemical Foundation, a nonprofit organization which had become interested in power alcohol, which allowed me to spend my full time on disseminating true facts and information on alcohol and its applicability in this country.

Senator GURNEY. May I interrupt to possibly put a word in there as to the Chemical Foundation's plan of operation, how the Foundation originated?

Dr. CHRISTENSEN. I would rather, Senator Gurney, that Mr. Buffum might have an opportunity to describe something about the previous activities of the Chemical Foundation and let me confine my remarks to its connection with the activities in power alcohol, otherwise I will certainly be here too long.

Senator HERRING. That is all right.

Dr. CHRISTENSEN. The Chemical Foundation, as I say, permitted me to spend my full time on power alcohol, in research and in disseminating the information and facts which I gained by such research, and that others had gained.

There was a great deal of interest in power alcohol, as I have mentioned. It was necessary to supply all of these interested people with information, to the end that a sound power-alcohol program could be developed in this country. There was no question in the minds of all of the really interested people of the Midwest, people who wanted to see the American farmer put on a sound basis, that power alcohol

had a very important part in the sound agricultural program of this country.

In 1936 the Chemical Foundation determined to establish an answer on a fully commercial and an entirely practical basis for the questions which had been brought up in connection with the establishment of a power-alcohol industry, and to that end furnished funds for revamping an alcohol plant at Atchison, Kans., and furnished technical information, advice, and supervision for the manufacture and distribution of power alcohol at Atchison, Kans.

It was my opportunity to be identified with the project until January 1 of this year; that is, through the experimental phases. That was my particular job, and I stayed with it through that stage.

I was at one time vice president and general manager of the Atchison Agrol Co., and during the last few months of last year was there simply as a consultant. My work in the experimental phases was through on January 1. The purpose of the Atchison Agrol plant I will describe a little bit later.

Now power alcohol is not a new subject for discussion. It has been an active project all over the world for many years. Sweden actively started a power-alcohol program just following the World War, and alcohol blends are sold in Sweden on a perfectly voluntary basis, and it is up to the maximum production of power alcohol within the country since that time.

In England the sale of alcohol blends has been on a voluntary basis until something like a year ago. Alcohol, in common with other fuels produced within England, including gasoline made from coal, such things as that, did not pay the import duty, but beginning about a year ago the alcohol production had become so large that the Government placed a tax on it.

I was surprised to learn just a few moments ago that alcohol did not pay the same tax as imported gasoline. The information I had from a good friend of mine, who has been identified with the power-alcohol industry there, is to the effect that they pay a full tax, that there is no preferential treatment at all. It is interesting to note that the sale of alcohol blends in England has not been slowed down by the imposition of this tax, but has continued to expand.

In the central European countries the use of power alcohol was always on a mandatory basis. The first country to pass such legislation was Germany, and the passage of the legislation followed a program seeking the voluntary establishment and operation of a power alcohol industry. Voluntary cooperation was denied by the gasoline distributors, largely American-owned, and a mandatory law was passed in order to accomplish the desired objective. The same development has taken place in many other central European countries. At the present time there is a power alcohol program in practically every country in the world, sometimes on a mandatory basis, sometimes on a voluntary basis, and sometimes on other bases, depending upon the local conditions.

The two objectives in these programs have been, (1) the benefits to domestic agriculture, and (2) a means for obtaining a greater degree of national self-sufficiency. In some countries one objective is greater and in other countries the reverse may be the case.

In the United States power alcohol has been discussed at three different periods. First in 1906, until 1914, when Dr. Wiley, who

headed the scientific work of the Department of Agriculture, introduced power-alcohol research as one of the first scientific projects of the Department. He was then interested in the fact that certainly power equipment was going to replace the power animal on the American farm, and he saw that there would be a need for finding a market for the products produced on those acres thus made available. The program was stopped in 1914 by the development of the war in Europe, which created a wholly abnormal demand for American farm products and therefore ended the need for a power alcohol program at the moment.

In 1920 the decreased purchase of American farm products by European nations had again brought about the threat of a surplus in this country, an unmarketable overproduction. Again there was an interest in power alcohol. The then Secretary of Agriculture published several editorials about power alcohol and its applicability in this country. There was a great deal of interest throughout the country in getting the power alcohol industry established. It is also interesting to note that one company, the Standard Oil Company of New Jersey, prepared and marketed alcohol blends in Baltimore, in Washington, and I believe in one station in Chicago at that time.

This interest and this one commercial development were stopped in 1924, when we had a drought, and when a renewal of export demand for American farm products produced a high price again not only for corn but also for blackstrap molasses from Cuba, or from any other source. As I recall, corn reached $1.25 a bushel on December 1 that year, and molasses went to 15 cents a gallon. So again the program was delayed. There was no further attention given to it until 1932. In other words, power alcohol always comes to the fore whenever there is a disastrous drop in farm product prices.

The interest of 1932 has continued, as evidenced by this hearing here today.

I would like to sketch very briefly some of the things that happened in the early days with this present program. We at Ames published our results, and otherwise tried to make them available to the public. But we were not the only ones interested in power alcohol. Simultaneously and wholly independently, organizations in Illinois, Indiana, Ohio, Idaho, and several other States were formed and preached, promoted and talked about power alcohol as an aid to American agriculture, as a means of handling these surpluses of farm production of all kinds, particularly the grains, of course.

There was a great deal of argument developed, wholly futile, wholly unnecessary, frequently wholly misleading; argument as to the quality of the blends, as to whether one would give better mileage or poorer mileage, so on and so on.

We at Ames had carried out a very fine research program, but we had discovered nothing particularly new. We had only confirmed the results of the scientific publications of the past 20 years; namely, we had found that alcohol, properly prepared, and gasoline were wholly mixable, could be mixed and would remain homogeneous under conditions of commercial distribution and use. We proved that, but it had already been proven long before we did any work with it.

Second, we found under the conditions under which such blends had usage in commercial application they would yield better mileage than gasoline of equal antiknock rating, on the average 8 percent

better. We found that they would give better acceleration, improved hill-climbing ability, and generally sweeter and more pleasing performance. We found that such blends, properly prepared, could be used interchangeably with gasoline of equal antiknock rating, without any change in carburetor or ignition adjustment, compression ratio, or other engine part.

On the basis of antiknock value of alcohol, which we studied and our results confirm those in the literature, we calculated the value of alcohol in the competitive motor fuel market today at 20 to 25 cents per gallon, exclusive of taxes, depending upon the point of blending. That is, we established this important fact: alcohol is not a substitute for nor a competitor of gasoline but is an ingredient of a superior fuel, a material added to gasoline to raise its antiknock rating and otherwise improve it, thus competing with processes and other materials used to accomplish this purpose.

On the basis of this calculated value of the alcohol we determined that farm products had a value, in the manufacture of alcohol, of from 75 cents to a dollar per hundredweight. I am talking about grains now. Perhaps I should change that to grains. That grains had a value of 75 cents to a dollar per hundredweight, depending upon their character, their quality, their point of manufacture, and other variables. In other words, at practically the level of the average price of grains in the United States during a period of 65 years. As a matter of fact it was our determination that the power-alcohol industry could pay somewhat more than that average price.

As I said, there was a great deal of wholly futile and unnecessary argument about every single phase, technical and economic. and it seemed that nothing could be accomplished until there was some actual commercial distribution. That thought occurred to people like Earl Smith of the Illinois Agricultural Association. In order to prove the marketability of blends the Illinois Agricultural Association during 1933 purchased alcohol from whatever source it could, blended it with gasoline, and sold the blends in its cooperative stations in Illinois. A large volume of blends was sold through these stations, and the station operators distributed questionnaires to the purchasers asking them to report their experiences. I will not bother the committee with a report on these questionnaires, but I shall sum the whole thing up by saying practically everyone who used the blends reported that they gave better mileage, better acceleration, and were generally a very satisfactory fuel, and that they would buy such blends in the event they were offered for sale.

Similar demonstration distributions were carried on by the chambers of commerce in Iowa, at Spencer, at Sheldon, and many other places in Iowa. These experimental distributions were carried out, and always with the same result; namely, fine consumer response and no trouble of any kind.

Actual commercial distribution of the blends was started in 1935 in the Dakotas, Minnesota, northern Iowa, and northern Nebraska. Alcohol was purchased again on the open market, wherever it was available—obviously the only way it could be obtained—was blended with gasoline at bulk stations, or even at service stations, a rather uneconomical method of blending but the only one then available. Blends were sold throughout this area, again with fine consumer response. I cannot give you the figures, but it certainly is safe to say

that the volume of motor fuels distributed by the organization carrying out this activity, The Fair Price Petroleum Co., greatly increased as the result of their offering these blended fuels to the public.

During these demonstrations and this initial commercial distribution there was approximately—and I will have to give it approximately only—there was approximately 3,000,000 gallons of blended fuel sold, without any preferential treatment of any kind whatsoever, purely on a commercial and competitive basis.

But the opponents to power alcohol, while they were willing at that time to modify some of their opposition on the basis of quality of the fuel, still said it could not be made from farm products. It was to answer that question, and to give proof that it could be made from American farm products, to give further proof of the marketability of the blends, that the Chemical Foundation undertook this great enterprise at Atchison, Kans. The plant at Atchison was built during the year 1936, and actually started producing alcohol in commercial amounts in September. On October 2, 1936, the initial shipment was made.

As I say, the two objectives were (1) to prove the marketability of the blends made with alcohol selling at not more than 25 cents per gallon on a purely and wholly competitive basis; (2) to prove that alcohol could be made from American farm products, to sell at a price paying the farmer a fair, decent, and dependable price for the products which he could grow. That was the dual purpose of this experiment—this demonstration; I would rather call it that. But, coincidentally, we expected to and did carry on a great deal of research on the production of and utilization of power alcohol, and we did make a number of improvements in the manufacture and use of that product.

Besides the accomplishments in research I want to point out what we did to answer these two principal questions. First, we made alcohol and sold it into the motor-fuel field and supervised its use in the manufacture of 15,000,000 gallons of blends during a 2½-year period ending January 1. I do not know what has been sold since then. This distribution, this volume can be easily established, if anyone cares to do so, by consultation of the State and Federal records. It is all a matter of official records; 15,000,000 gallons of blends were made and sold into the competitive motor-fuel market, the alcohol selling at 25 cents per gallon.

So far as costs of manufacture are concerned, that can be determined. The records are available. Exclusive of the costs of developing the sales, sales-development costs, and the costs of meeting the apathy, skepticism, and occasional downright vicious opposition, the alcohol could be made at 20 cents per gallon from 50-cent corn, with credit for all byproducts and the plant running at capacity. Those are records that are available.

I want to make it perfectly clear that this cost is based upon these assumptions: (1) Efficient plant management; (2) sound plant design and location; (3) marketing all byproducts in an efficient and economical manner; (4) operating the plant at capacity; (5) use of the most efficient processes; (6) provision of an adequate period, say a few months, in which to get the specific plant into balanced operation.

In other words, all of the claims, all of the findings of the scientific group at Ames were fully confirmed by actual full commercial-scale operation in the production and marketing of the fuel.

Senator HERRING. Dr. Christensen, from your experience and based upon the present market price of gasoline, at what price would you be compelled to buy corn in order to add the appropriate amount of alcohol to gasoline and not increase the cost to the consumer?

Dr. CHRISTENSEN. Alcohol has a value of 20 to 25 cents per gallon. It varies a little bit from one locality to another, naturally. On the basis of a good, sound, and efficient plant, if we neglect unethical opposition—I want to stress that—if we neglect the cost of meeting unethical opposition, then the alcohol plant could afford to pay from 75 cents to $1 per hundredweight for grains. Let us say 50 cents a bushel for corn, perhaps more than that in some locality and perhaps less than that in some other locality, but on the average that would be approximately what it would be.

Senator HERRING. Without any increase in cost to the consumer?

Dr. CHRISTENSEN. Without any increase in cost to the consumer, per gallon. That is, a gallon of the blend would sell at the same price as a gallon of gasoline of equal antiknock rating.

Senator HERRING. What about the mileage?

Dr. CHRISTENSEN. A motorist would get a fuel that would give him better mileage, lower maintenance costs, and in other ways he would benefit from the use of such fuel, as evidenced by the fact that on a voluntary basis 15,000,000 gallons were sold. It is not an academic situation; it has been proven commercially. That is the value which it will bring in the open market, the open competitive market. This is what it has brought, and we felt that that was the only way that the argument, the debate, or quarrels could be answered, was by actually doing it, and it has been done.

The best distributors we have had have been the farmers' stations. The Nebraska Farmers' Union cooperative stations in Nebraska, for example, the farm cooperative stations of Iowa, particularly north-central Iowa, Waterloo, Cedar Rapids, and so on. They have done very well. There are also today a number of independently owned chain stations. One operating in Arkansas, one in Oklahoma, one in Illinois. They have done very well with the distribution of blends with alcohol made from farm products at Atchison.

Thus, as I say, the findings which we secured in our researches at Ames have been fully confirmed in commercial-scale operation. I do not know of anything else that anybody could do to prove it more than that. Solution of all fundamental problems but one is well advanced but much can come from continued research; that, is the research program on power alcohol contemplated in the Regional Research Laboratories of the Department of Agriculture can do a tremendous amount of valuable work, in improving the processes for making the alcohol, and in finding new, more productive, more economical farm crops for this use. The conduct of such a research program is essential to continued advance and improvement, but I want to stress it is not essential for the initiation of the industry, it is already initiated, but it is absolutely essential for the improvement which any industry must make in order to keep abreast of the times and meet competition.

Many of the arguments of the opponents, beginning in 1932 and continuing, and we heard some today, have been based upon the assumption that the use of alcohol in motor fuel would be mandatory, and if we assume now and keep clear in our minds that we are going

to have something other than mandatory legislation, those arguments largely fall down.

Senator HERRING. You would not favor making the use of it mandatory?

Dr. CHRISTENSEN. No; I would not, not on a national basis. In a few States mandatory legislation is practicable.

Senator HERRING. Would you favor encouraging it by incentive tax benefits?

Dr. CHRISTENSEN. Yes. Just as we have encouraged other new industries when they needed help. Thus any arguments about the higher cost of blends, any arguments about making the motorist pay the costs, and so forth, are inapplicable in the present case, because they would only be applicable in the case of mandatory legislation. If people have their choice to use it or not use it they obviously will not use if if it costs them more, and obviously nobody is going to build a plant unless it is reasonable and profitable for him to do so. In other words, it is left on a voluntary basis, and that is the way it should be, on a national basis.

The manufacture of alcohol may be of some little interest. I am going to talk about grains, because they are the largest farm products available for this use. A bushel of corn, for example, will yield from 2¼ to 2½ gallons of ethyl alcohol suitable for motor fuel. Simultaneously it will also yield from 18 to 16 pounds of very high quality protein feed, and from 10 to 12 pounds of dry ice.

Senator GURNEY. Let me interrupt there. That protein feed, what is the value of the protein feed after the alcohol has been made out of the starch?

Dr. CHRISTENSEN. All of the nutrients of the raw material, the minerals and protein are left, only the starch is converted into alcohol. Thus in the ideal set-up the farmer would take the protein feed back to his farm. It would return to the farm all of the minerals, all of the nutrients. It would not remove them from the soil, it would leave them there.

The question arises as to the extent of the market for the feed. I used to be worried about that. Mr. Atwood, the president of the Allied Mills, finally became very provoked about my discussion of that particular problem, because he said there would never be a time when we could produce so much of that protein feed that there would not be a market for it. "Worry about the alcohol sales but don't worry about the feed sales," he said. There is a very large market for the protein. The feeders in this country have to depend to quite a little extent upon importations of feeds in order to meet the feeding requirements. Animal-husbandry people think the American feeder does not feed more than one-fourth to one-third as much protein concentrates he should to produce meat economically and of high quality.

Senator GURNEY. What is the value of this protein feed out of a bushel of grain compared with the bushel of grain before the starch is taken out?

Dr. CHRISTENSEN. The present market for distillers grains is $25.50 a ton in Kansas City. It is a much higher price in the East because of the freight charge. Thus it is worth approximately a cent and a quarter a pound. A bushel of corn yielding 16 pounds would yield 20 cents worth of feed on present market prices. The market for

distillers grains in this country has been improving in recent years because of the growing knowledge of its great value.

I might make this statement about it. It has been found at Iowa State College and at Cornell (Professor Savage did a great deal of work there) that the protein content is complete. It is practically 95 percent digestible or available to the animal, and thus is a very high quality material.

It is interesting to note that the yeast produced in the fermentation of the grain is also recovered. Indeed that is the only sound way to do it, and almost 10 percent of that dry feed is dry yeast. As I recall it, dry yeast is selling in the feed market for almost $240 a ton, so you can see there is a great deal of value in that. The feed does sell very well. For example, in the feeding experiments at Iowa State College a year and a half ago steers fed with distiller's dry grains made from corn graded higher than steers fed with the same ration but with linseed oil-cake meal instead of the distiller's grains, and the profit per steer fed was $8.35 greater when distiller's grains were used as the protein supplement than when linseed oil-cake meal was used.

There are some very interesting developments in protein supplements. As I say, we are not self-sufficient in our protein requirement in this country; we have to import. Our domestic production of protein concentrates has declined and is bound further to decline as the result of the decrease in cotton production, so there is a great need for an increase in domestic production of protein concentrates.

So far as dry ice is concerned, there has been a great deal said about the huge potential market for it. It is only necessary to point out the great applicability which this material has in transportation refrigerators. It has been estimated by some authorities that if the railroads used dry ice for refrigeration that their pay load per car could be increased by 50 percent. But the dry ice is not available uniformly, so it seems to be impossible for them to use it now. It won't be possible to do that until we get production over a wide area, which of course the power alcohol development will provide.

As to other grains, wheat will yield more alcohol and more dry feed than corn. Grain sorghums will yield about the same. In all of the Great Plains States the tremendously increasing acreage of sorghums provides a wonderful opportunity for the development of the power alcohol industry in that area. The grain sorghums are replacing corn, replacing wheat, and giving the farmers very, very much more dependable and far greater income per acre.

A startling comparison might be cited. Last year in the upland nonirrigated sections of Nebraska where corn yielded from nothing to 5 bushels per acre, the grain sorghums yielded from 20 to 30 bushels per acre, with no more cost per acre, in fact less cost than of growing corn. The acreage this year in Nebraska will be more than two times the acreage of last year.

Thus there is no question about the fact that the farmers can raise the raw materials. The raw materials that any plant would use is the crop which can be produced most economically, most dependably, and most efficiently in the area surrounding the plant. How far would a plant reach out to draw out this material? There is no general rule. It depends on the local conditions. Certainly the production of raw material would be near the plant, and that is as it should be, and in the ideal relationship those farmers that raised the grain, brought it

to the plant, would take home, on a purchase or barter basis, whichever seemed desirable, the protein feed also produced at the plant, in order to improve their feeding operations to produce meat and dairy products more efficiently and more economically.

In the case of the Atchison plant, for example, the farmers within the area from which raw materials would naturally be drawn are now consuming more protein concentrates than the plant would produce per day. So that there is plenty of market for it. But in each case, in each installation, naturally that market must be studied, and naturally conditions vary. In locating a plant that is one of the factors that must be given very good consideration.

Now so far as the formulation of the blends is concerned, there is no need to go into all the details. To do so will take a great deal of time. With the alcohol produced at Atchison we developed blends in various localities, made at several refineries. We had four refineries blending in Kansas, and in each case the blend was developed around the basis of the special type of gasoline available. There are lots of kinds of blends, just as there are lots of kinds of gasoline. In general, however, the alcohol content of around 10 percent was most desirable. It might be used alone with 90-percent gasoline, or it might be used in connection with benzol, or it might be used in connection with tetraethyl lead. The matter of preparing blends, formulating them to produce the desirable results which blends can yield, is a matter that any refiner can handle. He has the facilities and he either has or he can easily get the knowledge necessary to do a considerably better job of blending than we were ever able to do, because, after all, we did not have the control of the manufacture of gasoline which we had to use. Where the refiner can control the quality he can do a better job, and a more efficient and economical a job than we could do. There is no problem in that connection. Any refiner who wants to do it can easily do a fine job.

Now the problems that we encountered in power alcohol I want to mention just briefly. The first one was denaturization. The alcohol marketed had to be so denatured that it contained no ingredient harmful to motors and at the same time so denatured that the bootlegger would not sell it into the tax-paid field. With the very fine cooperation of the Alcohol Tax Unit, such a formula was developed and has been used. Undoubtedly it will be improved. We would be very disappointed if it were not. However, there is a satisfactory formula, it has been used, and there is no record any place that any of this alcohol has ever been diverted into tax-paid fields.

Another problem which we had to consider was raw material procurement. An alcohol plant has to sell its output into markets of rather fixed prices. I do not mean that there is price fixing, I mean the price is stable, at least it is stable as compared with farm-product prices. Since about 80 percent of the cost of the alcohol is chargeable to raw material, it is obvious that raw material price fluctuations would produce a tremendous effect upon the cost of the finished alcohol. Thus it is necessary for a plant to have a stable supply of raw material. It must be stable in quality, in price, and in volume of supply.

There are a number of methods by which such a procurement program can be developed. Each plant has to face its own procurement problem, and each plant has to effect its own procurement program, yet the methods of procedure have been well established. Thus, in

the case of grain sorghums, for example, the best method found has been contract, an arrangement by which the farmer would contract to grow so many acres and the plant would contract to buy the output of so many acres at a stated price, stated time of delivery, and so on. That is very, very satisfactory to the producer and consumer alike, that is, to the farmer and alcohol manufacturer.

In the case of other farm products other methods can and have been used, and there is no problem there except the problem of developing a program for each installation, and it takes only good, sound business sense, a knowledge of farming and a knowledge of alcohol manufacturing to do that job.

Problem number 3: Developing markets, and that is the unsolved problem which I mentioned a moment ago. I can state it all rather simply, I think, in this way: The blends that are sold, let us say, contain 10 percent of alcohol and 90 percent of gasoline; until now the alcohol manufacturer has had to pay the cost of developing the market, servicing the market, and so on, for that merchandise of which his own product constitutes only 10 percent. It would be analogous to the tire manufacturer carrying the cost of selling automobiles in order to find a market for his tires, and it is not difficult to imagine the situation which the alcohol manufacturer therefore has to face. Thus, if it costs 1 cent per gallon of blend for initial sales development expense, sales service, advertising, and all that sort of thing, which is not an excessive figure in the motor-fuel market, according to the information which refiners have given me, that cost would be 10 cents a gallon on alcohol, and carried back to corn, would be from 22 to 25 cents per bushel of corn. You can see the simple arithmetical relationship which creates that problem. Incidentally, it is interesting to note how the tax exemption comes into it, 1 cent a gallon on 10-percent blend or 7-percent blend offsets the cost of sales development, and therefore takes care of the solution of that one remaining problem.

Now yesterday one of the gentlemen mentioned a figure of 28 cents per bushel of corn would be competitive in the manufacture of power alcohol, and I want to stress that I know a great deal about the development of that 28-cent figure and want to point out that that calculation allows for the sales-development expenses, at least in large part, and it does not include any tax differential, or any benefits of any other kind. Let us just assume that that 28-cent figure is correct, since, after all, it was accepted in the conference as a figure. If the Federal tax were exempted on the 7-percent-alcohol blend the corn would be worth 61.7 cents a bushel. That is the value of the 28-cent-plus-the-tax-exemption tax exemption. If the exemption is applied to the 10-percent blend the corn becomes worth 51.6, with 28-cent plus the value of the tax exemption.

Now certainly these high sales development costs will not always continue. That is a thing that always attaches to a new industry. It certainly will decrease in time. Thus it is easy to see that the price the manufacturer can pay for corn or for other farm products would certainly be within the range and perhaps above the level that the farmer used to get for his farm products.

Now as I view the tax differential plan which you have considered and are considering, it seems to me that we can analyze it in this way: If the plan succeeds, that is, if granting the tax exemption will bring into existence the power alcohol industry to produce sufficient alcohol

for a national 10-percent blend, there would be produced a new and profitable use for the products of 30,000,000 acres or more of American farm land, new and profitable employment for 1,000,000 men directly, and several times as many, undoubtedly, indirectly, taking the Department of Agriculture and Department of Commerce figures, a new and needed supply of protein feed.

Incidentally, I was interested in yesterday's testimony, in a remark that there was difficulty in selling the soybean oil cake meal from the soybean oil plants in Iowa. That is not in agreement with the information I had. The plant at Fort Dodge, with which you are undoubtedly familiar, Senator, has been producing soybean oil and oil cake meal for some little while, and the manager of that plant wrote me a little while ago and asked if I could tell him where he could buy more protein concentrate.

As another benefit we would have a new supply of dry ice; a better transportation refrigerant would be provided. We will have the basis for other industrial developments on power alcohol which might completely overshadow the use of it in motor fuel.

It seems to me that the only cost is the loss of tax revenue, and that would be more than offset by the benefits to the farmer and to labor.

The other alternative is that the plan would fail; that there would be no power alcohol industry established as the result of the passage of this legislation. If that should happen then there would be no change in the present situation; no one hurt and no one helped, we would be just where we are now, and no one has had to pay out any money either. Under the plan no one has to make alcohol, no one has to invest money in plants, no one has to blend, no one has to sell blends, no one has to use blends, but we, who have been in the industry, know that all will be done. On how large a scale I do not want to predict, but it will be done.

Now there were some questions asked. I am sorry Senator Clark isn't here. He asked about the Cuban blackstrap molasses. I want to point out that in all the countries selling us sugar, there is enough molasses produced to make 200,000,000 gallons of alcohol. It would be enough for a 1 percent national blend, or 0.1 of what you are thinking about today. Probably not more than half of that is now available to the United States because of the local development in those countries of power alcohol industries using that molasses. So that is a problem which automatically takes care of itself.

Now insofar as the administration of the law is concerned, I want to point out that Nebraska has a tax-exemption law. The alcohol produced from American farm products does not pay the State motor-vehicle tax in Nebraska. The law has been in effect since 1935. The administration is very simple. The people who are administering it have told me time after time, and I work very close with them, that they are very happy about it, very satisfied with it. While it seemed at first that there might be some problems, there have not been any. It is very simple.

The findings of the tests supervised and conducted by the American Automobile Association contest board were carried out by the National Bureau of Standards. Dr. Oscar C. Bridgeman who was in charge of a large part of the work, a member of the Bureau of Standards staff,

repudiated all of the technical findings from that test before a meeting of the American Chemical Society at Kansas City in April 1936. He said that due to certain errors in formulating the tests that they were of no value at all.

I want to mention that the Chemical Foundation's purpose in taking out these patents which have been mentioned only just recently was not to secure a large revenue. I want to stress the fact that the Chemical Foundation is a nonprofit organization and could not make a great deal of money. The money it made would have to be used for research and education. The purpose of the Chemical Foundation in taking out the patents was to furnish a basis by which the power alcohol industry could be carried on in a sound manner, and not to make money for itself, and that nonexclusive licenses were expected to be issued under these patents and that thereby the industry could be controlled and guided by a very high type altruistic organization on a sound basis.

I would like to mention one other fact. Every now and then somebody brings up the matter of the failure of the French plan for using power alcohol, and I want to mention that France is the one country in the world in which power alcohol has not worked well simply because it has been on a mandatory basis; it has not been based on a sound technical basis at all. They had sometimes a law requiring 50-percent blends, and at other times none. It has been an unsound law; power alcohol has not been unsound.

I have taken a great deal of time, Mr. Chairman.

Senator HERRING. Will you be available tomorrow morning?

Dr. CHRISTENSEN. Yes; indeed.

Senator HERRING. Senator Connally had some questions which he wished to propound to you. He is not here now. If you will be here tomorrow we will appreciate it.

We will recess until 10:30 tomorrow morning.

(Whereupon, at the hour of 12:05 p. m. the hearing was recessed until 10:30 a. m. of the following day, Thursday, May 25, 1939.)

USE OF ALCOHOL FROM FARM PRODUCTS IN MOTOR FUEL

THURSDAY, MAY 25, 1939

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON FINANCE,
Washington, D. C.

The subcommittee met, pursuant to recess, at 10:30 a. m., in the Finance Committee rooms, 312 Senate Office Building, Senator Bennett Champ Clark (chairman) presiding. Also present, Senator Gurney of South Dakota.

Senator CLARK. The committee will be in order. Dr. Christensen, we have some questions we would like to ask of you.

STATEMENT OF DR. LEO M. CHRISTENSEN—Resumed

Senator CLARK. Doctor, here are some questions that were left by Senator Connally, which he requested to be propounded.

"I have heard a good deal about an experimental alcohol plant that was subsidized in various manners by the Chemical Foundation at Atchison, Kans. There has been some talk that it sold alcohol at a profit at 25 cents a gallon. Is it not a fact that the plant is shut down at present and is practically bankrupt?"

Dr. CHRISTENSEN. To understand the situation at Atchison it would be necessary to describe the Chemical Foundations' interest in it, and the reasons for undertaking the project.

Senator CLARK. Just proceed in any way you see fit. That is Senator Connally's question.

Dr. CHRISTENSEN. Thank you. As I pointed out yesterday, the Chemical Foundation had tried, during 1934, and 1935 in particular, to secure sane and sound consideration of power alcohol as it could fit into the American economy, and particularly as it would benefit the American farmer, but a great deal of bitter controversy had developed purely—a great deal of it, at least—on unsound grounds, wholly unnecessary, and the Foundation decided that the best way to clear the atmosphere and get a sound basis for consideration of the project would be to get an actual commercial installation going somewhere. The Chemical Foundation is not a business organization; it is a research and educational organization operated not for profit. Its status, of course, has been well established and is known to most people in governmental activities today. Through the opportunity that was created by the fact that there was an alcohol plant at Atchison, Kans., the Chemical Foundation was able to secure such commercial demonstration. The Chemical Foundation loaned money to what is now the Atchison Agrol Co.

Senator CLARK. The Atchison what?

Dr. CHRISTENSEN. The Atchison Agrol Co. There has been no subsidy. The Atchison Agrol Co. got its funds from the Foundation in the usual way, by borrowing, secured by notes, or by stock transfer. There has been no subsidy of any kind from any source.

The plant was remodeled during 1936, to put it in better condition than it had been, and it went into production, the first shipment being made on October 2, 1936. The plant operated as a research and demonstration plant; primarily it was research during 1936 and 1937.

Although we used, on a commercial scale, some 11 or 12 different American farm products, to find out how to process them, the yields of alcohol, the yields of byproducts; in other words, to find out the cost in making the alcohol from them.

A little over a year ago, in January 1938, we started out to develop the markets to a little larger extent than we had, and built up the markets by May 1938, a year ago, to 30 percent of the plant's capacity. Sales were increasing very rapidly every month, sometimes double and sometimes more than double from one month to the next.

The Atchison Agrol Co. was carrying forth this activity purely on the basis of a private corporation operated for profit. It was making a profit, or at least was not facing any loss a year ago, and then disaster struck it in the form of a false—and I think malicious—rumor which spread all over the territory which it was serving, to the effect that the alcohol it was making was made from blackstrap molasses, and the impression was it was imported. Since most of the distributors to which the Agrol Co. sold alcohol were farmer cooperative stations, and the stations were certainly interested in the American farmer, you can easily visualize what happened. Sales dropped very, very rapidly, and all of the capital of the Atchison Agrol Co. was used up, all of its available cash reserves were used up, in overcoming the damage which resulted from that rumor.

Its financial condition today is this: It is not bankrupt. That is the ruling by the man who is in charge of bankruptcy proceedings in Kansas. It is a wholly solvent org nization today, but it lacks working capital. It used all of its available cash in fighting this false and malicious rumor that went through the whole territory last summer.

Senator CONNALLY. May I ask a question?

Senator CLARK. Certainly.

Senator CONNALLY. You say you spent all the money in fighting the rumor. In what way did you fight it?

Dr. CHRISTENSEN. Through advertising; through sending people all over the territory to explain the true facts of the situation; through personal contact with distributors and consumers, the only way that it could be done. All this cost a lot of money, directly and indirectly, because, of course, the indirect charge is frequently greater than the direct one, in this way: The fact that the plant is forced to operate on a smaller than its capacity operation greatly increases the cost of production.

That is the position of the Atchison Agrol Co., very briefly. That is how it got into it. Frankly, it is lacking working capital to bring its plant into production again. It takes some money to open a plant and to produce, and it lacks it; it needs working capital.

I might point out that the remodeling that was started in 1936 was not fully completed. The plant was really an experimental plant. There are certain items, certain units, in the plant that we left in the old form, unremodeled, in poor condition, because we did not know exactly what we wanted to make of them. It would be necessary, before the plant could produce in the efficient and economical manner that we would like to have it, to put in some additional units and better equipment in the plant, but that is relatively a small matter. It is working capital that it lacks. I would be glad to elaborate on that, Senator Connally, if you like.

Senator CONNALLY. At what price did you produce this alcohol commercially?

Dr. CHRISTENSEN. The most recent carefuly controlled test run to determine the actual cost of production was in October 1938.

Senator CONNALLY. That was when you were operating?

Dr. CHRISTENSEN. That was the last operation of the plant. We made a special test run for some outside observers who came there to find out what it did cost to make alcohol at this particular plant. They had a man there who did nothing but follow every item of expenditure and every bit of the operation of the plant. On the basis of his careful analysis and his report, the alcohol was made during that 20-day run—making a correction for the fact that the feed market could not be developed during that short space of time—in other words, making a correction for the marketing of the feed—and applying a credit for the dry ice which was not produced, but could have been produced from the waste carbon dioxide which was thrown away—with those corrections made, very simple and reliable corrections, the alcohol was made for approximately 20 cents a gallon, with raw materials aggregating about 50 cents a bushel of corn, or the equivalent of that; that is, approximately 85 to 90 cents a hundredweight.

Senator CONNALLY. When you were in business what were you selling the alcohol at?

Dr. CHRISTENSEN. 25 cents a gallon.

Senator CONNALLY. 25 cents a gallon?

Dr. CHRISTENSEN. Yes. If an elimination of the costs of meeting opposition and the costs of developing markets were made, that is a level which would have yielded the plant a profit.

Senator CONNALLY. At 25 cents a gallon?

Dr. CHRISTENSEN. Yes.

Senator CONNALLY. What is the wholesale price of gasoline today?

Dr. CHRISTENSEN. There are all kinds of gasoline. They vary in price.

Senator CONNALLY. Well, take the best gasoline, at wholesale.

Dr. CHRISTENSEN. The refinery price will vary from a shade over 3 cents a gallon to a little over 6 cents a gallon.

Senator CONNALLY. Do the motorists save any money by mixing 5-cent gasoline with 25-cent alcohol?

Dr. CHRISTENSEN. That is right.

Senator CONNALLY. Why isn't it being done now?

Dr. CHRISTENSEN. There have been 15,000,000 gallons of blend sold in the past two and a half years. In three and a half years there has been about 18,000,000 gallons of blend sold on a competitive basis.

The prices charged for the blends vary, of course, as much as a cent a gallon. The alcohol is not a substitute for gasoline and does not have to compete with gasoline in price. It is an antiknock agent or material added to gasoline to improve its quality.

Senator CONNALLY. You say you can take a barrel of this gasoline and put this alcohol in and make a blend of it?

Dr. CHRISTENSEN. Roughly speaking; yes.

Senator CONNALLY. If you used only 10 percent of the alcohol, 0.1 of a gallon would cost two and a half cents?

Dr. CHRISTENSEN. Yes.

Senator CONNALLY. Now you put that into gasoline being worth three and a half cents, so the one-tenth would cost almost as much as the other nine-tenths, would it not?

Dr. CHRISTENSEN. That is almost right; but you see, the value of alcohol is determined not by the price of gasoline but by the difference in price between the several grades of gasoline.

Senator CONNALLY. Why don't they do it now? If this is cheaper and makes a better product, why don't they do it without a law making them do it?

Dr. CHRISTENSEN. You mean the present gasoline manufacturers and distributors, perhaps?

Senator CONNALLY. Yes. You could go out in the market, could you not, and buy the cheap gasoline and put your alcohol into it and sell it?

Dr. CHRISTENSEN. That is exactly what has been done.

Senator CONNALLY. All right. You went busted, didn't you?

Dr. CHRISTENSEN. No; I wouldn't say we went "busted." We can't meet the opposition that we have.

Senator CONNALLY. Exactly. That is just what I was trying to find out.

Dr. CHRISTENSEN. Here is the situation financially: The alcohol manufacturer has had to sell, in effect, a piece of merchandise in which his own product constituted only 10 percent of the total, therefore the total cost of selling that particular merchandise has had to be charged to the product constituting only 10 percent of the total, which makes an unsound situation.

Senator CONNALLY. The filling-station man would not charge any more, would he?

Dr. CHRISTENSEN. If I were going to go into blending I would have to buy gasoline. If I am an alcohol producer and wish to sell a blend, I would have to buy the gasoline; I would have to pay the same for that gasoline exactly as the man to whom I sell the blend. I have no profit in handling the gasoline. I have to push through 9 gallons of gasoline for every gallon of alcohol through all my organization. I have no profit for handling it—no margin of profit at all.

Senator CONNALLY. If we pass this bill you would still do it the same way?

Dr. CHRISTENSEN. The better method of blending is for the producer of gasoline to buy the alcohol and blend it and sell the blend, rather than have the producer of alcohol buy the gasoline and make the blend.

Senator CONNALLY. The producer of gasoline can buy it now and blend it, if he wants to, can he not?

Dr. CHRISTENSEN. Yes; and four refineries in Kansas are doing that.

Senator CONNALLY. You say four refineries in Kansas are doing that?

Dr. CHRISTENSEN. Yes.

Senator CONNALLY. You want a law to make the rest of them do it?

Dr. CHRISTENSEN. No; we do not want a law to make the rest of them do it.

Senator CONNALLY. That is what this is.

Dr. CHRISTENSEN. I don't look at it that way. I say this proposed law offers an inducement for them to do it, but does not force them to do it.

Senator CONNALLY. How much do you figure the loss to the Government would be by this bill?

Dr. CHRISTENSEN. It depends, of course, on how large the industry becomes. I think Mr. Wilken pointed out that the total loss of revenue would be $250,000,000 if all of the gasoline sold were 10 percent blend, which of course would be done in time, but it would be hard to get that much alcohol in production in the near future. Perhaps in 5 years it would reach that point.

Senator CONNALLY. Would not the corn producer be better off to just take that bounty instead of fooling with this?

Dr. CHRISTENSEN. No. This plan costs a great deal less than present subsidies to farmers, per bushel of grain affected, but yields him more. In addition, the improvement in employment must be considered. The best proof, I think, of the marketability of the blends, the best proof that people will buy it, is the fact that they have bought more than 15,000,000 gallons during the past two and a half years on a purely voluntary basis, with no help, no encouragement of any kind, and it has been sold, as I say, on a competitive basis. The motorists who use it say they like it because it gives them better mileage, it gives them better performance, and generally more economic operation of their car, their truck, or their tractor. So that the whole problem, as we have found it, in power alcohol is the fact that the alcohol manufacturer has had so far to bear the cost of selling this merchandise, of which his own product constitutes only 10 percent. As I said yesterday, it is analogous to a condition in which the tire manufacturer might have to bear the cost of selling automobiles in order to find a market for his tires. It puts him in a very, very bad situation. He would have to have a very large margin of profit in order to be able to carry on that type of sales activity.

Senator CONNALLY. Of course, the big item of your cost in making this alcohol is the farm products that you use. When they are high you would not make as much profit, would you?

Dr. CHRISTENSEN. Probably not.

Senator CONNALLY. Competition would be more severe and you would not sell as much gasoline.

Dr. CHRISTENSEN. Probably that is right.

Senator CONNALLY. So your prosperity depends on keeping the farm prices low.

Dr. CHRISTENSEN. No; it does not, because certainly the farmers are not going to buy this material, certainly it is not going to sell well if farm purchasing power is low.

Senator CONNALLY. Exactly. You are not going to pay the farmer any more than you will have to, are you?

Dr. CHRISTENSEN. The best way of raw-material procurement that we have had anything to do with, or have seen or heard of—and it is particularly applicable in the Great Plains States, from Texas north—is the purchase of the raw materials on the contract basis. The best farm product, the best raw material, so far, has been the grain sorghum.

Senator CLARK. Has been what, Doctor?

Dr. CHRISTENSEN. Grain sorghum.

Senator CONNALLY. You buy that as cheaply as you can, don't you?

Dr. CHRISTENSEN. We contract for it on an annual basis.

Senator CONNALLY. When you contract with them on an annual basis do you give them a bonus?

Dr. CHRISTENSEN. The contract that has been in operation at Atchison was devised by a committee of 3 county agents and 12 farmers, and the company there accepted the contract because it was favorable and entirely satisfactory. The price basis was 80 to 85 cents per hundredweight on kaffirs, delivered at the plant, 80 cents for a 1-year contract and 85 cents for a 3-year contract.

Senator CONNALLY. When was that contract in operation?

Dr. CHRISTENSEN. That contract was in operation last year.

Senator CONNALLY. That is the year you went broke?

Dr. CHRISTENSEN. The company is not insolvent.

Senator CONNALLY. You are not doing business, are you?

Dr. CHRISTENSEN. Yes; the company is still selling alcohol. It is not, however, making alcohol at the moment, because the plant has been shut down, but it has been selling alcohol out of stock and out of purchases in the open market.

Senator CONNALLY. Have you any statistics as to the amount of grains that are now being used for manufacturing beverage alcohol?

Dr. CHRISTENSEN. I haven't any recent figures in my mind. I can get them very easily.

Senator CONNALLY. It is quite a large volume, isn't it?

Dr. CHRISTENSEN. Yes; it represents a large volume. It is mainly corn, rye, and barley, of course. But the factory, wherever it is built and however it operates, would have to have a raw-material procurement program satisfactory to the farmers, or it is not going to have their cooperation. It would be just committing suicide if they tried to cheat the farmers out of their just income.

Senator CONNALLY. Nobody said anything about cheating. You are not going to pay any more than you have to, of course.

Dr. CHRISTENSEN. Well, so long as the Chemical Foundation has to do with the policies of the power-alcohol industry, it is the objective of the Chemical Foundation to see to it that the farm-factory relationship is on an entirely sound basis; that is, the farmers receive fair and just prices for their products. I could point out about 2,000 farmers who last year received more for their grain sorghums sold to the alcohol plant than they could have gotten on the open market by quite a little bit; a great deal more.

Senator CONNALLY. That is because the price went up after the contract was made?

Dr. CHRISTENSEN. The market price went down very badly.

Senator CONNALLY. I mean it went down after the contract was made.

Dr. CHRISTENSEN. The company lived up to the contract and paid the contract price.

Senator CONNALLY. Certainly. You had to.

Senator CAPPER. What company is that?

Dr. CHRISTENSEN. This was the the Atchison Agrol Co., at Atchison, Kans. The situation, I think, is analogous to that in the beet-sugar industry, by which the beet-sugar manufacturer contracts with the farmers for the cultivation and production of sugar beets for his use. There have been some troubles, of course, but in general the relationship between the beet-sugar manufacturer and sugar-beet grower have been on a very satisfactory basis, I think, and in the areas where sugar beets are the main crop the farmers who are growing them profited by their cultivation. The beet-sugar manufacturer has realized he will not prosper, he will not succeed, if the farmers with whom he is working in the cooperative set-up cannot also make a decent profit.

Senator CONNALLY. Over how big a territory did your company buy these grain products?

Dr. CHRISTENSEN. As near the plant as possible.

Senator CONNALLY. Of course.

Dr. CHRISTENSEN. There were about 1,000 acres of raw materials grown for the plant in Nebraska on a demonstration arrangement; but, in general, the plant purchase its raw materials within a range of 50 to 75 miles of the plant.

Senator CONNALLY. Don't the freight rates ruin the company?

Dr. CHRISTENSEN. They do not necessarily ruin the company, but they do take away from the profit which the farmer and the plant together or separately would receive. Naturally it is not an efficient thing to transport farm products any further than is absolutely necessary. There is a return-haul proposition in this in the fact that we have always felt that the farmer who grew the raw material should also take back his pro rata share of the very high quality protein concentrate that comes out of the plant as a byproduct, in order to maintain his soil fertility and build up a sound feeding program. Of course, that haul-back is also important in keeping the producer and the alcohol plant near each other. It is just a matter of efficiency, that is all.

Senator CLARK. Are there any further questions, Senator Connally?

Senator CONNALLY. How much was the capital of that company to start with.

Dr. CHRISTENSEN. That is a rather difficult question to answer, because, after all, this was a remodeled old plant. The Atchison Agrol Co., a Kansas corporation, is about 35 years old, so it was not a brand-new enterprise. I do not know whether I can answer that question very specifically or not. There is approximately $300,000 invested in the plant in physical equipment. There has been approximately $100,000 of working capital, so far as the alcohol plant has been concerned.

Senator CONNALLY. You mean $100,000 in addition to the $300,000?

Dr. CHRISTENSEN. $100,000 in addition to the $300,000, yes.

Senator CONNALLY. What was the capital of your company?

Dr. CHRISTENSEN. The company is capitalized at $755,000. That is its authorized total stock issue. Of course that goes back and includes the old activities of the company as a farm implement manufacturer, and so on, back about 35 years. So that it is a rather

complicated picture, so far as the corporate financial structure is concerned.

Senator CONNALLY. You say you have got a capital of $755,000?

Dr. CHRISTENSEN. Yes.

Senator CONNALLY. And you had $400,000 worth of Property?

Dr. CHRISTENSEN. In the alcohol end of it alone. There is also a farm implement industry that is involved, that is in the same corporation. Now, as I say, that is an old plant. It has a long, long history. Its financial history is also represented in the $755,000.

Senator CONNALLY. If the referee in bankruptcy, or somebody who had charge of the bankruptcy matter, wanted to make an investigation to find out what the value of the assets was, what would he find as the value of the physical property?

Dr. CHRISTENSEN. I do not have the full details of that. The financial part of the management was not in my hands. All I can say is what he told me. He made a survey and investigation and he told me that the company was not bankrupt was not insolvent, because its assets are a great deal more than the liabilities. That is as far as I can tell you, Senator. I am sorry I do not have that data. I can get them for you, but I do not have them with me.

Senator CONNALLY. Are you still connected with the company?

Dr. CHRISTENSEN. No, I am not connected with the company. I have not had any connection with it since the research and demonstrational part of it was at an end. That was my job, and when it was finished, of course my work with it was completed.

Senator CONNALLY. Whom are you connected with?

Dr. CHRISTENSEN. I am connected with the National Farm Chemurgic Council as associate research director. My interest, my job and duties were not in the commercial operation of the plant but rather the construction of the plant, placing it into operation and conducting the research, which we did for about some 2 or 2½ years.

Senator CONNALLY. All right; that is all.

Senator CLARK. Doctor, you may have testified to this yesterday in my absence, but before I left yesterday there was testimony by a treasury official to the effect that this alcohol and gasoline could be separated by the simple addition of water, so that the bootlegger could draw off the alcohol from the bottom of the container or tank, or whatever it might be, and by very simple processes redistill it and use it for alcohol. Will you tell us what your experience was in the way of denaturing this alcohol at your plant to make that sort of business impossible?

Dr. CHRISTENSEN. The establishment of a satisfactory denaturing formula was the first really tough job that we had, and I want to point out at the outset that in the development of the formula which has been used subsequently the finest possible cooperation was had from the Alcohol Tax Unit of the Bureau of Internal Revenue. The problem, of course, was this: We had to have a formula in which there was no danger of this sort of thing happening. Then we had to have a formula in which there were no ingredients which would be harmful in any way to the engines in which the fuel was used; in other words, that were perfectly acceptable motor fuel ingredients. That dual objective was realized, so far as we can find out. When I say "we" I mean the manufacturing company, the Alcohol Tax Unit representatives, the inspectors, and other interested people.

There has been no illegal diversion of the alcohol as far as any of the above have determined. It has been satisfactorily denatured, so that that has not happened.

As I pointed out yesterday, the denaturing formula at present in use will undoubtedly be improved as time goes on. We would naturally except that such improvement should be made, and this should be written down as one of the objectives in carrying on research. For example, in the regional research laboratories of the Department of Agriculture in the manufacturing companies and other interested organizations, that is just a matter of good, sound, ordinary, and normal technical attention, to prevent that sort of thing happening.

I do not think there are any unusual problems. It is not a problem; it is a job; it is something that we all have to give attention to.

Senator CLARK. Was that a secret formula?

Dr. CHRISTENSEN. No.

Senator CLARK. Is that a patented formula, or one that would be available to the whole trade?

Dr. CHRISTENSEN. I would say now that the formula is available to whomever wants to use it. He has to satisfy certain requirements, of course, of the Alcohol Tax Unit, but beyond that the formula is available.

Senator CLARK. Senator Capper, do you have any questions?

Senator CAPPER. No.

Dr. CHRISTENSEN. You asked yesterday, Senator Clark, about the matter of blackstrap molasses, and I think I supplied the information you might have wanted in that connection.

Senator CLARK. Doctor, I would be glad to have you give it to me again.

Dr. CHRISTENSEN. I pointed out the limited supply of blackstrap, the blackstrap molasses production in the countries from whom we buy sugar. Those are the ones that normally would supply the blackstrap molasses. They could supply us with enough molasses to make 200,000,000 gallons of alcohol per year, or enough for a national 1-percent blend. Yet all of that molasses could not be brought to this country. I estimated half of it could. Brazil, for example, has just recently instituted a power-alcohol program designed to consume practically all of the molasses obtained in her production right at home, and the other countries producing the molasses would do the same thing, on the basis of improving their national economy.

Senator CLARK. But you can use 100-percent alcohol as a motor fuel, can't you?

Dr. CHRISTENSEN. That is what a lot of the countries are doing.

Senator CLARK. I know when I was in the Philippines some years ago I saw all the motors of the big sugar refinery, the railroad and motor cars, the motor cars on the railroad, operated exclusively by alcohol.

Dr. CHRISTENSEN. And the engines and locomotives are both made in this country.

Senator CLARK. Senator Connally, is there anything else?

Senator CONNALLY. Do you know Mr. John Orr Young?

Dr. CHRISTENSEN. Yes; I know Mr. Young. I was associated with him.

Senator CONNALLY. Do you know anything about a statement, when he resigned as president of your plant, that he said:

The plant has never demonstrated it could produce from grain a sufficiently low-priced product for a profitable business?

Dr. CHRISTENSEN. Yes; I know something of that statement, and what he had in mind. I know, because he told it to me himself.

Senator CONNALLY. Wait a minute now. I asked you if you knew he made that statement. Did he make that statement?

Dr. CHRISTENSEN. I would not say that that is the exact wording, but I would say essentially the thought expressed in there was included in his statement; yes.

Senator CONNALLY. You are going to tell me what you think he meant?

Dr. CHRISTENSEN. What he told me he meant by that statement was this—that paying the farmer the present prices, or perhaps above the present prices for farm products, and making the alcohol from it did not leave a sufficient margin between the cost and selling price to pay the cost of developing the sales in face of apathy, skepticism, and open opposition.

Senator GURNEY. Was not his statement based on the fact that the Atchison plant did not include the necessary equipment to process the byproducts?

Dr. CHRISTENSEN. Yes; he also had that in mind. I am sorry I did not mention that. There is no dry-ice unit there, for example, and thus the company is losing the credit for the carbon dioxide which it produces. It is losing as much as 5 cents a gallon of alcohol simply because it does not have a dry-ice unit.

Senator CONNALLY. Whose fault is that?

Dr. CHRISTENSEN. It is just lack of capital to put it in. It was not a sound thing to put the unit in at the start, because no one knew how continuously that plant might run. When you sign contracts to deliver dry ice you have to deliver. Consequently it did not seem wise at the beginning, when nobody knew how rapidly the power alcohol might be expanded, to put in the dry-ice plant.

Senator CONNALLY. Is your plant the only one of its kind in the country, or are there others?

Dr. CHRISTENSEN. It is the only plant which is devoted specifically and entirely to the production of power alcohol, that is right. There are other plants that manufacture alcohol.

Senator CONNALLY. Your interest in this bill is the hope that it will put the company back on its feet?

Dr. CHRISTENSEN. I have no connection with the company at all.

Senator CONNALLY. You have a general interest, in the general welfare of the power-alcohol industry?

Dr. CHRISTENSEN. I have interest in the general welfare of the power-alcohol industry and the welfare of the American farmer.

Senator CONNALLY. If you have an interest in the general power-alcohol industry and this is the only one in existence then you have an interest in this company.

Dr. CHRISTENSEN. Only an academic interest, that is all.

Senator CONNALLY. I understand. Academic or otherwise, you figure this bill would put that company back on its feet?

Dr. CHRISTENSEN. I rather imagine it would. I do not know, but I expect it would, but it certainly would bring a great many other plants along also.

Senator CONNALLY. Of course the stockholders are all for this bill?

Dr. CHRISTENSEN. I suppose they are. I have not talked with any of them; I do not know.

Senator CLARK. I guess all the stockholders in the oil companies are against it, aren't they?

Dr. CHRISTENSEN. I know for a fact there are some for it, but I could not say what percentage.

Senator CONNALLY. I suppose the consumers are anxious for the bill to pass too?

Dr. CHRISTENSEN. The attitude of the petroleum industry, as far as I have been able to tell from discussions with many of the officials, has been this: They have felt that the market for motor fuels in the United States is rather fixed and constant. Let us assume 20,000,000,000 gallons a year—it was a little more than that last year. For every gallon of alcohol that went into motor fuel there would be 1 gallon less of gasoline sold, and for every gallon less of gasoline sold there would be approximately 2 gallons less of crude oil taken from the ground. That is the profit in the petroleum industry, taking the crude oil from the ground. Consequently they do not want anything that might decrease the gasoline consumption.

Senator CONNALLY. Don't you think the consumer has got some rights in this proposition?

Dr. CHRISTENSEN. Yes, I think he certainly has.

Senator CONNALLY. He is going to pay the bill.

Dr. CHRISTENSEN. Your present plan simply says if he wants to use the blend he may, and if he does not want to use it he does not have to.

Senator CONNALLY. Hasn't the Government some interest in the $210,000,000 to $250,000,000 of revenue?

Dr. CHRISTENSEN. I think it has a great deal of interest in it.

Senator CONNALLY. Under this bill, if you had 10 percent of alcohol you would not pay any tax to the Government?

Dr. CHRISTENSEN. That is right.

Senator CONNALLY. The man that burns alcohol with gasoline, he rides on the road free and helps wear it out, and the fellow that uses the other kind of fuel would pay all the taxes.

Dr. CHRISTENSEN. Of course, there are still the State, county, and city taxes.

Senator CONNALLY. I know, but I have reference to the Federal taxes.

Dr. CHRISTENSEN. That is right.

Senator CONNALLY. He would pay all the Federal taxes.

Dr. CHRISTENSEN. That is right.

Senator CONNALLY. The fellow that had the 10 percent blend would pay nothing to the Federal Government in taxes?

Dr. CHRISTENSEN. That is correct.

Senator CONNALLY. He would go just as fast as the other man, he would wear out the road just as fast as the other man.

Senator GURNEY. He would go faster, with the better fuel.

Senator CONNALLY. If he had alcohol in him he would turn over faster too, wouldn't he?

Dr. CHRISTENSEN. Of course I couldn't say.

Senator CLARK. That is where they have the alcohol.

Senator CONNALLY. If he would pay a premium on his gas the chances are he would have a little alcohol in both places.

Dr. CHRISTENSEN. It has not been our experience.

Senator CONNALLY. Your company had a good dose of alcohol and it went busted, didn't it?

Dr. CHRISTENSEN. It isn't broken, it isn't "busted," and it isn't my company.

Senator CONNALLY. That is all.

Senator CLARK. Dr. Hale.

STATEMENT OF DR. WILLIAM J. HALE, MIDLAND, MICH.

Senator CLARK. Doctor, will you identify yourself for the record, please?

Dr. HALE. William J. Hale. You might say I am a chemical consultant, National Farm Chemurgic Council.

Senator CLARK. Do you have a statement you wish to make?

Dr. HALE. Mr. Chairman, I am looking at this thing entirely from another direction. You have heard yesterday, and the day before, what I will call a synopsis of the pros and cons, for and against alcohol and gasoline. All of that is very interesting, but much of it is not to the point.

The whole thing, as I look at it, is a means of building up a new industry, if it is possible; and if we can build up a new industry the quicker we build it the better it will be for the country.

As a chemist I have been studying organic chemical reactions for some few years. Not long ago, after the war, in looking over this question of burning gasoline in an automobile motor, I was impressed with the frightful ineffectual burning. Scarcely three-fourths of the gasoline is burned. One-fourth is thrown out, wasted.

Upon examining the reports of our automotive engineers, discussing this matter with the Bureau of Mines, and other specialists, they tell me that never can they expect to burn more than three-fourths of the gasoline fuel they introduce in the motor.

Now, I cannot here take up the time to explain to you why that is, but suffice it to say that it is due more or less to the fact that you are burning a mixture of hydrocarbons, many of which are really not readily burned. You might liken it to a forest. As you pass a flame over the forest to produce a forest fire it is impossible for any human being to burn down the forest in one fell swoop. It cannot take place. But you may burn down a forest of brush completely, and this is representative of alcohol of only two carbon atoms in the molecule.

Now, then, these hydrocarbons in gasoline contain about five to nine carbons in a single molecule, and we all know in organic chemistry that the more compact the molecule the more difficult to disrupt it. Therefore you cannot expect a flame to burn up this hydrocarbon immediately. The result is, as in the forest which I have depicted, a mass of charred stumps; and in the gasoline motor you have unburned or partially burned molecules. The partially burned compounds represent carbon monoxide, various unsaturated hydrocarbons, and some carbon dioxide. No automotive engineer is able to bring it into complete combustion.

Now, then, with that known, and one-fourth of our gasoline wasted, it is a simple matter to calculate what the country is losing. We use some 20,000,000,000 gallons, or 21,000,000,000 gallons, a year. One-fourth of that is 5,000,000,000 gallons. At 15 or 16 cents a gallon it

makes $800,000,000 that we pay, with no returns, simply to see the automobile go around. In other words, with $800,000,000 wasted of our national resources, I, as a chemist, feel duty-bound, being patriotically interested, to find out what is the matter with the automobile industry. What is the matter with the chemist? Why not get together and do something to save this petroleum waste? And that as why I happen to be interested in alcohol.

Now upon examining the B. t. u.'s as they all tell you, that go into this automobile, we find that gasoline has 18,500 B. t. u.'s.

Senator CLARK. Will you describe for the record what the British thermal unit is?

Dr. HALE. That is the heat brought out by burning 1 pound of product and represented in degrees Fahrenheit. But I do not want to discuss that in detail. We will just say "heat units"; that is, in burning 1 pound of product there are so many heat units evolved.

You can only burn three-fourths of the gasoline introduced into an internal-combustion motor. There is not a child that I know of, past puberty, who cannot figure out that you do not get 18,500 B. t. u. in the combustion of gasoline in the automobile motor; you get 13,500 B. t. u.'s. Immediately we take this into consideration and we find that alcohol has 12,800 B. t. u.'s in its burning, we come to the conclusion that we are comparing alcohol with gasoline practically on the same thermochemical relationship. There is no difference of any consequence between the heat units in the performance from 1 gallon of alcohol and 1 gallon of gasoline. So we refute all these hypothetical conclusions of those who do not seem to like alcohol. We know what we get out of the automobile, and the work of the Bureau of Standards has proven abundantly that the performance of a 10-percent alcohol-gasoline mixture is practically identical with the performance of gasoline fuel. We take that as final.

Now, with this in mind, with our wasting this tremendous quantity of gasoline per annum, naturally, when we want to go into an alcohol-substitution fuel, or what we call an alcohol-blend fuel, we are immediately confronted with the idea as to the cost of the alcohol, and that is what you have heard here the last day or two. What does it cost to make alcohol?

I am in the chemical business. I know what it costs to make alcohol. The Atchison Agrol Co. has found some figures, but those of us who are in the chemical manufacturing business can tell you exactly what it will cost to make alcohol.

But we have conditions attached to our manufacture. A chemist who goes into the manufacture of any product without a byproduct is a dead man at the start. Therefore we work those byproducts, and as we work them we drive down the cost of the main product. Therefore, when you ask me what is the cost of manufacturing ethyl alcohol I can tell you truly you can make it for nothing—absolutely nothing.

Now then, you want the conditions. If you go into the cattle-raising business to use up the dry feed, and if you hire enough people to take care of the cattle, and if you feed all of the ensilage that grows along with the grain, it is no trouble to calculate you can make 3,000,000 gallons of alcohol at no cost, and about $25,000 to $50,000 extra, all by the agency of 15,000 head of cattle that are easily marketed.

Senator CONNALLY. Are you doing that?

Dr. HALE. We are not doing it in this country. They are doing it in Poland.

Senator CONNALLY. You say you are not doing it?

Dr. HALE. I am giving you the chemical feature of it.

Senator CONNALLY. You are not doing it?

Dr. HALE. When I am referring to it I am speaking of the chemical features in connection with it.

Senator CONNALLY. Why aren't you doing it?

Dr. HALE. They are doing it in Poland.

Senator CONNALLY. Why not come over here?

Dr. HALE. I will bring you over here in a few minutes. We have to start somewhere. Now then, realizing what has been done in Poland, and what they are getting out of this, and realizing that they are flooding this country with Polish hams—why are Polish hams in demand in America? Because Polish hams are better than American hams. Because they are feeding this distillers' dry feed from the grain, rich in certain proteins, and mixed with additional proteins, that leads to a product of highly desirable flavor.

Senator CLARK. Would you say they are better than American hams?

Dr. HALE. I would say they are better than American hams.

Senator CLARK. Do you believe that Argentine beef is better than American beef?

Dr. HALE. I do not believe that. I might take the fact that people pay a higher price for it, or will go to the market and ask for it, whereas if they do not ask for it I will say they are not better. The people always ask for what they want. At least, they sell Polish hams in Boston. I was there and found out they could not sell American hams. I inquired about that and went abroad last summer to look into it.

The results then, Senator Connally, are that from the standpoint of the farmer he can really make this thing a success on the basis of byproduct feeding.

Now then, when it comes to the chemist, he has another proposition on his hands. We, as manufacturers, cannot handle cows, although there are certain manufacturers who do in Italy. I could go into detail and tell you how they handle hogs, in connection with making artificial wool, but no chemical manufacturer likes to handle the feeding of animals. So our byproduct must be used in some other way.

As I look upon this matter, we want a pure alcohol to develop the "Agricrude" alcohol industry. I will state it this way: In order to develop a pure alcohol for a new industry we must have a cheap agricultural crude alcohol, or Agricrude alcohol. Now with a cheap Agricrude alcohol the properties in this mixture are such that if I take off the upper distillate I get a very high grade alcohol at a very low price, and as soon as I get that I am then able to enter into the new industries, such as the acetaldehyde industry, the cellulose-acetate industry, the ethyl-cellulose industry, and one that will interest you most, the synthetic-rubber industry. Now synthetic rubber can be made from ethyl alcohol at a very nominal price, and we will make it in this country within a year or two, and that opens up a tremendous future for our alcohol. But all the time recall to mind this alcohol is coming off of our Agricrude alcohol. Thus leaving this Agricrude

alcohol rich in what we call propylalcohol, butylalcohol, and so on, but all these impurities are exactly the best things we can have for the internal-combustion motor. Therefore our Agricrude alcohol residues become cheaper as we advance chemically, and as they become cheaper so also will they be supplied at a lower price to the gasoline blender.

Now then, if you ask what the cost of this will be, I have to go back into the figures a little bit. From 50-cent corn you can make 20-cent alcohol without any trouble at all, but that we are not interested in. From 50-cent corn we can make 12- to 13-cent alcohol with very little trouble, but we cannot do it now because we haven't those processes thoroughly worked out. But we know how to save 5 cents today on every gallon of alcohol that can be made from farm products, and none other than those in our own crowd at Atchison Agrol understand it, but we shall later explain it in detail. We know whether we shall lose or not. We know we can do it. Why stop at that? We can go into other products. I predict, therefore, that Agricrude alcohol will be made at about 10 to 14 cents a gallon. This calls for raw agricultural products at 1 cent a pound. That is the way I look at it. You can confidently expect that within 3 years.

It is possible to lose our money. We are not going into the game with our eyes shut. But even though confident, we are continually met with objectors here and objectors there, and even some of the gentlemen who have spoken here decried the terrible loss this Government will sustain. If I felt this Government was organized on such basis I would feel we had lost the first principles of business. If you, by the expenditure of, say, $50,000,000 a year, can bring into this country an industry which is to be twice the size of the automobile industry, who loses? Certainly the Government doesn't lose. This industry which I predict from alcohol is to be twice the size of the petroleum industry plus the automobile industry, all within 20 years.

You say, "Well, where is it?" Go to Italy. Go to Germany and see what they are doing. They have entered the industry. We are the boobs in this world, and we do not enter any new industry. Of course, you have a right to ask, "Why don't you?" Well, I shall answer. Because the international banker says we shall not. Because the international banker says the farmer in America must be kept a peon. When Sir George Paish in England describes the great central part of our country as the market and buying center of the world he merely means to say "that is where we will Chinafy the United States." Look what we did to China. We cannot get ahead without constructive work. Today we are losing our agricultural output.

Never will we make anything by export of agricultural products. Anyone who knows anything about chemistry knows that is forever forbidden. International trade in agriculture must cease in a modern world. That means we must become more self-sufficient, and to do that we must build up this extensive use of agricultural products in industry.

Stop and think what it means. What would all our good friends in the petroleum world do? Count it up in tons. And then ask yourselves: What does Nature do? Nature brings into existence a thousand times as many tons as all the human beings on this planet—for nothing. And we go around arguing about price.

What we want is to get this thing started, if it is worth while; and if it isn't, forget it. And I claim that agriculture leads to our biggest industry. It will produce Agricrude alcohol at a very nominal price. It doesn't matter whether alcohol is a dollar a pound or a cent a pound, as far as Congress is concerned. Do you want to try the greatest thing, or do you want to let it pass by?

That is the way I look at this bill, which may be construed as lending encouragement to the extent of 1 cent a gallon. It may be very, very simple to you. Well, to us it is this way: I wish that you could take that cent a gallon of Federal tax off for 5 or 6 years and at the end of that time put it back double; then taxing 2 cents on every gallon of gasoline that contains 10 percent or more of alcohol. And the alcohol will be right there in the future fuel you buy, because we know it is a far, far better fuel than gasoline itself. It has advantages the like of which are hard to describe. First, there is no knock; second, no carbon in your cylinders; third, quick starting; fourth, cuts down carbon-monoxide poison by half. All of these are advantages which are obtained by the use of alcohol and cannot be obtained by any messing with the gasoline by itself. You can praise to the limit your polymeric gasolines; they are still hydrocarbons; they still won't burn completely; you will still lose $800,000,000 a year in this country. But as soon as you put alcohol in, strange as it may seem, this alcohol, under compression, takes up from the air an oxygen molecule in combination, and when the explosion takes place you have an even burning, no knock. Ask me not why. No living man can explain that in detail. We know that alcohol facilitates the even burning of gasoline.

The question then is: Why should we not try it? We should try it, and will try it, but we have this constant agitation and opposition on the part of the international banker, who hates to see this thing succeed. Not that they are worried about a little petroleum loss of 10 percent, but they foresee the farmer in this country becoming prosperous, and as he becomes prosperous he will direct the expenditure of his own money. That is what they fear.

You might ask the question: What would you suggest as a substitute for this proposed bill? If you think it is only an encouragement, well, I will give you the substitute. Wherever there are 100 or more citizens who request the delivery of an alcohol blend at a filling station, make it incumbent upon the petroleum companies to supply that demand. They are citizens; they have a right to get what they want. I shall gladly pay 5 cents a gallon more for every gallon of 10-percent alcohol blend than any gasoline blend, because it is better. I cannot get it now in a constant supply. Show us a law whereby if there are 100 citizens in any town who want it they shall be supplied with it. I do not know how you are going to do it, but let them have a chance to get what they want.

Senator CLARK. You are not comparing the filling stations with public utilities, are you?

Dr. HALE. Yes. That will answer the whole question.

Then another thing, it might be made a felony for anybody to speak against any new product. Let it stand on its own legs. It will die if it is no good; don't worry.

Senator CONNALLY. Dr. Hale, what is your company?

Dr. HALE. Well, I am with several things. I am with the Dow Chemical Co., and with the National Farm Chemurgic Council. I have retired, Senator. I quit 5 years ago.

Senator CONNALLY. You are not active then?

Dr. HALE. I am not active in anything save trying to get a new chemical industry started.

Senator CONNALLY. Well, you went on to talk about "we" could do so-and-so.

Dr. HALE. I am a chemist; an organic chemist.

Senator CONNALLY. You are retired; you said.

Dr. HALE. I am still a chemist. I cannot retire from that.

Senator CONNALLY. I understand that. You made evidently such a good success in the world that at an apparently early age you are able to retire from active work, where a lot of us still have to work.

Dr. HALE. I am as old as you, Senator.

Senator CONNALLY. I say some of us still have to work at our age.

Dr. HALE. Pardon me. Well, I believe in always being active, Senator.

Senator CONNALLY. Is this concern that you were formerly with making alcohol now?

Dr. HALE. No, no.

Senator CONNALLY. Did it ever do it?

Dr. HALE. Never.

Senator CONNALLY. Why didn't it?

Dr. HALE. Well, if you are going to ask me that, may I quote a little word from my father-in-law, who was the president of the company, when I first went there? I suggested this little thing of going into the agricultural lands and showing the farmers how to develop products that we could use. Do you know what his answer was?

Senator CONNALLY. No; I do not.

Dr. HALE. "My dear son-in-law, no business can run on raw material at political prices."

Senator CONNALLY. In 1919 we did not have any farm legislation.

Dr. HALE. We had a lot of political prices.

Senator CONNALLY. Did he mean by that the political prices were all too high?

Dr. HALE. The idea, Senator Connally, is this: I do not know how it ever got started——

Senator CONNALLY (interposing). Tell me about your father-in-law. When he told you that, did he mean the prices were so high you could not make any profit?

Dr. HALE. No; he meant prices one year might fluctuate so much because of various and sundry things that might happen. By the way, that was right after the war and there was a great outlet abroad for quite a few things, one of which I know was Michigan potatoes. Of course, as soon as the man from abroad increased the price, why, those of us in the chemical business, relying upon agricultural produce would go broke. That is not the way we intend to pursue this thing.

Senator CONNALLY. I understand that, but that was a fact too, wasn't it?

Dr. HALE. That was a fact then.

Senator CONNALLY. Therefore you did not make the alcohol?

Dr. HALE. Therefore we did not make it.

Senator CONNALLY. Never have made it?

Dr. HALE. No, sir.

Senator CONNALLY. You spoke about establishing a new industry. I thoroughly agree with you that where we establish a new industry in this country we ought to establish it. However, isn't that predicated on the idea that the industry should be a useful industry?

Dr. HALE. Yes, sir.

Senator CONNALLY. In that it will serve not alone the producers but the people who consume the article?

Dr. HALE. Absolutely.

Senator CONNALLY. Now if an industry is not economically profitable there is no sense in having it, is there?

Dr. HALE. Well, I don't know. We will turn the wheel over and over and keep the people busy, and if we do that I would say it would be better than letting them lie idle.

Senator CONNALLY. If we wanted to we could grow bananas in this country, couldn't we?

Dr. HALE. We could.

Senator CONNALLY. We could build hothouses, with artificial heat, artificial light, and all of that, by spending a lot of money and we could produce bananas in the United States but that would cost us a great deal more than the bananas we are now buying, wouldn't it?

Dr. HALE. Yes.

Senator CONNALLY. Would it be any service to the people who eat bananas to produce them in the United States at that high artificial cost?

Dr. HALE. Let me put it in another way.

Senator CONNALLY. Answer my question first.

Dr. HALE. I can't answer your question, because I do not know what kind of banana you want.

Senator CONNALLY. A good banana.

Dr. HALE. Suppose I give you a better banana than you ever saw, would you pay more for it?

Senator CONNALLY. Yes; I would pay more for it.

Dr. HALE. Well, that is what we should do in this country.

Senator CONNALLY. Why don't we?

Dr. HALE. We are trying a lot of things, but we haven't reached the bananas yet. The only trouble about that is the food industry. We have got the food industry pretty well developed, and we do not want anything more. You can only eat 1,400 pounds a year. What is the use of trying to eat any more?

Senator CONNALLY. I don't eat that much.

Dr. HALE. We must develop agriculture in the nonfood business.

Senator CONNALLY. A banana is an agricultural product.

Dr. HALE. I did not make myself clear to you. We can only eat so much. The idea is we get enough bananas now, we get them cheap enough, and it isn't worth while to develop a high-priced banana, since we eat few bananas. Let us say it is in nonfood products there is no limit. As we put more people to work we will consume more.

Senator CONNALLY. Don't most of the foods come from the farm? Don't most of the foods come from agriculture?

Dr. HALE. Would you like me to define agriculture?

Senator CONNALLY. I think I know as much about it as you do.

Dr. HALE. What do you think agriculture is?

Senator CONNALLY. I think I know.

Dr. HALE. What is it?

Senator CONNALLY. I used to be engaged in it. I don't think you ever saw a cotton patch.

Dr. HALE. No; I never saw a cotton patch. I have seen a few potato patches.

Senator CONNALLY. I have eaten a few potatoes.

Dr. HALE. What I mean is this: Agriculture is not primarily concerned with the production of foods.

Senator CONNALLY. It has produced all the food there is.

Dr. HALE. We are not concerned primarily with that. In this country we have not been able to suppress this medieval interpretation that primarily agriculture is a food supplier.

Senator CONNALLY. Where would you get your food if you did not get it from agriculture?

Dr. HALE. That is the question we have to face.

Senator CONNALLY. You can't live on alcohol indefinitely.

Dr. HALE. I don't refer to that, but what I meant to say is that our great outlet is industrial use.

Senator CONNALLY. I believe that is all I have.

Senator CLARK. Senator Gurney, any questions?

Senator GURNEY. May I ask the doctor to enlarge a little bit on whether or not gasoline is good airplane fuel?

Dr. HALE. Oh, it is very bad airplane fuel.

Senator GURNEY. Would this be a benefit particularly to the airplane industry?

Dr. HALE. The fuel for the airplane should not have any gasoline in it at all. As I said before, gasoline does not burn thoroughly and completely. Then, in the second place, you do not get all the power out of it. The difficulty with an airplane is in the high clearance between the piston and cylinder, and when you put in lead, and such things, you introduce deleterious material which leads to pitting of cylinders and makes the airplane of course more and more unsafe. But the great difficulty with an airplane is with gasoline alone. With moisture coming in from the upper atmosphere you usually get the possibility of ice crystals in your feed lines, and then you have what they call "icing up." The *Cavalier*, the hydroplane that sank between New York and Bermuda a few months ago, went to her destruction by reason of the fact that she had no alcohol in her fuel. Had she had alcohol she would not have fallen.

Senator GURNEY. Why wouldn't she have fallen?

Dr. HALE. Because alcohol does not freeze under those conditions. Any moisture coming in there is dissolved in the alcohol.

Senator GURNEY. It is held in suspension?

Dr. HALE. Held in solution. No plane will freeze with alcohol. The Italians, when they flew over here at the time of the World's Fair in Chicago, did not use gasoline. No high-grade motor for racing uses gasoline. Take the Roosevelt races at Roosevelt Field in 1937. Forty entries, American and foreign, and the first seven that came in, were of foreign make and had no gasoline. Benzene and alcohol were the fuels used.

Senator CLARK. What is that?

Dr. HALE. Benzene and alcohol, Senator Clark, were used in that race.

Senator CONNALLY. That is a petroleum product, isn't it?

Dr. HALE. No; pardon me. It is a coal-tar product. It is spelled b-e-n-z-e-n-e, sometimes called benzol. We call it in chemistry "benzene." The Dupont Co. supplies a fuel called "Dinax," I believe made up of methyl alcohol and benzene.

This must come. It is just a question of how long we delay it. Other countries are going ahead. Brazil has just made it mandatory month before last. Every gallon of fuel in Brazil must contain alcohol up to 10 percent. It will not have enough alcohol plants to get the blend up to 10 percent, short of about 3 years.

Senator GURNEY. Tell me, can an engine be run on part alcohol and part water?

Dr. HALE. The future fuel, Senator Gurney, as I told you or your father, I believe, the future fuel for the automobile will have no gasoline in it whatsoever, it will have nothing but alcohol and water, and it will contain about 50 percent alcohol and 50 percent water. The efficiency of motor operation on such fuel measures about 40, which is twice the efficiency of the ordinary automobile today. If you wanted to study the alcohol-water mixture you might look at it in this way: the alcohol is sparked, and burns completely, the water is vaporized by the liberated heat into steam, and you positively have an internally fired steam engine. The steam, of course, drives your piston up and down. In other words, you have an ideal condition there. You have the firing inside the tubes, instead of the condition today in putting the fire outside the tubes, putting the fire under a little boiler and raising the heat and getting the steam inside the tubes in a roundabout way.

Don't take me as saying it will be only ethyl alcohol. It will contain propyl alcohol and other alcohols, which we find very very satisfactory.

Let us take a picture of the future. If we want to compare the fuel that will be burned 10 years from now with the fuel that is being burned now, how much alcohol will be necessary to obtain the same efficiency as in 1939? Exactly one-quarter of a gallon of alcohol will balance our present-day gallon of gasoline. If the price is 30 cents a gallon, 7½ cents worth of alcohol 10 years from now will do the same work as a gallon of gasoline of the highest quality today. The future lies in the direction of alcohol and not in the direction of gasoline.

Senator GURNEY. Tell me, in the present development of internal-combustion engines, and the fact that our country is now basing its national defense on the supply of crude petroleum, what is the outlook for the future?

Dr. HALE. I don't want to throw any scare into the group, but the fact that we today rely upon gasoline as a fuel for our airplanes is indicative of a complete upset in a moment's notice. One thousand men, spies, in one night can eliminate all airplanes in this country. Now, if we had alcohol, Senator Gurney, it would be in every county. I do not think a thousand men could quite dispose of the alcohol storehouses.

Senator Connally might very well ask where is all the alcohol to come from, and who is going to keep it there. Senator Connally, in this connection I want to say this commercial development from agricultural products absolutely demands 1 year's full supply in advance, in storage. That is very, very necessary.

Senator GURNEY. Is it to our advantage to conserve our present supply of crude petroleum for this national defense?

Dr. HALE. That is for Congress to say. I hope you do, but I don't own the petroleum fields.

Senator CONNALLY. Why should we, if it is no good?

Dr. HALE. Now, Senator Connally, that is a very, very likely question. The reason is this: We should, because you and I do not know the wonderful properties of the compounds in that petroleum, which today we thoroughly wreck and destroy through the waste of half of the petroleum. The day is coming when we shall take them out with less cost.

Senator CLARK. Doctor, isn't it generally agreed among chemists that alcohol in the future is likely to come from petroleum?

Dr. HALE. By the way, it could not. There isn't enough petroleum to make it.

Senator GURNEY. Or coal.

Dr. HALE. Coal, yes.

Senator CLARK. That was testified to by several eminent chemists in connection with sugar.

Dr. HALE. I disagree with them entirely. You can't make alcohol from coal unless you do it by way of ethylene—ethylene is a gas from petroleum—and it would cost you at least 2 cents a pound, or 2½, maybe 3 cents a pound. From coal it will cost you the same. We have here an interesting point for comparison. A plant necessary for production of alcohol out of petroleum and coal costs so much that if we were to amortize the plant completely in 1 year on the gallonage of alcohol basis we would have a price of 50 cents a gallon; whereas, if we take agricultural products and put them through an alcohol producing plant and amortize it completely, in a year it wouldn't be 10 cents a gallon.

Another strikingly phenomenal point arises here. On the basis of ordinary industrial costs one man can be put to work for the expenditure of $8,000, but to put him to work in an agricultural chemical industry it is $770 a man.

Senator GURNEY. Per year?

Dr. HALE. That is all paid for in a year.

Senator GURNEY. That is the capital set-up?

Dr. HALE. That is the capital set-up. In a hearing last year before a Senate committee you heard Mr. du Pont testify that it costs $8,000 to put a man to work. We know that. But it costs $770 to put a man permanently to work in the agricrude alcohol industry. And this is phenomenal.

Senator GURNEY. Through the development of the alcohol industry, is it your idea, or do you agree with it, that it will help materially in putting the farmer back on his feet so he can maintain himself?

Dr. HALE. To put 10-percent alcohol in gasoline will put a million men to work on the farm. It will put about 2,000,000 more men to work in allied industries, and the use of copper, and all these things, is so high that I hate to begin to calculate them. Of course you can figure from that that it will take about 30-percent alcohol to put all of our unemployed to work. A great many of our unemployed will never work, they will be buried.

Senator CONNALLY. Doctor, you talked about the airplane.

Dr. HALE. I talked about the airplane; yes.

Senator CONNALLY. You said it would be so much better for the airplanes, the Army planes and Navy planes.

Dr. HALE. I don't know about Army and Navy planes. I was speaking of airplanes in general.

Senator CONNALLY. That is an airplane. Because it is in the Army doesn't change it from being an airplane.

Dr. HALE. They have special requirements.

Senator CONNALLY. Why don't they use this alcohol gas?

Dr. HALE. They have a rule, a very peculiar rule.

Senator CONNALLY. They may change the rule.

Dr. HALE. Did you ever see it done? They don't change it easily.

Senator CONNALLY. If I was in the Army I might change it, but I am on the outside.

Dr. HALE. They say in the Navy their airplane fuel must be a hydrocarbon.

Senator CONNALLY. They don't have to follow the rule forever. They can change it.

Dr. HALE. It is printed in the rule that it must be a hydrocarbon.

Senator CONNALLY. Certainly it might be printed. If that is the present regulation within the Department that doesn't mean because it is printed it cannot be unprinted and something else printed. Now these people are experts; they are Government agencies. Congress gives them practically everything they ask for, and if they wanted alcohol for these airplanes in the Army and Navy, Congress would give it to them tomorrow. Why don't they do it, if it is better, faster, smoother, slicker, and all that sort of business?

Dr. HALE. I could answer, but I would rather not answer.

Senator CONNALLY. Why could you not answer? Are the international bankers running the War Department?

Dr. HALE. That is correct.

Senator CONNALLY. Are the international bankers running the Navy?

Dr. HALE. Correct.

Senator CONNALLY. The international bankers control the United States?

Dr. HALE. I would not say "control." They have an influence that we cannot buck.

Senator CONNALLY. They have an influence over the Navy?

Dr. HALE. They have.

Senator CONNALLY. They tell them they cannot use alcohol?

Dr. HALE. I did not say that.

Senator CONNALLY. That is what we are talking about.

Dr. HALE. They let it be known it would be unpleasant for them to have the change made.

Senator CONNALLY. So they tell the Secretary of the Navy or the Secretary of War what to do?

Dr. HALE. They leave that inference. I did not say they said it. That is the inference.

Senator CONNALLY. How do they get it over if they do not say it?

Dr. HALE. I don't know their secrets.

Senator CONNALLY. It is your idea that they did get it over in some sort of way?

Dr. HALE. I know they did.

Senator CONNALLY. Through spies, lobbyists, or somebody?

Dr. HALE. Not spies; just through influence.

Senator CONNALLY. I want to get your idea as to how they contacted the Secretary of the Navy and the Secretary of War.

Dr. HALE. I can't explain the inside of that. I can give you an illustration in my own experience. A certain member of the—well, I will say the Cabinet, made a public statement in which he deplored the waste of petroleum. I personally wrote a letter——

Senator CONNALLY (interposing). Secretary Ickes, was it?

Dr. HALE. That was his name. I asked that I might be able to show him what could be done to save petroleum, and the answer came back: No such thing was possible. So, being an organic chemist and being in the organic chemical business, and that being an organic chemical problem, I took it for granted it was not the proper thing for an organic chemist to discuss organic chemical problems; it is a matter for higher-ups.

Senator CONNALLY. That is all.

Senator CLARK. Mr. Keefe, did you desire to make a statement?

Mr. KEEFE. I just was going to suggest that you hear from Dr. Jacobs, if he is going to have time. He is here from the Department of Agriculture.

Senator CLARK. Dr. Jacobs, it will be necessary for the committee to adjourn very shortly. About how long would your statement take?

Dr. JACOBS. My statement might take some little time. I wonder if the committee would be willing to have me extend my remarks for the purpose of the record?

Senator CLARK. We would be very glad to do it. Are there any other witnesses who desire to be heard besides Dr. Jacobs?

Mr. KEEFE. Senator, if you don't mind, I am representing the consumer group, and there has been a very unusual procedure here in that the proponents for these measures have appeared at the tail end of the list. The chair graciously gave me permission yesterday to offer some material in the form of rebuttal. I am not adequately prepared at this moment to do that. I beg your indulgence.

Senator CLARK. In view of the fact that the full Finance Committee will meet tomorrow, therefore, unless Dr. Jacobs desires to proceed now, I suggest that we recess to 10:30 Monday.

Senator CONNALLY. I would like Dr. Jacobs to have plenty of time.

Senator CLARK. Dr. Jacobs will have all the time he wants.

Mr. KEEFE. Then, if the Chair please, I request that we have an expert from the National Bureau of Standards as a witness here to state their side of the case. They have been referred to here as having made statements which are contrary to my knowledge of the situation, and I would like to ask the Chair to take under consideration the advisability of calling in such a witness.

Senator CLARK. I will call in anybody you wish to have me call. We will adjourn until 10:30 Monday.

(Whereupon, at the hour of 12 m., the hearing was recessed to Monday, May 29, 1939, at 10:30 a. m.)

USE OF ALCOHOL FROM FARM PRODUCTS IN MOTOR FUEL

MONDAY, MAY 29, 1939

UNITED STATES SENATE,
SUBCOMMITTEE OF THE COMMITTEE ON FINANCE,
Washington, D. C.

The committee met, pursuant to recess, at 10:30 a. m., in room 312, Senate Office Building, Senator Robert M. La Follette, Jr., presiding. Also present, Senator Gurney of South Dakota.

Senator LA FOLLETTE. Dr. Jacobs.

STATEMENT OF DR. PAUL BURKE JACOBS, BUREAU OF CHEMISTRY AND SOILS, DEPARTMENT OF AGRICULTURE

Senator LA FOLLETTE. Dr. Jacobs, will you please give your full name, your present position, and for the record explain the studies which you have made of this subject matter that is involved in the bills and amendments now pending before this subcommittee? As I understand it, you are the author of this Miscellaneous Publication No. 327?

Dr. JACOBS. That is right. My name is P. Burke Jacobs. I am an employee of the Bureau of Chemistry and Soils, of the Federal Department of Agriculture, and I am chief of the section relating to the production of motor fuels from farm products. I would like to add to that statement that the genesis of this study dates back to some years ago when I was on the campus of the Iowa State College. I was then chief of the Agricultural By-Products Laboratory, and was on the campus at the time that the initial work was done by the Iowa State College on motor fuels. Previous to that, a good many years ago, I was manager of a plant producing alcohol from molasses. I have had rather long experience in the distillation of alcohols and related compounds; consequently, about a little less than 3 years ago, the Department brought me into Washington because of their desire to ascertain more correctly what the facts were on this subject, so that they would be better prepared to answer questions that might come up. The result of that is that we made a study which is primarily a survey of the existing literature. We did no research work on it at all. Then we published some of the results of this study in this bulletin form, because we thought it might serve for clarification purposes, trying to reduce this rather controversial subject to a basis from which it could be considered.

Senator LA FOLLETTE. Doctor, are you familiar with the testimony which has been given before this subcommittee?

Dr. JACOBS. To a great extent; yes. I heard it, as I was present at all sessions.

Senator LA FOLLETTE. I can understand your natural reluctance to volunteer any testimony on that subject, but I would like to request you, as one member of this subcommittee, to review some of that testimony and in the light of your study of this problem, to give the subcommittee the benefit of your reactions to the testimony, and give us any expert opinion which you think would be helpful to the committee in considering this general subject matter.

Dr. JACOBS. That is a fairly large question, Senator, because the testimony has been very largely both for and against the problem. I think, frankly, that the testimony has carried the discussion away from the real points which are pertinent. For example, there has been considerable injection into the testimony of the Atchison Agrol plant.

Senator LA FOLLETTE. Are you familiar with that operation?

Dr. JACOBS. I am quite familiar with the general set-up there. Through the courtesy of that company, I have visited the plant on three or four occasions. I was sent out there by the Department to make a rather confidential survey, the results of which I am unable to disclose because of the ethics concerned. We have it in the files of the Department.

Senator LA FOLLETTE. Well, such public information as you have, that is available for the benefit of the committee, I think would be very helpful.

Dr. JACOBS. I must say, and I would like this to be taken exactly the way I mean it, the operations of that company have not been such that they should be considered as a criterion in this matter at all.

Senator LA FOLLETTE. Will you explain why you have that view?

Dr. JACOBS. In the first place, the plant was an old, rebuilt plant. It never reached anywhere near its maximum efficiency. It never even approached the rated gallonage which it was set up to produce.

Senator LA FOLLETTE. Was that due to the facilities within the plant or lack of market?

Dr. JACOBS. I think it was more particularly due to facilities within the plant, and possibly lack of capital. I am adding that merely as a surmise. Their actual performance out there, as I say, was so handicapped by various factors that it is my opinion that practically all of the results that they got there should be very largely discounted. with perhaps the exception of the work that they did just at the end of their operation period. For example, in the first year of their operation, they only produced 87,660 wine gallons of alcohol, and that was produced from a variety of materials. Taking the over-all efficiency of all materials for that year, the figures are relatively around 48-percent efficiency, whereas a commercial operation should get around 85 or better. So you see you would largely have to discount everything that was done that first year and consider it purely experimental.

For one thing, on that first year I would like to advise the committee that a quantity of molasses was used equivalent to about 30 tank cars, according to the public records. From that molasses enough alcohol might have been produced to account for more than the entire gallonage of alcohol which they did produce from all materials in that 1 year.

I offer that statement primarily because of the question that has been raised in the testimony regarding allegations that the company has been using blackstrap molasses. It is shown definitely in the

record that in the first year they did use blackstrap molasses to that degree, and in the same year they only used 14,156 bushels of corn. The rest of the materials can be ignored as being trivial.

Now, in the second year of operation they, of course, did considerably better. It may be assumed that with some improvements which they made and with the improvement of knowledge of the personnel, there was an improvement in efficiency because the alcohol produced, calculated against the entire raw materials used—now, that is raw materials as received, and it includes everything, and I cannot break it down any further—showed an efficiency overall of about 63 percent, as against the 85 percent that they should have produced. Plant operation that year apparently was very largely based on corn, because they used about 166,000 bushels of corn. They also used sorghum, rice, screenings, rye, and a lot of materials, which bears out the contention that it was largely an experimental operation; they were trying everything.

The third year there was some additional improvement. I might add in the second year that they produced practically 316,000 wine gallons of alcohol. The current year, in 4 months' operation, they produced 209,000 plus gallons of alcohol, and achieved an efficiency on the same basis of about 71.5 percent, based again on all materials as received. The principal materials in the last year were 88,000 bushels of corn and about 11,000 bushels of rye, with some minor quantities of other materials.

On the basis of those figures I therefore think the committee will support me in my contention that it is rather unnecessary to have this problem stand up fully on the basis of production at Atchison. They themselves have admitted that the production was never up to the standard that they had hoped. At no time, as far as I can ascertain, did they ever reach more than one-half of the rated capacity, except, perchance, on one or two short operations. The total amount of alcohol produced there in 2½ years' operation was only a little over 600,000 gallons, and at their advertised 10,000 gallons per day capacity you see that would only be a 2 months' operation.

I think, therefore, that most of the testimony regarding the operation of the Atchison Agrol plant can be discounted up to the point of the trial run, which they made just before closing down, in which they did make an attempt to reach production plant figures, and those figures, of course, can be considered, but still it must be recalled that those figures were obtained on the basis of the plant being in a very poor mechanical condition.

Senator La Follette. I am sure, Doctor, likewise, that the committee would be glad to have your comments on any of the other testimony that has been adduced here. We are confronted, as usual, with a conflict of expert testimony, and any comments which you could give to the committee would be of benefit to it in a study of this problem.

Dr. Jacobs. Senator, it is rather difficult to avoid injecting what are merely personal opinions. I have the impression that this legislation may perhaps be a little premature. At the same time, I think it is only fair to say that I believe that eventually something like this will be brought about. Whether the time is ready at this moment or not I am unable to say, I would not care to hazard an opinion. We

have looked at the matter rather realistically, on the basis of the existing conventional alcohol process and the existing status of the agricultural situation. In the bulletin, we do very little surmising as to what might be the result if and when you change certain factors. Basing it purely on today's situation, as we point out in the bulletin, it is obvious if you made any large-scale production of alcohol you are going to meet certain limitations. Either you are going to remove so much crop material from the market that you are going to affect prices or possibly raise prices of materials to a point where the alcohol plants can no longer operate economically.

I want to call to the committee's attention rather particularly one pertinent fact. The alcohol produced from farm materials, used against gasoline on a straight competitive basis, is limited automatically to a comparatively fixed price. The sales price cannot fluctuate. On the other hand, it has been the history of agriculture that the raw-material prices will fluctuate and do fluctuate to rather extreme degrees Therefore, I have the feeling that until some equalization can be obtained as to raw-material costs, I think these proposed alcohol plants are going to be in continual difficulties.

I have the further feeling that perhaps the local aspect of this will be the wrong way to do it in the long run.

Senator LA FOLLETTE. What do you mean by that, Doctor?

Dr. JACOBS. I mean the idea of local plants situated just here and there, at random, trying to compete in a national fuel market. I do not think that the small number of plants will have weight enough to change the existing situation, and certainly a good many economic factors will have to be changed in order to make this alcohol scheme really successful. Therefore, I have always felt that far more could be accomplished if the program were planned on a national basis rather than on a local basis.

Senator LA FOLLETTE. Will you explain what you mean by that?

Dr. JACOBS. Take the Atchison plant, for example. They attempted to carry the whole load of this program of merchandising The cost of merchandising, the costs of meeting the fluctuating prices, which they had to pay for the raw materials, were so much that it is obvious they could not meet the situation and continue to produce alcohol at the price that they could get for it. Now, that may be true of any plant, it may be true of a number of plants. It is only when you get a large production and a general equalization of the costs of the alcohol that is produced in various localities from various materials that you can hope to make this thing work without coming into a tremendous amount of difficulties.

For example, supposing that you were producing alcohol from sweetpotatoes in the South, and from sugar beets in Utah and corn in Iowa, each of those materials, or the alcohol produced from each of those materials would have a different cost. Presumably the alcohol produced from each of those materials would sell at a certain figure in the local market. The minute the expansion of that production got to the point where the areas would compete with each other at the edges some equalization of the cost of alcohol would be necessary, and the more you expand the thing the more of those difficulties you will run into. One plant located at a given point, as I pointed out in the bulletin, might be able to so situate themselves as to reach a very desirable condition as to byproduct markets in the local area.

A second plant coming in there will naturally set up competition in the matter of those sales and tend to drop the prices, and therefore the more you expand the industry the more competition you are going to have in the purchase of raw materials and in the sale of the byproduct, and the more you are going to reduce the whole matter to a common level, and I am afraid that that common level will be too low for the plants to support themselves at the prices they can obtain now. Ten years from now it may be different.

Now, for the committee's information, certainly legislation of this character will tend to go a long way toward offsetting the differential which these plants have to face. I do not deny that for a minute, but it would seem to me, and I want to make it perfectly clear that I am not an economist and do not pretend to be one; but speaking purely as a technical man, it would see to me that if we are going to subsidize agriculture in this way then there should be an equivalent decrease of existing subsidation. Also if we are going to shift our system from one to another, which may be perfectly allowable, certainly I think before we shift, the whole thing should be planned so as to see that equalization will be possible on all crops, and also that we have a definite and well-understood objective and a method of reaching that objective.

Senator LA FOLLETTE. Do you know whether or not there is under consideration by the Department any further experimentation in this field?

Dr. JACOBS. I do not quite understand the word "further." There has been no experimentation by the Department.

Senator LA FOLLETTE. I will take the word "further" out. Do you know whether there is any contemplated experimentation by the Department?

Dr. JACOBS. We are planning to build a small pilot plant at our northern regional laboratory at Peoria. This pilot plant, as we intend to consider it, will be scaled down to the basis of about 300 to 500 gallons a day, total capacity; but we are only planning to operate it most of the time on one shift, which will be 100 gallons a day. In other words, our point is that if we are going to explore the possibilities of the production of alcohol and the reduction of costs, which we consider essential, we must do that on as small a scale as possible. That, I think, is one of the mistakes made at Atchison, that they did the preliminary experimentation on these various materials on a large scale, and of course any mistake that way is very expensive.

Senator CONNALLY. Did they fail at Atchison?

Dr. JACOBS. Well, they are shut down now and out of capital.

Senator CONNALLY. That answers the question. Go ahead.

Dr. JACOBS. In order not to leave that sound just the way it may sound, you understand that they undoubtedly had a large amount of expense there which perhaps is not directly chargeable to alcohol production, as far as my information may extend.

Senator CONNALLY. What did they charge it to?

Dr. JACOBS. Well, they could charge it to the whole idea of power alcohol, perhaps, because that is what they started out to do, to demonstrate the feasibility of power alcohol.

Senator CONNALLY. That is what I am talking about. Therefore, they could not produce it at an economic cost, to get a profit out of it, and they went broke; is that true?

Dr. JACOBS. That is largely true, Senator. As I explained a moment ago—perhaps you were not here when I said it—the difficulty of this whole thing will be that your raw materials will fluctuate in price, whereas you are up against, in this case, a very fixed price for the product which you are selling. In the case of the industrial-alcohol man, he does not care so much about that, because his alcohol price (on industrial alcohol) will fluctuate directly with the raw-material market. The power-alcohol manufacturer will not be able to secure that same advantage. He will have to make it up in fluctuations of prices for byproduct feed or carbon-dioxide recovery.

Senator CONNALLY. Doctor, is it not your view that before we should embark on any large-scale program like this, that there ought to be further experimentation under Government supervision and direction, an impartial scientific investigation of this whole problem?

Dr. JACOBS. I have that feeling; yes.

Senator CONNALLY. You made a report, I believe it is yours, publication No. 327?

Dr. JACOBS. That is right.

Senator CONNALLY. It is entitled "Motor Fuels From Farm Products." I notice there that you say:

> Alcohol production from present crop wastes, culls, and surpluses is unlikely to be continuously adequate for a national 5 percent blend. Such materials would provide uncertain annual quantities of alcohol at variable costs.

That is on the same point that you just testified a moment ago, that by reason of this condition in some years you would have an adequate supply, or at least a substantial supply of waste products that you could use for alcohol, and maybe the next year you would not have hardly any.

Dr. JACOBS. That is right. I made the point clear in the bulletin that if you are going to create an alcohol industry you will have to support it year after year. It is there, it will "eat its head off" if you do not support it year after year. Therefore, you must supply adequate materials, and these materials must be secured at a price which will allow the alcohol to at least break even.

Senator CONNALLY. Of course, this is an effort to subsidize agriculture indirectly.

Dr. JACOBS. It is unquestionably that, in my opinion.

Senator CONNALLY. On page 125 of your bulletin you say:

> As present costs of producing alcohol do not permit equal competition between blends and straight gasoline, fuels from agricultural products could be used only with some form of supplementary financial support, which might, however, replace present direct or indirect Government farm aid.

That is true, is it not?

Dr. JACOBS. That is right.

Senator CONNALLY. You also say:

> Although the sale of crop materials unsalable under present conditions would bring farmers a higher gross income, farmers themselves would carry 20 percent or more of the higher cost of alcohol fuels.

If this fuel with the blends is to cost more than at present, the farmer would bear a large share of that, would he not, of that increased cost?

Dr. JACOBS. The farmer will be involved in that on both sides of the calculation. He will pay more for his fuel, assuming that the blend will cost more than the straight gasoline.

Senator CONNALLY. Yes.

Dr. JACOBS. On the other hand, he may secure additional income which he is not now securing.

Senator CONNALLY. Some of the farmers.

Dr. JACOBS. Some of the farmers.

Senator CONNALLY. Not all of them.

Dr. JACOBS. Not all of them.

Senator CONNALLY. All of the farmers would not get an increase, would they?

Dr. JACOBS. I do not know how you could make this thing work so that all the farmers could benefit by this. A certain class will.

Senator CONNALLY. Those that produce these particular farm products or byproducts, the waste materials from which alcohols can be made, they have a surplus of it, it is otherwise not utilized—not utilizable—they will get something for that, but on the other hand farmers who do not produce those kinds of agricultural products will have to pay more for their fuels and get nothing in return.

Dr. JACOBS. That is true.

Senator CONNALLY. Take for instance the cotton industry, the cotton farmer would not get anything out of this but he would pay whatever additional cost the fuel would come to, would he not?

Dr. JACOBS. May I remind the Senator that of course this does not look toward anything mandatory and that therefore it will be optional.

Senator CONNALLY. Not mandatory? Why, it takes the tax off. The Government tax is 1 cent per gallon and it takes it off if they use the blend.

Senator CLARK. That does not make it mandatory then, does it?

Dr. JACOBS. The farmer does not need to buy the blend; he can still purchase straight gasoline.

Senator CONNALLY. If that is true there would be another economic waste, would there not? The dispenser would have to maintain two different plans of distribution and handling, and all the expenses of conducting the business. He would have to have a double-barreled arrangement. One man wants a blend and the other man does not want a blend. There would be a lot of bootlegging. Would not it be difficult of administration on the part of the Treasury Department? Here is a fellow that wants a fuel that is tax-free, and another one wants straight gasoline. It would be very easy for that gasoline to get mixed up, would it not, when it comes to pay the tax, just as a practical proposition?

Dr. JACOBS. There might be some of that.

Senator CLARK. Some of them have three or four different kinds of gas on sale now.

Senator CONNALLY. They all pay a tax, though.

Dr. JACOBS. It would certainly complicate the distributing system. You notice in my bulletin I have recommended that these blends be distributed from established channels rather than to further complicate the situation by going out and creating new distributing channels.

Senator CONNALLY. Senator Clark says that some now handle three or four different kinds of gas from the same plant. They all pay the tax, though, do they not?

Dr. JACOBS. They all pay the tax.

Senator CONNALLY. There is no temptation to switch one for the other. The blended gasoline fuel would cost more, would it not?

Dr. JACOBS. According to my computations, it would. If at some future time you can get the cost of alcohol down it may change the situation.

Senator CONNALLY. Of course, that may happen at some future time, but now it would cost more, would it not?

Dr. JACOBS. I have prepared some figures here which perhaps the committee would care to look at, to answer specific questions. There is a single sheet there marked "Alcohol costs."

Senator CONNALLY. What do you figure, in your bulletin here, that this alcohol can be manufactured for? What is the cost?

Dr. JACOBS. I am about to submit an exhibit to you which will illustrate that.

Senator CONNALLY. All right.

Dr. JACOBS. On this table I have calculated alcohol costs for corn at from 10 cents to a dollar per bushel. This is based on the present conventional process, and it is based on an assumed recovered by-product-feed price of three-quarters of a cent net. I have not felt that in the long run any plant can consistently maintain a return on byproduct feed over that figure; just merely for the purpose of the exhibit I have made the calculation on that basis.

You notice that the price of the finished-alcohol cost ascends there from $0.1863 to $0.4660. Those figures may not be wholly accurate, they are all subject to a lot of "ifs" and "ands," but at least the scale of the cost is, I think, clearly shown there, the way the alcohol costs will fluctuate with the corn cost.

(The table referred to is as follows:)

Alcohol costs (for corn, at various prices)

A	Ton cost (35.7 bushel ton) B	Total value of feed recovered per ton of corn [1] C	Total feed credit per gallon alcohol [2] D	Net raw material value in 1 gallon of alcohol [3] E	Probable finished alcohol cost [4] F
Corn at—					
10 cents per bushel	$3.57	$0.59	$0.0072	$0.0363	$0.1863
20 cents per bushel	7.14	1.61	.0196	.0675	.2175
30 cents per bushel	10.71	2.63	.0320	.0983	.2483
35 cents per bushel	12.50	3.15	.0384	.114	.2640
40 cents per bushel	14.28	3.65	.0446	.129	.2790
45 cents per bushel	16.06	4.16	.0508	.145	.2950
50 cents per bushel	17.85	4.66	.0568	.161	.3110
56 cents per bushel	20.00	5.30	.0646	.179	.3290
60 cents per bushel	21.42	5.70	.0694	.192	.3420
70 cents per bushel	24.99	6.73	.0820	.222	.3720
80 cents per bushel	28.56	7.76	.0946	.253	.4030
90 cents per bushel	32.13	8.76	.1070	.285	.4350
$1 per bushel	35.70	9.77	.1190	.316	.4660

[1] Calculated at 16 pounds feed per bushel of corn. Price of feed based on ton cost of grain less $1.50 per ton handling charges (28.6 percent of corn recovered as feed) (571 pounds per ton). No carbon dioxide credit considered.

[2] Based on 82 gallons anhydrous alcohol per ton of corn, or 2.3 gallons per bushel.

[3] Amount in column B, less column C, divided by 82 (i. e. after feed credit deductions). Column E plus column D by 2.3 will equal bushel cost in column A.

[4] Raw material cost, net, plus 15 cents (8 cents conversion, 3.5 cents malt, 3.5 cents sales cost plus profit). Finished 99.6 percent alcohol, undenatured and unpackaged, basis tank-car shipment, without freight. Malting costs not included.

Senator GURNEY. May I ask the doctor one question?

Senator CLARK. Certainly.

Senator GURNEY. On this schedule have you given full credit for all by-products, dry ice, feed, and so forth?

Dr. JACOBS. No dry ice is included in this figure, and malting costs are not included.

Senator CONNALLY. What kind of costs?

Dr. JACOBS. Malting costs. Carbon dioxide credits and malting costs will more or less offset each other. That is the reason I left them both out, because, after all, I do not intend these figures as finalities; they are merely an approximation which will show the scale.

Senator CONNALLY. Are these estimates as accurate as you can make them?

Dr. JACOBS. I can probably make them a little more accurately, but at the time I made these I thought these would serve the purpose.

On the long sheet—I am still replying to your question as to costs—taking the same alcohol costs as established on the first sheet and translating them against the corn production in the years 1930 to 1937, you will notice that in the fourth column, "corn (average price received by farmers)," that in the past years the price of corn as received by the farmers varied from 31.9 cents to 104.5. In the column next to that the similar fluctuation on alcohol costs is shown as derived from the first sheet which I submitted. Then in the next two columns this alcohol is interpreted into gasoline blend, and you will see, coming to the third column from the right, that the net increased cost of the fuel, (of the mixed blend) per gallon is shown, and you will see that that varies from 0.92 cents to, in the worst year, 2.92. In this table I have given a half a cent compensation to the blend for increased octane rating.

Senator CLARK. Increased what?

Dr. JACOBS. Increased octane rating. There is a possible additional half cent securable from that source. On the other hand, there may be a half cent additional distribution cost on the alcohol itself, so I ignored those two as more or less canceling each other for the purpose of this representation.

(The table referred to is as follows:)

Probable cost of a power alcohol program for the period 1930–37

Year	Taxable gallons of gasoline consumed	Corn (bushels harvested as grain)	Corn (average price received by farmers)[1]	Relative alcohol cost from such corn [2]	Gasoline cost [3]
			Cents	*Cents*	*Cents*
1930	14, 751, 309, 000	1, 757, 238, 000	59. 6	.360	.1615
1931	15, 407, 650, 000	2, 230, 125, 000	32. 0	.276	.1298
1932	14, 250, 173, 000	2, 576, 407, 000	31. 9	.275	.1330
1933	14, 224, 321, 000	2, 103, 308, 000	52. 2	.337	.1241
1934	16, 136, 137, 000	1, 146, 884, 000	81. 5	.425	.1368
1935	17, 160, 339, 000	2, 015, 007, 000	65. 5	.377	.1355
1936	19, 011, 552, 000	1, 253, 766, 000	104. 5	.483	.1410
1937 [4]	21, 208, 977, 000	2, 343, 258, 000	55. 1	.348	.1458
Total					

[1] Season average price received by farmers, not Chicago price. Weighted average. Average of 8 years 60.3 cents per bushel.

[2] Table A price plus 2 cents freight (basis tank cars alcohol at service stations, but without margin to distributors), average 36.

[3] Retail average for United States, exclusive of tax, service station (60 cities). It should be noted that the distributor margin is included in this figure.

[4] 1937, estimates only.

Probable cost of a power alcohol program for the period 1930–37—Continued

Year	Producing cost of a 10-percent blended fuel per gallon [1]	Net increased cost of fuel per gallon	Increased national motor cost if entire gasoline had been a 10-percent blend	United States revenue received during period (potentially lost if 1-cent tax had been removed on entire gasoline
	Cents	*Cents*	*Dollars*	*Dollars*
1930	.1764	1.48	218,319,373	147,513,090
1931	.1394	.96	147,913,440	154,076,500
1932	.1422	.92	131,101,591	142,501,730
1933	.1404	1.63	231,856,432	142,243,210
1934	.1602	2.38	384,040,060	161,361,370
1935	.1647	1.92	329,478,508	171,603,190
1936	.1702	2.92	555,137,318	190,115,520
1937 [2]	.1610	1.52	323,376,450	212,089,770
Total			2,320,223,175	1,321,504,580

[1] Credit of 0.5 cent per gallon allowed for increase in octane rating.
[2] 1937, estimates only.

Senator CONNALLY. Well, Doctor, on this other page that you have got here, you show that if the farmers get the munificent sum of 10 cents a bushel of corn the alcohol still costs 18.63 cents a gallon made from that corn, is that right?

Dr. JACOBS. That is right.

Senator CONNALLY. What does gasoline cost, wholesale?

Dr. JACOBS. Five cents.

Senator GURNEY. That cost is where?

Dr. JACOBS. That is at the refinery.

Senator GURNEY. That is the quotation f. o. b. Tulsa?

Dr. JACOBS. Wherever the refinery is.

Senator GURNEY. The market is based on Tulsa prices; am I not right in that?

Dr. JACOBS. What I was considering was in any case both of these were based on refinery prices, so they would be equivalent at any point.

Senator GURNEY. What is the cost of gasoline say at Omaha, Nebr.?

Dr. JACOBS. I do not understand the question.

Senator GURNEY. What is the cost of gasoline when it is shipped to Omaha, Nebr.?

Dr. JACOBS. I hesitate to answer some of those questions that concern marketing.

Senator GURNEY. Do they figure the transportation cost?

Dr. JACOBS. Generally the service station price of gasoline has been running at about 14 cents.

Senator GURNEY. Without tax?

Dr. JACOBS. I am discounting tax in any case. The difference between 5 cents refinery price and 14 cents is of course the handling, margin to the retailer, and expense of that character.

Senator CONNALLY. You have got to transport this alcohol?

Dr. JACOBS. That is right.

Senator CONNALLY. Your prices are made on the basis of refinery prices in both cases, is that true?

Dr. JACOBS. In this case I have used the service station price on gasoline. You will notice the gasoline cost does run from 16 to 12.98, 13.3, 12.41. I took those figures from the American Petroleum

Institute records, and those are the prices received at service stations in 50 cities. I simply used those for comparison.

Senator CONNALLY. They include, of course, all the handling commission?

Dr. JACOBS. They include all the handling commission.

Senator CONNALLY. Your figures on alcohol are made at the factory?

Dr. JACOBS. They are made at the factory.

Senator CONNALLY. They do not include the distributor's margin?

Dr. JACOBS. No.

Senator CONNALLY. Exactly.

Dr. JACOBS. That is stated there.

Senator CONNALLY. If it would be fair to take the alcohol at the still it would also be fair to take the price of gasoline at the refinery, would it not?

Dr. JACOBS. Possibly.

Senator CONNALLY. There is no "possibly" about it. Is that true or not true? What is there about gasoline that makes it propel itself over the United States to the point of distribution without any cost, and you do charge for gasoline?

Dr. JACOBS. Of course, you can ship gasoline, for example, in pipe lines, and at the present time there are no alcohol pipe lines.

Senator CONNALLY. It costs something to do it that way.

Dr. JACOBS. It costs something to do it that way, but it is less than the freight would have to be.

Senator CONNALLY. That would make the alcohol cost still more then.

Dr. JACOBS. I took that into consideration in my statement that I only allowed a half a cent increase in the octane rating, because the other half cent offset the additional cost. I tried to bring these down to a comparable basis.

Senator CONNALLY. I am sure you have. That is the reason I am bringing it out. If I did not think you did, I would not ask the question. What is corn selling at now?

Dr. JACOBS. I haven't any recent figures on that. The last I heard it was 40 cents.

Senator GURNEY. It is 35 cents up in our country.

Senator CONNALLY. About 35 cents. On the basis of 35-cent corn, according to your table here, the alcohol would cost 26.40?

Dr. JACOBS. Yes.

Senator CONNALLY. In other words, it would cost 26 cents a gallon, as against 5 cents a gallon for gasoline at the refinery.

Dr. JACOBS. That is right.

Senator GURNEY. May I ask a question?

Senator CONNALLY. Go ahead.

Senator GURNEY. Gasoline is refined, as a general rule, in Texas and Oklahoma, but it is consumed all over the country. That is right, is it not?

Dr. JACOBS. Yes.

Senator GURNEY. If an alcohol plant were operating, say, at Waterloo, Iowa, and the alcohol was available at Waterloo, then you would have to compare the costs between alcohol and gasoline, and would have to, therefore, add transportation on the gasoline to Waterloo, would you not?

Dr. JACOBS. That is perfectly true for Waterloo.

Senator CONNALLY. Exactly. If all of it was used at Waterloo, that would be true; if all of it was used at Waterloo that might work.

Dr. JACOBS. That would be true. On the other hand, if you were selling a blend at some point in Texas which was quite remote from an agricultural area, or from an alcohol plant, and you had to transport the alcohol to that point, then the situation would be reversed.

Senator CLARK. Senator Connally does not admit that there is any point in Texas that is remote from transportation.

Senator GURNEY. Have you any information about an alcohol plant being proposed at Lubbock, Tex.?

Dr. JACOBS. I merely know there has been some rumor in the press that there is such a development under consideration.

Senator GURNEY. I do not have any definite information, so I just asked you that question.

Senator CONNALLY. It is not here asking for this bill, at least. You have not heard from them as advocating this bill.

Senator. CLARK. Have you finished with your questions?

Senator CONNALLY. I am going to ask one or two. Senator Gurney said, or implied, at least, that nearly all the gasoline in the United States was refined in Texas and Oklahoma. Are not there refineries in Pennsylvania? Are not there refineries in New Jersey—big ones—at Bayonne, N. J.? Are not there big refineries in Illinois? Are not there refineries in California? Are not there refineries in Kansas, and are not there refineries all over the United States? So all the gasoline does not have to be shipped from Texas or Oklahoma, either one. Here is one little plant at Atchison and it busted. They would have to ship whatever alcohol they produced all over the United States, unless other plants came into operation. A busted plant is not a very great inducement to a businessman to go into an industry of this kind.

Senator GURNEY. It is not busted.

Senator CONNALLY. Under this bill the Government would lose the tax of 1 cent a gallon, and on 35-cent corn—let us see what it is. The gasoline costs, that is the blend, are 26.40 cents. One-tenth of that would be 2.64 cents per gallon, and if gasoline is 5 cents, nine-tenths of it would be 4.50 cents. That would make gasoline cost 7.14 at the refinery, and considering no freight at all on the alcohol. So the consumer would pay at least 2.14 cents more than he would otherwise pay for his gas, for power. The Government would lose a cent, so somebody would be out-of-pocket 3.14 cents per gallon, would they not?

Dr. JACOBS. On your basis; yes.

Senator CONNALLY. Is not that basis right? I have figured it here, you heard me figure.

Senator CLARK. That is not the basis set up in this table.

Senator CONNALLY. I am not asking him that. He has got his own table and I have got a table of my own. I am asking him if that is not right.

Dr. JACOBS. I would just like to point out one thing, and that is this: After all, this is a very complicated thing which cannot be definitely interpreted by rule for any geographical point. That is the reason I have set down the generalities rather than the specific instances.

Senator CONNALLY. Of course, I understand that.

Dr. JACOBS. I would like to state that in the preparation of this table I had not the intention of trying to show conclusively what the alcohol costs were. It was my intention to approximately show to this committee about what the magnitude of the sums involved would be if you carried a chain of reasoning through to its conclusion. I will ask the clerk if he will submit the third page in which I have done that.

(The table referred to is as follows:)

Cost of a power alcohol program based on use of 15 percent of corn crop for the period 1930-37

Year	15 percent of the corn crop was (bushels)	Gallons alcohol producible from such corn (at 2.3 gallons per bushel)	Revenue on motor fuel represented	Increased cost to motorists
1930	263,585,700	606,247,110	$60,624,711	$89,724,572
1931	334,518,750	769,393,125	76,939,312	73,861,740
1932	386,461,050	888,860,415	88,886,041	81,775,158
1933	315,496,200	725,641,260	72,564,126	113,279,525
1934	172,002,600	395,606,980	39,560,598	94,154,223
1935	302,251,050	695,177,415	69,517,741	133,474,063
1936	188,064,900	432,549,270	43,254,927	126,304,386
1937	351,488,700	808,424,010	80,842,401	122,880,450
Total			532,189,857	840,454,117

NOTE.—For the period 1933 (part year) through 1935, inclusive, rental and benefit payments by the Federal Government, to farmers, on carbohydrate crops was as follows (Agricultural Statistics, 1938, p. 432)

Corn	$222,000,000
Wheat	315,000,000
Rice	10,000,000
Sugar beets	31,000,000
Sugarcane	12,000,000
Total	590,000,000

In the years 1936-37 gross payments were made on a general program, without specific break-down.

Senator CONNALLY. Let me ask you right there, before you go any further. Would not it be much fairer and more just if the Government would give directly to the alcohol producer a bounty, say, of 1 cent a gallon, just pay it to him and let him do what he pleases with it?

Dr. JACOBS. You mean a cent a gallon on the blend?

Senator CONNALLY. No.

Dr. JACOBS. You would have to give him 10 cents a gallon on the alcohol in order to arrive at the same figure.

Senator CONNALLY. I am not talking about that; what I am talking about, would it not be fairer and more just to give him the straight bounty of a cent, or whatever it is, rather than to try to force the thing on the automobiles by taxing everybody, by taxing these farmers and other farmers as well?

Dr. JACOBS. Of course, there are several ways in which this can be done. My chief objection, if I might go so far as to state an objection, would be that the farmer himself will secure only a reflected benefit in all of this, he will not receive a direct benefit. At the start, and for a great many years, the benefits which the farmers will derive through this proposal will be limited to the larger growers of the more concentrated raw materials, such as corn and wheat. The other smaller farmers will be unable to really participate in this material supply to any great degree.

Senator CONNALLY. They will participate in paying the higher costs, though, will they not?

Dr. JACOBS. If they buy it.

Senator CONNALLY. Unless they walk.

Dr. JACOBS. They can still buy the other fuel, Senator.

Senator CONNALLY. I am talking about buying this. If they do not buy it, the farmer himself will not get any benefit, the wheat and corn men will not get any benefit unless somebody buys the blend. The whole theory is based on the fact that they are going to make alcohol and somebody is going to buy it. If they do not buy it, it does not do the farmer any good that raises the raw materials, and if they do buy it, then every other farmer and every other consumer pays an increased cost, is that not true?

Dr. JACOBS. That is true.

Senator CONNALLY. It is claimed by the proponents of this bill that they can make this alcohol from 50-cent corn for 20 cents a gallon. Is that true?

Dr. JACOBS. Let me answer it this way: There is no such thing as an exact cost of producing alcohol. It is all a purely relative matter, as to how much you can get in a given instance on a given date for your alcohol, for your byproduct, and how much you pay for the raw materials at that time from which you made the alcohol. It is a fluctuating matter that goes all over the map.

Senator CONNALLY. They assume that they can make from 50-cent corn 20-cent alcohol. Your table shows that from 50-cent corn it costs 31.10.

Dr. JACOBS. I will show you just how a figure like that can be arrived at. On page 56 of my bulletin, I have shown a cost figure for producing alcohol under present conventional processes, using 10-percent malt, based on the average plant as it exists today, and conditions as they exist today, no futurities in this at all, it is just based on existing conditions, on the existing situation.

Senator RADCLIFFE. Doctor, what would you list as the chief variables in the cost of production of alcohol, in addition to the cost of corn?

Dr. JACOBS. The first variable is the cost of corn. The second variable is the value which you will get from the byproduct. I was about to illustrate that from this table. On page 56 of this pamphlet, I break down the costs into, first, conversion costs, which I indicate as 7.5 cents. Obviously if you were going to make a grade of alcohol which could be very poor in quality—I am speaking now concerning odor and taste, you are not concerned with that—you can cut down the capital cost of the plant, you may be able to cut down the labor cost, you may be able to make other changes there and come out at a cent or a cent and a half lower. That is one of the things we plan to experiment with in the regional laboratory. But on the basis of my own figure, suppose you take a cent and half off on that point, and then suppose again that instead of getting 85-percent recovery you get 90-percent recovery, which is possible under certain conditions, there is another if, that would be 3 cents more you can take off. I have assumed in this computation that you get three-quarters of a cent net credit for the feed residue, per pound. Supposing a plant was fortunate enough to get 1 cent, or a cent and a quarter, again your values would change and increase. Therefore, your net net

would already come down perhaps 7 cents at that point. Then if they are fortunately situated, that is, if the Government permits them to use a denaturing formula which can be used less expensively than the one I have indicated, there is another cent there. And so on. If you get a series of ifs you can bring those costs practically down to 20 or 22 cents from corn around 50 cents. I do not say any plant can do it today, but it is possible. It might be done some day, there is no gainsaying that. My figures are based on the theoretical proposition that I am assuming flatly 85 percent recovery. In my own experience I have seen plants that do better than that, especially on corn. They would more likely do 90.

I would like the committee to understand clearly that the set-up of costs as illustrated there is intended to be exactly what it says, a definite recovery under present conditions only at a fixed 85-percent efficiency.

Senator RADCLIFFE. Why should there be so much difference in the use and value of the byproduct?

Dr. JACOBS. I do not believe I heard that clearly.

Senator RADCLIFFE. Did not you tell me just a moment ago it depends entirely upon what use you make of the byproduct? I say, why should there be such a variation in use and value of these products? I was trying to follow out the situation. You said a while ago it depends on what you can do with the byproducts, what you can get out of them. I wondered why there should be so much doubt in regard to that.

Dr. JACOBS. Take the market on stock feeds. There are literally dozens of different varieties on the market. Every one of these agricultural processing industries, working on agricultural materials, are producing these residue materials, and are trying to sell their material in the animal feed market. You have linseed meal, cottonseed meal, soybean, and many others. The breweries have been selling their spent grain for years, the distilleries have been selling their grain for years, and the price of such material has fluctuated widely, and a lot has been based in the past on purely arbitrary standards. Nobody has gotten down to make an exact study as to how far one feed is superior to another. It depends altogether on the availability of the protein or the nutritive value.

In our bulletin, in order to arrive at some basis for comparison, we adopted the idea that in the last analysis a farmer is hardly likely to haul his corn to an alcohol plant and then haul back feed, when he would pay more in the long run than his corn was worth to start with. In other words, if I were a farmer, under a situation like that, I would probably feed the corn directly to the stock and forget the alcohol plant.

So we took as the basis for our figures the feeds at the value of the original grain less a dollar and a half for handling, which we thought was fair. I have talked to alcohol manufacturers on this question. A great many of the alcohol manufacturers only recover the solid portion of their byproduct feed because of the expense connected with recovering the thin slop, as we call it, and the price of the feeds in past years has fluctuated to points where in some years they have not recovered it at all, while in other years they recovered it and received good prices.

Senator RADCLIFFE. You would not say there has been any stabilization in the use of byproducts in the last few years?

Dr. JACOBS. Absolutely not. It is an open market. A good selling organization would make an entirely different return out of the same feed than a poorer selling organization would that perhaps is not situated as advantageously. One of the factors that we have looked at with a great deal of question is the fact if you bring about an industry of this kind—not that we are in any way against an industry of this kind, but unless the thing is done according to a program, so as to equalize all these thousand and one points which will require equalization I think in the long run it is just going to be such a snarl of cross purposes, that, especially at the start, there is going to be a lot of money lost, a lot of lost motion and inefficiency, which I think might be avoided if the thing was done on a planned basis. As the Senator said, if we have a plant at Lubbock, Tex., trying to do one thing, one at Atchison doing another, and one some place else trying to do another, the more you intensify that situation the more trouble you are going to have as those plants come into each other's areas.

Senator GURNEY. How would you get uniformity in matters of that kind?

Dr. JACOBS. That, I am afraid, is beyond me.

Senator CONNALLY. On that point, as I understood your suggestion a while ago, that is a problem that really requires a great deal of research and investigation by the Government, an impartial agency. If that course were followed, and if it proved successful, then all these plants of course could follow along and take the suggestion as the result of that research.

Dr. JACOBS. Precisely.

Senator CONNALLY. Your point is that one going one way and another one another way is not going to be a very helpful approach to this problem.

Dr. JACOBS. It is going to be a very difficult thing to try to control this on its present basis. My remark merely simmers down to this, that I think before this is opened to a lot of haphazard trial and error, as an alternative it might be possible to consider trying to plan an economy and bring the situation about.

May I, to follow up that line of thought, conclude what I started to do with these sheets a minute ago? I wanted to show you in the last sheet that if—now, this is merely an if, based on the last 8 years—if we had taken 15 percent of our corn crop, which is about the maximum you can take without disturbing the price—and all my arguments have been based on taking it only up to the point where we would disturb the corn price, I have not gone beyond that speculative point—but based on 15 percent of the corn crop in the past years, the situation would have been about as I show you in this table. Assuming you would have had the taxes in existence over that period, which you actually did not, the Government would have lost an income of $532,000,000 plus in revenue, based on the 1 cent a gallon exemption proposal. On the other hand, as I show you in the notes down there, during the period of 1933 to 1935 the Government spent on agriculture approximately an equivalent amount.

Senator CONNALLY. In other words, according to your figures then, agriculture got back what the whole country paid on the gasoline. Is that what you mean?

Dr. JACOBS. It might be stated that way. It is not exactly true.

Senator CONNALLY. Let me ask you, whenever any industry, whether it is alcohol, or gas, or clothers, or food, or anything else, whenever an industry cannot support itself and cannot make a go of it, according to the natural laws of production and economy, does it do anybody any good except the fellow that is getting the subsidy?

Dr. JACOBS. At no time, Senator, have I stated, as far as I can recall, that it is my present belief that a subsidy is the proper way to do this.

Senator CONNALLY. I know you have not, but I am speaking now generally. If you are going to start out to make a new product, unless you make that new product more economic and reduce the cost of it to the consumer who is using some other product at present, you are not serving any economic or useful purpose, are you, by developing that project? I am talking about the general welfare, all of us, everybody. I will not press you.

Dr. JACOBS. A question like that is largely speculative. I was always personally in favor of an industry standing on its own feet.

Senator CLARK. We have had a good many industries in the country that have existed for a good many years behind a subsidy in the form of a protective tariff.

Senator CONNALLY. That is very true, Senator, there is no argument about that.

Dr. JACOBS. This whole matter of subsidy is very complicated.

Senator CLARK. I think it is bad economics to permit that condition to exist, but nevertheless it did exist.

Senator CONNALLY. We put the tariff on to protect the domestic product. According to this testimony they are not forced to buy one or the other. I do not believe I care to ask the witness any more questions.

Senator GURNEY. I would like to suggest that these schedules that Dr. Jacobs has submitted be printed in the record in full.

Senator CLARK. They have been included in the record.

Dr. JACOBS. In putting them into the record, they should be put in so as to show they are estimates only, intended to illustrate a certain point, and not as being final.

Senator CONNALLY. On page 125 of your report you say:

> Production of motor fuels from agricultural materials would entail economic adjustments and present legal and sociological problems. It would also greatly increase costs of Government administration and control of alcohol, although regulatory difficulties might perhaps be minimized by using an impure grade of alcohol. A suitable denaturant must be found.

That is correct, is it not?

Dr. JACOBS. That is correct.

Senator CONNALLY. As a matter of fact, we have an alcohol administration now that looks after all the alcohol that is produced, do we not?

Dr. JACOBS. Yes.

Senator CONNALLY. Industrial or beverage, or any other kind?

Dr. JACOBS. Industrial or beverage.

Senator CONNALLY. So if we adopted any measure of this kind, it would vastly increase the number of inspectors and agents and snoopers that Senator Clark was so anxious to get rid of under the eighteenth amendment?

Senator CLARK. There are a lot of different kind of snoopers. I do not know that the net result was getting rid of them.

Senator CONNALLY. I am not complaining, but it would entail maintaining a great many more Government "flunkies."

Dr. JACOBS. It would entail a big increase in personnel. I would not say "flunkies."

Senator CONNALLY. I withdraw the "flunkies." It would require more agents, both in the tax end of it and in the control of the alcohol, to keep from diverting it into beverage uses. Of course, corn alcohol is as good alcohol as anybody ever made, is it not?

Dr. JACOBS. It has been considered as such.

Senator CONNALLY. Right during prohibition days the choicest liquor was made from bootleg corn liquor.

Dr. JACOBS. I believe so.

Senator CONNALLY. I am asking you as a scientist, not as a layman. So it would entail a large supervisory force, both in the alcohol control end of the Government's activities and in the tax collecting end; is that true?

Dr. JACOBS. Also in the regulation of the highway reports.

Senator CONNALLY. It would take more highway patrolmen, too, would it not? As a matter of fact, would not they have to go around and check up every little jerkwater filling station in the country every once in a while to see it was not bootlegging this gasoline?

Dr. JACOBS. That is precisely why I stated a while ago that I thought this thing, if done, should be done on a planned basis, the plan would take into consideration factors of that kind; otherwise I am just afraid the result is going to be a considerable amount of grief. Some plants may be able to run and a lot of other plants will unquestionably fall by the wayside.

Senator CONNALLY. Mr. Chairman, I was not here the other day. Did the Treasury report on the bill?

Senator CLARK. The letter from the Secretary of the Treasury has been inserted in the record, and a representative of the Treasury appeared before the committee. Mr. Keefe, do you desire to make a statement?

STATEMENT OF THOMAS J. KEEFE—Resumed

Mr. KEEFE. Mr. Chairman, and members of the committee, I want about 3 or 4 minutes to offer some rebuttal.

Senator CLARK. Will you identify yourself for the record?

Mr. KEEFE. My name is Thomas J. Keefe, general manager, American Motorists Association, a consumer group.

Senator CLARK. Why are they consumers? What do they consume? You call it the Motorists Association. What do they consume?

Mr. KEEFE. In his testimony Dr. Christensen stated——

Senator CLARK (interposing). I am curious about it. How does it get to be a consumers organization?

Mr. KEEFE. Well, it is a consumers' organization, Senator, in that they would have to purchase this proposed alcohol blend if these proposals were enacted into law. While it would only be optional, it is

my personal opinion it is only a matter of time that this optional legislation, if enacted, would be an entering wedge to make it compulsory.

In his testimony Dr. Christensen stated that Dr. Bridgemen of the National Bureau of Standards in an address before the American Chemical Society in April 1936 ruled out the findings on alcohol blends of the American Automobile Association tests in 1933, and also indicated that 10 percent blends give 8 percent better mileage, and that they are definitely a superior fuel to gasoline.

I quote the opening statement in the summary of Dr. Bridgeman's paper before the 1936 Kansas City meeting of the American Chemical Society:

> Blends containing ethyl alcohol have no material advantage over gasoline as motor fuels, although they can be utilized satisfactorily if full advantage is taken of the available technical information.

It is a fact that Dr. Bridgeman's paper does not confirm Dr. Christensen's statement as to the superiority of 10 percent alcohol blends nor the 8 percent greater mileage claimed for them.

This observation is predicated upon an interview I had subsequent to Dr. Christensen's testimony with Dr. Bridgeman; to wit, on Saturday, May 27, 1939.

At that interview, Dr. Bridgeman reaffirmed "that blends containing ethyl alcohol had no material advantage over gasoline as motor fuel."

In a letter from Milo Perkins, of the Federal Surplus Commodities Corporation, to Senator Reed, dated February 18, 1939, which was referred to by the witness Fox, it is shown that corn would have to be purchased at 28 cents per bushel to allow the Atchison Agrol plant to operate on a moderately profitable basis. Yet Dr. Christensen testified that it was possible to pay 50 cents per bushel at the distillery and to produce alcohol from that corn to sell for 20 cents per gallon. Knowing these facts, Dr. Christensen failed to explain this difference of 22 cents in raw material costs.

Also, since Dr. Christensen testified I have learned that officials of the Atchison Agrol Co. on two occasions, namely, January 20 and February 5, 1939, were denied by the Board of Directors of the Reconstruction Finance Corporation the several applications for a Government loan in the amount of $220,000.

Senator CLARK. There are a lot of other applicants for R. F. C. loans in that regard, are there not?

Mr. KEEFE. That is true, Senator.

Senator CONNALLY. That does not prove that all of them ought to be granted, does it?

Mr. KEEFE. I believe not.

Mr. Chairman and members of the committee, in conclusion it is interesting to note that none of the great farm organizations, namely, the National Grange, Farm Federation, or the Farmer's Union has endorsed the proposals before you.

I ask you distinguished gentlemen of the committee to report against both proposals.

Thank you very much.

Senator RADCLIFFE. Mr. Keefe, what is the attitude of the farm organizations to which you have referred? You say none of them have appeared for it. Do you want to express an opinion of your own?

Mr. KEEFE. I would rather not, Senator, for the reason that I did not have time to confer with the officials of the various organizations. However, it is significant to me that they have not appeared here to support the proposals.

Senator GURNEY. They have not appeared either for it or against it.

Mr. KEEFE. That is true.

Senator CONNALLY. There has been no testimony from them.

Mr. KEEFE. No.

Senator CLARK. Thank you. Senator Gurney, do you have something to insert in the record?

Senator GURNEY. Mr. Chairman, I have no desire to hold the committee here for a long time, or request the committee to extend these hearings for any more days. I would like to finish it up today, unless the committee wants to call more witnesses.

I would like to call Dr. Christensen for about a 1-minute statement, in reference to a telegram I received on Saturday afternoon from Lincoln, Nebr. It is signed by Frank L. Robinson, who had been active in the promotion of power alcohol. The telegram reads:

Power alcohol bill passed this morning for enrollment and review 20 to 9.

I would like to request that Dr. Christensen be called to just testify on what that bill is before the Nebraska Legislature. It is a very short statement.

Senator CLARK. Doctor, will you come forward?

STATEMENT OF DR. LEO M. CHRISTENSEN—Resumed

Dr. CHRISTENSEN. Mr. Chairman.

Senator CLARK. Dr. Christensen.

Dr. CHRISTENSEN. Senator Gurney, would you like to have me introduce the letter and the copy of the bill?

Senator GURNEY. I would like to have you do that, but for the benefit of the committee here, I would like you to state in a few words what the bill is.

Dr. CHRISTENSEN. Perhaps I can do it better by reading it than in any other method.

Senator GURNEY. All right.

Dr. CHRISTENSEN. The bill, as acted upon on last Saturday, came up for first reading. It will have two other votes before it is finally passed by the legislature. I understand the third reading is scheduled for Tuesday or Wednesday this week, tomorrow or the next day.

I shall read the amendment to the existing bill. In other words, this is the bill as introduced:

No person, firm, or corporation shall manufacture, have in possession with intent to sell, offer, and expose for sale, sell, or deliver any motor vehicle fuels which do not conform to the following requirements: It shall be free from water and impurities. One hundred cubic centimeters of a sample shall be distilled in the manner recommended by the American Society of Testing Materials (A. S. T. M.), and must conform to the following Nebraska specifications for motor vehicle fuels as follows: 1. Ten per centum of the sample must be distilled and recovered at a temperature below 167 degrees Fahrenheit; 2. Fifty per centum must be distilled and recovered below 284 degrees Fahrenheit; 3. Ninety per centum must be distilled and recovered below 392 degrees Fahrenheit; 4. The end or dry point of distillation must be not higher than 437 degrees Fahrenheit.' (b) All motor vehicle fuel, except for use in aircraft sold in the State of Nebraska after January 1, 1940, shall contain a blend of not less than 10 per centum, by volume thereof, of ethyl alcohol manufactured from agricultural

products produced wholly within the United States: *Provided*, That, until the supply of ethyl alcohol is sufficient to provide the required minimum blend of 10 per centum, the department of agriculture and inspection is hereby ordered to require a blend containing 5 per centum of such alcohol, but if there should not be available a sufficient quantity of ethyl alcohol for a blend containing 5 per centum of such alcohol, then the administration of subsection (b) of this section shall be held in abeyance until such ethyl alcohol is available as found by the director of the department of agriculture and inspection; and *provided further*, if and when the price of ethyl alcohol used and employed in such blend shall exceed 25 cents per gallon, exclusive of taxes; the director of the department of agriculture and inspection shall hold in abeyance the administration and enforcement of subsection (b) of this section until such time as the price of said ethyl alcohol shall reach the level of 25 cents or less per gallon; and *provided further*, the administration of the provisions of subsection (b) of this section shall be held in abeyance until such time as the director of the department of agriculture and inspection shall find that there is a sufficient quantity of ethyl alcohol which is available for the blend containing at least 5 per centum of said alcohol, as aforesaid, which is manufactured in plants located within the State of Nebraska.

SEC. 2. If any clause, sentence, paragraph, or part of this Act shall for any reason be adjudged by any court of competent jurisdiction to be invalid, such judgment shall not affect, impair, or invalidate the remainder thereof but shall be confined to its operation to the clause, sentence, paragraph, or part thereof, directly involved in the controversy in which such judgment shall have been rendered.

SEC. 3. That said original section 66-306 (Comp. St. Supp., 1937) is hereby repealed.

3. Amend the bill (cited above in amendment 2) page 1, title, line 2, by striking all of said title after the word "Act" and by inserting in lieu thereof the following: "to amend section 66-306 (Comp. St. Supp., 1937) relating to motor vehicle fuels and specifications thereof; to require that all motor vehicle fuels sold in the State of Nebraska after January 1, 1940, shall contain an alcohol blend of not less than 10 per centum of ethyl alcohol manufactured from agricultural products produced wholly in the United States; to provide that until the supply of ethyl alcohol is available to provide said 10 per centum alcohol blend, the department of agriculture and inspection shall find that there is a sufficient quantity of ethyl alcohol available for said 5 per centum alcohol blend manufactured in plants located within the State of Nebraska; to provide that if and when the price of ethyl alcohol used or employed in such blend shall exceed 25 cents per gallon, the enforcement and administration of subsection (b) of section 1 of this Act shall be held in abeyance until such time as the price of said ethyl alcohol shall reach the level of 25 cents or less per gallon; to provide a validity clause; and to repeal said original section."

Senator GURNEY. What would be the effect of it?

Dr. CHRISTENSEN. The bill essentially says this, as I understand it: If on January 1, 1940, there are sufficient power alcohol plants within the State of Nebraska to produce alcohol sufficient for a 5 percent blend and offering that alcohol at 25 cents a gallon, then it shall be mandatory upon all who sell gasoline within the State to purchase that amount of alcohol and blend it and sell the blends within the State. If there is enough available for 10 percent blend, then it shall be 10 percent. If there is not enough for a 5 percent blend, then none need be added.

Only plants within the State can qualify, and they can qualify only if they offer the alcohol at 25 cents or less per gallon f. o. b. plant, exclusive of taxes.

What it does is, in effect, to say if and when the plants are built that the alcohol produced must be used in the State up to a maximum of 10 percent. In other words, it is a mandatory law.

Senator GURNEY. The alcohol content of the motor fuel will be exempt from the Nebraska State tax?

Dr. CHRISTENSEN. Yes; that exemption was provided in the law of 1935, that the alcohol produced from crops grown within the continental limits of the United States, suitably denatured and a suitable

quality, is exempt from the payment of the State motor-vehicle tax, which is now 5 cents per gallon.

Senator GURNEY. Thank you, Doctor.

Dr. CHRISTENSEN. I will submit this letter for the record.

Senator CLARK. The letter may be printed in the record.

(The letter referred to is as follows:)

NEBRASKA STATE LEGISLATURE,
Lincoln, Nebr., May 27, 1939.

Hon. CHAN GURNEY,
United States Senator, Washington, D. C.

DEAR SENATOR GURNEY: I have your telegram of the 27th and this is to confirm that my LB 1, which is the power alcohol bill, passed on general file with a vote of 23 to 11, 9 not voting. There was a lot of discussion; in fact, we were on it about 5 hours. Enclosed is a copy of this bill.

We have a law here in Nebraska exempting all of the State tax on power alcohol used for motor fuels. It is State-wide. I think that the sooner we get a lot of these manufacturing plants in the United States the better off we will be. My idea is to make the exemption great enough so there will be an incentive to use more gasoline blended with power alcohol, or otherwise if it can be done. We should take that 1-cent-a-gallon Federal tax and use it for the purpose of building these processing plants.

I have worked so hard on my bill that I have not had time to think of a bill that would be Nation-wide. Frankly, I think that we should have a national bill something like the one that I have proposed here in Nebraska. I think we could eliminate this thing of over-production overnight if we could get a blend of at least 5 percent in all our gasoline used in the Nation. We certainly would be traveling in the right direction.

I am sending this by airmail as I feel you will get it as soon that way as by night letter.

I would appreciate hearing from you as I know that our hearts and minds are interested in the same advancement.

Very truly yours,

FRANK SORRELL.

Senator CONNALLY. Why should anybody be exempt from taxation? Why should you be exempt and I have to pay a tax?

Dr. CHRISTENSEN. You mean that as a very general proposition?

Senator CONNALLY. On anything.

Dr. CHRISTENSEN. The only general rule I would know that could be applied in a generalization of that kind would be if there is some benefit to be obtained by offering tax exemption and the benefit justifies the tax exemption, then there is a net gain by granting it. If there is no gain, in other words, if the tax exemption does not buy its money's worth, it should not be given.

Senator CONNALLY. If the tax exemption does not react for the general welfare?

Dr. CHRISTENSEN. That is right.

Senator CONNALLY. Not for some group.

Dr. CHRISTENSEN. That is quite right.

Senator CONNALLY. This bill has a mandatory feature, does it not?

Dr. CHRISTENSEN. The Nebraska bill?

Senator CONNALLY. Yes.

Dr. CHRISTENSEN. It is mandatory.

Senator CONNALLY. That represents the view of those who sponsor this bill. Whenever they can make it mandatory all over the United States, they will make it mandatory.

Dr. CHRISTENSEN. I would like to state in that connection that there has been no organized program of promotion for this bill. It has been more or less spontaneous, having the active support of the two farm organizations within the State.

Senator CONNALLY. I do not object to Nebraska doing it. Nebraska has the birthright to do what it pleases. What I am getting at is, it represents the conception of those who are advocating this bill, that we try to propitiate you with this 1-cent tax.

Dr. CHRISTENSEN. The people who have spoken here in favor of the bill have been Mr. Wilken, Mr. Buffum, Dr. Hale, and myself. None of us has taken any active part in promoting the legislation in Nebraska.

Senator CONNALLY. Well, you are for it, though, are you not?

Dr. CHRISTENSEN. As a bill in Nebraska, if you ask my opinion, and I have been asked my opinion in Nebraska and I have said I am sure Nebraska can handle this in a practical and effective manner.

Senator CONNALLY. You are for the bill?

Dr. CHRISTENSEN. I have been asked in Iowa whether I would favor a similar bill and I have said "no," because I do not think Iowa can do it, but I think that Nebraska can. My opinion is based on a careful analysis.

Senator RADCLIFFE. Under the Nebraska bill there would be a loss, of course, in revenue.

Dr. CHRISTENSEN. That is right.

Senator RADCLIFFE. Have the proponents of the legislation in Nebraska attempted to visualize or state specifically how that would be offset, whether it would be in general benefits, or have they attempted to be in any way concrete?

Dr. CHRISTENSEN. That was in connection with the bill passed in 1935. Yes; there was a great deal of discussion about it. As a matter of fact, as I recall it, it took 2 whole days for the bill to pass, because so many people had opinions to express, but the consensus of opinion was that the benefits to the people of Nebraska from finding new, larger, and more profitable markets for farm products through the manufacture of power alcohol would far more than offset any loss of revenue. In other words, revenue from other sources would be so much greater. I might say that in Nebraska the farm income last year was only 55.5 of the farm income of 1929, the lowest record of any State in the Union.

Senator RADCLIFFE. They did not attempt to be more concrete than that, did they?

Dr. CHRISTENSEN. No. As a matter of fact, the Good Roads Association out there at that time—I happen to know the man who was representing them in Lincoln—made a rather careful study of the problem, and he told me it was their determination if this bill succeeded in bringing the power alcohol industry to Nebraska, the income from taxes on gasoline would be so increased by increased farm purchasing power, that it would far more than offset the loss from giving the exemption to alcohol. That was their analysis.

Senator RADCLIFFE. I suppose they did not attempt to give any figures on it. Did they visulaize it by figures?

Dr. CHRISTENSEN. Yes, they had to visualize it based upon figures, or call them guesses, because that is all we can do after all, but it was perfectly evident with this principle applied there would be no decrease in revenue if there was a new industry that came into existence. You could not have this condition that you would not have the industry and would still have the loss of revenue. You would not have

to pay, in other words, until you had something. How much it would be nobody knew, and neither do we know, under this bill.

Senator CLARK. Are there any further questions?

Senator CONNALLY. Yes. Doctor, about your plant, it is going out of business?

Dr. CHRISTENSEN. No.

Senator CONNALLY. It has closed down?

Dr. CHRISTENSEN. The plant is closed, but the company is selling alcohol.

Senator CONNALLY. If you had gotten a cent more a gallon for your power alcohol, could the company have made a go of it?

Dr. Christensen. A cent more for the blend?

Senator CONNALLY. One cent a gallon on every gallon of alcohol that you made.

Dr. CHRISTENSEN. One cent a gallon on the alcohol would not make much difference. One cent a gallon on the blend would have made a great deal of difference.

Senator CONNALLY. I am talking about the plant. You are in the alcohol business, you are manufacturing alcohol. If the Government, or anyone else came along and said, "We are going to let you make another cent a gallon," would it save your company?

Dr. CHRISTENSEN. That is a cent a gallon on the alcohol?

Senator CONNALLY. That is right.

Dr. CHRISTENSEN. No.

Senator CONNALLY. If you made 2 cents a gallon more, would that have saved your company?

Dr. CHRISTENSEN. That would be twice as much as 1 cent.

Senator CONNALLY. I understand that myself.

Dr. CHRISTENSEN. Evenutally you would come to the point where it would do some good.

Senator CONNALLY. I want to know how much it would have taken, how much additional per gallon you would have to get to make a success, to make a profit in this concern.

Dr. CHRISTENSEN. I should say approximately 10 cents.

Senator CONNALLY. Ten cents a gallon?

Dr. CHRISTENSEN. Yes. Not all the way through. I would say that at the start. How much it would be the second year, how much the third year, I do not know.

Senator CONNALLY. You say in Nebraska it will work and in Iowa it will not work. Does not corn in Iowa have as much alcohol in it?

Dr. CHRISTENSEN. Because the alcohol produced in Nebraska will not be made from corn, it will be made from grain sorghum, a far higher yielding, far more profitable crop for the farmers to grow in Nebraska. That distinction has got to be kept in mind. There is no established commercial market for grain sorghums in the sense that there is for corn, therefore the speculative aspect for raw material supply does not apply in the case of grain sorghums as it does in corn. Consequently there is the opportunity to avoid that fluctuation in raw-material price which Dr. Jacobs mentioned in Nebraska using grain sorghums. It does not exist in Iowa using corn.

Senator CONNALLY. How about Illinois?

Dr. CHRISTENSEN. Illinois is a corn State.

Senator CONNALLY. If it will not work anywhere but in Nebraska why not let you have the law as you have it there and let the rest alone?

Dr. CHRISTENSEN. As far as mandatory law is concerned, if I had any opportunity to give my opinion, I would not favor mandatory law in any State where there is not a raw material supply free from the speculative market.

Senator CONNALLY. That is all.

Senator CLARK. Thank you, Doctor.

Senator GURNEY. I happen to be a member of the Public Lands and Surveys Committee, and during March we had a hearing, at which time Captain Stuart, director of naval petroleum reserves, testified. I have picked out perintnent paragraphs that seem to touch on this subject in reference to petroleum reserves and the Navy's needs, and I ask these paragraphs be inserted in the record.

Senator CLARK. That may be inserted.

Senator CONNALLY. There is a lot of other testimony rebutting all that that I do not have time to put in the record, but I will not complain.

Senator GURNEY. It is the testimony of a naval officer, a Government man.

(The matter referred to is as follows:)

EXCERPTS FROM STATEMENT OF CAPT. H. A. STUART, UNITED STATES NAVY, DIRECTOR OF NAVAL PETROLEUM RESERVES, BEFORE THE COMMITTEE OF PUBLIC LANDS AND SURVEYS, UNDER DATE OF MARCH 21, 1939

Captain Stuart introduced as evidence letter written by Mr. Charles Edison Acting Secretary of Navy Department, dated February 20, 1939, containing the following paragraph:

"The conservation of such petroleum deposit is essential because the United States needs oil vitally. Now that almost every vessel of the Navy, the Coast Guard, and Merchant Marine is driven by oil, the powers conferred on the Congress by the Constitution of the United States 'to provide and maintain a navy' and 'to regulate commerce with foreign nations and among the several States', can vest be exercised by the conservation of petroleum deposits as provided in the proposed joint resolution."

Following paragraphs from Captain Stuart's direct testimony:

"The national defense of the United States, like that of every other modern nation, is dependent on an adequate supply of raw materials from which motor fuels, fuel oils, lubricants, and other hydrocarbon products can be manufactured.

"Crude petroleum in natural reservoirs is the only raw material in the United States from which it is commercially feasible and physically practical to manufacture the products needed at the present time. Insurance of a competent supply of crude petroleum to meet anticipated extraordinary demands for the national defense is, therefore, essential and imperative.

"The reserves of crude petroleum in the United States fall into two classes: (1) The industrial reserves, and (2) the governmental reserves. The known industrial reserves at present are estimated to be approximately 17,000,000,000 barrels or about 14 years' supply. The known governmental reserves at present are estimated to be anywhere from 700,000,000 barrels to 300,000,000 barrels.

"The Government can, of course, put its trust in the industry to supply the requirements for national defense in time of war as well as in time of peace. But no one knows when the industry may be unable to discover and develop reservoirs of crude petroleum as fast as it depletes them. Moreover, the industry is at all times not only producing and manufacturing petroleum products for domestic consumption, but also exports to foreign countries more than it imports. It would therefore seem to be an unwise policy to place entire dependence for the conservation of petroleum for national defense on the industry alone.

"The last war gives an example of the folly of depending entirely on industry for reserves. Although the industry found it profitable to supply petroleum to the warring nations and to manage to pull through successfully, at the end of the war stocks of petroleum were depleted the world over and there impended a serious shortage. This was a 4 years' war, not nearly so mechanized as the next one is likely to be. It is doubtful if the oil companies could have met the petroleum demands of a fifth year in the last war.

"The total known oil reserves of the United States as of January 1, 1939, are estimated to be about 14,350,000,000 barrels or a little less than 12 years' supply at the 1938 rate of production, 1,200,000,000 barrels. The American Petroleum Institute gives a figure of 17,348,000,000 or about 14 years' supply. It is evident then that, even though demand for our oil does not increase in the future, new discoveries aggregating approximately 1,200,000,000 barrels yearly must be made unless this comparatively small backlog of unproduced oil in known fields is going to be called upon to furnish part of our needs. In 1938, 27,149 wells were drilled for oil and gas of which number 19,121 produced oil, 1,985 produced gas, and 6,043 were unproductive. Of the 19,121 oil wells drilled in 1938 but 115 represented wells which discovered new fields adding to our domestic supply and 18,996 were drilled in connection with the further development of known oil fields. On January 1, 1939, the average oil well in the United States was producing at the rate of 9.16 barrels daily, the 359,045 producing wells having a daily production of a little less than 3,300,000 barrels."

Senator GURNEY. Then I would like to, with the chairman's permission, read a letter from the Farmers Union State Exchange, from Omaha.

Senator CLARK. Very well.

(The letter was read by Senator Gurney as follows:)

MAY 26, 1939.

Hon. CHAN GURNEY,
United States Senate Chamber,
Washington, D. C.

DEAR SIR: We notice in the news dispatches where an official of the Treasury Department, testifying before a Senate committee, stated that the use of alcohol in gasoline would result in unlimited bootlegging as the alcohol could easily be removed with water.

This man is either prostituting his position by promoting the false propaganda of the enemies of Agrol or he is so ignorant that he should not be holding a public position of trust that permits him to falsely influence legislation.

The only thing true about his statement is that the alcohol can be separated from the gasoline with water, but he fails to state that the denaturent used in the alcohol makes it impossible to use it as a beverage and that the formula for this denaturent is approved by the Treasury Department.

For your further information the Farmers Union State Exchange during 1938 marketed about 2½ million gallons of gasoline blended with Agrol through local cooperative oil associations in Nebraska and there is no record of any of it ever having been separated and used for beverage purposes.

Our farmers, however, did find that they got more power, increased mileage, and cleaner motors while trying to help pioneer an industry that can convert the product of their surplus acres into a product that will help provide the power for running their farms.

The writer believes that the Secretary of the Treasury, in the interest of truth and decency, without any question of the farmers' interests in the matter, should repudiate the testimony of this employee.

Very truly yours,

FARMERS UNION STATE EXCHANGE,
GEO. E. KINNEY,
Gasoline and Oil Department.

Senator GURNEY. I have a few telegrams here, one from Lincoln, Nebr., dated May 27, signed by the Nebraska Farm Bureau Federation, E. F. Winters, executive secretary. It reads as follows:

We strongly favor Federal-tax exemption on alcohol blends. Alcohol to be made from domestic grown crops.

I have one of the same date, from the Indiana Farm Bureau, Inc., Hassil E. Schenck, president. It reads as follows:

Urge support and passage bill to exempt, from Federal motor-fuel tax, 10-percent alcohol blend with gasoline. Tests prove it superior fuel. General usage would be great factor solving farm surplus problem.

In the testimony last Thursday, Dr. Christensen handed to the stenographer a booklet he had written on the possibility of making power alcohol from corn, and I sure would like to have that booklet printed in the evidence, if it can be done.

Senator CONNALLY. Mr. Chairman, we heard Dr. Christensen for 2 days here. I do not see why we should drag a publication of his in here and put it in the record, but I do not object.

Senator CLARK. Without objection, it may be included in the record.

Senator CONNALLY. I do not think it is good practice to load up the record with matter that no one will read anyhow.

(The matter referred to is as follows:)

[Reprinted from contributions from Iowa Corn Research Institute, vol. 1, January 1939. No. 21

THE USE OF CORN IN THE FERMENTATION INDUSTRIES

By Leo M. Christensen, the Chemical Foundation of Kansas Co., Atchison, Kans.)

I think I am expected to discuss the use of corn in only one of the fermentation industries. And it is logical to do this because only one of these fermentation industries is potentially large enough to be of real immediate importance to American agriculture. True, there is still a small production of *n*-butanol and acetone from corn, but this industry steadily is diminishing in importance. A still smaller amount of corn is converted to lactic acid by fermentation processes. During recent years the manufacture of potable ethyl alcohol has used rather large amounts of corn and other grains, but at present most of these distilleries are closed. It can be expected that this market will never become large enough to be of real interest to corn growers, although it is and will continue to be of interest to the barley and rye producers, at least in certain areas.

In each of these fermentation industries, there has been a tendency to discontinue the use of corn in favor of blackstrap molasses, the noncrystallizable sugars remaining after the recovery of sucrose from the cane and beet. Blackstrap is not appreciably cheaper than corn, on the average, but it is a great deal more stable in price. When it is considered that, except in the manufacture of potable alcohol, the products of the fermentation industries must sell into markets of very stable price and that in these industries the raw material cost is approximately 80 percent of the cost of the finished product, it can be appreciated that stability of raw material prices is a factor of the greatest importance. The shift from corn to molasses,as the principal raw material in the fermentation industries has been wholly due to the erratic prices asked for corn, as compared with the well stabilized price for molasses. At the present time, black strap molasses constitutes at least 90 percent of the raw-material supply for the fermentation industries, exclusive of the manufacture of potable alcohol.

Most of the blackstrap molasses used by industry is imported from the West Indies or from the South and Central American countries. The relatively small domestic production, limited because of the sugar quotas, is used principally in feeds. These annual molasses importations are equivalent to approximately 50 million bushels of corn, or 2 percent of our total domestic corn production. It is a fundamental objective in the chemurgic program to discover and develop the means by which American farm products can be made available to industry at stable prices, satisfactory to producer and consumer alike. Many of us believe that the development of a power-alcohol industry is a most important part of the program which will eventually accomplish this objective. Once this required stability is obtained, American-grown farm products inevitably will find wide use in the fermentation and other chemical industries.

In the present discussion, I shall say very little about the technical aspects of the manufacture or use of power alcohol. As most of you know, the careful scientific investigation made here at Iowa State College in 1932–34, conducted by staff members of the departments of Mechanical, Civil and Chemical Engineering, and Chemistry, confirmed the findings previously reported from Sweden, Germany, and England. The progress reports of the committee on the use of alcohol in motor fuel and the scientific publications from these laboratories adequately have set forth the facts. It is sufficient to say here that anhydrous

ethyl alcohol is miscible with gasoline and that such blends are stable under the conditions of commercial distribution and use of automotive fuels, and further, that such alcohol is not a competitor of or a substitute for gasoline but, properly blended with it, is an ingredient of a superior motor fuel. Used in this way, anhydrous ethyl alcohol is a high quality antiknock agent, a splendid gum solvent, and a combustion clarifier, as well as a superior fuel.

It is not possible for me to report on the influence of the 1938 farm program upon the use of corn for power alcohol manufacture, because I do not know the details of the program as it relates to corn, and as yet I have not seen any statement from a qualified source as to its probable accomplishments. I can say, however, that to the extent that it promotes sound land use and market stability it should prove definitely helpful. Perhaps if I present again a somewhat detailed analysis of the economic status of power alcohol in the competitive motor fuel market of today, and its probable status in the future, and from this calculate the values of the various farm crops in this new market, I can at least establish a basis upon which someone else can evaluate the relationship between this potential market for corn and the present farm program.

The value of anhydrous ethyl alcohol, made from American farm crops and suitably denatured, wholly is dictated by the cost of competing products and processes used in the production of motor fuels. To simplify this discussion, I shall use our trade name, Agrol Fluid, to designate such suitable alcohol. Agrol Fluid has no single competitor, however, since no single material or process contributes the same improvements in motor-fuel quality, but three analyses can be made. From these a reasonably accurate conclusion can be derived. Of course, this can be checked by an actual determination of the value as measured in practical distribution of these Agrol blends, and I believe our experience at Atchison is now adequate for such an evaluation. It will be necessary, in presenting these analyses, to consider very briefly the refining of petroleum to yield the several grades of commercial gasolines and to give some attention to the very complex marketing methods employed in their distribution and sale. To simplify the marketing analysis, I shall consider a single community, Des Moines, Iowa, as the location of a blending or fuel compounding plant.

Petroleum consists of a very complex mixture of hydrocarbons with boiling points ranging from below room temperature to well above 600° F. Petroleum from one field may be quite unlike that from another, and the products made from them may also be dissimilar. The methods of processing, however, are essentially the same. The first step consists of simple fractionation, usually at or near atmospheric pressure. The products of this simple mechanical separation are classed on the basis of the boiling temperatures, as, (1) gasoline, (2) kerosene, (3) distillate, and (4) residue. The residue may be used as a base for the manufacture of lubricants, or it may be cracked by the application of heat and pressure, thereby undergoing chemical change, to yield lower boiling hydrocarbons suitable for inclusion in gasoline. It may be used as a tar or bitumen in road building, the use to which it is put depending upon its character, which in turn depends upon the nature of the crude from which it was obtained. The gasoline made by this simple distillation, commonly boiling between 80° to 100° F. and 390° to 420° F., is known as straight run. It may have an antiknock rating as low as 45 octane or it may have a rating as high as 75 octane, depending upon the kind of hydrocarbons which comprise it, which in turn depends upon the nature of the crude from which it was separated. Generally the antiknock value is below 60 octane. Before this gasoline is marketed, it must be free from sulfur, acids and other undesirable impurities, and sometimes it is blended with other gasolines from other sources to correct deficiencies in volatility characteristics.

It is estimated that about 60 percent of the gasoline requirement of the United States, which last year reached nearly 25 billion gallons, was supplied by this straight-run product. The balance largely came from the cracking of higher boiling petroleum fractions. This process involves the thermal decomposition, generally under high pressures, of the kerosene distillate or residue portions from the first fractionation. Sometimes the straight-run gasolines are subjected to a similar treatment, called reforming, to improve their antiknock value (cracked gasolines generally are of high antiknock value) 60 to 70 octane, but since the content of unsaturates is high, they must be treated to reduce gum formation tendencies and always must be blended with other gasolines to correct deficiencies in volatility characteristics.

Several other types of gasoline also are used. Natural gasoline is an extremely volatile material recovered by refrigerating "wet" natural gas and is used only in blends with cracked or straight-run gasolines. Natural gasolines have high anti-

knock ratings, sometimes as high as 80 to 85 octane, but because of their very high vapor pressure can be used only in blends and then only in limited amounts. Polymerized gasoline is made from gaseous hydrocarbons in a vapor phase catalytic process involving the application of relatively high pressures. Its antiknock rating is high, having a blending value slightly above that of benzene. This is rather a recent development and probably will increase rapidly in importance. For automotive fuels, it always is used as a blend. Natural gasoline is available at very low prices, in the neighborhood of 3 cents per gallon at present. The cost of making polymerized gasoline has not yet been made public, but it is considerably above that of straight run or cracked.

There is almost no market in the motor fuel field for gasolines of lower than 70 octane antiknock value, and since almost none of the commercial gasolines as they come from the stills can meet this standard, it is obvious that only by the addition of antiknock agents can the consumers' specifications be satisfied. Improvements in cracking processes, the development of the polymerization process and other scientific progress in the refining of crude oil have not, and probably never will, keep pace with the improvements in automotive engines. It is likely, therefore, that the demand for antiknock agents will continue to increase.

In the United States the most commonly used anti-knock agent is tetra-ethyl lead, a volatile, organo-metallic compound, always used in admixture with ethylene dibromide and other halogenated organic compounds whose purpose is to supply enough bromine so that the lead may be eliminated from the combustion chamber as the volatile bromide. Two leaded gasolines are standardized by the Ethyl Gasoline Corporation, which owns or controls the basic patents on the use of tetraethyl lead. One grade is known as "Q-brand" and the other as "Ethyl gasoline." The Q brands, such as Conoco Bronze, Standard Red Crown, Phillips 66, etc., contain about 1 cubic centimeter of ethyl fluid per gallon but may contain as much as 4.2 cubic centimeters per gallon, the maximum allowed by Federal regulations. Under the ethyl gasoline contract, the anti-knock value of this grade must not exceed 70–72 octane. Ethyl gasolines generally contain the maximum legal content of ethyl fluid, 4.2 cubic centimeters per gallon, and under the ethyl contract must have an anti-knock value of at least 78 octane. About 60 million pounds of ethyl fluid were used in American motor fuels in 1937.

It is generally reported by refiners that it costs them 0.26 cents per cubic centimeter of ethyl fluid to treat gasoline in this manner, and this cost will be used in this report, although it is probable that certain indirect costs are not included. On the basis of present gasoline prices, American motorists willingly paid more than $500,000,000 last year to have their motor fuels treated with ethyl fluid. Because of the poisonous character of tetraethyl lead, all pumps from which these leaded fuels are dispensed are required to carry a sign warning the public not to use the gasoline for cleaning or any other process in which they will come in contact with the skin. Each compounder and each distributor of leaded gasoline is licensed by the Ethyl Gasoline Corporation.

A few cracking units yield gasolines of 70–72 octane, and these are sold generally at the same price as the "Q" brands. In many localities benzol blends of 70–72 octane rating, generally containing 10 percent of benzol, by volume, in 63–65 octane base gasoline, are available, sometimes at "Q" prices and sometimes at a small premium. Benzol is also used in the form of 25–30 percent blends, in the same kind of gasoline, these blends always selling at a premium over "Q" brands and generally at or above the price of ethyl gasolines, with which they are competitive in antiknock value.

Gasoline prices still are well below the levels of 1920–29, having recovered only about half the losses of 1929–32. With crude oil quoted generally around $1.25 per 42-gallon barrel, or 3 cents per gallon, and a recovery in processing of around 60 percent, the raw material cost of gasoline, exclusive of conversion costs, is 5 cents per gallon. To cover processing costs, sales costs and provide a profit, gasolines should sell at the refinery at 7 to 9 cents per gallon, exclusive of tax, which is about the 1920–29 level. Today, only the integrated refineries (those having their own crude supply) are able to operate and most of these at part capacity. The consumer is paying the same for gasoline today that he paid in 1920, but the refiner is receiving considerably less. The proportion of the consumer's dollar taken by city, county, State and Federal taxes has increased inversely as the refiner's share of that dollar has declined. That is, the benefits of refinery research and of improvements in marketing methods have not accrued to the refiner or the consumer but have increased the tax revenue. The consumer has, however, benefited from the improved quality of the gasoline offered him.

In table 1 are given the current refinery prices of the several grades of gasoline, classed according to their antiknock ratings, which practically is the only basis for grading gasolines now recognized by the trade.

TABLE 1.—*Tank car gasoline prices, (f. o. b.) refinery indicated district exclusive of taxes, at Apr. 11, 1938*

[From National Petroleum News, Apr. 20, 1938]

	Price per gallon
Group 3 (Oklahoma):	
62 and below octane	$0. 04375–$0. 04500
63–66 octane	. 04625– . 04750
67–69 octane	. 04875– . 05000
70–72 octane	. 05250– . 05500
Kansas:	
62 and below octane	. 04625– . 04750
70–72 octane	. 05500– . 05625
North Texas:	
62 and below octane	. 04500– . 04750
63–66 octane	. 05000– . 05500
67–69 octane	. 05375– . 05625
70–72 octane	. 05625
Western Pennsylvania:	
58–62 octane	. 05125
65 and above octane	. 06500– . 07000
Central Michigan:	
straight run	. 05000– . 05500
67–69 octane	. 07750
70–72 octane	. 08000– . 08250
California:	
below 65 octane	. 07500– . 0900
above 65 octane	. 08250– . 0975

If a table of freight rates now is consulted, it immediately becomes apparent that the price of any grade of gasoline at any point, whether in a producing area or not, primarily is dependent upon the price of that same grade in Oklahoma (group 3). This method of establishing prices was developed during the period when Oklahoma was the principal producing area and holds today, despite the relatively smaller importance of the Oklahoma fields. Throughout the Middle West the published quotations in the Chicago Journal of Commerce are the market standards. And since about 85 percent of the gasolines sold are of "regular" grade, 70–72 octane, generally "Q" brands, this is the grade of greatest interest and most stable price. Generally, the lower antiknock grades have about the same differential they have at the group 3 refineries, while ethyl gasoline usually costs the dealer 1.25 cents more than 70–72 octane and retails at 2 cents per gallon more. A somewhat different price schedule operates along the eastern seaboard where a great deal of imported gasoline is used, but the balance of the United States is rather orthodox.

In the Middle West there are two classes of dealers, so far as delivered gasoline costs are concerned. The major oil-company dealer sells a branded, advertised product which he obtains from a bulk station owned and operated by the major company, the gasoline being delivered to the bulk station by rail or by pipe line or by a combination of these carriers, the method of transportation being of no importance so far as delivered price is concerned. The second group of distributors buys direct from independent refiners, generally by tank car or by transport, although the gasoline may be transported by pipe line. If transport hauling is used, the transport may operate as a common, contract, or private carrier. A single pipe line may carry a dozen or more kinds of highly advertised gasolines, each better than any of the others, truly a triumph in hydraulics.

Taking Des Moines as a specific case, the delivered prices of gasolines of various antiknock grades were, on April 11, 1938, as shown in table 2, which was prepared with data taken from the National Petroleum News of April 20, 1938, and from other sources. In making this table, I have used the grading scale emphasized in group 3, since most of the gasoline used in Des Moines either comes from that area or is priced and graded in accordance with the custom in that area.

TABLE 2.—*Cost and selling prices of various grades of gasoline in Des Moines at April 11, 1938*

[Total State and Federal taxes, 4 cents per gallon]

	Price per gallon
70–72 octane gasoline ("regular" or "Q"):	
Delivered by tank car to independent distributor	$0.0750
Delivered by tank car to major company dealer	.0990
Delivered to station by tank wagon from major dealer	.1140
Cost to consumer at any service station (including taxes)	.1800
Ethyl gasoline:	
Delivered by tank car to independent distributor	.0875
Delivered by tank car to major company dealer	.1115
Delivered to station by tank wagon from major dealer	.1255
Cost to consumer at any service station (including taxes)	.2000
Tank car delivery various antiknock grades (from group 3);	
62 and below octane	.0650
63-66 octane	.0675
67–69 octane	.0700
70–72 octane	.0750
Motor benzol	.1450
Ethyl fluid	[1] .0026

[1] Per cc.

With the data of table 2 we can now calculate the value of Agrol fluid in the competitive motor fuel market and I shall use three methods of analysis:

(1) In competition with Ethyl fluid. This method is not wholly satisfactory because Agrol and Ethyl are not easily compared in their antiknock value and because Ethyl does not contribute the many other motor fuel improvements obtained with Agrol.

(2) In competition with benzol. This is a considerably better comparison than the first.

(3) In competition with gasolines of the several antiknock ratings. This is, after all, the most practical analysis.

I shall assume that we start with a 65-octane gasoline at our fuel compounding plant in Des Moines even though we might, by careful shopping, make a better buy in a higher bracket, and I shall assume also that we pay the published market price for this grade. With this gasoline we shall make a 70–72 and a 78-80 octane blend with Ethyl fluid, with benzol and with Agrol fluid, and I shall calculate the costs of the leaded blends and of the benzol blends and from these data compute the competitive value of Agrol fluid. I shall also calculate the competitive value of Agrol fluid from the published prices for these grades, all delivered in Des Moines and exclusive of tax.

TABLE 3.—*Cost of leaded blends and competitive value of Agrol fuel*

Delivered cost of 65-octane gasoline, per gallon	$0.0675
Delivered cost of Ethyl fluid, per cc	.0026
Cost of 70–72 octane blend (1 cc. Ethyl fluid per gallon), per gallon	.0701
Cost of 78–80 octane blend (4.2 Ethyl fluid per gallon), per gallon	.784

To produce these same antiknock values with Agrol fluid requires the addition of 5 percent and 10 percent by volume. It should be pointed out, however, that there are differences among gasolines in their relative alcohol and lead responses and, in addition, that the several methods of antiknock rating measurement do not give consistent results. The data of best value are obtained by road test and generally the comparative values I have used hold quite well (table 4).

TABLE 4.—*Competitive value of Agrol fuel on the basis of road tests*

$$
\begin{aligned}
(1\text{–}0.05)\ 0.0675 &+ 0.05x = 0.0701\\
0.0641 &+ 0.05x = 0.0701\\
&0.05x = 0.060\\
&x = 0.1200
\end{aligned}
$$

$$
\begin{aligned}
(1\text{–}0.10)\ 0.0675 &- 0.10x = 0.0784\\
0.06075 &- 0.10x = 0.0784\\
&0.10x = 0.0176\\
&x = 0.176
\end{aligned}
$$

Solely on the basis of its value as an antiknock agent, without regard to its other advantages, Agrol fluid has a value in the competitive motor-fuel market of 12 to 18 cents per gallon, delivered at the hypothetical compounding plant in Des Moines.

TABLE 5.—*Cost of benzol blends and competitive value of Agrol fluid*

Delivered cost of 0.9 gallon of 65 octane gasoline	$0. 06075
Delivered cost of 0.1 gallon of motor benzol	.01450
Cost of 70–72 octane benzol blend	[1]. 07525
Delivered cost of 0.75 gallon of 65 octane gasoline	.050625
Delivered cost of 0.25 gallon of motor benzol	.038250
Cost of 78–80 octane benzol blend	[1]. 088875

The competitive value of Agrol fluid then becomes:

$$\begin{aligned}
(1\text{–}0.05)\ 0.06750 + 0.05x &= 0.07525\\
0.0641 + 0.05x &= 0.0725\\
0.05x &= 0.01115\\
x &= 0.223
\end{aligned}$$

$$\begin{aligned}
(1\text{–}0.10)\ 0.06750 + 0.10x &= 0.088875\\
0.06075 + 0.10x &= 0.088875\\
0.10x &= 0.027125\\
x &= 0.271
\end{aligned}$$

[1]Per gallon.

TABLE 6.—*Competitive value of agrol fluid as determined by published gasoline prices*

(*a*) Without advertising or sales promotion activities. (Sales to independent distributors at prices competitive with gasolines from independent refiners.)

$$\begin{aligned}
(1\text{–}0.05)\ 0.0675 + 0.05x &= 0.0750\\
0.0641 + 0.05x &= 0.0750\\
0.05x &= 0.0109\\
x &= 0.202
\end{aligned}$$

$$\begin{aligned}
(1\text{–}0.10)\ 0.0675 + 0.10x &= 0.0875\\
0.06075 + 0.10x &= 0.0875\\
0.10x &= 0.02675\\
x &= 0.268
\end{aligned}$$

(*b*) With extensive advertising and other sales promotion. (Sales to distributors at same prices as other extensively advertised gasolines, such as major company products.)

$$\begin{aligned}
(1\text{–}0.05)\ 0.0675 + 0.05x &= 0.0990\\
0.0641 + 0.05x &= 0.0990\\
0.05x &= 0.0349\\
x &= 0.698
\end{aligned}$$

$$\begin{aligned}
(1\text{–}0.10)\ 0.0675 + 0.10x &= 0.1115\\
0.06075 + 0.10x &= 0.1115\\
0.10x &= 0.05075\\
x &= 0.508
\end{aligned}$$

In competition with motor benzol, Agrol fluid has a value base upon the relative antiknock effects of 22 to 27 cents per gallon, both delivered at the hypothetical compounding plant at Des Moines, exclusive of tax.

In this competitive field, without extensive advertising of either type of fuel, Agrol fluid as a value of 20 to 27 cents per gallon, but if Agrol fuels were advertised on the same scale as major gasolines are and were sold at the same prices, Agrol fluid would have a competitive value at the Des Moines compounding plant of 50 cents per gallon. Naturally, the price must include the cost of such advertising.

It obviously is impossible to arrive at any single definite value for Agrol fluid in the competitive motor-fuel market until a marketing plan is decided upon, and then the exact value must be determined upon the basis of actual commercial experience. Perhaps the comparison with benzol gives the best working basis. It has been well demonstrated that with benzol prices above 15 cents per gallon distribution continues on a stable basis and if benzol prices fall below 14 cents per gallon, new distribution can be expected. Translated to Agrol fluid, the maximum value becomes 25 cents per gallon, and the minimum value, below which Agrol fluid never need sell, becomes 20 cents per gallon. These limits agree well with the values calculated by method (a) in table 6, and our experience at Atchison over a period of nearly 2 years confirms this conclusion. I shall assume, therefore, a competitive value of Agrol fluid (f. o. b.) the Agrol plant, exclusive of taxes, of 22 cents per gallon and shall allow in this figure 2 cents per gallon for general administration and sales costs. Even if some of the Agrol fluid has to be blended at some distance from the plant, this price level definitely is within the competitive range.

It will be interesting at this point to examine briefly the economic status of Agrol fluid as determined by the cost of production of liquid fuels other than gasoline, to see what value might be obtained in the future when our petroleum resources have been exhausted. It has been estimated that gasoline from oil shale costs, at the plant, 23 to 25 cents per gallon. Gasoline was made from coal in Germany for 27 cents per gallon, but it was anticipated that the cost could some day be lowered to 21 cents.

Synthetic methanol and other alcohols at present cost near 20 cents per gallon and probably can never sell at much below this level. Thus it can be concluded that the 22 cents per gallon calculated as the present competitive value of Agrol fluid is very nearly its value in the motor fuel markets of the future as well; when our petroleum resources are exhausted, Agrol fluid can enter into direct competition with all other liquid fuels for internal combustion motors.

Now we can proceed to a consideration of the values of various farm crops in this new market, and I shall present a detailed review of the value of grains in particular. I shall assume yields per hundredweight of total grain used, of 4 gallons of anhydrous ethyl alcohol, 34 pounds of protein concentrate of 28- to 30-percent protein content and 18 pounds of dry ice. Naturally, the yields vary, but these may be regarded as typical with grains of around 14 percent moisture content. By use of improved methods, now developed and ready for use, the yields of alcohol and of dry ice may be increased, at the expense of the feed yield and become: 4.5 gallons of anhydrous alcohol, 28 pounds of feed of 32- to 34-percent protein content and 20 pounds of dry ice. With feed standards and prices as they are now, the new procedure has no important economic advantage over the older one, but that condition is likely to change. I shall use, therefore, the yield data of the present procedure.

The conversion costs, based upon the experience at Atchison, are approximately as shown in table 7. It is interesting to note how nearly these approach the cost data of the Iowa State College Progress Reports.

TABLE 7.—*Conversion costs in a 10,000-gallon (alcohol) per-day plant, costing $600,000*

[Annual Agrol fluid production 4,150,000 gallons]

	Cost per gallon
Fuel and water	$0.0175
Labor	.0180
Maintenance	.0025
Depreciation at 10 percent per year	.0145
Insurance, bonds and taxes at $10,000 per year	.0025
Management, administration and sales	.0200
Total	.0750

TABLE 8.—*Calculation of raw-material value in making agrol fluid*

Costs:	
Value of 100 pounds of grain	$x
Conversion cost at 4.0 gallons per hundredweight at $0.75 per gallon	0.30
Total	$0.30+x
Credits:	
34 pounds protein concentrate at $0.0125 per pound	.425
18 pounds dry ice at $0.010 per pound	.425
4 gallons alcohol at $0.22 per gallon	.880
Total	1.485

The value of the grain then becomes: $x=\$1.485-0.30=\$1.185$ per hundredweight.

In calculating the value of the raw material, I neglected direct denaturing costs but have included the indirect costs (bonds, loss of time, etc.) in operation costs above. I should point out that the above costs in table 7 include the operation of the feed recovery and dry-ice units. Upon this basis we can calculate the raw-material value (table 8).

This figure represents the value of the total grain used and, if barley malt is the saccharifying agent, this figure is the value of 92 pounds of grain purchased from the farmer plus 8 pounds of barley malt which at present costs 3 cents per pound. The net value of the farmer's grain then becomes $\frac{\$1.185-8\ (\$0.03)}{0.92}=$ $1.027 per hundredweight. No allowance has been made for the manufacturer's profit and this should be 6 cents per hundredweight, leaving a balance to be paid the farmer for grain delivered at the plant of 96.7 cents per hundredweight.

I have attempted to present a general estimate of the cost of manufacturing Agrol fluid and realize that local conditions are of considerable importance and may require some revision of manufacturing costs. I do not want it understood that my calculations are based upon more than a casual knowledge of conditions in Des Moines, the location we assumed. I do know these costs can be realized in or near Des Moines, however. One other explanation should be presented at this time. Dry ice is a seasonal product, and I have tried to take this into account in the unit price assumed which is approximately half the present actual unit price during the peak of the season.

We have made many of these cost estimates by a number of procedures and have always arrived at the same average result. The value of grains for Agrol manufacture varies from a low of around 75 cents per hundredweight for oats to a high of around $1.06 per hundredweight for very dry corn or wheat. At Atchison we are particularly interested in the grain sorghums because this crop is so far superior to other grain crops in that area. These grains are worth 80 to 85 cents per hundredweight at the plant, and we are contracting for 1938–41 delivery at that level.

On this same basis, the tuber crops have values varying from $5 per ton for cull Irish potatoes to $7.50 per ton for sweetpotatoes. Jerusalem artichoke tubers are worth from $5 to $6 per ton, depending upon the carbohydrate content, and sugar beets have a value of $5.50 to $5.75 per ton, which is also their value in the beet-sugar industry.

Farm crops naturally fall into two classes so far as their use in this industry is concerned:

1. Those for which power-alcohol manufacture supplies a market into which culls and surplus may be dumped through the use of some kind of two-price marketing plan. Fruits, Irish potatoes, wheat, and rice naturally are in this class.

2. Those for which power-alcohol manufacture supplies a stable profitable market for the total production and which probably can best be grown on a contract basis. Grain sorghums, sugarcane, sweet potatoes, and Jerusalem artichokes naturally belong in this class.

The only comment I can make at this time regarding the possible bearing of the 1938 farm program upon the use of corn for power-alcohol manufacture is that this program may determine into which group corn is placed. Will corn

be classed in the small production, high-price group or in the large production, moderate-price group? The answer to this question is, of course, of interest to those of us who are working for the establishment of a power-alcohol industry because it will influence the direction of future expansion, but it must be infinitely more interesting to the corn growers since it has a profound bearing upon their future activities.

Throughout this analysis, I have neglected one very important consideration. The development of the market for Agrol motor fuels has been hampered by wholly unethical and wholly unjustifiable opposition from a few of the major oil companies. I have not allowed for the cost of meeting this opposition, because it is not possible to predict how long it will last or what course it will take. If such opposition continues, provision must be made to fight it, and unfortunately the farmer, in his dual capacity of producer and consumer, will have to pay most of the cost. In fact, he will pay most of the cost for both sides of the campaign. We are doing the best we know how to eliminate this unpleasant phase of the development before a condition arises which will exhaust the farmer's patience and lead him to seek mandatory legislation to force these major companies to use power alcohol.

The Atchison Agrol Co.'s plant has a capacity of 10,000 gallons of anhydrous ethyl alcohol per 24 hours and at capacity uses 850,000 hundredweight of grain per year. To supply enough alcohol to provide a 10 percent blend for the entire United States will require 800 such plants, but before they can be completed there will be need for at least 1,000 such plants. To supply the raw material for these plants will require the output of 30 to 50 million acres and something like 1,500,000 men will find new creative employment in growing the crops or operating the factories. How much indirect employment will result can only be guessed. But this is not the end. As our oil resources become exhausted, the market for power alcohol can steadily expand, and no one safely can predict its eventual magnitude. Nor is there now need to predict it; it is enough for the movement to keep our eyes on the first 1,000 plants.

This program inevitably must have the cooperation of many agencies and cannot be ignored in the formulation of national farm policies and programs. I am interested particularly in the tremendously important contributions which thorough, energetic scientific research can make, particularly in the fields of agronomy, agricultural engineering, soils, mechanical and chemical engineering, chemistry and in fact, in almost every field of our agricultural-college activities.

Senator GURNEY. Then there is the American Good Government Society located in Washington, Richard A. Staderman, president. He has prepared some statistics here on the use of power alcohol in foreign countries, showing the exact operation of the alcohol in those countries, the sales volume and giving the percentages of blends in the different countries. It consists of 12 pages.

Senator CONNALLY. Who is Richard A. Staderman?

Senator GURNEY. President of the American Good Government Society.

Senator CONNALLY. Who is paying for his living?

Senator GURNEY. I do not know.

Senator CONNALLY. That is it exactly. It looks like he ought to come up here and let us cross-examine him, look him over, and try to find out something about him. This is quite a long piece sent up here by Richard A. Staderman, of the American Good Government Society. I do not object, but I think this is very bad practice.

Senator CLARK. Without objection, it may be included in the record.

Senator CONNALLY. We do not know anything about him, we do not know whether he knows anything about what he is talking about or not. I apprehend he does not.

Senator CLARK. I am unable to say anything about it.
(The matter referred to is as follows:)

GROWING USE OF ALCOHOL IN MOTOR FUELS IN FOREIGN COUNTRIES

(An unpublished study available as portion of a speech or extension of remarks by Hon. Chan Gurney, in the United States Senate)

Prepared under the direction of Richard A. Staderman, president, American Good Government Society, Tilden Hall, Washington, D. C. Available for use in whole or in part without charge, provided that the text of the speech gives due credit to the American Good Government Society for statistics furnished therefor

American agriculture has not been really prosperous since 1919. At that time farmers received dollars per bushel for wheat, corn, and other products.

Since that time there have been surpluses of crops of such size as to keep the price level down, and sometimes below actual cost of production.

Many remedies have been proposed and among them the conversion of surplus crops into alcohol to be used as fuel in automobiles. Persons have wondered whether we might be able to take a sufficient amount of crops off the market this way to give a decent profit to the grower.

In addition there is the question of petroleum reserves. The best available estimates give us only a few years before we shall be able to get less oil than we need from our own wells, with a further steady decline after that until our production of petroleum products drops to the vanishing point. What shall we do then for gasoline and oil for our autos, our trucks, and our tractors?

An important background for consideration of our own problem can be found in the experience of foreign countries, where alcohol blends with gasoline have been in use for many years. A number of factors have brought about this blending, of which one of the most important is the nationalistic arguments of military chieftains who wish to be independent of foreign sources of petroleum which might be cut off any time in case a war occurred.

Another objective has been to provide a market for surplus crops, consisting of either potatoes, molasses, beet roots or fruits—all surplus farm products abroad though different than our own surpluses of wheat, corn, sweetpotatoes and such.

At this point I wish to acknowledge the statistics and other information kindly furnished through the courtesy of the American Good Government Society and its president, Richard A. Staderman. This national nonpartisan organization, with headquarters at Tilden Hall, Washington, D. C., is composed of leading citizens in various parts of the United States who are striving for a happier America. In addition to publishing a magazine, the American Good Government Review, this society strives for better legislation of broad national benefit and I am happy to report its endorsement of my suggestions on the encouragement of the use of alcohol in motor fuels as an important aid in solving our surplus-crops problem.

The appeal for the home product of alcohol is of a patriotic sort in nations having to import petroleum or gasoline, and is accentuated by the lack of sufficient "foreign exchange" to pay for all the products that would be imported by a country having no import restrictions.

In considering the foreign experience we must remember that in practically all instances the selling prices of gasoline and other petroleum products is much higher than here in the United States, and the greater prices tend to encourage substitution or mixture of alcohol with gasoline in blends. For instance in Sweden, alcohol can be produced at low cost as a result of being made from the waste or byproducts of the wood-pulp industry. Except in the case of Sweden, however, aid to agriculture has been a factor in fostering the use of alcohol for motor-fuel purposes.

The growing number of countries using alcohol-blended automobile fuels comprises Australia, Brazil, China, Czechoslovakia, France, Germany, Great Britain, Hungary, Italy, Japan, Peru, the Philippines, Poland, South Africa, and Sweden, as well as our neighbor Cuba and our island possession, Puerto Rico.

GERMANY

Of these Germany is by far the largest user of alcohol in motor fuel, having compelled importers and producers, by the Government decree of 1930, to take from the Government alcohol monopoly a quantity of alcohol amounting to a

certain percentage of the amount of motor fuel handled, to be blended with gasoline as the dealers saw fit.

The required percentage of the decree was first 2½ percent, being increased by degrees to 10 percent by 1932, although lately having been lowered to 8½ and then to 6½ percent as explained below.

Under this stimulus German consumption of fuel alcohol expanded tremendously, growing to 17,000,000 gallons in 1930, to 55,000,000 gallons in 1934 and to an estimated 75,000,000 gallons in 1937—a growth of about 340 percent in the 7 years, according to data compiled by the American Good Government Society.

The primary purpose of German fostering of alcohol began as an effort to make a better market for potatoes, although since then the foreign exchange situation has given another incentive for import restriction in addition to self-sufficiency for military reasons. This very foreign exchange factor has in turn modified the alcohol policy. Due to the German Government's decision to encourage the people to eat more potatoes and less grains which have to be imported, the decreed alcohol proportion was reduced to 6½ percent as previously mentioned so as to release more potatoes for food instead of alcohol production. Whether this decree which was promulgated this year, will affect alcohol production, remains to be seen.

Technically the use of alcohol blends has been satisfactory in Germany. Some loss of power is complained of in small low-compression motors, but high compression motors find it better than straight gasoline, due to its high octane rating, which means its anti-knock characteristics.

About half of the motor fuel sold is ordinary gasoline. About one-tenth is a blend of 25 percent alcohol and 75 percent gasoline, and is sold under the trade names of "monopolin" and "bevaulin." The other four-tenths of motor fuel sold is a blend of 20 percent alcohol, 20 percent benzol, and 60 percent gasoline, this being sold as a quality product at a 4-cent premium over the ordinary gasoline or the alcohol blend, which both sell at the same price of some thirty-odd cents a gallon in our money.

German experiments are going even a step farther and redesigning motors for using substitute fuels. Two steam-power trucks have been developed which use an oil burner in front to make the steam and have the pistons built into the axle housing at the rear wheels, there being only a pipe to carry the steam back.

For some years now wood-gas generators have been made to be attached to ordinary trucks. A 40-passenger bus can get 60 miles on a single "tankful" of wood, although charcoal or peat are preferred for these gas generators.

Other "fuel economy" trucks include those which carry a cylinder of compressed gas from city mains in place of a gasoline tank. All of these are encouraged by the Government, as every gallon of motor fuel Germany doesn't have to import leaves just that much more foreign exchange at the command of Reichsbank President Hjalmar Schacht.

Then there is the Diesel type of motor. This special design to use low-grade fuels is an old story.

A German was the inventor of this type and for many years Germany and other nations have taken advantage of the economy and efficiency of the Diesel motor and in recent years thousands of trucks and busses have proven the economy of hauling by Diesel power.

Diesels have now been introduced in Germany on passenger chassis. One is mounted on a six-passenger Mercedes-Benz landaulet, designed for hire-car and taxicab service.

Thanks to the great economy of the Diesel, using oil instead of gasoline for fuel, this car is said to save the buyer at least half the purchase price within the first 60,000 miles.

The Diesel has been used for American airplane motors by the Packard Motor Car Co., and with apparent success.

FRANCE

Another important country where alcohol is mixed with gasoline is France, where beet roots, fruits, and molasses are the raw materials from which the alcohol is made. The French Government pays about 38 cents a gallon for alcohol and sells it for around 17 cents a gallon to oil companies, which is the approximate cost of gasoline. This loss is made up by a Government tax on all gasoline and kerosene, while the blended fuel is exempt from the tax.

Sold under the name of "Carburant Nationale," the product is a 50-50 blend of half alcohol and half gasoline. In 1930 about 7,000,000 gallons of alcohol were

blended with an equal amount of gasoline to make a total of 14,000,000 gallons of blend sold, out of a total of about 700 million gallons of total motor fuel consumed.

French statistics are notoriously incomplete and misleading, so that no precise later data than 1930 is available other than the total production of alcohol of all kinds, which from 57,000,000 gallons in 1930 has risen to 130,000,000 by 1935. A substantial part of this increase was presumably for motor fuel, but how much so it is hard to say exactly, according to the American Good Government Society.

SWEDEN

"Lattbentyl" is the name of a blend of 25 percent alcohol with 75 percent gasoline which is used in Sweden. Largely a byproduct of wood-pulp manufacture, half the industrial alcohol produced there is used for motor fuel. In 1930 Sweden consumed about 110,000,000 gallons of straight gasoline plus about 8,000,000 gallons of the blended type which contained 2,000,000 gallons of pure alcohol. By 1936 this amount of fuel alcohol had risen to 4,200,000 gallons or a 110 percent increase in the 6 years.

One of the interesting facts about Sweden is its use of an alcohol blend without compulsion. The first trials of the alcohol obtained from fermentation and distillation of the cellulose residue of pulp factories was begun in 1911 and greatly stimulated by the World War. It is stated that the mixture or blend involved no change in the operation of the engine except for the better by increasing its power and smoothness. Fuel consumption is not increased and in spite of the low temperatures in many parts of Sweden, the blend which includes some ether, remains homogeneous and no starting difficulty is experienced. Ether, incidentally, can also be produced from farm crops.

CZECHOSLOVAKIA

Blending of alcohol was not compulsory in the former Czechoslovakia, according to latest information available, although there has been a great increase in its use in motor fuel. The chief blend used is called Dynalkol and is composed of 30 percent gasoline, 20 percent benzol, and 50 percent alcohol.

In 1930 there were over 60,000,000 gallons of straight gasoline used plus blends containing alcohol totaling 2,800,000 gallons of blend of which half or 1,400,000 gallons of actual alcohol were used. By 1932 there were 2,400,000 gallons of alcohol so used. In 1933 this jumped up to 15,000,000 gallons and by 1935 to 20,000,000 gallons of alcohol used in motor fuels. This has been accomplished in spite of the fact the alcohol blend sells for about 12 percent more than straight gasoline.

JAPAN

According to a recent press release of the Department of Finance of the Japanese Government dated last February, a million yen have been appropriated to begin construction of five new alcohol factories.

In the Japanese-owned island of Formosa the owners of sugar plantations are being encouraged to expand crop production and capacity of alcohol-manufacturing equipment. It is estimated that when present expansion is completed there will be 14,000,000 gallons of alcohol produced in Formosa alone.

In 1932 there were 200,000 gallons of alcohol used in fuels, as compared with a thousand times that much, or 200,000,000 gallons, of gasoline consumed. Since then the ratio of alcohol used has been increasing, total gasoline being 220,000,000 gallons in 1933 and alcohol 300,000. In 1934 400,000 gallons of alcohol were used in fuel, as compared with 265,000,000 of gasoline, and by 1935 alcohol used was double the previous year at 800,000 gallons, whereas total gasoline had risen a much lower percentage to 290,000,000 gallons.

It is true that as yet the amount of alcohol used is only a fraction of total gasoline consumption, but at the rate alcohol blending is expanding and alcohol capacity is increasing, especially under the pressure of providing fuel for military purposes, it will not be long before alcohol forms an important part of the fuels used. Additional emphasis is given the matter from the striving for self-sufficiency, as well as by foreign exchange considerations arising from the present need for Japan to raise over $50,000,000 a year to pay for the petroleum products now imported into Japanese frontiers.

BRAZIL

A number of interesting blends have been tried out by our South American neighbor Brazil. In Pernambuco one blend used contains 70 percent alcohol to 30 percent ether, another 90 percent alcohol and 10 percent ether, and the "Gasalco" brand 88 percent alcohol to 12 percent gasoline.

The total amount of gasoline consumed in Brazil in 1930 amounted to about 75,000,000 gallons. The amount of alcohol blended fuel used is not available, though we are informed that blends were sold in only three cities, the ether blends in Pernambuco, and the "Gasalco" type in Rio de Janeiro and Nictheroy.

For 1936 we are informed that total gasoline consumed was about 150,000,000 gallons of which approximately 25,000,000 was of blends containing some 3,000,000 gallons of alcohol. This confirms the additional information that at present the blending is on the basis of about 10 to 15 percent alcohol to the remaining parts of gasoline.

Foreign exchange difficulties have prodded Brazil into trying to "do something" about automobile fuels, especially where petroleum products form about one-tenth of total imports into that country. The amount of petroleum imported amounts to over $20,000,000 and so is a focal point for consideration of the Brazilian Government.

ITALY

There would be some very interesting information available about Italy, if it were not for the fact that the Government there keeps a great number of statistics confidential. We do know that the Government has decreed a 25 percent part of all alcohol produced to be marked for motor-fuel use. This is verified by 1937 estimates of about 7,500,000 gallons of alcohol having been used for fuel purposes when compared with total production of alcohol for all purposes of around 29,000,000 gallons in 1936. This figure represents more than double the corresponding production of 13,000,000 gallons of all-purpose alcohol in 1935. With total consumption of gasoline by Italy estimated at 142,000,000 gallons for 1937, the 7,500,000 of fuel alcohol represents 5 percent as much as gasoline—a very substantial quantity.

The sources of Italian alcohol supplies vary from year to year. It is reported that the 1936 production was to the extent of 35 percent from sugar beets, with an unspecified amount from wines and other sources. The methods of obtaining alcohol vary widely from hear to year, depending upon the quality of the wineries. If there are very low grade and unpalatable wines produced, these are almost unmarketable for beverage purposes, and thus are available for conversion into alcohol. With a varying quantity of poor wines depending on more or less natural causes, governmental policies must be flexible and adjustable to be successful.

PERU

A beginning has been made in Peru in using alcohol in fuels. In 1932 the total gasoline consumed amounted to 139,000,000 gallons; by 1936 this had grown to 160,000,000 gallons. In 1932 there were 420,000 gallons of alcohol used in fuels, and in 1936 this had risen to 546,000 gallons.

Although the total quantity of alcohol used remains small—less than 1 percent of gasoline consumption—we find that the increase in alcohol used amounted to about 30 percent, as compared to only about 8 percent in total gasoline consumption.

POLAND

The Polish Government since January 1933 has decreed that the producers of petroleum buy an amount of alcohol equal to 9 percent of the amount of gas sold. The actual figures on gasoline are somewhat complicated due to the fact that Poland is an exporter of petroleum products The increase of alcohol used in fuel has been tremendous in Poland rising from 270,000 gallons in 1931 to 2,400,000 in 1936—a growth of almost 800 percent in 5 years.

After deducting the amounts of petroleum products exported from Poland, we can get the approximate amount consumed in that country. For 1936 the actual consumption of gasoline was about 25,000,000 gallons, and comparing our previous figure of 2,400,000 of alcohol with this, we have approximately the 9-percent proportion of alcohol legally required to be used as motor fuel.

THE PHILIPPINES

It may come as a surprise to many Americans to learn that our semi-independent territory, the Philippines, is one of the leading producers and users of alcohol in fuels. In 1930 the Philippines used about 4,200,000 gallons of alcohol, as compared to 27,100,000 gallons of gasoline, being a ratio of 15 units of alcohol to every 100 units of gasoline, as the American Good Government Society has pointed out. By 1936 the consumption of fuel alcohol has doubled to 8,600,000 gallons and gasoline had increased to 41,000,000. This showed a substantial increase in the alcohol proportion to 21 units of alcohol to every 100 units of gasoline.

THE BRITISH EMPIRE

British interest in substitutes for gasoline, largely for defense reasons, is well manifested in the Government-subsidized plant at Billingham, England, of the Imperial Chemical Industries, Ltd., now under construction. The works will cost $55,000,000 and will have a capacity of 45,000,000 gallons of petrol a year from the process of hydrogenation of soft coal. The chief object seems to be that of getting some self-sufficiency in the sense that British coal deposits could thereby be turned into liquid fuel. Otherwise it would have been far cheaper to have built an alcohol plant of similar capacity which could have been done for only $7,000,000 or less.

A blend of alcohol and gasoline is being marketed today in England without government compulsion but with encouragement by tax exemptions. Except for certain special cases, alcohol blends of gasoline are tax-free. In the case of the new Billingham plant the Crown will pay the firm a subsidy of 8 pence (16 cents) a gallon of gasoline petrol for 9 years to encourage the enterprise.

In the British Dominion of Australia the sellers of gasoline are required to purchase 1½ gallons of alcohol for every 100 gallons of gasoline, this law applying only to the Province of Queensland. The product sold to the consumer is called Shellpol and has from 15 to 35 parts alcohol added to enough gasoline to make a 100 parts of fuel.

The amount of alcohol reported used in 1930 was 240,000 gallons out of a total gasoline consumption of 268,000,000. In 1936 it is stated that 720,000 gallons of alcohol were so used with a total consumption of gasoline of 370,000,000. Although there is some question as to the accuracy of these figures, it would seem that the use of alcohol, while still small, is growing faster than the percentage gain in the amount of gasoline used.

British South Africa uses a blend of 60 percent alcohol and 40 percent ether under the name of "Natalite," the sales being confined mostly to one city.

HUNGARY

Hungary is a substantial consumer of alcohol fuel. According to 1930 figures, the latest available, over 3,000,000 gallons of alcohol were used in blends, as compared with about 21,000,000 of gasoline, giving a ratio of about 14 gallons alcohol for each 100 gasoline sold. The blend is called Motalco and consists of 20 percent alcohol to 80 percent gasoline.

FUEL ALCOHOL FROM WASTE SULPHITE OF PAPER PULP MILLS

The waste-product liquor from the pulping of wood by the sulphite process contains from 2 to 3.5 percent sugars of which about 65 percent are fermentable to alcohol. Before this liquor can be fermented, the sulphur dioxide, as well as the acetic and formic acids in it, must be neutralized either with lime or carbonate of lime.

As the fermenting agent, there is generally used a special type of yeast which has been adapted to sulphite liquors. The fermentation requires from 2½ to 4 days and produces an amount of alcohol equal to about 1 percent of the volume of the liquor fermented.

This process and material has not as yet been used to any great extent in the United States, but is an important source of industrial and fuel alcohol in Germany and the Scandinavian countries.

ALCOHOL FROM MILL AND FOREST WASTE AND TREES

There are two important steps for the production of ethyl alcohol from wood. First, the hydrolysis of the cellulose of the woods to simple sugars. Second, the fermentation of these sugars to alcohol by yeast in the usual way.

Experiments of this sort have been widely tried in the United States and at one time ethyl alcohol was produced commercially from sawdust. Yields of 20 to 24 gallons of pure alcohol per ton of dry wood were obtained. In Germany a new process now yields 50 to 60 gallons per ton.

BLENDING AGENTS FROM FARM CROPS

Gasoline and ordinary alcohol form an unstable mixture, so that "blending agents" are needed to hold them together. These blending agents have a high fuel value and many of them, such as butyl, isopropyl, amyl alcohols, acetone, and ether, can be produced from agricultural crops.

Senator GURNEY. Further, if the committee will permit, or if they want to handle it otherwise, it is for them to decide, Dr. Christensen has sat here in the hearings since last Tuesday, and with no thought on his part to make this thing too long, but he spent Saturday and yesterday preparing a further statement in reply to statements given by other witnesses, and as a matter of rebuttal he has prepared this statement, and I ask that that be put in the record.

Senator CONNALLY. I object, Mr. Chairman, to that, because we have had him for 2 days, he has put his publication in the record, and I do not see why we should let him, without cross-examining him, negative anything put in the record. If the committee wants to do it, wants to put it in, that is its business, but I am going to vote "no." I do not see how we can put anything more in the record unless we put him in.

Senator GURNEY. Of course, if there is objection, I believe the doctor could stay over another day, but tomorrow is Decoration Day, and it is a matter of expense.

Senator CONNALLY. Let me ask you, Senator, is there any point on earth that he has not testified to here?

Senator GURNEY. Yes.

Senator CONNALLY. Why did not he do so? He was on the stand awhile ago. Why did not you ask him when he was on the stand?

Senator GURNEY. The committee has been trying to hurry the hearings through and has not had opportunity to give him the time to get all the testimony in.

Senator CONNALLY. I move the committee recess until next Monday, and Dr. Christensen be invited to return and have all the time he wants.

Senator CLARK. Do you want to press that?

Senator CONNALLY. I will withdraw that. Yes; put it in. I do not want to be unfair, but I think it is very bad practice.

Senator CLARK. I will state to the Senator from Texas, I was just talking to the Senator from Wisconsin, with whose views I heartily concur. Inasmuch as these records are subject to examination by the Senators, they may give them any weight they please. It has always been my view of proper practice that you ought to permit anybody to have an opportunity to read what is put in the record. If the Senator from Texas wants to object, he has a right to object.

Senator CONNALLY. I withdraw the objection.

Senator CLARK. I feel as he does about the length of the record.

Senator CONNALLY. Of course, this sort of a moot court may be all right, but here is a witness who has testified for 2 days, and again this morning, and instead of hearing the testimony from his lips, where we can cross-examine him, he puts in a book here taking up other people's testimony and arguing against it, and trying to refute that

evidence without opportunity to cross-examine him on it. I am not going to object, but I will enter my solemn protest against that way of conducting the business of this committee.

Senator CLARK. Without objection, it may be included.

(The matter referred to is as follows:)

STATEMENT PRESENTED BY DR. LEO M. CHRISTENSEN BEFORE A SUBCOMMITTEE OF THE SENATE FINANCE COMMITTEE, MAY 29, 1939

Mr. Barton, of the Chicago Motor Club, said, "* * * We have followed with some concern the various proposals made in recent years to force alcoholized motor fuels into use." The present hearings are concerned with bills to encourage the use of alcohol in motor fuel, and decidedly do not contemplate the employment of force to secure such result. Most of the arguments of the opponents are based upon the assumption of some compulsory provision and are therefore not pertinent to the present case.

Professor Jacklin's objections to the proposed legislation are in reality arguments against mandatory legislation, and are not now germane. It might be pointed out, however, that the data from his tests of Friday hardly merit serious consideration because of the far more comprehensive studies of earlier researches and the very large scale commercial distribution of blended fuels throughout the world. As the witness said, a part of his remarks were facetious.

Mr. Barton again presented arguments against mandatory legislation. His remarks about selling the byproduct protein concentrate are also based upon forcing the farmer to buy feed. No such force is contemplated. The feed sells now, and with passage of the contemplated legislation, would continue to sell on a voluntary basis. And bear in mind that our domestic production of protein feeds is below our domestic requirement—we have to import these necessary auxiliary and supplemental feedstuffs.

It is of interest to note that sales of alcohol blends has continued in the Sioux City area on a volume level only a little below that obtained during the peak of the promotional activities sponsored by the chamber of commerce.

The committee should know that the production of gasoline from coal or oil shale requires as much or more fuel consumption in the factory than does the manufacture of alcohol. The manufacture of gasoline from petroleum uses a little less, but the difference is not large. This argument, besides neglecting important facts, is also not pertinent.

Mr. Kirk Fox refers to the dangers of promotion, stock selling, and the like. Most States and the Federal Government have laws and regulations designed to protect the investing public from fraud. Presumably, they are effective. It may interest Mr. Fox to know that farmers have found Jerusalem artichokes a good hog feed, and are growing them for that purpose, and also that plans to make alcohol and sugar from this crop are being studied by several well-established companies.

In connection with the letter written by Mr. Milo Perkins I ask to insert in the record two letters which I prepared and sent to Mr. J. S. Russell, farm editor, the Des Moines Register and Tribune, Des Moines, Iowa, which supply some very pertinent additional information in this connection:

MILLER, NEBR., *March 25, 1939.*

Mr. J. S. RUSSELL,
Farm Editor, the Register and Tribune,
Des Moines, Iowa.

DEAR MR. RUSSELL: On March 22, 1939, the Register carried an Associated Press story, with a Washington date line, captioned "Turns Down Bid on Corn for Agrol Use," in which was described a certain hearing before the Agricultural Committee of the House of Representatives in Washington. In particular, it related a statement by Mr. Milo Perkins, president of the Federal Surplus Commodities Corporation, in answer to questions by Congressman Everett M. Dirksen, of Illinois, about the Federal Surplus Commodities Corporation's attitude toward power alcohol and what stand it had taken in the matter of selling surplus corn and other grains to the Atchison Agrol Co. and other power-alcohol manufacturers.

As set forth in the Associated Press story, the report of the negotiations between power-alcohol manufacturers and the Federal Surplus Commodities Corporation is wholly misleading simply because it is only half the truth. Whether this is due to faulty reporting by Associated Press or to misleading statements by Mr. Perkins is not a matter of interest to me just now. My purpose in this letter is to set forth

the true facts about the matter. In accordance with my recent promise, therefore, I am sending you this statement and am also sending copies of it to editors of other Midwest papers and to the many individuals who have sought the early establishment of a sound power alcohol industry as an important part of a workable American farm program.

As a consulting chemist and engineer, I took a very active part in drafting two of the four applications I know to have been submitted asking Federal Surplus Commodities Corporation to contract to supply grain, particularly corn, on a stable price basis for power-alcohol manufacture. Since the first one was submitted by the Atchison Agrol Co. and since this is the one specifically mentioned in the above story, I shall particularly describe it.

On October 28, 1939, I joined Mr. John Orr Young and Mr. Carl McKeen, connected with and working for the welfare of the Atchison Agrol Co., in Washington and found that my presence was desired at a conference with members of the Bureau of Chemistry and Soils and the Federal Surplus Commodities Corporation to discuss the use of surplus corn by the power-alcohol industry. That conference was held at the United States Department of Agriculture at 10 a. m. on November 1, 1939.

Present at this conference were Drs. Knight, Skinner, Herrick, Jacobs, Newton, May, and Senseman, of the Bureau of Chemistry and Soils, Mr. King, representing Federal Surplus Commodities Corporation, and others of the United States Department of Agriculture divisions, and Messrs. Young, McKeen, and myself, representing the Atchison Agrol Co. I was called upon to present a résumé of the history of the power alcohol project conducted by the Atchison Agrol Co. during the 2 preceding years and to outline the results achieved and the situation at the moment. I pointed out that in spite of serious obstacles of opposition from certain petroleum interests, and particularly from a few individuals connected with that industry, shortage of raw materials during the drought years and certain political aspects, Atchison Agrol had promoted the sale of more than 15,000,000 gallons of alcohol-gasoline blends containing 1,000,000 gallons of power alcohol made at Atchison from some 400,000 bushels of grains and small amounts of other American farm products in the course of 2 years of operation. I pointed out that the experimental phase of the project was ended and that several very important new marketing organizations were ready to start distribution of blended fuels. These new markets required the completion of contracts for alcohol at a stable price level. I said that this requirement in turn necessitated a stable supply of raw materials at a stable price level, which need could be met by a contract between Atchison Agrol and Federal Surplus Commodities Corporation. Mr. Young, as president of Atchison Agrol, stated that he was authorized to make application for such a contract, in response to a public invitation by Federal Surplus Commodities Corporation for such bids.

Many technical details of the program were discussed and Dr. Knight, chairman of the conference, stated that he believed it desirable to develop the principles of such a contract to the end that Federal Surplus Commodities Corporation might have full information to allow it to arrive at a decision. He appointed a smaller committee, consisting of Messrs. Jacobs, Newton, Young, and me, to draft such a report, and this committee met immediately to prepare it, completing the work on the same day.

The discussions had are described briefly in the application submitted subsequently by Atchison Agrol. I shall relate briefly herein the reasoning followed in developing the contract price.

The committee first agreed, without debate, that the yield of alcohol per bushel or corn could be set at 2.5 gallons. Second, it was unanimously agreed that the alcohol could be sold into the competitive motor-fuel market at $0.25 per gallon. Third, the cost of conversion, exclusive of profits, contingencies, and sales costs, could be set at $0.07 per gallon. It was recognized by all present that during the first few months or year of operation sales costs might continue rather high, and in any event a large allowance for sales development activities should be made, since there was no way by which the magnitude of this cost could be evaluated beforehand. After considerable discussion, an allowance of $0.10 per gallon of alcohol was made for this activity, but it was generally recognized that the cost of this phase of the development of the power-alcohol industry would certainly decrease greatly as the markets for the fuels were expanded. The total cost of conversion and sales development was thus set at $0.17 per gallon for the initial period, say, 6 months to 1 year. This left $0.08 per gallon toward purchase of raw materials, or $0.20 per bushel of corn.

It was assumed without debate that the yield of byproduct protein concentrate distillers dried grains, would be 16 pounds per bushel of grain converted. Discussion was had about its value in the competitive feed markets. Distillers dried grains had sold during recent months at around $25 per ton, or $0.0125 per pound, but the market was largely in the eastern dairy regions, since in the past there had been little opportunity to secure the sound development of Midwest markets for this superior protein concentrate. It was recognized that during the initial period of operations money would have to be expended by Atchison Agrol to pay freight on shipments to these eastern markets and to develop the local markets. It was therefore assumed that this byproduct would net Atchison Agrol $15 per ton, or $0.0075 per pound. Since Atchison Agrol did not have a dry-ice unit, credit for the byproduct carbon dioxide produced could not be included, but it was recognized that continuity of operation of the Atchison plant would justify investment in such equipment and that later a credit amounting to as much as $0.03 per gallon of alcohol might be allowed, but that for the moment this would have to be excluded from consideration.

Thus it was assumed that byproduct credits during the period of initial operation under the proposed contract would amount to $0.12 per bushel of corn converted, but that as the plant operation became stabilized, markets were developed and a dry ice unit installed, the credit for byproducts might reach $0.275 per bushel of corn converted.

Thus the value of corn used during the initial period of operation under the contract was calculated at $0.32 per bushel, but it was recognized that the value of corn used during succeeding years would certainly be much greater, perhaps as much as $0.56 per bushel. This was clearly pointed out in the application which Atchison Agrol submitted to Federal Surplus Commodities. Such improvements were not a matter of laboratory scale research but could only result from actual plant operation, it was conceded. Further improvements certainly would result from continued research on the production and use of power alcohol, but the value of these was not forecast by the committee.

But, the committee, concluded, some allowance for profits and contingencies should be made, and this was estimated at $0.04 per bushel of corn converted, resulting in an estimate of $0.28 per bushel for the corn used during the first few months or year of operation under the contract. We all felt that this estimate was very safely conservative and could conceivably result in a large profit for Atchinson Agrol. To guard against the use of such earnings for payment of large dividends or for other purposes not in agreement with the purpose of the contract, Atchison Agrol agreed to operate under a limited profit arrangement, thus guaranteeing that all such profits, except a fair and reasonable return on investment, would be used for sales development or plant improvement.

The committee agreed that at the end of a year of operation under the contract, or at the end of the present crop year, the records of the Atchison Agrol Co. should be carefully examined by representatives of the Department of Agriculture, to the end that an exact record of the experience could be had. On the basis of such experience a contract for the second year of operation could be prepared. It was thought that during the second year a contract price of $0.35 to $0.40 per bushel might be feasible. Then on the basis of the results of the second year of operation, a new contract could be similarly decided and this might be at the rate of $0.45 to $0.50 per bushel. How much more might be paid for corn and other farm products could only be definitely decided upon the basis of just such experience. This plan of operation definitely assured that the farmer would receive every cent of the value of his products held in this new market.

Subsequent to these conferences, Chemical Foundation, thinking there might be some objection to cooperation with a private corporation operated for profit to itself, offered to sell the Department of Agriculture or some organization it would designate, all of the patents and inventions resulting from the research program it had supported during several years and pertaining to the manufacture and use of power alcohol, and practically all of the stock of Atchison Agrol, which it owned, on the assumption that this unit and the inventions could, and perhaps should be included in the new regional research laboratory set up in the United States Department of Agriculture. Foundation offered all of these assets at less than half the cost, stating that it was happy to contribute the balance to the development of a project of such great potential value to the American farmer and the American people.

In all of the reports to the United States Department of Agriculture, it was stated that the only problem remaining in power alcohol was the continued financing of the sales development program. The marketability of the fuels made with such alcohol and the profitable manufacture of alcohol for such market

had been conclusively proven. But it was still necessary to expend additional funds in developing the markets for the fuels and the byproducts and Foundation has frankly admitted that it does not have funds for such activity and has had difficulty in finding private capital for it. Thus far, power alcohol has been wholly privately financed, principally by Fundation, but the time has come when some other source of financial and moral support is required to make power alcohol quickly available for the great improvement in farmer well-being which it is capable of yielding.

Members of the two conferences, reviewing the results of their deliberations concluded that $0.26 per bushel for Federal Surplus Commodities Corporation surplus corn was a favorable opening price, since that figure was 1 cent per bushel above the average net return from dumping such corn on the world market, which activity was being conducted by Federal Surplus Commodities Corporation. Further, the power alcohol market was definitely susceptible to great improvement whereas the return from dumping on the world market could not be similarly changed. The subsidy required was considerably less than that applied to the development of the sweetpotato starch industry in the South.

When Messrs. Young, McKeon, and I went to the conference, we were prepared to offer $0.40 to $0.45 per bushel for corn, knowing that we would have to find capital for further sales development and plant improvement activities, but when the conference recommended $0.28 cents as the opening contract price we knew our work in finding such new financing was greatly simplified and we were glad to agree to the plan developed. We greatly appreciated the tentative offer of assistance toward the accomplishment of the results which had seemed to us so important.

It was my privilege to act also as consultant to the Merchants Distilling Co., Terre Haute, Ind., and the Indiana Farm Bureau, in making a second application of practically similar nature for corn to be used by the former for the production of alcohol to be used by the latter in making alcohol-gasoline blends to be sold by its cooperative motor fuel marketing units. This offer, too, is a matter of record.

It is variously reported that there are more than 300,000,000 bushels of corn sealed under Commodity Credit Corporation loan. Another normal or better than normal crop year could easily result in a very unwieldy surplus which could produce a serious market collapse. The improbability of reopening the European markets for American farm products was recently reported to Congress by Secretary Wallace. Then isn't it time to do everything possible looking toward the development of new markets for such surpluses? I feel very strongly that an opportunity has been offered the Department of Agriculture to participate in a constructive way of its own choosing in examining and developing the possibilities which power alcohol holds in this connection, and at little cost. In fact, the project probably would cost nothing at all, when it is considered that the price basis was better than that obtaining in the case of corn dumped on the world market or given to relief agencies. And if the experiment had succeeded, which I knew it would, a new market would have resulted which, Bureau of Chemistry and Soils experts say, could absorb every ounce of every American farm product surplus except cotton. I leave it to you to decide whether the experiment is worth while.

Of course, the importance of power alcohol is not solely connected with its influence upon farm prosperity. It has repeatedly been shown that if all motor fuel sold within the United States contained 10 percent of alcohol made from farm products, there would be required in its production and the cultivation of the raw materials required for its manufacture, at least 1,000,000 employees, and that twice that number, at least, would indirectly secure employment in one of several indirect activities. And who can say what increase in employment would result in establishments now operating if the farmer had fair and reasonable purchasing power? His need for farm equipment, automotive equipment, paints, and, in fact, everything now available to the consumer, is so great that it staggers the imagination.

I am writing you this in order to make the record clear. You may print it in full if you wish, or use it as the basis for a story. But in any event, I want to assure you that I have written this letter in the most friendly and cooperative spirit and have not intended to criticize your paper, the Associated Press, or Mr. Perkins. In some way the whole matter has been grossly misrepresented, simply because only half the facts were told. And sometimes half a truth is worse than a complete falsehood.

With best personal regards,

Sincerely yours,

LEO M. CHRISTENSEN.

MILLER, NEBR., *March 28, 1939.*

Mr. J. S. RUSSELL,
Farm Editor, the Register and Tribune,
Des Moines, Iowa.

DEAR MR. RUSSELL: "The Omaha World-Herald this morning carried an Associated Press story, with Washington date line, captioned "Showdown on Alky-Gas," in which is described the bill just introduced by United States Senator Gurney, of South Dakota, which would exempt a motor fuel containing 10 percent or more of alcohol made from American farm products from payment of the Federal 1 cent per gallon motor-vehicle fuel tax. Senator Gillette and Congressman Harrington, both of Iowa, have introduced similar bills.

It is interesting to note the effect of passage of the Gurney bill upon the price structure described in my letter to you of March 25, 1939. Assuming the alcohol content would be the minimum provided in the bill, 10 percent by volume, the tax rebate of 1 cent per gallon of blend would be equivalent to $0.10 per gallon of alcohol contained in it, or $0.25 per bushel of corn used in its manufacture, assuming a yield of 2.5 gallons of alcohol per bushel of corn.

Thus if we accept the United States Department of Agriculture recommendations for corn sold by Federal Surplus Commodities Corporation for conversion to power alcohol, the following tabulation can be set up.

	Value of corn for power-alcohol manufacture	
	With present tax structure	With Gurney plan in operation
During first year of operation under the contract	25 cents	53 cents.
Second year	35 cents	60 cents.
Third year	45 cents	70 cents.
Fourth and succeeding years	50 cents or more	75 cents or more.

I think your readers should be interested in this information. As before, I am sending copies of this letter to a number of other Midwest papers and magazines and to the many individuals who have so vigorously advocated the establishment of a power-alcohol industry in the United States.

By the way, I have looked in vain in the Register and Tribune for a report of the address by Dr. William J. Hale before a joint session of the Iowa Legislature last Thursday. I was reliably informed that you had a reporter there and that he did prepare a story. Dr. Hale told his audience that he had been authorized by the presidents of the two very large corporations of the finest type to announce that immediately upon passage of mandatory legislation in any of the agricultural States, their companies would start construction of power alcohol plants in these States. The story was of sufficient importance to lead to its inclusion that night in the news broadcast over WHC by H. R Gross. And do your readers know that this bill passed the house agricultural committee with only one dissenting vote and is now being considered by the sifting committee?

Nebraska is also considering a mandatory bill and it, too, has passed the agricultural committee and now is ready for consideration by the legislature as a whole.

With best personal regards,
Sincerely,

LEO M. CHRISTENSON.

I want to emphasize the very important fact that the power alcohol industry would be committing suicide if it did anything else than require sound land use practice on the farms producing its raw material. The Atchison Agrol contracts all make such requirement, and publicly the company has heartily endorsed the efforts of Federal and State agencies to promote conservation of soil fertility. I ask that the advertising booklet of the Atchison Agrol Co. be inserted into the record as evidence of this fact:

"'Agrol' means AGR$^{\text{icultural}}_{\text{alcoh}}$OL—a new use for grain and other crops.

"Agrol power alcohol, made from American farm products and blended with gasoline, is the new high-efficiency motor fuel for automobiles, trucks, and tractors, and is now sold at several thousand filling stations.

"Agrol is made by a special patented process, from corn, barley, rye, and grain sorghums such as milo, kafir, etc., and other crops.

"Agrol was developed out of the pioneer work of Dr. Leo M. Christensen and associates at Iowa State College, and Dr. Harry Miller, University of Idaho.

"What does Agrol mean to you?

"You are interested in better performance for your automobile, your tractor, your truck—at less cost per mile.

"Agrol gives you just that. Actual results of thousands of users under all conditions prove that Agrol gives greater mileage, more power, a cooler motor, less valve trouble, quicker starting, faster pick-up, freedom from carbon, fewer repair bills.

"This is not a newfangled fad. Alcohol-blended gasolines have been used for years in foreign countries. Due to the scarcity of crude oil, these nations had to develop a motor fuel more powerful and more efficient than ordinary gasoline. Power alcohol blended with gasoline was the answer—today used almost universally throughout Europe. Most world speed records have been won with alcohol-gasoline.

"Agrol, an American product, is a definite improvement over the alcohol produced abroad. American cars, trucks, and tractors now have the advantage of better performance at less cost per mile.

"Agrol and the farmer:

"Agrol vitally affects every American man, woman and child. Why? Because whether you are a farmer, laboring man, businessman, professional man, housewife—regardless of where you live or what your income—Agrol is important to you. American prosperity depends upon the health of our largest industry, agriculture. If the farmer is prosperous, you have greater prosperity.

"When the American farmer began to motorize his farm at the sacrifice of horses and mules that used to furnish the power and were "fueled" with the farmer's own crops, the farmer began to suffer from overproduction and lower prices. A group of American scientists got to work on this problem. It took years of study and thousands of laboratory tests, but they finally found a way to make excess farm crops into a new and useful product—a power alcohol of astonishing efficiency.

"Now, this better motor fuel, Agrol, is on sale at thousands of filling stations, and is succeeding on merit. If you will keep a record of your mileage and the price you pay per mile, you will be glad you found Agrol. It isn't the cost per gallon that is so important—it's how many miles you get per gallon—the cost per mile—the miles per dollar. Try a tankful—you'll be thankful.

"Agrol is mostly found at 'independent' stations—but eventually one of the major gasoline companies will undoubtedly have the foresight to cooperate, and then you, the consumer, will not have to go from station to station, demanding Agrol, as it will pay you to do in the meantime.

"National use of Agrol would require all of the crops produced on 30,000,000 acres of land—would help solve the problem of farm overproduction—would mean thousands of extra income dollars to American farmers, as well as to the businessmen, professional men, laboring men who largely depend directly or indirectly upon the farmer.

"But Agrol cannot benefit American business, labor, and farm interests unless you use it. Because of its economy and efficiency as a fuel, and because of its importance as a possible huge new use for farm products, Agrol should be used in the automobile, truck, and tractor of every American citizen who wishes to save money and help save his country a headache. Try a tankful—you'll be thankful.

"Agrol and the working man:

"National use of Agrol can create employment for 50,000 men in Agrol factories; 1,000,000 men producing raw materials; and additional thousands in such fields as mining, railroads, equipment manufacturing, and construction of Agrol factories.

"Byproducts—stock feed and dry ice:

"Two highly important byproducts result from the manufacture of Agrol.

"One of the most interesting and valuable is dry ice, increasingly used in food storage and transportation.

"Of more importance to farming interests is the byproduct Agrol Stock Feed Supplement made from the dried mash after the alcohol has been taken out. Agrol Feed Supplement, with its high protein content, is an excellent feed for livestock of all kinds.

"Try a tankful—you'll be thankful.

"When you buy Agrol you help yourself—by getting a superior fuel. You will have a happy surprise in the new pep and smoothness of your engine and your more miles per dollar. Before using Agrol, your motor may be clogged with carbon and gum. The first thing Agrol does it to give your motor a physic. Waste matter and carbon go out the exhaust pipe. Sometimes waste matter gathers in your gasoline filter. It takes less than 3 minutes for you or the filling station man to clean the filter—and away you fly like in a new car—a feeling of renewed power and smoothness. Give your engine a square deal. Try a tankful—you'll be thankful.

"Ask for Agrol by name. Be persistent. It will pay you for your trouble, even if you have to ask at several stations. If you insist enough, your dealer will get it.

"Try a tankful—you'll be thankful.

"To our farmer friends: We are in accord with the sound soil conservation procedure advocated by the United States Department of Agriculture.

ATCHISON AGROL CO., INC.

"What users say about Agrol (excerpts from actual reports from Agrol users):

" 'We used a 60–64 octane nonleaded gasoline as a base and added to it 10 percent of Agrol. This finished product was used in BK and BX 7¼-ton Mack trucks, both old and new. Our mileage records showed improvements of approximately 20 percent increase in miles per gallon with Agrol, against 72 octane leaded gasoline which had been used prior to these tests.

" 'As near as we could check, we saved around 3 gallons of tractor fuel in a half-day run, which paid for the alcohol.

" 'With the addition of 10 percent Agrol to the fuel, we averaged 24 percent increase in mileage.

" 'From a cost standpoint, I would have no hesitancy in saying that it would pay the operators of large fleets of cars or trucks to use a 10 percent blend of Agrol motor buel.' "

Mr. Tarleau seemed very uncertain about alcohol prices. To clear that situation, I wish to submit that anhydrous ethyl alcohol, formula SD 28–A, made from domestic molasses, is now being delivered as Midwest points at 25 cents per gallon. I expect to have, some time today, telegraphic confirmation of this statement.

It has been shown that there is no record of illegal diversion of any of the more than 1,000,000 gallons of denatured power alcohol distributed in the form of nearly 20,000,000 gallons of blends during the past 6 years. Mr. Tarleau's fears and apprehensions are largely unwarranted. I know the power-alcohol industry-to-be, and the farmers, will give their whole-hearted cooperation toward solving any administration problems that might arise. I hope the petroleum industries also will cooperate. By and large, the American people are honest, law-abiding citizens, and I am certain the costs of administration can, be good efficient, common-sense application of the laws, be kept within very reasonable limits. As I pointed out earlier, Nebraska has had absolutely no trouble administering her tax-exemption law. I am certain the Treasury Department can be just as successful.

Mr. Holloway, of the American Automobile Association, confined his remarks to mandatory legislation, not at issue here.

If Mr. Keefe is right in his remarks about the quality of alcohol blends, then there certainly would be none sold even if this proposed legislation were passed. Therefore, no plants would be built, no money invested in any kind of equipment, no blends would be sold, no motorist would pay the higher cost he claims, and no change would take place in the tax income from motor fuels.

If Mr. Keefe is wrong in his remarks about the quality of alcohol blends, then a great new industry will result from passage of the contemplated legislation, the American farmer will find a new high level of prosperity, several million men will find new employment, a new supply of motor fuel will be created, and many other benefits will be secured.

Evidence indicates that Mr. Keefe is wrong and thus it seems definitely worth while to give the plan which this legislation supports and encourages, a fair and reasonable chance to succeed. Especially this seems logical in view of the fact that it does not cost anything. Only if it succeeds will the Federal Treasury lose a source of revenue, and then the loss obviously will be only a fraction of gains from other directions.

When agriculture is prosperous, factory pay rolls are high, national income is high and Federal Government budgets balance.

Mr. Keefe suggests that the manufacture of gasoline from coal be similarly subsidized. I have never heard that coal-mine owners, operators, or employees wanted such a plan. If they do, I, for one, would favor granting it. They need help, too; and if it can be shown that a tax exemption on motor fuel made from coal would be helpful to them and the Nation as a whole, as we have shown that the exemption of alcohol blends will be to the American farmer and to the Nation, then I should certainly want to give my support to their program. I should like to suggest that the coal interests look into the matter.

I want to stress here that I have throughout my statement, held to the policy of using the term "alcohol" to mean a mixture of Ethyl alcohol, higher alcohols of the type recommended by Mr. Keefe, and required denaturants. That is the product upon which taxes are paid, and upon which invoices are made. Legally, power alcohol is the finished denatured product ready for blending with gasoline.

Mr. Keefe worries about loss of tax revenue, but elsewhere the organization he represents expresses the hope that the Federal gasoline tax will be dropped on all gasoline, and in the near future. He is not very consistent. Let us be realistic about this matter: Many of us have tried to estimate how rapidly plants might be built if this or some similar legislation were passed. It is obviously impossible to make any exact forecast of the future developments, but the following is, we believe, something like the program that could be expected, assuming a 10-percent blend:

Year	Number of plants in production	Gallons of alcohol produced	Amount of exemption
1939	1	2,000,000	$200,000
1940	5	15,000,000	1,500,000
1941	10	30,000,000	3,000,000
1942	15	45,000,000	4,500,000
1943	25	75,000,000	7,500,000
1944	50	150,000,000	15,000,000
1945	100	300,000,000	30,000,000
1946	200	600,000,000	60,000,000
1947	400	1,200,000,000	120,000,000
1948	600	1,800,000,000	180,000,000
1949	800	2,400,000,000	240,000,000

The Department of Agriculture has estimated that at present there is enough surplus production of all suitable farm products to make a national 5-percent blend, or to make a 10-percent blend for half the motor-fuel consumption. If that remains the situation then stabilization at the 1947 level would result.

It seems pertinent to remark here that if all the farm surpluses, except cotton, of all kinds can be removed from the markets, thus stabilizing farm income, factory pay rolls, national income, and tax revenue, all through giving up only $120,000,000 of tax revenue from motor fuels it is a rare bargain indeed, and any one should easily recognize it as such.

It would even help the American Automobile Association. They might be able to sell memberships to farmers, few of whom can now afford that luxury.

I have mentioned the fact that France has never had a good power alcohol program and that is a result of poor legislation, and is not a proof that a power alcohol program cannot be sound.

I do not wish to insert all these questionnaires in the record, but I have here several hundred from American motorists, reporting on the use of American blends in American cars on American highways. They are more than 90 percent favorable to power alcohol. I am going to leave these with Senator Gurney. I am sure he will be glad to show them to any of you.

Reference has several times been made during this hearing to the experiences of the Atchison Agrol Co. I want to take this opportunity to submit a copy of a report to Mr. John Orr Young, president of the Atchison Agrol Co., as of October 22, 1938, from Mr. C. G. Pritchard, a certified public accountant stationed at Atchison during the period from August to December 1938 for the purpose of making a thorough and disinterested study for an outside party of the cost of producing power alcohol in this plant.

MEMORANDUM TO MR. JOHN ORR YOUNG, OCTOBER 22, 1938

I am attaching hereto statement showing production, manufacturing expenses, etc., covering the trial period October 1, to October 20, 1938, both inclusive, or a total of 20 days' operation.

Due to the fact that we did not have adequate working capital at our disposal, the daily production was approximately 4,450 gallons per day instead of the contemplated 7,000-gallon daily production. This is responsible for at least $0.018 per gallon in these figures.

In my opinion, on such a short trial run as this there are losses incurred both in starting up and closing down, which cannot be accurately figured, such as running fires under boilers, etc., for approximately 24 to 36 hours prior to production.

With the expenditure of approximately $22,500 for mold-saccharification unit, and further mash-cooling equipment, our superintendent and engineer tell me we could cut this cost at least $0.05 per gallon, in addition to the $0.018 above, provided we increased our production to at least 7,000 gallons per day. This seems quite reasonable, in view of the fact that we would save a good part of the $0.03 per pound, we pay for barley malt and the $0.014 per pound we pay for bran malt.

The present market for corn in Indiana, where the next plant is to be operated, is $0.33 per bushel.

The average price paid for corn during our 20-day-trial run was $0.43 per bushel. Had we been able to purchase our grain at this figure, $0.33, we would have reduced this cost approximately $0.04 per gallon.

Respectfully submitted.

C. GRAHME PRITCHARD.

Statement of the Atchison Agrol Co., Inc., showing production, manufacturing expenses, etc., for the period Oct. 1 to Oct. 20, 1938

Total gallonage produced, Oct. 1 to Oct. 20, 1938	gallons	95,900
Purchases raw material:		
Malt		$4,724.28
Corn, kafir, etc		17,658.83
Miscellaneous		222.50
Total purchases raw material		22,605.61
Add: Value of inventories Oct. 1, 1938		13,089.75
		35,695.36
Deduct: Value of inventories Oct. 20, 1938		10,985.42
Total		24,709.94

RAW MATERIAL COST

Manufacturing expenses:	
Wages and salaries	$2,795.58
Repairs and maintenance	207.61
Depreciation	347.58
Fuel	3,080.00
Water (used in manufacture)	600.00
Laboratory expense	14.45
Miscellaneous	13.12
Insurance and bonds	330.36
Total manufacturing expenses	7,388.70
Total cost exclusive of byproduct credit	32,098.64
Deduct: Net value of byproduct feed produced	6,585.19
Total cost of producing 95,900 gallons	25,513.45

$25,513.45 ÷ 95,900 gallons = $0.2660

It will be noted that in this 20-day test run the cost of the alcohol produced was $0.266 per gallon, with corn at an average price of $0.43 per bushel. It should be pointed out in explanation that the grain converted during this period was generally of very low quality, and that if a higher quality grain had been used, say No. 3 corn, it would have been worth from 10 percent to 15 percent higher price to yield alcohol at the same cost.

It will also be noted that in the report no mention is made of possible credit from conversion of the byproduct carbon dioxide wasted during this test run. If it had been converted and sold as dry ice, a very conservative estimate would place additional income from sale of this byproduct at $0.03 per gallon of alcohol.

It will also be noted in Mr. Pritchard's report that he has stated that a reduction of at least $0.05 per gallon could have been made if the plant had been equipped with a saccharification unit, which would have eliminated the need to purchase expensive barley malt, and would have produced higher yields than those obpained. I wish to point out that the estimate given by Mr. Pritchard and supplied him by the plant superintendent and engineer, is based upon actual semi-commercial scale operation in the plant, and not upon theoretical considerations—that is, the estimate given is wholly dependable and demonstrable.

In view of these known improvements, it can readily be shown by simple arithmetical calculations what the cost of alcohol could have been had these improvements been available for commercial operation during this test run. These improvements can be listed as follows:

Increasing plant capacity to 7,000 gallons per day	$0. 018
Installation of improved saccharification procedure	.050
Recovery and the sale of dry ice	.030
Total demonstrable savings	.098

Thus the use of these known improvements would have lowered the cost of alcohol produced from corn at $0.43 per bushel to $0.266—$0.098 to equal $0.168 per gallon.

It must be emphasized that this cost includes neither a profit to the company, interest on plant investment, nor any part of sale expense. It is the actual base cost of the alcohol ready for denaturation. The estimate does, however, provide for depreciation or amortization at the legal rates, and provides for every possible capital and operating cost except those connected with sales.

It should also be pointed out that during this test run it was not possible to effect the most efficient and economical distribution of the byproduct feed, and further it should be noted that in a test run of this short duration, 20 days, there are certain inevitable losses in starting and stopping which are reflected in higher cost of production than would have been observed in continued operation. It is also pertinent to note that with an additional boiler, costing $35,000, the plant capacity would be increased to 10,000 gallons per day, providing about $0.02 per gallon reduction in cost.

It will be noted that if corn had been $0.33 per bushel, the cost of alcohol would have been $0.04 per gallon less than the cost at $0.43 per bushel. It is obvious that with corn at $0.53 per bushel the cost of alcohol would have been $0.04 greater. That is, with corn at $0.53 per bushel this demonstration run proves conclusively the possibility of producing alcohol at $0.208 per gallon. My earlier statement was that the Atchison trials had shown the possibility of producing alcohol from corn at $0.50 per bushel at a cost of $0.20 per gallon, which is a little higher than the result actually obtained.

Mr. Pritchard based his report on anhydrous ethyl alcohol. I based mine on completely denatured anhydrous ethyl alcohol. During the past year at Atchison, denaturation has not added to the cost of the alcohol and thus his and my results are exactly comparable.

Now, it will be interesting to determine the cost of blends made with such alcohol. It is assumed that the alcohol will be delivered at the point of blending at $0.25 per gallon, exclusive of taxes, thus providing for profit to the manufacturer, and allowing an adequate transportation charge. It is assumed that the blend will contain 10 percent of alcohol and 90 percent of 62-octane gasoline costing $0.04125 per gallon exclusive of taxes at a group 3 refinery. It is assumed that the blend will sell in competition with a 70-octane gasoline costing $0.0500 exclusive of taxes, group 3.

ALCOHOL BLEND		STRAIGHT REGULAR GASOLINE	
0.90 gallons gasoline	$0. 037125	Cost f. o. b. Tulsa, 1.00 gallon	$0. 0500
0.10 gallons alcohol	.02500	Freight on gasoline	.0300
	.02700	Federal tax	.0100
	.00000	State tax	.0500
	.05000	Inspection	.0010
	.00100		
	0. 140125	Cost per gallon delivered, tax paid	0. 1410

This shows the gasoline dealer's comparative costs for the two motor fuels in carload lots f. o. b. his plant. It will be seen that the blend is fully competitive with the gasoline on a gallonage basis and that the motorists actually can secure in the blend a better fuel yielding lowered operation cost per mile traveled or per acre plowed.

In closing, I want to empahisize that the Atchison Agrol plant was primarily for research and demonstration. It needs some additional equipment for efficient commercial operation. The Atchison Agrol Co. is still in business but it needs working capital and it needs some plant improvements. It has never been subsidized by anyone, but it cannot alone carry the cost of the fight to put power alcohol to work for the American farmer and laborer. Congress can help, and I know of no better or more efficient way than through the tax-exemption plan which the Gurney and Gillette bills contemplate. If this type of legislation is not passed, then I know that agricultural States will pass mandatory legislation. Such a bill passed first reading in Nebraska on Saturday with only 9 of the 43 legislators opposing the bill. I am confident other farm States will follow that lead, and I am afraid some of them will not be able to handle the program as well as I know Nebraska can and will. If mandatory legislation comes, credit it to the wholly unjustifiable opposition of the petroleum industry and its associated activities to a sounder method of developing this essential program.

Senator CONNALLY. Is there anything else Dr. Christensen has got that he wants to put in? We might as well put it all in.

Senator GURNEY. I asked for the permission of the committee to introduce it in the record. I introduced it with some hesitancy, because I felt it should be given by word of mouth, and a chance ought to be given for cross-questioning. I only asked it be included because it is rebuttal of testimony already given.

Mr. KEEFE. Mr. Chairman, and members of the committee, the committee was very kind to me. It permitted me to offer some material in rebuttal. I must object to this procedure.

Senator CONNALLY. You haven't got any right to object. You cannot object.

Mr. KEEFE. I understand that, Senator, but I would like to have this testimony of Dr. Christensen's made available to me, since it is in rebuttal.

Senator CLARK. Of course, there must be an end. You have been permitted to testify here twice, once in rebuttal, and there must be some end to rebuttal testimony.

Mr. KEEFE. Mr. Chairman, I testified in open hearing. I would like to have the opportunity of reviewing the reporter's stenographic statement, or the Public Printer's proof, for the purpose of surrebuttal.

Senator CLARK. I take it nobody has any objection to your doing anything you please, but it is not the purpose of the committee to continue these hearings indefinitely.

Senator CONNALLY. I think you may do that.

Mr. KEEFE. Thank you.

(Subsequently Mr. Keefe submitted the following statement:)

ADDITIONAL STATEMENT OF THOMAS J. KEEFE, GENERAL MANAGER, AMERICAN MOTORISTS ASSOCIATION, WASHINGTON, D. C.

In the closing minutes of hearings on S. 552 before the Senate subcommittee on Finance, May 20, 1939, proponents of the bill introduced into the record a large volume of material on which there was no opportunity for cross-examination by the committee nor rebuttal by opponents. Time is lacking for detailed comment on such a voluminous amount of material, and most of the issues raised in it have already clearly been answered by testimony of opponents appearing before the committee. Specific comment under the circumstances of lack of time must therefore be confined to only a few of the outstanding points discussed in this

large amount of new material introduced into the record of the hearings by proponents.

Much of Dr. Christensen's new rebuttal testimony was directed at supporting earlier testimony by him to the effect that the Atchison plant had demonstrated the possibility of processing 50-cent corn into 20-cent alcohol, as contrasted to the burden of the testimony of Mr. Jacobs, the Department of Agriculture's alcohol expert, indicating a probable scale of costs conservatively computed under present average commercial conditions as at least 10 cents per gallon higher. The new testimony introduced by Dr. Christensen definitely indicates that the Atchison plant even during its demonstration run did not succeed in making alcohol for the costs cited by Dr. Christensen as possible, and when carefully examined, further strengthens the conclusion that the low order of costs cited by Dr. Christensen are largely based on theoretical postulate of ideal conditions which at present are mere possibilities and not probabilities on any significant commercial scale.

In this connection Dr. Christensen included a copy of a report to Mr. John Orr Young, president of the Atchison Agrol Co. as of October 22, 1938, from C. G. Pritchard, accountant stationed at Atchison to make a study of the cost of producing alcohol in the plant for an outside party. The report covered only the trial period October 1 to 20, 1938, inclusive, and was accompanied by a statement showing that the cost of the 95,000 gallons of alcohol produced in that period was 26.6 cents per gallon, made from corn priced an average of 43 cents per bushel. In the copy submitted by Dr. Christensen, the second paragraph of Mr. Pritchard's memorandum to Mr. John Orr Young, October 22, 1938, reads as follows:

"Due to the fact that we did not have adequate working capital at our disposal, the daily production was approximately 4,450 gallons per day instead of the contemplated 7,000-gallon daily production. This is responsible for at least $0.018 per gallon in these figures" (26.6 cents per gallon).

Subsequent comment by Dr. Christensen on Mr. Pritchard's report would seem to indicate strongly that one of the reasons the plant did not exceed an average production of 4,450 gallons during its trial run, or at any period in its operations beginning October 1936, was that the plant's actual operating capacity was not much greater, and certainly not 7,000 gallons daily. For Mr. Christensen comments on Mr. Pritchard's report:

"In view of these known improvements, it can readily be shown by simple arithmetical calculations what the cost of alcohol could have been had these movements been available for commercial operation during the test run. These improvements can be listed as follows:

"Increasing plant capacity of 7,000 gallons per day	$0.018
Installation of improved saccharification procedure	.050
Recovery and the sale of dry ice	.030
Total demonstrable savings	.098"

It is surprising that a needed improvement in the Atchison plant was an increase in its capacity to 7,000 gallons daily, in view of repeated statements in publicity about the plant since its opening October 1936 that its rated capacity was 10,000 gallons daily. In the reprint of Dr. Christensen's own article appearing in the record of the hearings, The Use of Corn in the Fermentation Industries, published January 1939, Dr. Christensen states: "The Atchison Agrol Co.'s plant has a capacity of 10,000 gallons of anhydrous ethyl alcohol per 24 hours and at capacity uses 850,000 hundredweight of grain per year."

Mr. Pritchard reported the actual cost of producing alcohol from 43-cent corn at the Atchison plant as 26.6 cents per gallon during its test run October 1 to 20, 1938, a cost 1.6 cents per gallon higher than the f. o. b. Atchison price of 25 cents for which the plant's product has been sold to the motor-fuel trade. It will be noted that Dr. Christensen's estimates are based on what costs "would have been" and "could have been" had certain conditions and possibilities which he postulates been operative.

Although since October 1936 the Atchison plant's product has been sold to the commercial motor-fuel trade for a price of 25 cents per gallon f.o.b. Atchison, Dr. Christensen and others have stressed that it is an experimental plant, and Dr. Christensen specifically stated that "it has never been subsidized by anyone." In his letter of May 26, 1939, to the chairman of the Senate Finance Subcommittee, submitting information regarding the Chemical Foundation, Inc., Mr. William Buffum, treasurer and general manager of that organization, stated as follows:

"* * * the foundation became greatly interested in power alcohol, and during the past 5 years has taken an active part in the research connected with its manufacture, blending, and distribution, and has spent upward to $1,000,000 in its development. It established at Atchison, Kans., a research-demonstration plant to prove that power alcohol could be manufactured economically on a commercial basis from American farm products, and could be blended with gasoline to make a superior motor fuel, and that distribution of this fuel was feasible."

Since the high cost of alcohol compared to gasoline is generally acknowledged by people of all views on the question as the vital problem in need of solution to make alcohol blends commercially feasible, the question is distinctly in order why, with almost $1,000,000 spent for power-alcohol development, sufficient improvements visualized by Dr. Christensen as a means making a low order of alcohol costs possible were not actually made in the Atchison plant.

There is no evidence that alcohol was ever produced at the Atchison plant as cheaply as 25 cents per gallon. All lower figures cited in testimony were not based on actual cost at Atchison, but were estimates of costs had various conditions of operation been different. There is considerable evidence that costs of alcohol at Atchison greatly exceeded 25 cents per gallon. Mr. Jacobs, Department of Agriculture alcohol expert, showed in his testimony that in its first year of operation the Atchison plant produced only 87,660 gallons of alcohol, at an over-all raw material efficiency of only about 48 percent; about 316,000 gallons the second year for an efficiency overall of about 63 percent; the third year, in 4 months operations, about 209,000 gallons, showing an efficiency of about 71.5 percent on the basis of raw materials received.

In view of Dr. Jacob's estimates of the probable scale of alcohol costs, based on 85 percent efficiency in raw material yields from corn, it seems indisputable that actual costs of alcohol produced at Atchison considerably exceeded 25 cents per gallon, and that considerable doubt must be attached to any estimates based on Atchison experience, of alcohol costs of 20 cents per gallon and lower when alcohol is made from 50-cent corn. Mr. Jacob's table of estimates showed the probable scale of costs of finished alcohol as $0.1863 per gallon from 10-cent corn; $0.2175 from 20-cent corn; $0.2483 from 30-cent corn; $0.2640 from 35-cent corn; $0.2790 from 40-cent corn; $0.2950 from 45-cent corn; $0.3110 from 50-cent corn; and ranging progressively higher to $0.4660 per gallon from corn priced $1 per bushel.

Toward the close of his rebuttal testimony, Dr. Christensen makes the following computation of purported comparative costs to gasoline dealers. It will be noted that they are based on a series of assumptions which are purely theoretical. Dr. Christensen stated:

"Now, it will be interesting to determine the cost of blends made with such alcohol. It is assumed that the alcohol will be delivered at the point of blending at $0.25 per gallon, exclusive of taxes, thus providing for profit to the manufacturer, and allowing an adequate transportation charge. It is assumed that the blends will contain 10 percent of alcohol and 90 percent of 62-octane gasoline costing $0.04125 per gallon exclusive of taxes at a group 3 refinery. It is assumed that the blend will sell in competition with a 70-octane gasoline costing $0.0500 exclusive of taxes, group 3.

ALCOHOL BLEND		STRAIGHT REGULAR GASOLINE	
0.90 gallons gasoline	$0.037125	Cost f. o. b. Tulsa, 1.00 gallon	$0.0500
0.10 gallons alcohol	.02500	Freight on gasoline	.0300
	.02700	Federal tax	.0100
	.00000	State tax	.0500
	.05000	Inspection	.0010
	.00100		
	.140125	Cost per gallon, delivered, tax paid	.1410

"This shows the gasoline dealer's comparative costs for the two motor fuels in carload lots f. o. b. his plant. It will be seen that the blend is fully competitive with the gasoline on a gallonage basis and that the motorists actually can secure in the blend a better fuel yielding lowered operation cost per mile traveled or per acre plowed."

It will be seen that Dr. Christensen's own calculations admit an extra cost for 10-percent blends of 1 cent per gallon, for they do not charge the 1-cent Federal gasoline tax against the blend but do against the gasoline.

The delivered price of 25 cents per gallon for alcohol made from farm products has never been realized at the Atchison plant, which charged 25 cents per gallon f. o. b. plant for its product, and did not succeed in producing it at that price, using 43-cent corn, even during its demonstration run, according to Mr. C. M. Pritchard's figures which Mr. Christensen introduced. In his calculations Dr. Christensen apparently assumed an f. o. b. plant cost of 20 or 20.6 cents per gallon for alcohol made from 50 or 53-cent corn, for in introducing his calculations previously quoted he stated as follows:

"* * * That is, with corn at $0.53 per bushel this demonstration run proves conclusively the possibility of producing alcohol at $0.208 per gallon. My earlier statements was that the Atchison trials had shown the possibility of producing alcohol from corn at $0.50 per bushel at a cost of $0.20 per gallon, which is a little higher than the result actually obtained."

According to Mr. Pritchard's statement cited by Dr. Christensen, the result actually obtained in the demonstration run at Atchison was 26.6-cent alcohol from 43-cent corn. Alcohol costing 20.8 cents per gallon from 53-cent corn was not "the result actually obtained" but actually Mr. Christensen's opinion of what result was a possibility under an ideal set of conditions which were never realized at the Atchison plant and which there is serious doubt as to whether they could be realized at the present time on a significant commercial scale.

It will also be noted that Mr. Christensen's calculations of the comparative cost of alcohol blends and straight regular gasoline assign an arbitrary freight rate of 3 cents per gallon for gasoline to some unspecified point, yet specify no f. o. b. price for the alcohol nor freight rate for the alcohol. With the freight rate for the alcohol buried, there is no way of telling whether the alcohol and gasoline freight rates are on a comparable basis. National Petroleum News of May 24, 1939, quotes group 3 freight rates for gasoline to St. Joseph, Mo., a neighboring city to Atchison, Kans., at only 1.848 cents per gallon; similarly, to Kansas City, Mo. Quoted group 3 rates for gasoline to various Iowa cities, Des Moines, Davenport, and Mason City, are 2.376 cents per gallon, 2.574 cents, and 2.772 cents, respectively.

Realistic appraisal of Dr. Christensen's computations of the relative costs of alcohol blends and straight regular gasoline distributed leads one to the conclusion that the actual cost of distributing motor fuel would increase considerably if alcohol blends were used. It would be inescapable that to bring the alcohol and gasoline together for blending would multiply the number of expensive short and cross hauls now necessary in distributing motor fuel. Dr. Christensen also omitted the cost of additional storage facilities for alcohol which would have to be installed at blending plants.

An unpublished study entitled "Growing Use of Alcohol in Motor Fuels in Foreign Countries" was introduced into the record by Senator Gurney in the closing minutes of the last day of the hearings on S. 552. An authoritative survey by Dr. Gustav Egloff, Motor Fuel Economy of Europe, published in Industrial and Engineering Chemistry, October 1938, and introduced by me in previous testimony, is a much fuller report of the substitute-fuel situation abroad. It contains much more complete and recent statistical information than the study introduced by Senator Gurney.

These additional data clearly show that the use of power alcohol is waning instead of increasing in Europe, and that even among Europe's various substitute fuels, power alcohol has since 1937 ranked only third in use. Both benzol and synthetic gasoline hydrogenated from coal and from carbon monoxide gas derived from coal have constituted a larger portion of Europe's motor-fuel consumption since 1937. The study also shows that despite the declining use of power alcohol in Europe, and the artificially high costs of motor fuel there due to high taxes, the loss to consumers and government on the power alcohol used in 1937 was about $100,000,000 in subsidies, tax losses, and higher operating costs of vehicles. It also reveals that the use of power alcohol in various European countries is a product of peculiar economic and military conditions which fortunately have no counterpart in the United States.

Mr. Buffum has submitted for the record reprints by the Chemical Foundation of 1935 advertisements for alcohol blends, including the product Cleveland Discol, sold in England. These reprints fail to indicate highly pertinent facts concerning the marketing of alcohol blends in England, and consequently convey a distorted and misleading impression.

The sale of alcohol blends in England has never been compulsory, but it has been heavily encouraged by Government subsidies and tax exemptions. The alcohol itself was and still is subsidized directly by the Government to the limit of 17.5

cents per imperial gallon (14.6 cents per United States gallon). Until May 1938 the alcohol content of blends was exempt from the duty on gasoline, which until the close of 1937 was 16 cents per gallon and then was raised from 8d. to 9d. per imperial gallon (about 16 cents per United States gallon). The benzol content of alcohol blends also was and still is exempt from the duty on gasoline.

Typical British alcohol blends from 1935 to 1938 contained 15 percent benzol, 15 percent alcohol, and 70 percent gasoline, those contents deviating but slightly in adjusting the fuels for various seasons. As a result per United States gallon of blend received subsidies and tax preferentials of about 7.5 cents, permitting such blends to be sold at the same price as No. 1 spirit, the British equivalent of United States regular gasoline, and at a greater margin of profit. Despite this governmental encouragement of the marketing of alcohol blends since 1930, power alcohol constituted only three-tenths of 1 percent of total motor-fuel consumption in the United Kingdom during 1937.

Since British power alcohol is made from imported blackstrap molasses, the Government decided that encouragement of its use on grounds of being a national fuel was inconsistent, and in May 1938 rescinded the exemption of power alcohol from the duty on gasoline. The direct subsidy of alcohol itself and the exemption of benzol from the motor-fuel duty continues, however, with the result that 15 percent alcohol, 15 percent benzol, and 70 percent gasoline blends still command artificial advantages of approximately 5 cents per gallon, despite which fact the price of these blends advanced 1 cent above the price of No. 1 spirit, the equivalent of regular-grade gasoline.

A headline in the Chemical Foundation's reprints of advertisements for Cleveland Discol in England erroneously and misleadingly refers to that product as a 33⅓-percent blend. The root of that misleading caption doubtless springs from a careless reading of the portion of the advertisement which states that blends containing 33⅓ percent alcohol will raise the antiknock value of a fuel sufficiently to permit use without knocking in engines with compression ratios of 10 to 1, but the advertisement specifically states of the product Cleveland Discol that it will not knock in engines with compression ratios of 7½ and even 8 to 1.

No recognition is given to the fact that the British alcohol blends whose advertisements were reprinted by the Chemical Foundation are fuels of a totally different character than alcohol blends proposed for America. The presence of 15 percent of benzol, a coal product not widely available in the United States for motor-fuel purposes, avoids the danger of separation of the alcohol from the gasoline, since benzol admixed in that quantity acts as an effective stabilizer. Second, benzol is also a good antiknock agent, so that it aids the alcohol in increasing the antiknock properties of British blends far beyond those proposed in America, comprising 7 or 10 percent alcohol-gasoline. Third, benzol has even a higher heat energy content than gasoline, so that it to a considerable extent offsets the mileage loss resulting from the deficiency in heat energy content of alcohol compared to gasoline.

When the full facts are understood about the conditions surrounding the use of alcohol blends in England, particularly the subsidies and tax preferences of such magnitude created for them, the most surprising fact of all proves to be that they have never gained an important position in British markets.

In conclusion, testimony has clearly indicated that the Atchison plant over its 2½ years of operation has failed to produce alcohol for the low order of costs which proponents claim would raise the price of motor fuel containing 7 to 10 percent of alcohol only 1 cent per gallon, the amount of the proposed exemption of blends, from the 1 cent Federal gasoline tax. Radical reductions of present probable alcohol costs cited by Dr. Jacobs would have to be accomplished demonstrably in fact, and not as a mere possibility assuming ideal conditions which are in serious doubt as to realization on any appreciable commercial scale. Many complex technological, sociological, and economic obstacles to use of power alcohol would make its use at present clearly uneconomic and undesirable in America. Intensive research under impartial auspices to overcome these problems is clearly a necessity before a power-alcohol program of any sort can possibly merit consideration.

Senator CLARK. Is there anybody else who desires to be heard?

Senator GURNEY. Mr. Chairman, Mr. Buffum of the Chemical Foundation of New York, was on the stand here last week, and before I ask his letter be put into the record, on account of the conversation here in the last few minutes, I would just like to read the first few

paragraphs. The letter, by the way, is addressed to Senator Clark as chairman of this committee.

In answer to an inquiry by Senator Chan Gurney at the subcommittee hearings on May 24, I beg to submit the following information.

The Chemical Foundation was created in 1919 by an Executive Order of President Woodrow Wilson, with power to purchase from the United States Government some 6,400 enemy-owned patents. The foundation was organized not for profit, but to hold and administer these and other patents later acquired for the sole benefit of American industry, and also to act as a center of industrial and scientific research.

With that explanation of his letter and whom he represents I would ask that his four-page letter be included in the record.

Senator CONNALLY. Did he testify?

Senator GURNEY. Yes; he did.

Senator CONNALLY. Did not he tell us everything he wanted to say then?

Senator GURNEY. Some questions have been raised by other witnesses as to who the Chemical Foundation was.

Senator CONNALLY. Everyone knows who the Chemical Foundation is that knows anything. Go ahead and put it in.

Senator CLARK. Without objection, it may be included. I do not think it is very material myself. Everybody knows what the Chemical Foundation is, and some of us have a very low opinion as to the method by which the Chemical Foundation was established.

Senator GURNEY. It is quite material to the subject we have been discussing, as you will see by reading the letter.

Senator CLARK. Without objection, it may be included.

Senator GURNEY. Thank you.

(The letter referred to is as follows:)

THE CHEMICAL FOUNDATION, INC.,
New York City, May 26, 1939.

Hon. BENNETT CHAMP CLARK,
Chairman, Finance Subcommittee,
Senate Office Building, Washington, D. C.

DEAR SENATOR CLARK: In answer to an inquiry by Senator Chan Gurney at the subcommittee hearings on May 24, I beg to submit the following information.

The Chemical Foundation was created in 1919 by an Executive order of President Woodrow Wilson, with power to purchase from the United States Government some 6,400 enemy-owned patents. The foundation was organized not for profit, but to hold and administer these and other patents later acquired for the sole benefit of American industry, and also to act as a center of industrial and scientific research.

The United States Supreme Court held that the Chemical Foundation was intended to amount to a public trust for those whom the patents will benefit and for the promotion of American industries, and to give to them the right to have, on equal and reasonable terms, licenses to make, use, and sell the inventions covered by the patents.

In addition to the patents originally purchased from the Government, the foundation has acquired other patents, and to date has granted nearly 1,000 licenses covering products which are used in almost every industry in the country. Its charter provides that any American citizen or any corporation, of which not less than three-fourths of its stock is American owned, and qualified to manufacture the products covered by its patents, can obtain a license. All licenses issued under the same patent are on equal terms, and the royalty rates are very nominal. The royalties derived from the use of these patents are devoted entirely to research and educational purposes.

The president, vice president, and trustees receive neither compensation nor expenses.

Before the World War, America had no organic chemical industry, and the foundation's first function in 1919 was to aid in the development of this essential

industry. The emancipation of American industry from foreign patent domination was the cornerstone of our present world-renowned chemical industry.

The foundation supported American research on the application of chemistry to the problems of medicine, agriculture, and industry, and fostered the improvement of chemical education in our high schools and colleges. It also distributed millions of books and pamphlets for the instruction of the layman in the importance of chemistry in our daily lives.

Under our patents, there were manufactured several drugs, such as salvarsan and novocain, which were absolutely necessary for the alleviation of human suffering. The foundation's activities in medical research have included financial aid in studies on cancer, the common cold, tuberculosis, diabetes, diseases of the brain, leprosy, sinus diseases, diseases of the muscles, pneumonia, infantile paralysis, diseases of children, obstetrics and gynecology, anesthesia and sanitation. It has financed the research of Dr. Perrin H. Long, of Johns Hopkins Hospital, Baltimore, who initiated research of sulfanilamide in this country. This new drug is, at the present time, being successfully and dramatically used in numerous diseases.

The committee on standardization of biological stains, through which was created a small but exceedingly important industry for the benefit of the health of the people of the country, was organized and financed by the foundation. The biological stains manufactured in the United States are indispensable in the accurate diagnosis of many of our diseases.

The foundation financed the major portion of the research work of Dr. Charles H. Herty in the utilization of southern pine for the manufacture of paper. The result of Dr. Herty's researches has been the construction of some 16 kraft mills in the South at an investment of more than $100,000,000, thus furnishing employment to many thousands. This was the beginning of a new era for the South. Tomorrow, May 27, the first mill to manufacture newsprint from southern pine will be dedicated at Lufkin, Tex. The second newsprint mill has already been announced for Tupelo, Miss. This great new industry for the South is an indication of what can be accomplished by the establishment of a power alcohol industry for the farm areas of this country. However, we believe the power-alcohol industry would necessarily be on a much larger scale.

Closely akin to paper pulp is the subject of cellulose. This chemical is the basic material for many large industries, such as rayon, explosives, photographic film, cellophane and plastics. Realizing that there was still much fundamental knowledge to be obtained in the cellulose field, the foundation established its cellulose department at the Boyce Thompson Institute for Plant Research in 1935. This is one of the most elaborate cellulose laboratories in the world. Patents have been applied for on the remarkable results obtained by this department, and licenses will be available to all interested American manufacturers when the patents are granted.

The foundation has also supported research on starch from sweetpotatoes, tung oil, hemp, and soybeans.

In addition to these projects to aid American agriculture, the foundation became greatly interested in power alcohol, and during the past 5 years has taken an active part in the research connected with its manufacture, blending, and distribution, and has spent upward of $1,000,000 in its development. It established at Atchison, Kans., a research demonstration plant to prove that power alcohol could be manufactured economically on a commercial basis from American farm products, and could be blended with gasoline to make a superoir motor fuel, and that distribution of this fuel was feasible. The plant at Atchison has operated on some 10 different raw materials grown on the American farm. It has satisfactorily produced anhydrous ethyl alcohol, which has been blended with various kinds of gasoline. This blended fuel has been distributed through some 3,000 gasoline stations in 7 States. Some fifteen million gallons of blended motor fuel have been sold. The Chemical Foundation's part in this project has now been accomplished. As we are neither industrialists nor manufacturers and cannot go into commercial business, the manufacturing operations at Atchison have been discontinued, but the plant is ready for operation when capital and industry wish to carry on.

There has been such a demand from customers for this superior motor fuel that for the past few months the Atchison plant has been purchasing alcohol made from Louisiana molasses, which is being denatured at our plant, and sold to our customers. Although no effort is being made to promote sales, they do not seem to decrease which is an indication that the consumers desire the alcohol blend. It provides greater mileage, more power, a cooler motor, quicker starting, faster pickup, freedom from carbon, and consequently fewer repair bills.

I am sending herewith a booklet describing the British alcohol motor fuel, Cleveland Discol, and a folder containing data regarding the British Koolmotor Alcohol Blend. Ther are also attached copies of some advertisements of American trucks, tractors, and locomotives built to use alcohol as motor fuel.

In the course of the research work at Atchison, the foundation's investigators made many discoveries of importance in connection with the manufacture of power alcohol. Patents have been applied for on many of these inventions, and some patents have already issued. These patents are available to American industry by license at a nominal royalty rate. They have already been offered for use by the Government, through the Department of Agriculture.

There can be no monopoly in the holding of these patents by the Chemical Foundation because of their availability by license to any qualified manufacturer. One of the objectives in obtaining patents on these new discoveries was that through them we believe that equitable distribution of the profits from the manufacturer of power alcohol can be made, both to the farmer who grows the raw material, and the manufacturer who produces the alcohol. The nonexclusive feature of the foundation's licensing arrangement precludes any monopoly aspect, and allows its licensees to compete against each other, thus giving the public the benefit of their competition.

One of the objects in the certificate of incorporation of the foundation is to hold its patents in a fiduciary capacity "for the advancement of chemical and allied science and industry in the United States." The accomplishments of the foundation, from its inception to the present time, have been unswervingly in accordance therewith.

Agriculture is at the cross roads. It must either go back to a self-contained peasantry or find new industrial markets for its products. Power alcohol is the most promising large-scale outlet for the farmer's surplus.

This new infant industry should be encouraged by the adoption of Senator Gurney's amendment, at least for a time to give it an opportunity to become established. Mandatory legislation to compel the use of power alcohol is not acceptable to the American people. Undoubtedly the simplest means is the provision for a tax differential to favor the blend. This plan does not require any company to make or sell alcohol blends against its will and it does not force any motorist against his inclination to use such a fuel.

The adoption of a 10-percent blend program on a national scale would undoubtedly stimulate increased employment and demand for many classes of materials. Idle men and idle acres would be put back to work. Farmers, plant operators, and many others could purchase the manufactured commodities they desire, and thus do their share in stimulating general business.

Power alcohol awaits and deserves the recognition of the Congress of the United States by your cooperation in favoring this amendment to exempt from Federal tax, motor fuel containing 10 percent of more of alcohol.

Very truly yours,

THE CHEMICAL FOUNDATION, INC.,
WM. W. BUFFUM,
Treasurer and General Manager.

[An exact reprint by The Chemical Foundation, Inc.]

WHY SHOULD YOU USE CLEVELAND DISCOL, ANYWAY?

[Cleveland is the trade mark of the Petroleum Storage & Finance Corporation, Ltd., and Discol the trade mark of The Distillers Co., Ltd.]

Most of us have, at some time or other, run a car for a couple of years, and then bought a new one. If, after running the new bus for a fortnight or so, you went back to take a peep at the old one, you know jolly well that, although the old bus looked good for a few more thousand miles, you wouldn't like to swap back again. That just about illustrates the difference with Cleveland Discol. Other spirits are quite useful, and fulfill their purpose admirably, but when you have run a few hundred miles on Cleveland Discol—well, they're just not so good.

If you will spend exactly 5 minutes wading through this little book we will try to say why, and as untechnically as we can. All we say about Discol may sound a bit too hot, but just try it afterward and tell us if you don't agree. . . .

TREMENDOUS POWER, ACCELERATION, AND ANTIKNOCK

There are two principal reasons for using alcohol in your car—first of all, its tremendously high antiknock qualities and, secondly, its remarkable smooth-running effect, which latter point we talk about on the next page. It is a fact that mixture of about one-third of alcohol to two-thirds of petrol will so raise the antiknock value of the petrol that compression ratios can be increased from the normal average of 6 to 1 to anywhere up to 10 to 1, and so produce more power from the same size engine, or alternatively permit the size and weight of the engine to be proportionately reduced. That is why practically all air and land speed records have been made on alcohol-blended fuels.

Cleveland Discol, which is suitably blended with British alcohol, will definitely not knock in engines with compression ratios as high as 7½ and even 8 to 1. We are right, then, in saying that no ordinary car can knock on Discol, and pinking and consequent power loss is simply impossible. Acceleration is just amazing. Instead of easing your accelerator pedal down you can literally step right on it.

We don't want to bore you with a discussion on rates of flame propagation but Discol's low rate, plus the weightier charge in all cylinders, plus more complete combustion results in that considerable power increase which, to you, means the getting up this or that hill without the usual change down, and, what is more, getting up darn fast.

Please don't think that Cleveland Discol shows these results only in racing and really high compression engines. Just the same proportionate efficiency increase shows up in standard models for exactly the same reasons. Apropos our remarks on high-compression engines—in case you are running a motorcycle—our dealer friends tell us that most motorcyclists already know how Discol performs, and are almost invariably running on Discol.

ALCOHOL'S LATENT HEAT FACTOR MEANS REMARKABLE ENGINE SMOOTHNESS AND QUIETNESS

Alcohol has an exceptionally high latent heat of vaporization. This is difficult to explain untechnically, but means that, when Cleveland Discol gets into the inlet manifold of your car, it is considerably cooler and therefore heavier than is the case with regular petrols. This extra weight makes for more equal distribution, and, instead of some being starved and some overfed, each cylinder gets its proper supply of fuel; result—elimination of "bumpiness," and pronounced smoothness of running. There is a tremendous increase in power, especially when climbing, which is when you want everything your engine can give. This is because, under the improved inlet manifold conditions when using Cleveland Discol, a more solid and heavy charge is delivered to each cylinder; in fact the effect is almost comparable with that of a supercharger.

All this sounds very complicated, and you are probably thinking, "What the deuce happens in any case?" Well, the effect is very obvious in the first mile which you run on Cleveland Discol. There is a most noticeable smoothness, the engine is not half as noisy (or twice as quiet, whichever way you look at it!), and there is a real "floating power" effect with any engine. We've been told by motorists whose cars have engines bolted direct on to the chassis that, even if Discol didn't show them a much better performance, they would still run on it, just for the remarkable absence of engine vibration which they experience.

COOLING PROPERTIES, LESS VALVE AND GENERAL WEAR AND SAVING IN OVERHAULS

Following on the previous paragraph, it is obvious to the lay mind that this same high latent heat factor, and consequent cooler running, means better thermal efficiency—that is, less power lost through heat. The saving on exhaust valve wear particularly, valve seatings, and general wear is quite apparent.

SOLVENT ACTION ON CARBON; CLEANING EFFECT

Alcohol is actually a solvent of carbon. This means that carbon which would ordinarily remain on your exhaust valves and cylinder head goes out at the back via the exhaust. We don't need to prove this—just look at the floor of your garage at home. When you have been running Discol for, say a fortnight, you will see a thin strip of accumulated carbon there just beneath the place where your exhaust pipe usually stands (probably alongside the mangle!), just from getting away each morning. When you come to think that ordinarily this carbon and a great deal more would be in your engine, you see why top overhauls are only necessary infrequently, and certainly not half as often as formerly.

There is another distinct advantage of alcohol as a solvent. After months of use, some car tanks tend to rust and, while bits of this rust come through the line toward the carburetor, the balance accumulates round the walls of the tank. Alcohol has a powerful penetrating quality which will clean out this rust. When using ordinary petrol, any one of these bits of rust might wash through into the carburetor at any time and cause you to conk out miles from anywhere, so they are much better out of the way than in your car tank. Cleveland Discol will move any which may be there almost immediately, and if the filter on the tank side of your carburetor is cleaned after the first 50 or 100 miles on Discol, you have the satisfaction of knowing that your tank and lines are perfectly clear of rust, and will stay so as long as Discol is used. Many car tanks have no rust to wash out, but some older cars will find this clean-out extremely beneficial.

RACING ON ALCOHOL

Most of us know that alcohol has been used almost exclusively in racing fuels ever since racing began. We are referring, of course, back to the early days of Brooklands, rather than those of Jehu. While racing fuels containing alcohol are specially blended, the Cleveland Discol which you buy at the pump will give a pretty sparkling performance. We are not suggesting that you want to dash round Brooklands until you are dizzy, but it does bear out what we say about power and antiknock.

ALCOHOL'S AFFINITY FOR WATER

It is fairly well known that alcohol mixes perfectly with water, yet ordinary petrol doesn't. The affinity of alcohol for water is a very big advantage of Cleveland Discol. Over a period, an odd drop of water gets into most carbureters, and very few motorists have not had the experience of having to tickle up their carbureters for this reason at some time or other. When using Cleveland Discol this simply cannot happen, as a drop of water accumulated in the carbureter overnight (say, through condensation, which is very possible) will simply be mopped up by the alcohol in Discol and burned, whereas, with ordinary petrol, a total stoppage will most likely occur.

Some remarkable demonstrations of this can be given. It is possible to pour almost half a pint of water into a car tank containing 10 gallons of Cleveland Discol without the slightest trouble—in fact, in some circumstances with better running. Some of our chaps are optimistic enough to give practical demonstrations with their own cars, and manage to get away with it.

Under present-day conditions of handling petrol it is almost impossible for it to come into contact with any appreciable amount of water, but, in this respect, Cleveland Discol is dozens of times safer than ordinary petrol.

MORE MILES PER GALLON AND INCREASE IN MAXIMUM SPEED

We seem to be getting long-winded, so will try to be a bit more snappy.

When we produced Cleveland Discol our object was, primarily, sparkling performance, acceleration, and power, rather than more mileage; but, even so, Discol does increase miles per gallon. The cooler running, the tremendous power which means that practically all running is done in top gear, and the more complete combustion explain why. On this latter point, our chemists have actually analyzed the different exhaust gases, and those from Discol invariably show a smaller percentage of carbon monoxide. We are not shouting about more miles per gallon, but they are there.

We did intend to increase maximum speeds with Cleveland Discol, and have definitely done so. The extraordinarily high antiknock value means that your ignition can be well advanced, and this, with more complete combustion, results in a very substantial increase in all-out speed. You try for yourself.

BRITISH ALCOHOL USED EXCLUSIVELY

British alcohol is used exclusively in the blending of Cleveland Discol. Actually the whole of it is supplied by the Distillers Co., Ltd., who know what is what where alcohol is concerned. We don't say buy Cleveland Discol because it is blended with British alcohol, but it is worth your knowing that, in using Cleveland Discol, you are supporting a rapidly growing British product.

The alcohol is 99.9 percent anhydrous—anhydrous, by the way, means free from water—so that there is no room for any impurity. It is only just lately that

a commercial method of producing water-free alcohol has been discovered, which will explain why alcohol blends are now becoming so widely used in all parts of the world.

IS ANY CARBURETOR ADJUSTMENT NECESSARY?

This is a question we are frequently asked. It is worth noting that a famous engineer recently said that 9 carburetors out of 10 are not efficiently adjusted, and that an expert could almost invariably improve the running of any car on the road in this respect. Cleveland Discol will put up an exceptional performance on 95 percent of carburetors without the slightest adjustment. In line with the above, however, some attention to the carburetor by an experienced dealer will give even better results.

There is just one exception—those cars which have a tendency to be over-cooled. With these models it is possible that the mixture on an unchanged carbureter setting will be a little too weak when changing over to Discol, due to the fact that the high latent heat factor of Discol results in a greater weight of air being drawn into the cylinder, and, at full throttle particularly, the mixture would be too weak. This is immediately and easily corrected by slightly enrich-ening the mixture by the usual adjustment provided in all makes of carbureters.

RESEARCH AND TESTS

Cleveland Discol was not put on the British market until we were absolutely certain that it was right in every detail and all conditions—including the weather. For months we ran every conceivable test and check test, in all sorts of weather conditions, laboratory, bench, road, and track. This same detailed research is carried on every day, and as engine designs advance (and the tendency now is always toward higher compression) Cleveland Discol will keep pace. What is more—time, gentlemen, please.

Our 5 minutes are up. What we say must all sound very good, but must also sound pretty well exaggerated. Don't take our word for it. With a perfectly open mind buy some Cleveland Discol at the next garage you come to. There are 2,000 of them already selling it here and there.

Overleaf, by the way, we quote a half-dozen letters from other fellows about Discol. We should need an omnibus if we wanted to publish even a fair selec-tion. They have to be anonymous, but you can certainly see the originals if you like.

We think you will agree, when you've tried the spirit, that the 5 minutes spent reading this is well repaid by the additional pleasure you will derive from driving on Cleveland Discol. Your engine certainly will.

Thank you.

LONDON, W. 2, *September 29, 1935.*

DEAR ———: As I find that you are out of town, I am writing to tell you some interesting facts on Cleveland Discol.

As you will no doubt remember, you spoke to me about this spirit before I left for Folkestone on July 28. On arrival, I was glad to find that the garage where I deal had recently fitted a Cleveland Discol pump. As my petrol tank had but 2 gallons in it, I filled up with 12 gallons. The following day, during the afternoon, it was made clear to me what a difference Cleveland Discol was making to the car.

However, not until my return to town, were the true facts clearly shown. I had six passengers, including myself, and a cabin trunk and five suitcases on the luggage grid; in spite of all this, the car cleared Wrotham Hill at 45 miles an hour. In case you don't know that road, the hill mentioned is not so very steep, but rather a long drag, with cross roads halfway up. On other occasions I have only managed to clear it at 40 under similar conditions, so you can imagine my surprise at such an improvement. Not only has Cleveland Discol improved the pulling power, but also in speed by 5 miles an hour; consumption by 2 miles per gallon. Whereas I got 20 miles per gallon, I now get 22. The quick get-away, and even smoother running when just ticking over. In every way has this petrol improved the general running of the car.

As you know, she is a 1930 25 horsepower ———, and they take a great deal of beating on anything.

Yours faithfully,

LONDON, *August 8, 1935.*

Messrs. ———
Cleveland Petroleum Products Co., London.

DEAR SIR: I have much pleasure in writing to say how pleased I am with your fuel. As a keen motorist, with over 25 years' experience, including several years of motorcycle racing, I have naturally studied the most suitable fuel.

I am at present driving a 2-litre ——— in which the correct fuel is most important. As neat petrol was quite unsuitable, I had to make up my own mixture. I recently tried your fuel, and find it really fulfills all you claim for it.

I recently did a run of 291 miles, at an average speed of 38.6 miles per hour, with a petrol consumption of 30.5 miles per gallon, which I think is remarkable, the best consumption I could get on my own mixture, on long runs, being about 25.7 miles per gallon.

Yours faithfully,

——— ———.

BOURNEMOUTH, *May 16, 1935.*

Messrs. ———,
Cleveland Petroleum Products Co.,
Royal Edward Dock, Avonmouth.

DEAR SIRS: Having recently fitted high-compression pistons to my ———, I thought you might be interested to know my experience of using your Cleveland Discol fuel.

I use the model as a daily "hack" in addition to grass-track racing and trials, and until I tried your Discol fuel, I was at a loss to find a spirit that would eliminate the excessive pinking caused by the high-compression ratio.

I am pleased to say that your Discol definitely does this, and enables me to make full use of the delightful acceleration without constant manipulation of the ignition lever.

Petrol consumption and easy starting seem unaffected, and I only hope the present high quality of Cleveland Discol will be maintained, and you will reap full benefit from your enterprise.

I am,
Yours faithfully,

——— ———.

CAMBRIDGE, *September 10, 1935.*

TO CLEVELAND PETROLEUM PRODUCTS CO.

DEAR SIRS: Just a few lines in appreciation of the finest petrol obtainable, i. e., Cleveland Discol.

I have given Discol a very good trial. In my ——— "ten" I get an extra 4 miles per gallon. The ignition I have advanced so that with any other brand of petrol pinking is excessive, yet with Discol I feel I'm driving a 6 cylinder.

Also, from experience, I find decoking need not be done so often, and when done the valves only require a very little regrinding, as pitholes are a thing of the past.

I am positive if only more motorists would try Discol sales would be more than doubled.

Yours faithfully,

——— ———.

——— CLUB, PALL MALL, S. W. 1, *October 15, 1935.*

CLEVELAND PETROLEUM PRODUCTS.

DEAR SIRS: It may interest you to know that I have used Discol in my 4½ litre ——— for the last 2 years.

The car was bought from ———, guaranteed as new, including a new cylinder block, in 1933.

I have traveled over 27,000 miles during this time, and have not yet had the engine opened up for decarbonising, or any other purpose.

It is running as well today as it always has done.

Yours truly,

——— ———.

BIRMINGHAM, *November 21, 1935.*

Messrs. CLEVELAND PETROLEUM PRODUCTS CO.,
Central House, Upper Woburn Place, London, W. C. 1.

DEAR SIRS: Replying to your letter of the 20th inst., we have now carried out tests of Cleveland Discol. We find that this fuel is quite satisfactory for use on any of our machines on their high-compression setting. In this connection we should explain that most models of our range are sent out arranged to operate on ordinary No. 1 petrol, with two compression plates fitted underneath the cylinder which can be removed by the client, provided he is prepared to use suitable fuel.

We propose, in future issues of our instruction books, to recommend Cleveland Discol as an alternative to 50 percent benzol mixture. In this connection we have not found that any change in carbureter setting is necessary.

Yours faithfully,

———— ———— ————.

CHEMICAL WORKS,
Leeds, October 16, 1935.

CLEVELAND PETROLEUM PRODUCTS CO.,
London, W. C. 1.

DEAR SIRS: I think perhaps you may be interested in my experience of your Cleveland Discol in my ——— 10/4, which I have just sold, after covering a distance of 33,000 miles.

This car has been run on Discol since I bought it new in October 1934, and when I sold it the other day it had yet to have its first "decoke" and valve grinding.

Some of my friends would hardly believe me when I told them the cylinder head had never once been lifted, but this is an absolute fact; and the engine was running perfectly on the day I sold her. I attribute most of this extraordinary freedom from carbon to your clean-running fuel, and have decided to use nothing else but Discol in my new ——— 14.

In my younger days I used to indulge in a little amateur motorcycle racing before the ban on the roads came into force, and I used to find that a rag dipped in the racing fuel (R. D. 1 in my case) was all that was needed to remove the carbon on stripping down the engine after a speed trial. So that I think the alcohol content must have some beneficial effect in softening and removing the carbon as it is formed.

Yours faithfully,

———— ————.

Cleveland Petroleum Products Co., Central House, Upper Woburn Place, London, W. C. 1. Depots and offices: Alloa, Avonmouth, Aylesford, Barking, Bedford, Boston, Ellesmere Port, Exeter, Glasgow, Goole, Ipswich, Kendal, Killingholme, Leeds, London, Lymington, Manchester, Newport (Mon.), Nottingham, Oxford, Preston, Ripley, Salisbury, Shoreham, Sunderland, Talke, Taunton, Thames Haven, Uxbridge, Worcester.

STANDARD OIL CO. (NEW JERSEY) REAL MARKETERS OF 33⅓ PERCENT ALCOHOL BLEND

In the registration statement filed by the Standard Oil Co. (New Jersey) April 9, 1935, with the Securities Exchange Commission, the following information is set forth as part of answer to item 10:

Item 10. List the following and indicate the respective percentages of voting power as required by the instructions:

(*a*) All subsidiaries of the registrant.

Page 3:

Pan American Foreign Corporation	percent	99.33
Ebano Oil Co., Ltd	do	100.00

The World Petroleum Directory 1934–35 edition (p. 296), describes the Ebano Oil Co., Ltd., as follows:

Ebano Oil Co., Ltd., 14 Waterloo Place, London, S. W. 1, England. Organized, England 1920. Directors: Sir William Alexander, K. B. E., C. B., C. M. G., D. S. O., chairman, Bruce Aldrich, Sir William Alexander, W. E. Duxbury, Vaughan Russell, F. J. Wolfe, A. Cunningham, Jr., secretary. Subsidiary of the Pan-American Foreign Corporation which is controlled by the Standard Oil Co. (New Jersey). Owns 50 percent interest in Petroleum Storage & Finance Corporation, Ltd., which was acquired on April 30, 1931. Organized December 1929. Authorized capital: 150,000 shares, par £1, issued 125,517 shares. Marketers: Petroleum products. Operate terminals at Grangemouth, Scotland; Preston, Lancashire; Purfleet, Essex.

The World Petroleum Director 1934–35 edition (pp. 301–302), describes the Petroleum Storage & Finance Corporation, Ltd., as follows:

Petroleum Storage & Finance Corporation, Ltd., Central House, Upper Woburn Place, London, W. C. 1, England. Cable address: Storfinan, Kincross, London. Organized June 1928. Directors: E. A. Radford, F. C. A., chairman, Sir William Alexander, K. B. E., C. B., C. M. G., D. S. O., M. P., deputy chairman, Sir Thomas D. Nicol, K. B. E., R. G. Stewart, Charles F. Lumb, N. Davis, managing director. Edw. O. Collinge, secretary, R. St. A. Griffiths, chief engineer. Fifty-percent interest obtained by Ebano Oil Co., Ltd., which is a subsidiary of the Pan-American Foreign Corporation, which is controlled by the Standard Oil Co. (New Jersey). Subsidiary: British Oil Storage Co., Ltd. Authorized capital: Ordinary: 400,000 shares, par. £1, all issued. Deferred: 1,500,000 shares, par 1s., all issued. Importers, exporters, and marketers of petroleum products. Own storage depots with pipe-line and transport facilities operated by subsidiary, the British Oil Storage Co., Ltd., formerly Ellesmere Port Oil Wharves, Ltd., at Ellesmere Port on the Manchester Ship Canal; also Newport, Preston, Sunderland, Shoreham, Avonmouth, Goole, Worcester, Aylesford, and Barking, with a total capacity of 55,000 tons. Distributors of Cleveland Motor Spirit. The Cleveland Petroleum Products Co., Ltd., is not operating but is owned by the parent company, Petroleum Storage & Finance Corporation, Ltd. In conjunction with The Distillers Co., Ltd., are producing an alcohol petrol blend which is sold under the name "Cleveland-Discol." Financial report for the year ending October 31, 1933, showed a profit of £134,113 compared with a loss of £85,354 for 1932.

The World Petroleum Directory 1934–35 edition (p. 294), describes the Cleveland Petroleum Products Co., Ltd., as follows:

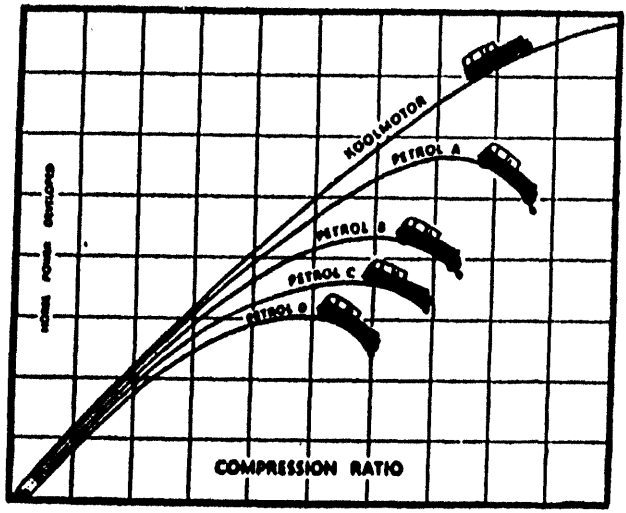
Cleveland Petroleum Products Co., Ltd., Central House, Upper Woburn Place, London, W. C. 1, England. See Petroleum Storage & Finance Corporation, Ltd.

CITIES SERVICE OIL CO., LTD.

New Oxford House, Hart Street, W. C. 1

WHERE OTHER PETROLS KNOCK KOOLMOTOR IS SILENT

This chart shows where other well-known petrols start to knock as compared with Koolmotor Alcohol Blend.



The Relation of Compression Ratio to Power and Efficiency

ON LAND—ON SEA—IN THE AIR—ALCOHOL BLENDED PETROL HAS BEEN USED IN BREAKING WORLD'S SPEED RECORDS—AND NOW FOR THE FIRST TIME IT IS AVAILABLE WITH ALL ITS ADVANTAGES TO EVERY MOTORIST—AT A PRICE NO DEARER THAN ORDINARY PETROL

The supremacy of an alcohol-blend fuel for speed work has been proved over and over again during the last 5 years. Most world speed records on land, sea, or in the air have been made on an alcohol-blended petrol. The prohibitive price, however, of alcohol has, until now, confined its use to racing. It remained for the Cities Service Oil Co., Ltd., to commercialize the manufacture of such a spirit and to place it at the disposal of every motorist. This they have done. Scientists have now perfected Koolmotor Alcohol Blend, which has all the advantages of a super racing fuel, but which costs no more than ordinary petrol. This advance in petrol blending keeps pace with the progress being made in engine design.

The trend of modern engine design is toward higher compression engines. This is the outcome of years of experimenting with racing cars of all classes, where extremely high-compression ratios have been used. It is well-known that the higher the compression ratio of an engine the greater the power developed per stroke; but each increase in compression is attended by a corresponding increase in the tendencies of the engine to "ping" or "knock." (See chart.) The manufacturers of modern cars are compelled in many cases to make a compromise, giving the greater speed and power (by increasing the compression) that modern motorists demand, whilst sacrificing as little as possible of the comfort and smoothness that is expected by every motorist. Such a compromise results in a distinct tendency to harshness when the engine is of the high-performance type, and sluggishness when speed must be sacrificed for smoothness and quiet running.

Koolmotor Alcohol Blend petrol is a distinctly advantageous fuel for all types of motor car and motorcycle engines—whether of high or low compression. It gives any engine a greater power output with a smoothness and flexibility that has never before been realized. This is explained quite simply: Koolmotor Alcohol Blend petrol has a low rate of flame propagation. This ensures even, steady power output such as no other spirit could give. In addition, the alcohol molecule, unlike the petrol or benzol molecule, contains an oxygen atom which acts

as an exciter agent in the combustion of the vapor, and this, of course, ensures more rapid acceleration and reduced carbon deposit. Furthermore, when the vaporization of the spirit takes place there is a greater drop in temperature than is the case with ordinary petrols. Thus, as air contracts as it cools, a greater weight of vapor is compressed in the cylinder which, of course, makes for greater power when ignition takes place. This briefly explains the reason why Koolmotor Alcohol Blend, now available to every motorist, claims and proves itself as meriting the following advantages:

1. The entire absence of "pinking" or "knocking."
2. Greater flexibility and greater power output which means a much better top-gear performance, particularly noticeable in hill-climbing.
3. Assurance of a higher maximum speed and also greatly improved acceleration, because it permits a more advanced ignition timing to be used.
4. An increase in miles per gallon because of the better performance that will be obtained in top gear.
5. Assurance of a cleaner and cooler engine. This advantage is particularly noticeable in air cooled motor cycle engines.

Senator CLARK. The hearing will be adjourned.

(Whereupon, at 12 noon the hearing was adjourned).