PETROLEUM RESOURCES

Dr. Richard J. Gonzalez

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Reviewed by: Colonel P. B. Klein, USAF

Date: 11 December 1959

INDUSTRIAL COLLEGE OF THE ARMED FORCES

WASHINGTON, D. C.

1959-1960

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COL. BLACK: Oil is one of our most important items in war when considered in terms of its total uses. Oil is also one of the most important natural resources in terms of effecting a progressive and effective economy. Oil is our subject for today.

Before introducing our speaker this morning I would like to take this opportunity to welcome to the school and to each one of you individually our numerous panelists sitting in the front rows this morning. In order for you to get better acquainted with them or at least to know whom you are going to be with, allow me to individually introduce each one of them prior to the introduction of our speaker for the morning. And when I introduce each one individually, please withhold your recognition in the form of applause until all of them have been introduced. Then will save time. And when I mention your names, gentlemen, please stand for a second to be viewed by our student body.

Mr. Jack Tarner, Phillips Petroleum Company. Colonel Ralph E. Zahrobsky, Military Petroleum Supply Agency. Mr. James A. Ransford, Tidewater Oil Company. Mr. Richard J. Miller, Petroleum Supply Agency. Colonel J. B. Slimp, Office of the Assistant Secretary of Defense. Dr. Bruce C. Netschert, Resources for the Future, Inc. Mr. Charles J. Hedlund, Standard Oil of New Jersey. Colonel Merwin H. Smith, the Joint Chiefs of Staff. Captain V. R. Glocheski, Office

of the Chief of Naval Operations. Mr. William D. Price, Shell Oil Company. Mr. William B. Harper, American Petroleum Institute. Mr. Carl C. Anderson, Bureau of Mines, Department of the Interior. Mr. Ralph W. Fowler, Pure Oil Company. Mr. Alexander H. Chapman, consulting engineer. Captain A. A. Pabst, Office of the Assistant Secretary of Defense. And last, but certainly not least, one of our own students, Colonel James R. Maedler.

Our speaker this morning is Dr. Richard J. Gonzalez, Director and Treasurer of the Humble Oil and Refining Company, of Houston, Texas. You have all read his biography and noted his accomplishments. I might add this: that a few days ago I was talking to, I think, one of the most recognized oil experts in Washington. In our conversation I happened to mention that we were successful and very happy in securing Dr. Gonzalez to speak to us today on petroleum resources. He immediately replied, "You have the best man in the business." I think, in my opinion, and I am sure in the opinion of you after the talk, that Dr. Gonzalez' professional stature has been categorized correctly.

Dr. Gonzalez, it's indeed a pleasure for us to have you here this morning and to welcome you back as an old friend of the Industrial College; and I take a great deal of pleasure in presenting you to the class of 1960.

DR. GONZALEZ: General Mundy, Colonel Black, Distinguished Guests, and Members of the Industrial College: It's an honor and a pleasure for me to be back with you again to talk about petroleum resources. Someone with my background of teaching in a university always enjoys

the sound of a class bell that summons him back into the academic life.

One of my favorite stories about economics concerns a graduate who went back to the 25th reunion of his class, and in the course of his discussion with his professor inquired what questions they were asking the students. The professor handed him a set of mimeographed pages. The man looked at them briefly and then said in surprise: "Professor, aren't these the same questions you asked us when I was in school?" The professor said, "Yes. They are." The man's next question was, "Well, don't the students catch on and pass this along to the next class?" Immediately the professor said: "Of course they do, but we keep changing the answers."

As long as we live in a dynamic world, we will find that our answers to economic problems keep changing. Unfortunately, the common assumption that we like to make, and frequently have to make, about many things is that circumstances will remain the same; but, of course, they never do remain the same. They are constantly changing.

I think this meeting is particularly timely, because it comes at the centennial of the oil industry. A hundred years ago, at the end of August, 1859, the first commercial production of oil was discovered in the United States. It's interesting to think of the changes that have taken place since then.

At that time the United States was what we now call an underdeveloped nation. That is to say, it seemed to have a great potential,

but it lacked capital. Fortunately, our Government adopted policies which encouraged the accumulation and the investment of capital. It also adopted policies which encouraged initiative, individual enterprise. These forces led to the development of the nation's resources, to industrial expansion, and to our present position in world affairs.

The changes have been truly dramatic. A few slides will give us a background for a consideration of the importance of the petroleum industry, the development that it has had in the United States, and then the relationship of our present industry in the world picture. With that background I believe we will be in position for your sessions later today, which really are the important ones of this meeting, where you will engage in a discussion of many different questions and aspects of petroleum resources.

(Slide 1) Our first slide shows how resources are made useful. First, exploration locates resources. Second, known resources are either economically available or non-commercial. The distinction here is an important one. Let us take shale oil as an example.

We know of the existence of tremendous quantities of shale oil in the Rocky Mountain area, but that oil cannot be made available at prices that make it economically useful to us. Therefore it is not commercial. The same thing is true of a great many other resources. There's a great deal of coal that's at a depth so that it can't be mined immediately, and other coal in thin [redacted] seams that do not warrant economic utilization at this time.

The third point about resources is that technology affects their economic availability. A few illustrations will bring this point out.

For example, it has been known for a long time that oil deposits exist offshore in the continental shelves of the United States. Some of that oil was tapped by the technology available at the time years ago. For example, in California directional wells were drilled from onshore to tap sands lying beneath the waters. In the Gulf of Mexico a few wells were drilled in water. But the technology did not permit us to reach the deeply buried oil offshore. Postwar our technology has improved to the point where we are now able to tap resources where we have to go out in a hundred feet of water or more. And so we have platforms built in the Gulf of Mexico and being built in California to tap oil resources that were known to exist, but that were not previously economically available.

The same thing is true of lower-grade ores of recovery--in copper, in coal, in iron. There are many examples of technology converting what were previously non-commercial resources into useful resources.

The fourth point is that production draws on our known reserves, but stimulates new development. This is an important point to bear in mind in connection with the common belief that production of resources automatically means an exhaustion of what we have. This is an over-simplification of the true facts. The unknown and undeveloped resources have no economic significance. The oil resources of this country were of no use to the American Indians hundreds of years ago. It is only the known resources that are significant. And the known resources are

affected not only by a process of withdrawal, but by the process of creation, the discovery, and the development of resources that were previously unknown. This will be something to keep in mind as we consider some of the questions about petroleum for the future.

(Slide 2) The second chart shows the relation between energy consumption and gross national product in the United States from 1929 through 1958. We see, of course, that there is a very close relation between these two components. After all, it is inanimate energy that enables us to multiply man's productive capacity. Without inanimate energy to run machines for us, we are limited largely to what we can do with our own muscles. That means, of course, that we would be limited to a subsistence level of agriculture if we didn't have machines and energy. In a recession or a depression or a boom we can see the use of energy going hand in hand with the changes in gross national product.

(Slide 3) The relationship which we have seen in the United States over a period of time is also broadly true throughout the world in different countries. Our third chart shows energy consumption and income in a number of countries. You can see the United States and Canada at one end of the scale, where they have high energy consumption and high per capita income; and by contrast you can look at Burma and at India, at the opposite end of the scale. The progression as we go up these two charts shows that you must have more energy per capita if you expect to raise standards of living. This, of course, is the hope of the world, and this means that potentially there will be a great increase

of energy
in the consumption throughout the world.

(Chart 4) We turn next to a more specific consideration of the petroleum industry in the United States. Our first chart shows the development of production from the beginning in 1859 on up to the year 1958. This is a period of 99 years, which we have divided for convenience into 33-year periods, roughly generations.

In the first generation, up until 1892, production was quite small. Petroleum was used principally for kerosene, illumination, and for lubrication. The total production for that entire period was only 555 million barrels. The additions to reserves were quite small. That is to say, we lived more or less hand to mouth during that period of time, using our resources about as rapidly as we developed them.

Beginning with the 20th century, our production began to increase sharply. You can see from the chart that in the second generation our production increased until it reached a level of roughly three-quarters of a billion barrels a year, and aggregated for that generation something more than 8 billion barrels. Now the additions to reserves were fairly sizeable. By the end of the period, however, the United States only had about 5 billion barrels of proved oil reserves.

The great expansion of the domestic petroleum industry has occurred in the latest generation, beginning with 1926. You can see from the chart that production has approximately tripled; that total production for this generation has been 51.6 billion barrels; that our reserves have continued to increase; and that we have added to reserves in this latest generation

another 26 billion barrels, bringing our total proved reserves at the beginning of this year to something over 31 billion barrels.

There is another line on this chart dealing with what our estimated known reserves of crude oil have been. These are plotted on a different scale--a relationship of roughly 12 barrels of reserves to one barrel of production--to show that, broadly speaking, the trend of reserves and production has been closely related in this most recent generation.

Note from this chart that the major expansion of crude oil production has occurred in the last third of the first century. One of the common beliefs about the development of resources is that is that all of the easy and big resources are found first, and therefore that as time goes on, we have left to find and develop only the poor resources. If our technology were static, this would be true. But our technology is not static; nor is our knowledge. And with greater knowledge and better technology we are able to reach resources that were previously unavailable to us. Therefore we are able to continue a remarkable expansion in our development of resources.

(Chart 5) Our next chart shows the changes of the major energy resources in energy consumption in the United States. First of all, we note that coal was by far the dominant energy resource in 1910, supplying about 85 percent of our energy. The participation of coal in our energy consumption has dropped now to the range of about 25 to 27 percent.

Next we note that petroleum liquids and gas, which supplied only about 10 percent of the energy in 1910, have now become predominant

forms of energy in the United States and supply approximately 70 percent of the energy in the United States.

Finally, the small, narrow band at the top of the chart shows that waterpower has supplied a remarkably constant fraction of the energy consumption in the United States--roughly 5 percent throughout this period--despite the continued expansion of our hydroelectric development.

(Chart 6) Our next chart shows the changes in energy consumption in a slightly different fashion. This chart uses a semi-logarithmic scale, so that we may see the rate of growth in demand for energy as a whole and for the petroleum component and the natural gas component. Gas and total energy have here been expressed in oil equivalents on the basis of their heat content in British thermal units.

The top line shows us the indicated trend for energy consumption as a whole, which has been in the past 30 or 40 years in the range of 2 1/4 to 3 percent. If we measure from the depression period, it looks as though our recent trend is fairly close to 3 percent for energy consumption as a whole. When we look at the petroleum segment, we see a much faster rate of growth until fairly recently. The same is true of the natural gas component.

For a long period of time the consumption of oil in the United States increased at about 5 percent a year, and natural gas increased at about 6 percent a year. This period was, of course, the one in which oil and gas were building up their participation in the energy market. They can continue to grow faster than energy as a whole only so long as they are taking

an increasing share of the market. When they reach the stage where they are now, where their potential expansion in the market has more or less approached saturation, it becomes much more difficult for them to increase more rapidly than total energy consumption.

In fact, it seems likely that oil consumption in the future in the United States may increase at only about 3 percent a year. This year, being a recovery year after a recession year, the increase in demand will perhaps be around 4 to 4 1/2 percent. But this is almost positive proof that we no longer have a 5 percent trend, because in a recovery year our rate of growth in demand should be higher than the trend. Therefore we can be reasonably sure that our rate of growth trend-wise for petroleum is now less than 4 percent--probably about 3 percent.

Natural gas has recently entered some important markets here on the East Coast and also on the Northwest, and for a time may continue to grow fairly rapidly; but within a period of five to ten years its growth too is likely to turn downward.

(Chart 7) Let us consider now what the preceding information tells us about the development of oil resources in the United States. This chart shows us the relation between that development and the number of wells completed. The statistics are shown in the top section, with figures on both total wells completed, including dry holes and natural gas wells, and on oil wells alone. The figures are shown first for the long interval up to 1925, and then by 10-year periods through 1945, and encompassing the final period stretching through 1958.

The figures on the left show that in the early days of the oil industry, up to 1925, we developed only about 19,000 barrels of crude oil per total well drilled, and only about 25,000 barrels per oil well drilled. There was a sharp change in this pattern beginning with 1925, when we entered a period of conservation regulations and improved technology. Broadly speaking, this was the era when we began wider spacing of wells. Previously it had been customary to drill wells very close, frequently almost on top of each other, one to an acre or even less.

In this more recent period, our third generation, in which technology has become such an important factor, the spacing of wells has changed very greatly. You can see from the figures that there was a dramatic shift in the volume of oil developed per well; and that there has been a surprisingly stable relation since 1925 in the amount of oil per well. We see some falling off in the latest period, since 1945, in the new oil per total well; about the same, however, in the new oil per oil well.

This question of what we get for new wells is an extremely complex one. It has led to a lot of discussion and speculation in the industry, that there is evidence that we may be finding it a great deal more expensive to develop new resources. This deserves careful consideration.

(Chart 8) Our next chart takes our most recent period and divides it into two pieces of five years each, to see what we can ascertain about these trends. We take here in the top section of the chart the gross additions to oil and gas reserves, and we note first of all that there has been

a falling off in the most recent 5-year period in the amount of new crude oil and new natural gas liquids. The decrease has been approximately 3 billion barrels--something over a 15 percent decrease in gross volume.

However, the third column of figures shows us that our development of natural gas has increased sharply, by 20 trillion cubic feet--a very substantial rise, of more than 25 percent. When we express natural gas in terms of oil equivalent on a heat content basis, and add that equivalent to the liquids, we find that the total energy, as developed by the petroleum industry, has continued to increase in this latest 5-year period. The picture is not quite as gloomy as when we erroneously looked at results only in terms of liquids. After all, this industry is engaged in the exploration for and development of both oil and gas, and not only in liquids.

There is more to the story, however, as shown by the bottom section of the chart. The number of wells drilled has increased in the most recent 5-year period by something more than 20 percent above the previous 5-year period. So that the results per well have shown a falling off.

There are several factors in operation in this most recent 5-year period that have a bearing on this development. Perhaps the most important of all is the introduction of a new technique called fracturing, that the industry has applied to areas of fairly shallow production--to go back in and develop what were previously considered non-commercial deposits of oil. This has led to the drilling of many shallow wells that have tended to pull down the average results per well. There is some

1948. It is interesting to note that in real terms the price of crude oil currently is about the same as the average that prevailed in the first quarter of the 20th century, from 1900 up till 1926.

The bottom section of this chart shows the real retail price of gasoline in constant dollars, excluding excise taxes. That real price is now in the range of 20 cents a gallon--about the lowest that has been experienced--roughly half of what the real price of gasoline was some 40 years ago. This is quite an achievement for an industry that has experienced such an expansion of its resources as we have seen in this last generation that is of particular interest to us.

(Chart 10) We will look briefly also on this next chart at the real prices of natural gas, because there has been so much discussion in recent years of the rising price of natural gas in connection with the controversy over the regulation of prices paid to producers on their interstate sales.

The price of gas has gone up in real terms, but from a very low level that prevailed at the end of World War II to a level that is still below the average of the 1930's. The bottom line on this chart shows the price at the well, and that has shown a reasonably modest rise from the low levels at about 1948 and 1949.

The sharpest rise in price has occurred at the point of consumption, and this has been influenced by the extension of lines to new areas far removed from the point of production; so that the transportation and distribution costs become a major factor in the delivered price to the consumer.

If you look at the closing figures, you can see that the delivered price of gas to consumers is roughly four times as much as the price received by producers at the point of production. In other words, the costs of transportation and distribution are three times as big a factor in the ultimate price paid as the cost of the gas itself. These latter factors are really service charges rather than charges for the commodity itself.

(Chart 11) Our next chart deals with the returns on net assets of leading corporations in selected industries. These figures are plotted from the statistics that have been published over a long period of time by the First National City Bank of New York.

The heavy line on petroleum runs pretty much in the center of the lines plotted here for various major industries--automobile, chemical, iron and steel, all manufacturing. The average rate of return in this period of time has been about 14.8 percent for petroleum and about 14.1 percent for all manufacturing.

This brings out the point that the rate of return on investment in the petroleum industry is not significantly higher than it is for manufacturing operations in general, contrary to the common belief that the oil industry is fabulously profitable. It is true that oil companies report large earnings, but these large earnings have to be considered in relation to the size of the investment. It is also true that some operators in petroleum are unusually successful, but this must be considered in relation to the fact that many operators in petroleum experience serious losses. We never hear about the operators who go out of

business, who lose all of their funds on dry holes. We only hear about the unusual successes, and then only while those operators are successful.

For example, I'm sure that all of you will remember reading about Glenn McCarthy in his heyday, when he was building the Fairmont Hotel; but I venture to say that very few of you have kept up with the subsequent development in Mr. McCarthy's fortune. This is an illustration of the problem the industry faces in getting across to the public a balanced perspective of what the results are on its total operations. This chart shows you that on the average the returns on investments in this industry are surprisingly comparable with what they are in other industries.

(Chart 12) We turn now from a consideration of strictly domestic problems of the petroleum industry to a broader analysis of the relationship of the United States industry in world affairs. Our next chart shows the estimated reserves of liquid hydrocarbons in the free world as of 1957. The figures used in this chart are those presented by the famous geologist Wallace Pratt to the Joint Committee on Atomic Energy, and are somewhat higher for foreign areas than frequently carried in the published literature.

The bar on the left-hand side of the chart shows the reserves in the United States for crude oil and natural gas liquids of approximately 36 billion barrels in 1957. The other western hemisphere resources at that time were estimated at 34 billion barrels, principally Venezuela and Canada. The eastern hemisphere reserves, according to Mr. Pratt,

are rated at 230 billion barrels for the Middle East and a small segment of approximately 10 billion barrels for the rest of the eastern hemisphere.

Obviously in volume the oil resources of the eastern hemisphere considerably dwarf those of the western hemisphere. But we must consider these also in relation to population. In terms of population the differences are not so great. At the bottom of the chart we can see that the barrels of reserve per capita are 211 in the United States, 162 for other western hemisphere, and 166 for the free eastern hemisphere. In other words, the United States is not, as we are sometimes inclined to think, a "have not" nation in terms of petroleum resources. It has developed its resources more intensively and utilized them much more freely than foreign areas.

(Chart 13) Our next chart deals with the consumption of petroleum in the free world in 1957. Again we see the figures for the United States, for other western hemisphere, and for the eastern hemisphere.

The United States, of course, is the dominant consumer of petroleum. Its consumption of petroleum per capita amounted to 18.8 barrels, other western hemisphere 3.8 billion barrels, and free eastern hemisphere 1.3 billion barrels. In terms of consumption we do use a great deal more oil per capita than people in the rest of the world.

The rate of growth in consumption, however, is increasing much more rapidly abroad than in the United States. We have an economy that already is highly dependent on oil, whereas Europe and most of the rest of the world still has a great distance to go in the full utilization of energy

resources, particularly petroleum, to increase standards of living.

(Chart 14) Our next chart shows world crude oil production since 1900 for the United States, other western hemisphere, eastern hemisphere, and the Russian-dominated areas. The United States clearly dominates the portion of the chart up until the period after World War II. Since then the United States has continued to expand its production, but the chart makes it quite clear that the major increase has occurred in foreign areas. This has been due to tremendous discoveries outside of the United States. These discoveries have been used principally to supply oil to foreign areas, but they have also created additional volumes of imports into the United States.

The figures for Russia represent the commonly accepted statistics, although we have to recognize that our information on Russia is not very good. We do know, however, that Russia is engaged in a rather intensive drive to increase its production of petroleum and natural gas. We know that it has developed important new areas to supplement the production from the great Baku area that for so long was its primary source of production.

(Chart 15) Our last chart deals with the major tanker routes of the world, to call your attention to the distances involved in transportation of oil from some of the principal producing centers to the principal consuming centers.

You are aware, of course, that there is a great movement of oil by tanker from both the Gulf Coast and from Venezuela to the Eastern Coast of the United States. Routes 1 and 2 on this chart show you the

distances to New York from these two sources of supply. They are relatively close in distance. They are exposed to about the same risks in terms of interruption by submarine warfare.

As we look at some of the other tanker routes throughout the world, we can see that they are considerably longer--some of them half way around the world; and that they are, of course, quite vulnerable to interruption. The movement through the Suez Canal is susceptible to disruption by the closure of the canal, as well as by other types of operation. We are aware of the fact that Russia has concentrated on the development of submarines, and we can well remember the terrific impact that submarines had on the movement of oil during World War II.

The potential disruption of source-of-energy supplies is, of course, a matter of concern in peacetime as well as in war. This has given great stimulus and interest in the resources of the Sahara area. You are all familiar with the developments in Algeria and Libya, which give promise of providing important new production to supply the European market from sources that are west of the Suez Canal and not subject to interruption at that point.

You are also aware of the fact that Great Britain became very much more interested in the development of nuclear power after the Suez Canal incident; that a number of European countries are concerned about their increasing dependence on oil from the Middle East.

This cursory review by means of statistics and charts merely sets the background for consideration of many problems that will come up

for your discussion later in the day. There are a few problems that I would like to touch on now, because they are so much in the public mind.

Perhaps the one of greatest interest to you gentlemen is the question of imports. In your reading materials I am sure you have been exposed to some of the documents dealing with this question, including, I hope, the report of the Cabinet Committee to the President recommending the imposition of control on imports for reasons of national security.

This is one of the most controversial questions and one that is probably hardest for people to understand. I know that the common view is that if we are concerned about our resources, we should do everything we can to conserve them by using foreign oil while it is available. It seems like a very logical course of action until we analyze it carefully and try to get at what we mean by conserving resources.

If we could simply use foreign oil without affecting the development of our own domestic resources, the conclusion drawn by this common observation would seem reasonably sound. However, it is perfectly apparent that the importation of oil does affect the incentive to develop domestic resources. Therefore, if it affects the exploration and development of new resources, it may well place us in a poorer position to supply oil from domestic resources in the future than we would be if we continued with our traditional policy and with the policy of restriction of imports.

I doubt that I am going to change any opinions on this on the part of any of the participants in the panels or the College, but perhaps we may, as one of the professors at the Harvard Business School says, rearrange your prejudices somewhat on the point.

I think the crux to this question is really whether we think that the United States is beginning to run short of oil. Frequently we are inclined to jump to the conclusion that it is by these nice little charts that plot the future of the oil industry in the United States from now to the year 2100. I would like to caution you against these statistical projections into the indefinite future. They have so many assumptions inherent in them that they cannot be relied upon as significant guides for policy.

Last year I believe a participant in one of the sessions concluded: "Well, this looks pretty good for the next 25 years, but what about the next hundred years?" I'd like to remind you that a hundred years ago the people who were worrying about energy for the next hundred years were those engaged in searching for whale oil; and in a hundred years time we have seen what changes have occurred to their business as a result of technological developments.

Don't forget also that you have some other classes coming along in the years to come that may be not satisfied with your solutions to these problems for the next hundred years and may like to have something to work on themselves.

On the question of what our resources will be for the future, I would

like to call attention simply to studies by the U. S. Geological Survey, Department of the Interior, Resources for the Future, which indicate that we have a very large resource base to draw on. Actually, when we say that we have 36 billion barrels of liquids in sight, we're giving you a very conservative figure that we can absolutely guarantee is going to be delivered, but is by no means a true measure of all that can be delivered from our known fields. Bear in mind that this is based on what can be recovered with existing practices and technology at existing price levels.

Again, the assumption of technology comes in. We all know that our technology is improving greatly, and the processes for getting more oil out of existing reservoirs are undergoing very important changes right now that promise us great additional recovery from existing fields.

It is true that we are faced with having to drill deeper. It is true that we are having to look in more remote and more expensive areas, such as offshore and Alaska. But our technology is also at work, as it has been throughout the history of the industry, to offset some of these developments.

It is also true that the industry's technology is fully adequate to space wells much more widely than we have spaced them in the past; so that we can develop resources without any major change in technology at lower cost than we are developing them today. This will take some improvement of our State conservation regulations, but it is the type of improvement that has been going on for a long time.

Speaking of conservation regulations, I know that many people look merely upon them as a price-fixing device. I would like to call your attention to the evidence of the charts, which shows the sharp change in development of oil per well that occurred about the time that conservation was introduced. I would like to point out to you that conservation has made it possible to develop our resources with fewer wells at lower cost. It has made it possible also for us to recover more oil than could be recovered by the older production techniques. Therefore, conservation has made more oil available to us at lower cost and lower prices, as we have seen from the charts.

There are other questions that I am sure we will be talking about in the sessions, but I don't want to take an undue amount of your time here at the moment. I would like in conclusion to talk briefly about what I see ahead for the domestic industry and for the world industry.

I think the demand for petroleum in the United States will probably increase at a rate of only about 3 percent a year. Now, that sounds small, but it means that your demand approximately doubles in something less than 25 years time. But this is a change, because at a 5 percent growth, to which we have been accustomed, demand would double in 15 years. So the doubling process is going to take a good deal longer in the future than it has in the past.

This has a bearing on our requirements. It has a bearing on our present problems, because we have the problem of an industry that has been geared up to a 5 percent growth adjusting itself to this new 3 percent

growth. Its the question of inertia and momentum.

As for resources, a mere continuation of the rate of development of resources that we have had in the past twenty years would provide us with roughly three-quarters of what we will probably need to add over the next twenty years.

The improvements in technology that we are talking about with respect to old fields and new fields give us reason for some confidence that we can continue to keep pace in our domestic developments with the future growth of demand if we want to do it. This may not be the cheapest way. Conceivably we might do it cheaper if we wanted to rely more heavily on foreign oil. But we would have to pay a price in terms of risks and in terms of what the cost might be of an interruption of our supply. You will recall how greatly we were concerned about the effects of the closing of the Suez Canal on the European economy in the winter of 1956-57 and how fortunate it was that the United States and Venezuela were able to supply additional quantities so that Europe did not suffer any interruption of its economic development.

In the world we foresee a fairly rapid growth of demand in foreign areas, of probably 6 or 7 percent, and an abundance of supply to meet those demands. You all know the tremendous drive of the people of the world for higher standards of living, for improved economies. This drive can materialize successfully only if greater quantities of energy are used to multiply man's productive capacity.

Oil and gas are going to continue to be the foundations of economic

progress for a long time to come. I suspect they will continue to be quite important to you in military operations for at least a generation even in this age of nuclear power and intercontinental missiles. After all, we have a tremendous industrial complex that needs the cheapest and best form of energy to operate, and oil and gas will continue to supply that form of energy for a long time to come.

Thank you.

COL. BLACK: Dr. Gonzalez is ready for your questions.

QUESTION: Would you give us your judgment of the influence on the industry's position in this matter of the importation of oil that the annual statement to the stockholders might have at the end of the year?

DR. GONZALEZ: Would you like to clarify that a little more specifically?

QUESTION: Well, you're in business to make money and there is some indication that imported oil might be somewhat less expensive than locally produced oil. This may or may not have a bearing on the industry's action.

DR. GONZALEZ: I think it's quite obvious that the amount of imported oil has a bearing on industry action. It would have a bearing on a number of things.

Let us presume for the moment that we would import enough oil to reduce the price of crude. Clearly this would affect profit margins. It would affect cash flows. It would affect your incentive to spend money for exploration and drilling. What the net of that would be on the financial reports I can't tell you, but I can tell you that my company for

one would certainly reduce its expenditures for exploration and drilling if we had developments that made it any less profitable to produce domestic oil.

QUESTION: Do you have any figures on the relative production of gasoline for automobiles versus engine oil and why it is that a quart of oil costs as much as or more than a gallon of gasoline?

DR. GONZALEZ: Well, the processes for making lubricating oil are a great deal more complex than those for making gasoline; and the volumes, of course, are completely different. The yield of gasoline from a barrel of crude oil is approximately 45 percent, and the yield of lubricating oil from a barrel must be in the range of 1 or 2 percent. So the difference in volume, plus the difference in processes--there's a select cut out of certain crudes that can be made into lubricating oil. It would have to be treated through many expensive processes. Finally they end up being packaged in a can, so that you may be sure that you're getting a fresh product that isn't contaminated. And the whole process is subject to this great mark up that takes place in distribution. The refiner's price for lubricating oil is not anything like what you pay for it at the service station. It is higher, of course, than gasoline. But relatively I would say that the lub oil ends up being no more profitable in proportion to its investment to the refiner than gasoline. However, to the distributor I think it is considerably more profitable to sell a gallon of lubricating oil than a gallon of gasoline.

QUESTION: Doctor, in view of the advancement in exploration

techniques, can you explain why there are still so many dry holes?

DR. GONZALEZ: I am reminded of Leon Henderson's remark during World War II when he was being talked to about the problems of the industry and its cost in dry holes and he said that it's an impoverished science that allows the industry to drill dry holes.

Let me make it clear to you that our exploration technology has not yet reached the point where it can locate oil directly. The only thing it can locate is structures, geologic formations, considered potential traps for oil. Unfortunately, when we go to test those structures, we frequently find, (a) either that oil isn't there, or (b) that it's a good deal more complex for us to locate its exact position on this structure.

Let me use an example. On the Gulf Coast we have a great many salt domes. Some of these are what we call piercement salt domes, that have severely fractured/formations around them. They generally contain oil, but just exactly where on the perimeter of this salt dome is something that takes a good bit of drilling; and in the process we do encounter these dry holes.

Unfortunately, the covering of a large acreage in the search for oil inherently involves us in drilling many wildcats--exploratory wells. We haven't really found a way of improving our success ratio on that strict exploratory drilling.

QUESTION: Doctor, Humble recently had some experience in drilling up in Alaska, didn't it?

DR. GONZALEZ: Yes.

QUESTION: First, was it really a dry hole; and, second, what does Humble now think of Alaska?

DR. GONZALEZ: Well, the hole was dry, 4 million dollars worth, to be exact; and temporarily we have lost interest in Alaska.

QUESTION: Dr. Gonzalez, having been stung once on this prediction that we would deplete our resources concerning iron ore in the Mesabi Range, I wonder if perhaps it would be some advantage to the oil industry here in the United States that if they can acquire the crude oil from overseas resources at a lesser price, that perhaps they tap into those resources and bring them in here, and then with the savings between that price and the U.S. price, plus perhaps the saving on the matter of the subsidy of 25 to 27 percent depreciation/tax release, it might not save enough money to permit it to subsidize enough continued exploration regardless of these disadvantages.

DR. GONZALEZ: This is an intriguing idea--that we could use these cheap foreign oils in place of our domestic oil and yet continue the development of our domestic resources so they would be available in case of an emergency. If we had one company owning all domestic oil and producing it, what you propose might be feasible. But when you have the competitive situation that exists in the industry, it does not seem practicable to work it out.

As you know, we have the problems of the drainage of oil by one producer versus another in a field that is competitively developed; so that all of them have to produce ratably. And you have the problem that

of the impact that has already been mentioned of these developments on other competitors. Take, for example, the possibility that one large operator might be willing to forego some domestic production if he were given an extra quota to import foreign oil. This would give him conceivably a competitive advantage over some of his other competitors in the U.S., and they would immediately be quite unhappy about his competitive advantage. But beyond that, their own incentive to develop resources would be affected, you see.

So the problem that we have never been able to work out is how you can use this foreign oil without impairing the rate of development of your domestic resources. If you can figure that out, I'm sure that there will be many people in the industry who would like to know it.

QUESTION: My question has been largely answered by your last answer. I was thinking also of the possibility of a Government subsidy in order to conserve our resources in this country. Could you give us a dollar figure on about how much we have spent on exploration in this country?

DR. GONZALEZ: The figures on exploration and drilling--because, after all, we must consider most of the drilling as having largely an exploration and development character--indicate that this industry spends between 4 and 5 billion dollars a year on exploration and development. This is a tremendous amount of money. Of course it can only be carried on if you have the financial cash flow to warrant that kind of development.

COL. BLACK: Thank you very much, Dr. Gonzalez. I know

that you have built a very valuable springboard into our following seminars. On behalf of the Commandant and the College, thank you so much for being with us.

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