PETROLEUM AND NATURAL GAS

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Rear Admiral Burton B. Biggs, USN, was born in Elliot, West Virginia, 3 July 1898 and was graduated from the United States Naval Academy and commissioned an ensign in 1920 (class of 1921). He has served aboard the USS Utah, Shaw, Seattle, Oglala, Richmond, Chester, and as commanding officer of the USS Arctic and the USS Saint Paul. He was instructor of Economics and Government at the U. S. Naval Academy from 1935-1938; the logistics officer on the staff of Admiral R. A. Spruance during amphibious operations for the capture of the Gilbert, Marshall, and Marianas Islands, and at Iwo Jima and Okinawa; in the first battle of the Philippine Sea; in carrier raids on Truk, Palau, Tokyo, Kyushu, and the Inland Sea Areas from 1943-1945; the deputy executive officer, Army-Navy Petroleum Board in 1945; plans officer, Commander Service Force, Pacific Fleet in 1947; chief of staff and aide, Commander Service Force, Pacific Fleet in 1948; and is presently the Executive Secretary, Munitions Board Petroleum Committee (formerly the Armed Services Petroleum Board).

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GENERAL HOLMAN: Gentlemen, this morning we are going to hear about petroleum as an economic and a military resource. I think we can all be very certain that in any war between two major powers petroleum and petroleum products will rank right up along with steel and agricultural products as being 100 percent vital to the national military effort.

I think, too, it is important for us not only to understand in a generalized sort of way the peculiarities of the petroleum industry but also to know many of the specific details.

To give us that picture this morning, we have with us an officer who has made a study of the petroleum industry, especially the logistics of petroleum supply. Admiral Burton B. Biggs has had a long and distinguished career in the Navy, as both a commander and a staff officer. Most recently, though, he has been over on the logistics side. He served in the command of Admiral Spruance, in the Central Pacific operations, in the thickest of all our operations over there, for two years or more from 1943-1945.

I have an idea that you will hear this morning not only about the petroleum industry and the vital part that industry plays in our military planning, but that you will also be given some golden nuggets on logistics as well.

Admiral, it certainly is an honor for us here in the Industrial College to have you with us this morning. We certainly welcome you to the platform, sir.

ADMIRAL BIGGS: General Holman, gentlemen: If any of you have been so unfortunate as to have read some of the lectures I have delivered here and elsewhere at various times, and you should check up on this one and say "That doesn't sound anything like the last one," remember one thing I must have told you: That when you are talking about petroleum at any time, at any place, or when you make a statement concerning petroleum logistics and the petroleum industry, be sure to put a date line on it because it, just as sure as heaven, will probably be different tomorrow--even worse next week.

Our experience during World War II indicated that although the military petroleum demands relative to United States production were approximately 21 percent of that total--I am speaking of the direct military consumption--it was in most cases 50 percent or more of the total logistics supplies shipped overseas. That was a lot of petroleum.

Usually, when you deal in food, ammunition, and similar things you find a rather wide variance between the tonnages. I remember that during the week of 24 April 1945 off Okinawa the Mobile Logistics Unit delivered 50,000 tons of petroleum, 500 tons of bombs, and 250 tons of food every 24 hours. That does not necessarily represent the total consumption, but that is what was delivered at sea under way.

In any war in the foreseeable future, we will probably have to depend upon petroleum as our vital fuel supply. Perchance we will have a nuclear-powered submarine or an atomic-powered airplane in the distant future--no more world shaking than the development of the Wright brothers, possibly--but until we get a little more positive as to how those things are going to operate and how we should build them, we had better stick to petroleum and try to keep politics out of it as much as we can.

The requirements for the ground forces in a future war effort will probably not be very much different in either type of product or quantity per capita from those of World War II. However, the Air Force and the air arms of the other services are building bigger and better airplanes, heavier, and with different types of propulsion. As a result, not only will they require different products but many more of them.

Now, where does all this stuff come from? We might look for a minute at the over-all supply of the United States. Where is it? (Referring to chart 1.) You will notice these shaded areas on the map indicate the various producing localities in the United States. They represent something in excess of 28 billion barrels of proven petroleum reserves. Remember, we use that word "proven" advisedly because potential ones are not of much help. (Charts were not reproduced.)

There is an area, not shown on this map, up in Alberta Province in Canada, where recently, within the last year and a half, the reserves have increased from about 700 million to about 1.2 billion barrels. The potentialities of that part of the country may be as much as 10 billion barrels.

When we entered World War II we had a certain amount of excess production. (Referring to chart 2.) There is a weird concept known as "maximum efficient rate." Actually, it is not a line; it is a zone. Every oil well is supposed to have one. You play around with it. What happens if you produce a well too fast? Well, you lose pressures, and other things cause you a certain amount of difficulty. You will notice that we started the war with a million barrels per day excess productive capacity. A combination of that, plus civilian rationing, plus about two million barrels a day from foreign sources, got us through. You will note we have here, in my opinion, something of a coincidence (I hope it is not what it indicates): We had almost a million barrels a day of

shut-in production in 1949. However, will that be as helpful as the previous million? Unfortunately, I am afraid it won't. One of the reasons is the tremendous increase in demand for the civil population.

It was predicted just after World War II that consumption would drop back to the 1941 level. The economists who made that prediction are still blushing for the simple reason that if we could blank out these figures down here (indicating the years on chart 3), I think we would have a great deal of difficulty trying to determine whether or not World War II really took place. A lot of this increased demand has been built into the essential civil economy to such an extent that it will be extremely hard to recapture in the event of a war.

Let us look for a moment at one product as an example. (Referring to chart 4.) That is the Diesel fuel consumption of the United States from 1937 to 1950. We skipped the war years except for 1942. Incidentally, the 1949 consumption of the railroads alone is about 25 percent more than the total for all users in 1942. It is going to be devilishly difficult to transform a Diesel locomotive into a coal-burning one. In case of war, consumption will probably take a 25 percent jump in the railroads because of the transportation we will need. Maybe we can get them to burn propane!!? I don't know.

Now, where do we get our energy sources? Where are they? (Referring to chart 5.) There they are. You have seen that chart before, especially the top figures. If you bring this curve out (indicating) and you bring this curve out (indicating) to 1950, the facts are, instead of petroleum and natural gas being 51 percent of the total they might be as high as 56 percent because there has been a marked increase in the use of natural gas and a considerable increase in oil. For 1951 there is a guess that it might go up about 6.5 percent in petroleum alone; maybe more in gas.

How do we take this barrel of crude and cut it up? What would happen if we had maximum production of certain products--one example, jet fuel? (Referring to chart 6.) This 25 percent maximum production of jet fuel, you will notice, takes a bite out of your motor gasoline. It puts a little squeeze on your Diesel and kerosene. On some of the heating oils its effect is not so marked.

Now, if you went all the way out, that is what it could do to you (indicating). Jet fuel (grade JP-3) consists of about 62 percent gasoline, 27 percent middle distillates, and about 11 percent kerosene.

That is presented just to give you an idea. That 25 percent production might be, say, 500,000 to 700,000 barrels a day; 50 percent production might be 1.25 million barrels; and full production 2.5 million barrels a day. Those are relative numbers, which will be different next year.

The next thing I would like for you to see is the relationship between the aviation grade gasolines, my good old friends 100/130 and 115/145. It just so happens that with the same type of alkylation plants it is possible to make two barrels of 100/130 while only one of the 115/145 can be made. That is because of the alkylate requirement in the 115/145. So, if we can make 512,000 barrels of the 100/130, we can make only 262,000 barrels of the 115/145. But if we want to produce them simulatneously, from existing equipment, the more 115 we make, the smaller the total of the two grades becomes (referring to chart 7). So that not only are we limited in the amount of 115/145 we can make, but we are also limited in the total of the two grades; that is, with our present existing facilities.

To make those things, we must have a lot of refineries scattered all over the United States. There they are (referring to chart 8). Now, one difficulty with that picture is that they are highly concentrated in certain areas of the country. Why? Because a refinery is built either at the point where there are large sources of crude and good transportation facilities to get the products away or where there is a large consuming population; or, if we are fortunate, we build it where we have both. It is much easier to add a unit to an existing refinery than it is to go out and build another one somewhere else and have to get all the necessary lines and everything to get it running.

Now, we have to take crude oil, put it through the refineries, and then transport it somewhere. Take a quick look at some of our pipeline transportation. (Referring to chart 9.) This is not a spider web on the screen--I wouldn't even insinuate that the Industrial College would have such things--but it gives you some idea of the crude and product lines operating in the United States. The man in west Texas may tell you that the reason he cannot meet his "allowables" is because he cannot get pipeline space at the right time of the month for so many days. So you have a limitation on how much you can get from the wells to the refinery.

A companion to crude and product lines are the gas lines (indicating chart 10). You will note the heavy dark lines (indicating). These particular lines are the so-called "Big Inch" and "Little Big Inch" which at the present moment are in natural gas service. I seriously doubt that it would ever be possible to put these lines back into petroleum duty for the simple reason that the gas they transport is too thoroughly integrated into the industrial and domestic picture. We might have to build other ones if a submarine menace got bad enough.

There is a line being built from Alberta to Lake Superior, a distance of 1,150 miles, which should be finished soon. (Finished December 1950--added at time of editing.) It will probably start out by delivering 55,000 barrels a day to the Lakes and can be stepped up to 100,000 barrels a day. This can be accomplished by doubling the line, looping it, and adding

pumping stations. However, we are going to need a lot of storage up there unless we can get some pipelines to take it out because the Great Lakes have a habit of freezing up.

In addition to all this network we have tankers. Tankers were one item of petroleum transportation that I was interested in, for two years particularly. It seems to me I spent a great deal of my time gnawing my fingers down to my wrist, wondering when that next tanker was going to arrive. You will hear a lot about having a 30-day supply on the line, and a 30-day supply on the ships, and a 30-day supply back up somewhere else; but when you are 8,000 miles from home plate and are using petroleum at the rate of about a half million barrels a day, any time you get a five-day supply ahead you are really the happiest fellow in eight states. I know; I was. It was only when we got down to about three or 2.5 days that I began to have nervous attacks. And it became contagious, you know. Various group commanders and various assortments of stars--there were long rows of them, three and four in a bunch--began to get very upset about the whole thing.

Now you would think inasmuch as the military offtake before Korea was about 3.7 percent of the United States production, that our so-called "police action" would not throw us into a dither. Well, maybe it didn't; maybe it did. Our purchase requirements for aviation gasoline two months ago were about three million barrels short of coverage for the last six months of 1950. That shortage has been reduced as of the day before yesterday down to 1.5 million barrels. Why the shortage? Because our aviation gasoline producing units have been divorced from each other and each big refinery was geared to a specific commercial setup to produce a certain set of products. You also had about 2 percent alkylate in your premium motor gasoline. Alkylate is the real "McCoy" when it comes to making avgas. That was another reason.

The refiner who said to his friend across the street, "Joe, how is it to lend me two tank cars of butylenes to put in my alkylation plant and I'll "swap" you a couple of carloads of premium motor gas-blending agents so you can keep your motor gas going and I can meet the military requirements for avgas? It's a very simple exchange." Their intentions were the best but the next morning both of them went to jail. Our local antitrust laws do not allow such collusion as that. So, before we had a National Production Act there were no real authorities to authorize this type of exchange.

We have many blending agents in the Middle West and on the east coast--strange things called codimers, isobutanes, butylenes, and other things about which my technical outfit tries to educate me--but the largest number of alkylation units to take care of that job are down in Texas and

over on the west coast. We must have pressure tank cars to move the butylenes, so they tell me. We tie those butylenes or propylenes together and we get a codimer. That is a liquid, so it can be put in an ordinary tank car. But right at this particular period is when the liquefied petroleum gas people are trying to fill up tanks outside the farmhouses, so those tank cars get in a "bind."

That is why we had to have a Petroleum Administration for Defense. Fortunately, it is staffed with industry personnel who know their business. Many of them have been members of our Military Petroleum Advisory Board for a matter of two and a half years. That is one of the things the Industrial College really counts for in my business--to get an exchange of information between industry and the military and other governmental departments so that we will not spend two and a half years of another war getting introduced to each other. It was a terrible thing. It was like trying to introduce two bulldogs, each of them on a leash. You know each one is making insulting remarks to the other and that each is being held, so they get into a fight. I think that is one of the things that the Industrial College has done more to cure than any other outfit I know. We do know the language of the other fellow. Even I know something about butyl--I wouldn't know one if I met it on the street, but I know a lot of the words even if I don't know the music. So, when I do talk about these things, I sound reasonably intelligent, so long as I don't get tangled up with someone who knows too much about it.

In preparation for any emergency, the Joint Chiefs of Staff said to the Army, the Navy, and the Air Force, "You should have on hand, in your possession, a 75-day supply of products." That was to allow industry to get regeared and start producing. In the Far East, when the Korean War started, we had 71 percent, over-all, of the 100-octane requirements under the JCS directive. We had approximately 35 percent about three months later. We had 21 percent of the 115-octane requirement, and about 10 percent of the jet requirement in storage in June. Why? Because we cannot buy storage and we cannot buy a product without money. We were, up to a short time ago, rather short in that very necessary commodity. On the first of June we had 71, 21, and 10 percent of our requirements of these three products. On the first of September we were down to 35, 18, and 8 percent, respectively. We had to move a lot of these products a long distance. It takes time.

Getting away from these details, let us take a look at some of the bigger items of the world situation. (Reffering to chart 12.) Now, 80 billion barrels is a lot of oil. The question which comes up is: Where is it? You can see that about 50 percent of it is in the Western Hemisphere and almost that much is in the Middle East. Those are the two most important areas.

You will notice that our production and our refining capacity quite over-balance, in percentages, the amount of reserves relative to the Middle East and the other countries. We produce them much faster. We refine much more of them. That gives you some idea of how the oil is distributed. It is predicted that this number will probably go up to 10 million barrels a day during the next year--maybe more than that.

Let us take a look for a minute at one of the Joint Chiefs of Staff concepts which we tested here a short time ago (indicating chart 13).

Actually, this is a composite. We took a two-year short-range plan. We extended the assumptions more or less in our own shop out to a five-year period to see where we would wind up using the best information we had. Now, if we are short of crude, there is not much use of our worrying about being short of refining capacity. You noticed, no doubt, on that last picture what happened to the world in the way of refining capacity as it developed its oil. It is concentrated in the United States, the United Kingdom, and various other places.

Supposing we held a million barrels of oil somewhere, or we developed it some place, and then we lost two million barrels of refining capacity due to enemy action or other reasons--and that is about what we would lose if we lost the refineries in certain areas--I do not mean lose them physically but if they were damaged--we would be a million barrels short of refining capacity. So our next reaction is, let's build some more refineries. There are some other things we might do. Let us take a look for a minute or two at this world map. And again I am going to let my imagination run riot because you cannot check up on me on the figures. (Map was not reproduced.)

Now, if we had this crude supply we could change the picture I showed you. At the same time, however, we would lose a large slice of refining capacity. Remember, I'm not playing around with a Joint Chiefs of Staff assumption. This is like the boy said in the poker game, "This game from here on in is being played according to me." It has no standing in the community whatsoever.

We need a million barrels of refining capacity, we will say. The first thing we want to know is the type of refining capacity. The man with the reciprocating engine aircraft said, "Alkylation plants--lots of them." The man with the jet airplane said, "Oh, no, brother. You're going out of commission here pretty soon. You're outmoded. I'm not interested in alkylation plants. I'm interested in jet fuel production, which is a different breed of cattle. Most any old refiner can make JP-3."

So then two questions arise: First, where are we going to build those refineries so that we will get crude to put in them and they won't get knocked to pieces? And, second, where in this program do we shift

our feet from the alkylation side of the family to the jet fuel side of the family? Those are some of the questions we have to answer.

How does our friend over here do (indicating the Soviet Union)? Well, its production, including that of its satellites, is probably somewhere in the neighborhood of 900,000 barrels a day, we believe. That is arrived at by a strange, weird, and peculiar system of statistical gymnastics because we do not know a whole lot about it. We take various production figures for 1939 and 1940 and we set our own Five-Year Plan. Then we try to read between the lines and see what percentage of the Five-Year Plan has been accomplished. Although "Pravda" means "truth," we doubt it.

The thing the Russians do have, however, is this: They are very accomplished at moving troops by foot and not by truck. They have no difficulty, I believe, with civil rationing of petroleum products. It is a very simple matter: The guy who uses too much, they shoot him. They not only reduce what he uses, but they eliminate him. So that part of it is comparatively simple.

I would not for one minute discount the possibilities of how long the Russians can last. For example, Germany lasted quite a while on a total production of 400,000 barrels a day. That is just a comparative figure. In the United States we look at 7 million barrels, and then we take 80 percent of it and commit it to the essential economy. It does not leave as much as it does the way the Russians work it.

That "essential economy," gentlemen, is the story that we must never forget. If we do not have an economy that can support us in the manner to which we are accustomed, then the United States taxpayer is wasting every dime he spends on a military force, because it won't be worth a dime to him if he cannot support it and back it up. That is one of the credos I know you gentlemen have in front of your eyes all the time.

Let us take a look for a moment at what you are going to do as commanding and staff officers when you finish here. All you have to do is read your commission. It is very broad and yet to the point. I believe it says, "Reposing special trust and confidence in so-and-so, I do hereby commission him, and so forth, and he is to do and perform all manner of things thereto pertaining."

But if you happen to get hit with a logistics job, remember that the military cannot take it all. There has to be a balanced division between the civil and the military. We are reaching the point where the superengine requiring a superfuel is a thing that you need like a hole in the head.

Furthermore, remember that this petroleum business requires special techniques and treatment: First, because of its size; and second, because of its peculiarity of being as fluid as gasoline and partaking of some of the characteristics of mercury (we can't get our finger on it). A few gallons of Diesel oil in some thousands of gallons of 115-octane gasoline ruins it. So, some of you may be back trying to control the quality on the receiving end.

We may have lots of barrels of petroleum, but what are they? That question gets more and more important. The nonavailability of one particular type of fuel may throw us one way or the other. I am convinced that there is no such animal left for any of us to do that will be a unilateral operation, gentlemen. There isn't a chance of it ever being that again.

And remember, whether you make petroleum plans or any other kind of plans, do not get married to them too closely. Never let them become the law of the Medes and Persians "that cannot be changed." The flexibility of our thinking must be ever present. If we should find our industry associates in a rut, let us get them out even if we have to use nuclear fission to do it.

And don't get yourself in a solid position of infeasibility. That is a terrible disease for a logistics officer to get because he will invariably come up against the same proposition that I heard a supply officer at the Great Lakes Training Station in 1927 step into. Admiral T. T. Craven, USN, was the commandant. He called this gentleman in and told him to do something. The latter said, "No, it's against the rules and regulations. You can't do that." The Admiral said, "Look. I know you're doing your best to keep the Old Man out of trouble. But I'm a permanent Rear Admiral in this U. S. Navy and I have had a reputation for some years of thriving on trouble"--it was probably an understatement--"I know all the places in the book where it says 'no.' Now you get out of here and find a place where it says 'maybe'."

Thank you, gentlemen.

QUESTION: Admiral, I have heard a lot about the shortage of tank cars and also tankers both during the war and after. Would you please comment on the current situation? Are we in a position to support a full-scale war so far as the shipment is concerned?

ADMIRAL BIGGS: On the tanker side of the family we probably could get by for a certain period. I believe the first six months of that period would be spent getting our routes readjusted to a wartime economy and if we lost a considerable section of that tanker fleet in the process, we would be in a very tough position.

The tank car situation is very tight. The National Production Authority and the Petroleum Administration for Defense are really doing things about that right now to build up more pressure tank cars and liquid-carrying tank cars of the ordinary type.

We would certainly have to have an intensified shipbuilding program both on the tanker side of the family as well as on the cargo side. That is more or less a personal observation but one backed up with certain educated guesses.

QUESTION: Admiral, you have not discussed the Venezuelan sources of oil. I was wondering how the Maracaibo region with refineries at Aruba and Curacao fit into the picture in the event of a future war.

ADMIRAL BIGGS: They have been considered as a part of world supply to the tune of about 1.75 million barrels per day production. I forget the exact figure on the refining side. But those have been built into that availability curve I showed you.

But to answer your question, that has been considered as part of our indigenous supply, practically speaking, the same as it was during World War II. At that time we were getting at times close to 900,000 barrels a day out of Venezuela, and about 500,000 barrels out of the Middle East.

QUESTION: Admiral, I would like to know if you have any more figures on the Russians' distribution of their production? Do they have the same situation in their "essential economy" as we do?

ADMIRAL BIGGS: Of course, their best production is concentrated around the Caspian and Baku fields. We do not know much about the fields they have in other parts of the Russian territory. The production in Roumania and some in Poland is about what it was, we think, before World War II. Information is extremely sketchy as to how much has been discovered in other parts of Russia.

Now, one of their great troubles, of course, is that their pipeline system would handle only about 10 percent of their supply; the tank cars possibly 40 percent. They would have to depend on various other means--barges on the rivers and trucks--for the remainder. One of their toughest assignments would be getting the supplies from here to there, although from some of the logistics of the local North Koreans they must have a solution for it.

QUESTION: Admiral, can you tell us whether any study has been made to determine the cost, petroleumwise, of laying down a barrel of oil, say, at different distances in Asia in an all-out war where we have to furnish escorts and combat potential submarine action?

ADMIRAL BIGGS: I know that the Joint Logistics Plans Group of the Joint Chiefs of Staff has made certain estimates of what it would take in the way of effort to transport oil that distance. But I could not make any statement that I think would be useful along that line.

Frequently, those things would be decided by just how badly the item was needed. As an example, in World War II we were fresh out of escorts, so we ordered some 30 tankers to sail from Eniwetok to Uluthi sans escort. They all got there.

QUESTION: Admiral, in some locales there has been a difference in view between the Air Force and the Navy with respect to the grade of aviation fuel that is to be used or is required. That has been true in the Pacific. Does that constitute a real problem, and if so are we making any progress toward reconciliation in the services?

ADMIRAL BIGGS: We have gone quite a distance. One thing that has been decided which I think has helped is that both services agreed they would not limit the aromatic content of the high-test gasolines. A second one was that they would accept 4.6 cc of lead.

The Navy side of the family insists on the 145 rich side of the mixture because the naval flier hasn't very far to go before his wheels leave everything solid. He is particularly interested in it for that purpose. The Air Force, on the other side of the picture, also is specifically interested in that 145 octane--performance number, rather--when he goes over a target or takes a fighter into combat.

On the jet side of the picture, the Air Force and the Navy are sold. They agreed on that one. One of the reasons I think is because we all more or less started off together, which was a great help. So they have agreed on a JP-3 type of fuel.

You have probably heard much argument about the vapor pressure of that fuel, whether it should be 2, 5, 7, pounds, or what have you. Neither of the services is wedded to that vapor pressure per se, but they are wedded to the JP-3 type of fuel because of the availability. The kerosene type, the old JP-1, is not too plentiful. You can get only about 6 to 10 percent of any barrel of crude that is straight distilled kerosene, which is the basis of your JP-1.

I believe that for a considerable period into the future, we will use 100 and 115 octane in the piston-type engines. I think the Air Force and the Navy have both agreed that we will need those two grades.

I think we are making definite progress.

QUESTION: Admiral, would it be worth while mentioning the prospects in Alaska?

ADMIRAL BIGGS: I really do not know too much about it. But in Alaska we have two small fields at the moment. If they were down on the Gulf Coast of the United States, they would be in commercial production. Being where they are, they are not of commercial size.

There have been two or three gas wells. The units at Point Barrow are literally "cooking with gas."

The oil shows are promising and a lot of people believe that the Devonian Basin in Alberta runs all the way to the Arctic Ocean.

The program, I believe is, after the 1952 appropriation if we do not have sufficient results thereafter to indicate real production, that the party will be called off, except probably some geological work farther south.

MR. LOUDEN: Admiral Biggs, on behalf of the staff, faculty, and student body, I assure you we have enjoyed your lecture very much. It was most instructive and informative.

Thank you.

(1 Feb 1951--350)S.