

MINERALS IN THE NEXT WAR
24 April 1946.

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GENERAL ARMSTRONG:

Gentlemen, we are all familiar with the fact that the mineral resources of the United States have been seriously depleted as a result of World War II. Captain Henning attended a meeting of the heads of the copper industry on Monday; I think that the story he brings back--I believe most of you are familiar with it--is one that is not very encouraging.

How much industrial mobilization anybody can accomplish in the atomic age remains to be seen; it may not be much; we may have to fight a war with what we have; but nevertheless our mineral resources are fundamental and must continue to be one of the most essential elements in our thinking and planning in the Industrial College.

Today we have one of America's outstanding experts in the field of mineral resources. He has devoted his life to that subject. He has had many outstanding positions; in each, he has used his expert knowledge of raw materials. He was the Mineral Adviser to the Shipping and War Industries Board in 1918; Mineral Adviser to the American Commission to Negotiate Peace in 1919; and Chairman of the Mineral Inquiry from 1929 to 1938. In order not to delay his talk, I will not go on telling you of how many boards and commissions he has been chairman. In conclusion, gentlemen, he is one of our outstanding authorities and it is a privilege to present to you Dr. Charles K. Leith, whose subject this morning is "Minerals in the next war." Dr. Leith.

DR. LEITH:

I do not propose to burden you this morning with any facts and figures. I assume that you have been getting them on your own. With your permission, I am going to let my imagination run a little bit into the mineral problem of the next war. I hope I will not be here to see it, and I hope none of us will be able to check up on some of the things I may have to say.

The atomic physicists have recently been pretty active in trying to save the world by discussing not only the physical but also the political implications of the subject; and it is too much of a temptation for me not to attempt a little contribution from the standpoint of a "hard rock geologist" dealing with mineral raw materials.

Now as General Armstrong just said, minerals are important for war. They are the materials of the machines of war. They constitute the materials that drive the machines of war. They are the basis of communications of all kinds. Minerals appear in every phase of the war activity. It has been estimated that 90 percent of the weight of all materials going to war is steel. Whether that figure is exactly true or not, I do not know, but it will convey the idea of the large proportion of steel.

I will just leave the question of the importance of minerals with the generalization that minerals are the eggs to make the omelet of war. They are basic.

The second basic fact is that these minerals are not equally scattered over the globe. They are very unequally scattered, and that applies to all but a very few minerals. Over a hundred minerals were used in our war effort and very few of these are really widespread in our own country. In fighting the war, it is necessary for any nation to mobilize minerals from the far parts of the world. We ourselves in World War II imported quantities of 60 different minerals in spite of the fact that we are the richest mineral country in the world. When demand reaches the scale of a World War, it is obvious that world mobilization of minerals is necessary. In World War I we were not big and strong enough in minerals to do it ourselves; it took not only world mobilization but also the control of the sea. In World War II, mobilization was on a still larger scale; and, I presume, you will agree, if we are unfortunate enough to get into another war, it will make the last mobilization look small.

I want to emphasize that fact, that no world war can be won without mobilization of mineral resources. No mobilization on a scale large enough to lick the world is possible without control of the sea and access to 15, 20 or 30 different nations. One could develop that thesis. We cannot have radar without quartz crystal available only in Brazil; we must go outside for nickel, manganese and chrome, and so on down the list, including some of the materials for the atomic bomb to which I will make some reference later.

Now we have that general picture in front of us; in the first place, the general importance of the minerals for war; and, second, the necessity to mobilize the world minerals in order to win the modern type of war. These wars are not little wars where we can dig minerals ore out of the back yard and lick the next fellow in making machines of war. We literally must have access practically to the whole world and so control of the sea is a very important element.

Just recently I was interested in reading a comment on "Time" about Haushofer, the father of geopolitics, who had a good deal to say in discussions at the opening of the war. "Time" says:

"According to the laws of geopolitics, German land power defied sea power and nearly won the war. According to the same laws, Germany exhausted herself in the depths of Russian space and was finally beaten by allied land power."

While this is a striking statement, I think that it should be challenged. If time permitted, I would like to discuss this question of land masses versus sea power, and I am tempted to make some fairly extreme statements. I would be willing to let all of the Eurasian land area go under one control, but give me the rest, together with control of the sea, and I think that it would win because of the potential mobilization of minerals.

In approaching the problem of mineral supply for the next war, we might review very briefly some of the lessons of World War II. General Armstrong has already referred to the very great depletion of minerals.

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Production was so accelerated that we made quite a raid on our mineral reserves in the First World War and a bigger raid in this war. It alarmingly shortened the lives of our reserves of a great variety of minerals. You have the facts and figures. It is a simple matter of arithmetic to show that when you take iron ore out of a single pit at the rate of 25 million tons a year for several years, as we did on the Mesabi range, that huge ore body begins to look pretty small and has only a few years left. Even without wars we would be getting gradually into the depletion stage, but with the great acceleration of production of war materials, we have made very large raids on our resources with the result today that even such minerals as iron ore, copper, zinc, lead and finally even oil, which we supposed was sufficient, are not now sufficient to meet our full needs. Mr. Davies, the other day, made a statement on the oil situation. He is the head of our War Petroleum Board. He said that this nation is no longer self-sufficient in oil.

To those of you who have been following this situation closely, it must seem incontrovertible, that depletion is going very fast and that we must rely on foreign sources for increasing proportions of mineral supplies, both for war and industry. That thesis would seem obvious to us here, but it is not at all popular west of the Mississippi River.

We have had a good many speeches and a good many savage editorials on the subject that the Washington crowd is trying to "sell them down the river" in the interests of international trade and not supporting the western mining industry enough. They say that all this talk about depletion is "bunk"; that all we must do is spend a little more money in this or that county or election district to give this country all it needs. They say that there have been these scares and bugaboos before, but look what we have done--how far we have increased production. As a matter of fact, that attack, when it takes political form, is in some respects a very serious threat to the intelligent handling of the problem of the inevitable increase in use of foreign minerals.

There is still another aspect of the problem that aroused the ire of the western public. The idea of necessity has been coupled in some quarters with the idea of conservation. Conservationists say that if we are getting down to a short supply, let us put some of our reserves aside in the interests of the far future. Certain mining groups say that is again Washington trying to throttle American industry in the interests of international trade. I merely want to make it clear that the problem of supply is being obscured by controversy of this kind.

Discovery used to keep up with depletion, but it does not any more. The rates of discovery for practically every mineral have been falling steadily now for a good many years. That generalization is also denied by some people. They say, "Well, how about this, that, and the other particular discovery?" I think that when we put those discoveries in perspective of size and take the over-all curve of discovery expressed in tons, we cannot get away from the fact that that curve of discovery is definitely falling.

In World War II, as we did in World War I, we moved heaven and earth to make discoveries. We started exploration all over the place, offered

very high prices, and put a great premium on discovery. But the results of discovery in the last war, as in the first war, were not at all impressive. You have heard a great deal about this and that development, but put it in terms of over-all tonnage this enormous extra effort did not bring about a proportional result. In terms of percentage, it was a very small return.

Some of us who thought we knew something about the physical background in this country thought we knew where the principal ore bodies were. We were skeptical from the start about some of these moves to explore. I came down here to the first meeting of the Defense Council at which we started our planning--that was in June 1940--and from that time on, we were overwhelmed with development projects of various kinds. Requests for help ran into hundreds of millions of dollars. We had to spend quite a lot of our time in fighting off what seemed to us to be crackpot ideas.

On the other hand, no one can be sure where he can make discovery so we conceded much leeway to that kind of exploration, and we did make contracts that aggregated tens of millions of dollars. In some cases they were definitely against our better judgment, but just to play safe the record has shown, I think, that our judgment was not very far off and that these new and startling things just did not develop.

Then we went in for extraction of ores from low-grade sources. We did not have much high-grade manganese, but we had quite a lot of low-grade manganese, so naturally we went at that; we tried it in the first war and did not get far; we tried it again in the second war and spent a good many millions on it; we got a little further, but not very much. We have not solved the problem yet. We found out how to do some of these things at very high cost, but the problem of really extracting manganese on a large scale is still unsolved.

You are familiar with the effort we have made, in the recent war, to get aluminum out of clay because of the cutting off of the Caribbean source of bauxite. Also we worked on the exploration of domestic bauxite the use of low-grade deposits. And you are familiar with the fact that something like--I just generalized--fifty million dollars have been spent on that type of study. Four semicommercial plants for extraction of aluminum from clay and thus low-grade sources, plants a little larger than pilot size, have been started. What is going to happen to them I do not know. It is one of the problems of war preparation. I want to emphasize the fact that the problem has not been solved today. There are all kinds of pilot plant and laboratory tests which point the way, but we are quite a long ways from having proved a process which is capable of operation on a large scale with anything less than an excessive expenditure of cost and equipment.

Another feature of the last war, which is also a feature of the first war, was the use of new minerals, minerals that had not before been regarded as important for industry. As industry grows, technology grows with it, and there is much greater variety of needs of all kinds. Most of the technological advances result in requirements for new minerals,

such as new qualities in alloys, which can be met by using things that were not used before. We used about thirty minerals in the recent war which were seldom, if ever, heard of in the last war, and thirty is a pretty conservative estimate; it all depends on how you want to divide them up into species; they could be so divided that 125 minerals may be involved. That sort of thing is going to go on; there is no question about it. There is nothing to stop it. Whereas about a hundred minerals will now cover the principal needs, for either industry or war, it is perfectly certain that it will not be long before that number will be 200, 300 or 400; I do not know where to draw the line. There are two or three thousand mineral species to draw on, and if we get up to a thousand, we are not using this old earth of ours fully--using all the varieties of minerals available.

The new minerals, perhaps not so much talked about, may be used in small quantities, but in the new technology, they may be very critical. We might name mineral after mineral, such as quartz crystals and tantalum required for radar. The volume may be small, it is important out of all proportion to the volume.

I remember several times when I was with the War Production Board that the Army or Navy requested certain minerals of which we had never heard. We had to hustle around to get a mineralogy textbook to see what they were. You might have thought that the war had to stop in another week unless we were able to dig them up.

Another great effort was made in this war in the direction of substitution. We substituted silver for copper and when one mineral got short, we tried to substitute something else. When tungsten was short, we substituted molybdenum; when molybdenum got shorter, we shifted back, and so on. One could give many illustrations. Now some new and big possibilities of substitution were found, but I would like merely to emphasize one fact. During this war, the preceding war and the interval between, we have had some rather startling and striking substitutions and a good deal of talk about them. But with all the substitutions, the demand on the primary minerals has not been materially affected. In other words, the curve of increase of consumption has risen for every mineral. We could put on a chart here a series of growth curves of 40 or 50 of our minerals. All are steadily rising. All show variations from year to year, but I defy any one to spot wherein came a substitution. An exception is coal, which reflects the substitution of oil.

Now you might ask the question, "How about the raw materials of the atomic bomb?" In other words, if that form of energy is developed to the limit, what about the trend lines of use of all the rest of the minerals? I will not attempt to answer that question or be dogmatic about it, but I want to say that I am pretty thoroughly impressed with the idea that this world is going to keep on using more and more of everything, regardless of substitutions; and if I had to make a guess--put it in an envelope and open it 20 years from now--I would say that atomic energy is not going to lesson the use of other raw materials. In other words, we shall need them, both for industry and for war, on a larger scale than before.

If we are wrong about this assumption and if in the future there is a convergence on the use of atomic raw materials, both for industry and for war, lessening to some extent the use of the other materials, perhaps flattening their trend lines, it would not change the nature of our problem of supply. In proportion as the pattern converges toward uranium it simply means that the problem of discovery, development, distribution, requirements and so on will be the same problem in kind and probably one that will not displace the old problem of getting increased quantities of other minerals.

Now I would like to call your attention to another factor to be taken into account in setting up a program of mineral supply for the next war, and that is the spread of nationalization of mineral deposits the world over. As countries have waked up to the importance of minerals, not only for their heavy industries but also for war preparation, and as they are about the same thing really, they have said, "We must do something about it." They want to keep control of what they have, and to extend that control outside of their boundaries. This has resulted in the spread of public control in one form or another, starting with the last war, going on with increasing momentum right on between the two wars, and through this last war and going right on to the present moment. This is a new factor in the supply problem. The public is taking control of these mineral resources and is narrowing the field for private initiative day after day.

Now this trend is brought to a head and dramatized by the problem of control of minerals needed for the atomic bomb. You see this nationalization and that nation passing laws day after day to bring mineral raw materials for the bomb under control. We can be sure that those minerals are going to be completely nationalized; the only question is whether or not they might be, in addition, internationalized.

But I would like to leave in your minds the thought that the trend in the atomic energy field is only a rather striking illustration of a trend that affects the entire mineral field in varying degrees. Looking forward to the future of preparation for war, we can see at once that the problem is something entirely different from the one that was faced in the past. It is not a case of going around to the department store and buying the necessary stuff over the counter or going to any other source and saying, "We have to have so many tons of manganese to fight the war." If you get your manganese or any other mineral for the next war, it will be because you have made an international deal on the political level.

Now with a few of the generalizations as a background, let us view some of the obvious things that must be done in the next war in regard to minerals.

Of course, there must be the usual calculations for requirements and supplies in sight. It is not a simple problem of two and two making four. The problem has many shifting variables for which nobody has yet developed the mathematic equation to give the definite answer. I had occasion one day, at a meeting, to listen to a discussion on minerals,

based on the thesis that two and two make four. When I questioned this assumption, the speaker looked at me in amazement. He said, "Doesn't it?" And I said, "No, not in Washington, in these days of wartime." You start by adding two and two, but you have to add this and this variable factor and pretty soon you have so many variables that you cannot solve it mathematically. I merely want to emphasize the fact that the study of requirements and demand is going to be complicated to even a greater degree in the next war than it was in World War II.

Next, we want stockpiles. We wanted them in the last war. Unfortunately, we had a poor start due to the fact that Congress was slow in making appropriations. We got around some of the worst trouble by the fact that industry had been farsighted, had seen trouble coming, and had stocked up pretty generally. That was the cushion that carried us over some of those early stages of preparation in 1940 and 1941.

As you know, there is now a stockpile bill in Congress which has been revised several times. There is a good deal of pressure back of it. It is stated in pretty good form, I think, and many of us are hoping that that will pass. But there are a lot of other important measures in Congress right now and as the war recedes into the background, the enthusiasm for that type of legislation is fading day by day. Frankly, at this moment, I would not bet very much on the success of that bill. That is just my general impression, just because there is not back of it--perhaps I am talking too much the same kind of organized political pressure groups that are back of several other measures. The stockpile bill idea is backed by the Army and the Navy, to be sure, and has a scattering of public support, but political organization for its passage, outside of the Army and Navy, just does not exist so far as I know.

But even if we get the money which we hope for, it will not be possible to accumulate stockpiles large enough for real security. The size of stockpiles needed in the last war will certainly not be the size needed for the future. Demands are going to rise out of all proportion to available supplies. It begins to look as if it would be impossible for any nation, including our own, the strongest nation in the world, ever to acquire enough minerals to win a war. The requirement is just too big. The world's total production is not enough to take care of stockpiles while at the same time supplying industry. At the present time, there are industrial demands for copper which seem to be in excess of the world capacity for the immediate future. Our government stockpile is being drawn upon. Where is the copper stockpile to come out of that situation? Industry, of course, will have to take precedence.

Emphasizing the inadequacy of stockpiles, I do not mean to say we should not try to build stockpiles. In other words, partial preparations are a lot better than none at all. I merely call attention to the fact that a stockpile big enough to win the next big war, which will be a world war, judging from the results of the past, will have to be a stockpile of practically the world's reserves of these minerals. You just cannot transfer that much material into a stockpile.

There are other forms of stockpiling; we might call them that. There is the problem of the maintenance of reserves and productive capacity in all of our mineral products. Here the Armed Forces can be very helpful. There is, for instance, the problem of extraction of manganese from low-grade deposits. There is the chrome situation out in Montana where a big ore body has been developed. We found how we can take that chrome out and concentrate it, but the concentrated product is too high in iron. We have gone far enough to know that chemically we can do something to change the iron-chrome ratio, but the process has not been established. This makes the difference between sufficiency and insufficiency in chrome for the next war. I do not know if there is enough in it commercially, when we resume importing from the chief low-grade foreign sources, to warrant any private company in carrying on the research and investigation that is necessary.

I was interested to note that the chairman of P.W.A., Mr. Davies, stated in Congress the other day that included in the necessary war preparation was government expenditure on the exploration of the tideland areas just recently acquired by the United States by edict, off the shores of the continental shelf. He said that private capital can not do it; that the U.S. has not enough oil for the next war; that the U.S. Government ought to go into it. This is only one of the many illustrations that could be given of the types of things which are necessary in preparation.

Mr. Davies also puts government expenditure on synthetic oils in the same category of preparation. That is the taking of the oils out of coal. The Government has already appropriated quite a large sum to the Bureau of Mines for this purpose. The Germans have already gone quite a ways on such research, but Davies recommends that the military follow up as a necessary security measure.

Of course, when we start to use that term "security" broadly, we can spread it to almost any of our human activities.

Another problem is that waste, which, in a sense, is the other side of the problem of acquiring new resources. If we can stop waste, we have added just so much to our reserves. You are all familiar with the fact that there are wastes and that it is possible to do something about them. In oil, for instance, there are conservation laws controlling production in eight states; in eleven states there are none--in Illinois, for instance. Here is something that calls for public attention, and again Mr. Davies throws it into the security classification.

I also direct attention to another security problem that arises more or less from our present war experience and the general advances of technology and that is what might be called the by-product problem. Increasing proportions of minerals are coming from mixtures where one mineral is a by-product of the other. This makes the problem of acquisition of ores more and more difficult.

I might give you just one illustration--vanadium. Vanadium is a mineral which is short in commercial production, but we do know that

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vanadium occurs in the titaniferous iron ore which is mined in the Adirondacks. Vanadium also occurs in the phosphate beds. The Geological Survey did a fine piece of work during the war in localizing the high content vanadium layers in the phosphates. Some extraction has been found possible, but it is not proved on a commercial scale. If that problem could be completely solved, it would put the United States on easy street in that particular alloy mineral. It would be mined as a by-product in phosphate. In phosphate beds are nickel, cobalt, molybdenum and finally traces of uranium. Oh, yes, I left out one other element. When phosphate rock is processed to make commercial fertilizer five to six percent of fluorine is lost--an important acid constituent of modern technology. No one yet has found a way to recover the fluorine.

It just happens that quite a number of minerals which we are short of may be recoverable as by-products and should be considered as a security problem. Commercial companies will go a certain distance, but unless somebody puts on pressure, it is doubtful whether the Government will go far enough or whether funds will be available to carry on all of the research necessary to solve problems of that sort.

Another element of security is the necessity of knowledge of foreign supplies of minerals. Lots of work has been done on that. We were caught napping in the first war; we just did not know enough about foreign supply. We went into the recent war with much better knowledge and were able to act more quickly, but we did not solve the problem completely. There are some gaps in our information even now. It is a big world and there are many things to be watched. This is far up on the list of items in the preparedness program.

The acquirement of foreign supplies is involved with the question of nationalization of minerals to which I referred. Americans have been more active in exploration and development of mineral resources than any other nation. The British have been the close second. The two nations, between them, have been responsible for the development of an overwhelming proportion of the world's mineral supplies, but Americans are finding it more difficult and the British are finding it more difficult to carry on, because the doors are being closed by various measures of nationalization. Obviously no American can go in now and explore in Russia, but in some degree the same situation exists all over the world, and it is getting worse every day. Access to foreign sources looms as an important security problem.

Mineral supplies must come from all these foreign countries, in an increasing volume, instead of from our own back yard, we must have control of the sea. I have always been a disciple of the idea that control of the sea is a very critical feature in world affairs, but I think developments in our mineral field have clinched this idea. I do not think it is possible for any nation to win a war without control of the seas and access to foreign mineral deposits.

The problem of mineral supply in its foreign aspects is passing pretty much into the political field. The Atlantic Charter, you remember, went on record for freedom of access, and in many public announcements

various groups have stressed freedom of access, equality of opportunity, freedom of international trade and so on. Presumably, some effort will be made to reach these objectives in forthcoming economic conferences under the U.N. But so far--perhaps I am overstating--we are standing in the sidelines shouting for freedom of access and trade without coming to grips with the realities of world trends in the mineral field, some of which are irreversible. What is needed is a program of adjusting our program to these trends.

It is an enormously complex problem. We are not getting much help in places where we should have it. I cited the fact that some western miners do not like our depletion talk. I should also like to cite the fact that they do not like the idea of making a deal with foreign nations for mineral supplies. They say in effect that this is an effort to stifle domestic production.

In making bargains from the public standpoint as to what is needed by the U.S., the military have a very great responsibility in seeing to it that the security aspects of that problem are taken care of.

Another problem might be discussed under the general heading of sanctions. You can call it the stockpile problem in reverse. It is not only necessary to get what we need, but it is also necessary to see that the other fellow does not get what he needs. We did it to Japan and Germany and we are talking about doing the same thing for the raw materials of the atomic bomb. The report issued by Dean Acheson and Mr. Lillienthal from the State Department the other day emphasized the control of raw materials; they put it as number one on the program for control of atomic energy. It is a problem that needs a lot more study than it has been getting. It is an enormously difficult and complicated problem, particularly when we remember that more and more of our minerals are coming from by-products of other minerals.

After we have done everything possible along the line I have discussed, I do not think we have done enough to assure winning the next war. Even with stockpiles in the next war will not have enough oil, or enough copper or enough of fifty or 60 or a hundred minerals. We must have access to foreign sources. I do not know whether or not we can acquire sufficient control abroad to become really prepared. If we maintain our close cooperation with the British, we can do better because they have a very large control of world resources. It has been estimated that between us we control nearly three quarters of the world's mineral resources. Whether that figure is right or wrong, it is still a very large proportion, and if these two countries hold together, they can get pretty far along toward the degree of control necessary to win almost any war, particularly if they retain control of the sea.

In conclusion, we are really facing a problem of a magnitude which seems to require something of the nature of the United Nations. In other words, the raw material situation seems to be heading into a complexity, not capable of solution by any one nation but to be capable of solution only by real international cooperation. At the present stage, the U.N. is not in a position to do this job. It is questionable

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if it will ever be in that position. It is a continuous follow-up job throughout the years.

I will conclude with a rather obvious statement that the growing magnitude and complexity of the mineral problem, both for war and industry, is becoming a tremendous deterrent to war.

GENERAL ARMSTRONG:

Dr. Leith, I think that the naval members of this class have been exceedingly gratified for your adherence to that theory of the importance of control of the sea. You will notice we have 20 representatives of the Navy here, and I think that theory is very interesting, Doctor Leith, and one in which we like to believe.

However, considering the land masses controlled, at the present time by Russia and the contiguous countries that are constantly coming more and more under her influence, and assuming that some day she may be controlling all of Europe and all of Asia, does not that make her far more self-supporting than the land mass controlled by the United States?

DR. LEITH:

Well, it would make her very much more self-supporting than she is now. If all of Europe should be put together, I doubt if it would be in any better position or in as good a position as the North American continent, for instance, or the two Americas.

And I will say, furthermore, that so far as the mineral position of Russia is concerned, I think it has been very greatly exaggerated; that is the impression of some of us who have been trying to follow it for a great many years. Granting that she has great manganese reserves, oil, and so forth--when you remember that it takes over a hundred minerals to make the modern machines, in this modern industrial age, there are tremendous shortages and the amounts available are not up to a high industrial standard.

Let me give an illustration. You cannot fight a war without iron ore--and a lot of it. You need a big steel industry. You need a big reserve of iron ore. The Russians have not yet developed iron ore on a scale at all comparable to that existing in the United States. Some of the ores that they were mining during the war were not all high grade and they needed concentration in order to make them usable. But I want to call attention to the fact that the best and highest grade of ore in all Russia is small potatoes as compared to the Lake Superior region ore. One of the vice chairmen of the War Production Board had charge of exploration over there. He had twenty-two American engineers with him. When he came back he said, "Yes, the Russians have a lot of ore". I said, "Bill, what do you mean by a lot of ore?" "Well", he said, "I will put it in the category of the Geogebic range, one of the smaller of the six iron ranges of Lake Superior."

When the Russians start to draw on those resources to meet developing industrialization, then they do not look so big. And I could repeat

that illustration for other minerals. Russia could extend a long ways into China; she could extend to other places, but give me control of the sea and she can have all control of the resources of most of Eurasia.

QUESTION:

I would like to ask a question on Alaska. I think there has been much said as to Alaska being practically one lump of minerals; to what extent has exploration gone on there and what do they have there?

DR. LEITH:

That is a very much exaggerated statement. Alaska, of course, has been exploring resources and naturally it has minerals, but there has not been anything big or striking and new there for a long while. There are undeveloped coal reserves. We made quite an effort during this war to find some new stuff up there, but we did not get it. The Governor of Alaska came down to the War Production Board and wanted us to spend two million dollars on further exploration and development. We submitted this proposal to the Geological Survey and Bureau of Mines. They had already been doing quite a lot in Alaska and they could not see how they could spend more than a half million. We got that appropriation through and work has been continued for several years. I happen to know about it because it came across my desk. The result does not amount to very much. It is a small item in preparation of industry for war.

QUESTION:

Dr. Leith, I may give an example of my lack of knowledge of physics, but I thought there were less than a hundred elements, and I believe you spoke of over a thousand different kinds of minerals; what is the relationship?

DR. LEITH:

Well, the elements are combined in all kinds of proportions to make up different minerals. For instance, a dozen elements could make a hundred minerals by different combinations.

QUESTION:

Doctor Leith, you referred to yourself as a "hard rock geologist", but you also strayed into the field of oil, in considerable detail.

DR. LEITH:

Only by quotation, sir.

QUESTION:

I happened to be with an oil company in peacetime and it was the one company in the United States that did not subscribe to the theory that we are running out of oil. The last report that the Sun Oil Company made

showed--according to the report--that there were better and larger known oil reserves now than ever in our history. Our own drilling and exploration has increased our own known reserves, I think, about 15 percent in the last two or three years. Would you care to comment on that contradiction?

DR. LEITH:

Well, I can simply refer you to Davies' report which I just happened to read last night, in which he rather flatly contradicts your statement for oil as a whole. He concedes the fact that there are many discoveries but just the same he claims that the rate of discovery is falling in proportion to increases in production--he publishes certain paragraphs under Proportion of Reserve to Production. Always remember that production is rising and it is a question of the relative rise of reserves and he draws these inferences. I have followed oil exploration for a great many years and have a commercial interest in it. I think a great deal depends on how you state these things. We are not finding oil quite so fast and the oil men respond and say, "It is because of war conditions. We could not explore". There is more wildcatting going on this minute than during the war and before, and oil discovery is not coming through in the necessary volume. They are making discoveries, but I am willing to concede that the curve of discovery is not maintaining its proportion to the rapidly expanding production curve. Reserves are not big enough for the life of this Nation.

QUESTION:

Doctor Leith, during the war we developed a great many additional resources in Mexico; could you give us some idea of the exploration and future possibilities there in Mexico?

DR. LEITH:

Offhand I could not give you anything authoritative. I have followed it more or less. That was pretty much the work of FEA. They watched those developments. They subsidized production of zinc, lead, fluorspar and so on. My impression--and here again I would want to check on that--was that the results came far short of some of the expectations.

GENERAL ARMSTRONG:

Dr. Leith, I want to express the thanks of the Industrial College to you, sir, for your very valuable contribution. You have given us a great deal to think about and you have stated something that I am in agreement with and that is that the function of the Army today is to prevent wars and not alone to fight them; and I think the Industrial College, in its training and planning and thinking can be instrumental when we are backed up by experts like yourself who will help us and direct our thinking into the right channels. I am very grateful to you, sir. Thank you very much.

(20 May 1946--200.)s

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