THE NATURAL RESOURCES OF THE COMMUNIST BLOC

Dr. John A. Morrison

NOTICE

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Reviewed by: Colonel P. B. Klein, USAF

Date: 9 March 1960

INDUSTRIAL COLLEGE OF THE ARMED FORCES

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24 November 1959

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COLONEL SMITH: The subject of the lecture is The Natural Resources of the Communist Bloc.

Our speaker is Dr. John A. Morrison of Illinois.

As a former faculty member of the National War College and a regular on this platform, he knows how to deal with his encyclopedic subject and how to make it interesting and vital.

Gentlemen, may I present Dr. Morrison.

DR. MORRISON: General Mundy, Secretary Jackson, Staff and Students of the Industrial College of the Armed Forces: It is always for me a great pleasure to come back to this campus, as I would call it. It has many very pleasant memories and very stimulating ones.

As Colonel Smith has said so graciously in introducing me, the subject assigned to me is a rather broad one. The scope of the lecture is described in the curriculum as follows:

"A survey of the raw materials resources of the U.S.S.R., its satellites, and Red China, emphasizing those strengths and weaknesses materially affecting the national strength and military capabilities of the Soviet Union. A general assessment of the significance of these strengths and weaknesses when compared with the raw material resources position of the United States."

Well, that's a rather tall order, I would suggest, especially a tall order when I am told that I have about 45 minutes in which to cover it. I would say it is a good subject for a six weeks' course and we might get through it in that time.

Fortunately, there is an escape clause in the directive. Note that it says that the lecture will "emphasize those strengths and weaknesses materially affecting the national strength and military capabilities of the Soviet Union." That's what I propose to do. If the resources of the satellites or China seem to me to have little or no bearing on the military strength and national strength of the Soviet Union I will leave them out. The emphasis of this lecture thus is on the Soviet Union.

Even so, the time allotted obviously is not enough to touch on all the resources which might have a bearing on its national economic strength and its military effectiveness.

First let us consider the Soviet capability insofar as it is limited by nature for producing agricultural raw materials--that is to say foodstuffs, fibers, hides, and other raw materials. I don't suppose there is anything more fundamental to a nation's strength and well-being, as to an individuals, than the nation's ability to feed and to clothe itself adequately.

With our ever-increasing yield per acre and our mounting crop surpluses and our Government's efforts to restrict acreages and production, not very successfully, I might say, in order to decrease

production, we Americans tend to forget that for most of the world the problem is not overproduction of food but underproduction.

So in the Soviet Union, a country of 211 million people and increasing at the rate of about 3 million a year, the situation is just the opposite to what we have. Instead of doing its best to reduce agricultural production, the Soviet regime is doing its best to increase it by every possible means, and some of them impossible, in order that they can have adequate food and agricultural raw material resources.

Now, the Soviet capability for increasing its production of foodstuffs, especially of bread grains, and also other agricultural products, is fundamental to the overall strength of that country and to its military strength. It is significant, I think, that the size of the grain reserve has always been considered a military secret in the Soviet Union. Total agricultural production can be increased in two ways, broadly speaking--by increasing the yields on the existing cultivated area, and by expanding the area under crops. In both cases, however, climate is the prime limiting factor. Poor soils can be improved by adding organic mineral fertilizers and by better methods of cultivation. If the climate is favorable, yields will be higher.

Some of you have seen what the Germans have done with the light sandy soils of the North German Plain by adding large amounts of mineral organic fertilizer and better methods of cultivation. But there is no use in adding fertilizers to a poor soil when the growing season is too cool

or too short to mature crops on that soil or when there is insufficient moisture. The richest soil type in the world, the famous chernozems of the Russian Steppe , won't produce grain unless it has moisture. Unfortunately for the Russians, a large proportion of that belt of soils does not have sufficient rain.

The Soviet Union, because most of it lies in the high altitudes, is unfortunate in that there is only a small area in which the temperatures are such as to provide a growing season long enough to mature most crops, and there is also not a long enough season to mature the higher yielding varieties of crops which will grow in a short growing season. Generally speaking, the longer and warmer the growing season, the greater variety of crops which can be grown, and the higher the yield, other things, of course, being equal.

Note how little on this map (on slide) of the Soviet Union has a frost-free period of over 120 days--4 months--and how much less has a growing season of 5 months or over, free from frost, that is to say.

Now compare this with the situation in our own country. The contrast is certainly very striking. Most of our country enjoys four months, on the average, free of frost, and a large part of it, as you can see from this map, has a frost-free season of over five months, much of it seven months, and even longer. This means that we can grow a greater variety of crops and can obtain higher yields over a larger proportion of our total area than can the Soviet Union.

I should point out that this map and the previous map are on different scales. The actual area in the Soviet Union having 120 days or more of a growing season is about the same as that in the United States. I haven't actually planimetered it, but it is approximately the same. The important point is that we have actually a larger area, in spite of the smaller size of our country, which has five months and over; in other words, a really long growing season.

Unfortunately for the Soviet people, much of the area of their country which does have a long-enough growing season, say 120 days, doesn't have enough rainfall. In fact, a considerable area in the Soviet Central Asia has practically no rainfall. In other words, it is a desert.

Here again, the United States is much better off, as you can see by comparing the two maps, which in this case are on the same scale. As you can see, the entire eastern half of the United States has over 20 inches of rainfall or precipitation annually. Precipitation includes snow. So does most of the Pacific Coast. Thus, most of the eastern half of the United States and most of the Pacific Coast region have both a long growing season and a moderate to abundant rainfall.

Now, corn is a crop which, I am sure some of you know, produces a great deal of food per acre, but to do this requires at least 140 days free from frost, and, furthermore, hot days and nights during mid-summer, and also considerable rainfall. As you know, it is corn which

makes our Middle West one of the most productive agricultural regions in the world. Because our population pressure is not yet very acute, we can afford to feed corn to hogs and to beef cattle, and thus eat the corn in the form of meat.

You will also recall how interested Mr. Khrushchev is in corn. "Corn is sausage on the stalk. Corn is beefsteak; it is bacon; it is butter. That's why I am a booster for corn." Said the bouncy Mr. Khrushchev not very long ago. He went out to Coon Rapids to see how they raise corn and what they do with it in the State where the tall corn grows. I might say parenthetically that it grows just as tall in Illinois.

Four years ago the Soviet boss-man decreed that the area in corn in the Soviet Union should be more than tripled by 1960 as compared with 1955.

In this country little commercial corn is grown where the mean July temperature is below 68 degrees Fahrenheit, the mean July temperature, and the mean annual rainfall less than 20inches. As you can see from this map, which was drawn by Professor Chauncy Harris of the University of Chicago, nearly the whole eastern half of the country meets both the temperature and the rainfall requirements.

Now let us apply these same requirements to a map of the Soviet Union. Unfortunately for Mr. Khrushchev and the Soviet meat prospects, hardly any of the area which has the right temperature for corn-growing has the right amount of rainfall, and hardly any of the area which has

sufficient rainfall has a high enough July temperature. The largest area you can see meeting both these requirements is the Caucasian Isthmus, and not much of that area is topographically suited for growing crops at all.

The prospects for developing a Soviet corn belt would not appear to us to be too bright. Mr. Khrushchev would have done well to have consulted his very excellent climatologist and agronomist, and even a geographer, too, but, you know, when a dictator gets an idea in his head he doesn't consult; he orders.

If there were time I would show you also how the climate is affecting the expansion of wheat production, which is, I suppose really a more serious problem because of the importance of bread grains and bread in the diet of the Soviet people. But I think I have said enough to show you that Soviet capabilities for producing food and agricultural raw materials are severely restricted by climate.

Some further expansion of agricultural production is no doubt possible. For example, let us say a significant expansion of food production is being obtained and may be obtained further by increasing the area under irrigation. But irrigation on the scale they are doing it requires very large investments in capital and in labor, and, furthermore, only a small part of the area with a long enough growing season which requires irrigation if it is to grow crops can be irrigated.

If the Soviet population continues to increase at its present rate, it

will not be many years before the Soviet Union will have to import a significant part of its food supply, even though at the present time it is actually a net exporter.

Now, can the Soviet Union's allies and satellites make up for this Soviet weakness? Certainly China is much better equipped climatically for crop-growing than is its big neighbor to the north and west. Since it does not extend so far to the north and since it reaches well into the tropics, almost all of it has a growing season of over 140 days, as you can see from this map. Well South China has approximately a year-around growing season, which makes possible the growing of two crops annually on the same land, as indicated in this map.

Furthermore, a larger proportion of China than of the Soviet Union and a considerably larger actual area has sufficient rainfall for growing crops, as this map very clearly shows.

Unfortunately, however, most of middle and south China, where there is abundant rainfall and a long growing season, is so hilly or mountainous that much of the land cannot be cropped. In some areas even less than half of the total area can actually be cultivated, as is shown by this map.

However, even with the topographic handicap, China is the world's leading food-producing country. But as you all know it is also the world's most populous country, with three times the population of the Soviet Union, and increasing that population about 10 times as fast, as I recall, about

30 million a year increase. The Sovietplanners may be worried about the capacity of their country to feed their population, say, 15 to 20 years from now, but the Chinese are up against this problem right now, and they have been up against it for years. Tens of millions of Chinese, as you know, live on the very edge of subsistence.

China can't feed itself, let alone help the Soviet Union, even if it wanted to help the Soviet Union, which may be a question.

How about the European satellites? Can they help? Before World War II Hungary, Rumania, and Poland were all net exporters of foodstuffs. But, thanks to collectivization, they now have to import grain from the Soviet Union, as well as fiber and crops like cotton.

So I think for the Communist Bloc as a whole, and over the long term, the production of food and agricultural materials may be considered a weak point. Although climate restricts crop-growing to a relatively small proportion of the Soviet Union, it is by no means so hostile to forest growth. Most of the black area on this map is the boreal coniferous forest, the "taiga," as the Russians call it. It is the world's most extensive forest, and it covers nearly one-half of the area of the Soviet Union. This is one of Russia's richest natural resources and an almost inexhaustible one. Its fir, pine, spruce, and other conifers provide lumber for construction of all sorts, cellulose for paper, and a variety of other products.

Let us now turn to the resources of the earth's crust beneath the

soil on the surface, namely, minerals. Here I must confess to a feeling of embarrassment in speaking here, because the U. S. authority on Soviet mineral resources, my old friend, Demitri Shimkin, is a periodic member of your faculty, and for all I know he may have already been here and lectured to you this fall. However, I think Colonel Shimkin would agree with me that it is a safe generalization to say that the larger the area of a country and the more varied its geology the greater its mineral resources are likely to be.

The Communist Bloc, oreven the Soviet Union alone, certainly has an enormous area and it also has a greatly varied geology. It would be surprising, therefore, if this area were not rich in mineral resources. Naturally, not all parts of it are equally well endowed, and not all parts of it have had the same amount of geological attention and prospecting.

I don't think it is necessary to emphasize to this audience the ever increasing importance of minerals to national power. But I can't help pointing out that the U. S. A. and the U.S.S.R., the two super powers, are also the two leading mineral-owning powers and the two leading mineral-producing powers. Not that they lead in the production of every single mineral but that in overall mineral production they are the two leaders. Both co untries have a great variety of minerals and ample resources of many of them. But neither is completely independent of outside sources, although is more than any other industrial power.

Of the two, the Soviet Union is the more nearly self-sufficient,

at least in terms of present requirements. This greater self-sufficiency of the U.S.S.R. is due in part to the fact that it had a greater variety of mineral resources to start with, and it has ample reserves of some important minerals which the United States lacks all together or at least is deficient in seriously. In part this greater self-sufficiency is due to the fact also that the U. S., having been the leading industrial power of the world for now roughly a half-century, has used up many of its best mineral resources--and we are a notoriously wasteful people; don't forget that--while the Soviet Union has not as yet made heavy drafts on its resources, or let us say that its heavy drafts began only recently.

Let's look at the situation regarding some of the more important minerals--first the mineral fuels--coal, petroleum, and natural gas. With the progress of geological exploration, especially in Siberia, the Soviet estimates of their coal reserves have increased very notably. They now claim first place in the world, surpassing the United States, which for so long was considered the leading coal-owning power. They even claim that they have one-half the geological coal reserves of the world, that is reserves based purely on the geology and not on prospecting.

The last estimates of U. S. geological reserves of coal, made in 1937 for the International Geological Congress, gave reserves of bituminous and anthracite coal to a depth of 1200 meters as 1 trillion, 303 billion tons, and our reserves of lignite, down to a depth of 500 meters,

as 420 billion tons.

Soviet geological reserves to the same depths are now estimated at 4 trillion 487 billion tons of bituminous and anthracite, which is almost 3-1/2 times our reserves of those better quality fuels, and 1 trillion 34 billion tons of lignite, or almost 2-1/2 times our reserves of this low-quality fuel.

Well, even leaving out seams which are too deep or too folded for working, the Soviet claims are still 3 trillion tons of geological reserves, and they claim that, even if the workable seams in already developed parts of the country are included only, leaving out much of the remoter coal, they still have 1 trillion tons. These are all geological reserves, mind you.

Now the actually explored reserves, that is to say, those prospected by diamond drilling or by other means, are only 155 billion tons. However, at the present rate of production, even this small fraction of the geological reserves would last over 300 years. In any case, the Soviet Union has plenty of coal. But its distribution is not nearly as fortunate as is that of the United States.

Most of our bituminous and anthracite coal, as you know, is in the Appalachian region and in the Middle West; that is to say, fairly close to our major industrial regions, or actually in them, and our largest urban centers. But 91 percent of the Soviet reserves, including the best coal, and that most easily mined technologically, is in the Asiatic

part of the country, remote from the older centers of population and industry, west of the Urals.

Western and eastern Siberia alone, as is suggested by this map, have around 85 percent of the country's geological reserves. The European part of the country, still the chief coal-consuming area, has only 7-1/2 percent of the total reserves. And the Urals region, as we will see in a few moments, which is very rich in metallic minerals requiring coal for smelting, has almost no coal of coking quality.

As you can see from this next map, Siberia, especially the central and northern part, has vast areas underlain by coal. For example, the Tungus Basin covers an area of roughly a million square kilometers, and it is estimated to contain 1 trillion 743 billion tons--geological reserves, of course. The Lena Basin coal reserves are even greater, although in part they are, as you can see, lignite. Even the small basins along the Tran-Siberian Railway, as, for example, the great Kuznetsk Basin, which is south of the Railway, but does touch it on its northern edge, have a reserve of 900 billion tons, much of it of good coking quality. Yet the Donets Basin in south European Russia, because of its location, continues to be the country's chief coal basin in output, even though its reserves are little more than a quarter those of the Kuznetsk Basin, or the Kuzbass, and, though its coal seams are thin, much folded and faulted, and the coal is rather high in sulphur.

The Pechora coal basin in remote northeastern European Russia

has become a major producer, even though it lies north of the Arctic Circle, simply because it is nearer than are the Siberian fields to northwestern European Russia and the central industrial region around Moscow, a region which is deficient in fuel.

As a matter of fact, the only mineral fuel reasonably close to Moscow and the central industrial region of European Russia--and that is still the country's No. 1 industrial region--in not coal but, as you can see from this map, lignite. Yet, because of its location, it has become an important source of fuel, although it cannot be used for metallurgical coke.

It is this unfortunate geographic distribution of coal which accounts for the curious anomaly that the Soviet Union, the world's No. 1 coal-owning power, nevertheless imports coal from one of its satellites, namely, Poland; for it is cheaper for Leningrad and the Baltic region to import coal from Poland's Upper Silesian coal basin, via the Oder River, or direct by rail, to Gdansk or Gdynia, and thence by steamer across the Baltic to Leningrad or the Baltic states, cheaper than bringing it by rail all the way from the Donbass, that is the Donets Basin, or the Pechora Basin, with rail hauls of over 1,000 miles.

The concentration of so much of the Soviet coal in Siberia, especially coking coal, is one of the reasons for the rapid expansion of heavy industry in the Soviet East. Geological exploration and prospecting in recent years have changed the Soviet oil picture even more radically

than that of coal. I recall pointing out in a lecture to the ancestor of this College, which was located over in what is now the State Department Building--it was then the new War Department Building--I think that was back in 1946--that the shortage of the Soviet oil supply was their Achilles' heel. Yet even then geologists realized that, on the basis of the area of sedimentary formations capable of containing oil, the Soviet Union could be expected to be well endowed with this very valuable mineral fuel.

Note that on this map showing the world's potential petroleum area, a large part of the Soviet Union is shown as having most favorable conditions and also possible conditions. As a matter of fact, the area of the kind of bedrock in the U.S.S.R. capable of holding petroleum sedimentaries is considerably larger than that in the United States--3-1/2 million square miles compared to our 2-1/2million. Much of the oil originally in our 2-1/2 million has already been removed and used up and it can't be taken out of the ground any longer.

Soviet geologists claim that in terms of possible reserves of petroleum their country leads the world, that is reserves based on estimates of the area of sedimentaries. They claim even that it has half of the world's total--half the world's total of oil and half the world's total of coal, geological reserves. But, as some of you may know, perhaps unfortunately to your cost, oil is where you find it. The only sure way of proving the existence of oil is by drilling for it. In terms of proven reserves, what

the Russians call commercial reserves, the U.S.S.R. is far behind the United States, with only one-third as much proven reserves. The Persian Gulf region, including the several states in that area, has eight times the proven reserves of the Soviet Union. However, in recent years drilling has increased rapidly in the Soviet Union. In part this is due to an easing in the supply of pipe, resulting from the increase in steel production; in part it is due to a similarly rapid increase in the number of petroleum engineers and geologists; and in part it is probably also due to the ending of the strain of the Stalin period, when, if an oil driller brought in a dry hole, he was liable to be denounced as a saboteur, a Trotskyist wrecker, or a lackey of Wall Street imperialism, or some other choice Soviet example of official eschatology, and the result might be that he would be sent on a one-way trip to Siberia, and not to drill for oil.

The result, however, of these changes, which have been for the better so far as Soviet oil production is concerned, has been a radical and a continuing change in the Soviet oil map. New and productive oil fields have been found in rapid succession, and more are being discovered all the time. These changes have greatly improved the Soviet oil position. In the first place they have made possible a great increase in the country's overall production of oil. In the second place they have resulted in a favorable geographic distribution of proven reserves and production.

The single most significant development has been the discovery and the open-up development of a number of very productive pools in the region between the Volga and the Urals, the so-called Volga-Urals oil region, in the very heart of the country. Before World War II almost all Soviet oil came from the Caucusus, with three-fourths of it coming from the small district near Baku alone, the Baku District, which was an area remote, as you can see from the map, from the chief-consuming centers of the country, mostly around Moscow and the Volga region, and also strategically vulnerable, because of its nearness to the Iranian and the Turkish frontiers.

Last year, 1958, the Baku District contributed only one-fifth of the Soviet total, even though it still produces as much oil as it ever did. The new Volga-Urals region last year accounted for 70 percent of the total Soviet petroleum production. The importance of this shift of the Soviet oil center of gravity from the Baku District to the Volga-Urals region, simply cannot be overstressed. It is important not only economically but militarily and strategically.

As a result of this stepped-up prospecting, it has been established now that 50 percent of the country's proven reserves, proven reserves, as of the first of January last year, are under the so-called Russian Plain, the Eastern European Plain, that is, from the ~~Volga~~ Urals to the Western frontier.

In addition to this Urals-Volga region, oil has been found well west

of the Volga, in the central and northern Ukraine, in addition to the old fields in the western Ukraine, the so-called Galician fields. They are drilling even just south of Moscow. The results of exploratory drilling in the enormously think sedimentary beds of the west Siberian lowland plain, and also in East Siberia, have been disappointing to date. Gas has been discovered, but not oil, at least not in commercial quantity. However, exploratory drilling has hardly begun in these areas, and therefore it is too early to say that these areas, which geologically are favorable for oil, may not have it also.

At the present, however, central Asia has much better prospects than Siberia. In addition to the long-exploited small pools in the Fergana Basin, large and productive oil pools have been brought in just west of the Caspian Sea, the so-called West Turkman field, and there are good prospects of promising fields opening up down close to the Afghan border.

With 65 percent more drilling scheduled in the next seven years, the so-called Seven-Year Plan, than for the last seven, the likelihood of still further significant changes in the oil map cannot be discounted.

Now, while the Soviet Union is still far behind the United States in oil production--it produced less than one-third of ours in 1958, last year--and it produces only about half the production of the Persian Gulf region--it is increasing production more rapidly than those two leading producers in world oil production. The seven-year plan has set a goal

of from 230 to 240 million metric tons of oil for 1965, which would be approximately double the 1958 yield. It seems rather fantastic. However, the rate of increase in recent years does not make this seem too unreasonable. Two hundred thirty million tons, by the way, would be slightly more than the production of the Persian Gulf region in 1958, but still only a little over three-fifths of U. S. production last year. But the Soviet planners--dreamers if you prefer--have even longer-range goals. By 1972 they expect to produce between 350 and 400 million metric tons of oil. If they reach the higher figure, and if our rate of increase remains what it has been in recent years, roughly about 1 percent per annum, the Soviet Union will in 1972 overtake the United States and become the leading oil-producing country.

At present and for the foreseeable future, the Soviet Union is unlikely to again be bothered by a shortage of oil. It may have temporary stringencies in certain refined products, since their refinery growth has lagged behind the increase in petroleum production, crude production. In fact, after many years' absence from the international market, Soviet oil is again being exported in large enough quantities to worry some of the free world producers. I suggest that, with the Soviet lag in refinery development, there is a good chance that Soviet crude oil exports will increase.

Soviet oil now takes care of Polish and East German needs, and also those of Red China, which to date has not developed enough production

in its new fields in Sinkiang Province to cover the domestic demand. As you have read in the press, a pipeline is now under construction from the Volga-Urals field through Poland to East Germany.

Rumania is also an important producer that not only exports to Czechoslovakia and Hungary and Bulgaria, its neighbors, but also ships oil to the international market.

The overall picture for the Communist Bloc, then, as far as petroeum is concerned, is a strong one. The development of natural gas in the Soviet Union has been even more spectacular than the expansion of oil production. Before World War II this ideal fuel was produced hardly at all, virtually untapped, unused in the U.S.S.R. Today Moscow is getting natural gas from gas fields along the Volga, from the North Caucusus region, and a pipeline is under construction to Leningrad, and another one to Gorky and other cities of the central industrial region. Already natural gas amounts to about 6-1/2 percent of the Soviet fuel balance, and it is scheduled to rise to 21 percent by 1965, with the European part of the country in 1965 covering some 30 percent of its fuel requirements with natural gas, while the Uzbek Republic, down in central Asia, where one recently discovered gas pool is estimated to have something over a trillion cubic meters of gas, will in 1965 cover 65 percent of its fuel requirements with gas.

At the current rate of increase in production, these percentages of increase, which seem rather startling, are likely to be reached. Natural

gas production the first quarter of this year was up some 28 percent. Compared with the same period last year, oil increased "only" 13 percent. In other words the gas production is increasing considerably more rapidly, and, of course, both are increasing much more rapidly than coal production. The rapid increase in natural gas discovery and exploitation again reflects the improved steel position of the Soviet Union, for, even more than oil, gas depends on pipelines to get it to the market.

So much for the mineral fuels. Let us turn now to the metallic minerals. First and foremost, of course, is iron ore. As you are doubtless well aware, from the first Five-Year Plan in 1928 on, the Soviet regime has laid heavy emphasis on the expansion of the iron and steel industry, the cornerstone of a nation's industrial power and independence. As a result of forced growth, the Soviet iron and steel production is second now to that of the United States. In its Seven-Year Plan goal, to be reached in 1965, it calls for a production of between 86 and 91 million tons of steel. Our present capacity is about 110 million metric tons, but not our production, perhaps thanks to Mr. McDonald.

To produce this much steel, and also foundry iron included, of course, will require 150 to 160 million metric tons of prepared iron ore, plus some scrap. In the U. S., where much more scrap is used, because we are an older industrial country, 106 million tons of prepared ore was produced in 1957. This gives you some measure of comparison. Does

the Soviet Union have iron ore resources sufficient to stand this rate of production over a considerable period? And how does it compare in iron ore reserves with the United States?

The iron ore position of both countries, the United States and the Soviet Union, is similar in that each is near the end of its reserves of high-grade ore, and both have begun the mining of iron ore with such a low metallic iron content that it has to be treated before it can be smelted in a blast furnace. The U. S. A. is probably nearer the end of its high-grade reserves than is the Soviet Union, which still has large areas in Siberia, where new deposits of rich ore may be discovered. The two countries are also similar in that for several decades each has obtained most of its iron ore from a single area--the U. S. from the Lake Superior District, principally, of course the Mesabi Range, and the Soviet Union from the Krivoi Rog District in the Ukraine.

In 1957 over half--52.9 percent--of Soviet ore came from the Krivoi Rog. So great a dependence on a single district has been a strategic weakness for the Soviet Union, in view of the nearness of that district to the Western frontier of the Soviet Union and to the Black Sea. As you know, the Krivoi Rog was occupied by the enemy in two World Wars.

The Urals in 1957 accounted for approximately 30 percent of the Soviet iron ore production. However, it is unlike the Krivoi Rog in that it is much more widely scattered. There are several deposits, the most northerly being several hundred miles from the most southerly. The

largest single deposit is the famous mountain of iron, Mt. Magnitynaya, at the base of which is Magnitogorsk, the Soviet's largest iron and steel plant. But usable grades of Ural iron ore have been depleted so rapidly, largely as the result of the drain of war years, when the Krivoi Rog was out because the Germans were in occupation, that the Ural iron and steel plants will shortly have, and have already begun, to turn to other regions for ore.

Fortunately, large deposits of low-grade, but nevertheless easily mined, ore have been discovered in northwest Kazakhstan, only about 200 miles to the east of the mountain. This ore will have to be treated before it can be used in the blast furnace. Exploitation of an even larger deposit of low-grade ore has also begun in central European Russia. This is the iron quartzite of the so-called KMA, the Kursk Magnetic Anomaly. The iron content of that iron quartzite is only 33 to 35 percent, but there is a lot of it. Reserves are estimated, reserves of actual metallic iron, to be as high as 700 billion tons. It is probably the largest deposit of iron in the world, but it is very low grade. The difficulties in handling probably account for the great interest the Soviet metallurgists have shown in our taconite and methods for handling that.

This next map shows, by the way, the actual distribution of reserves, that is, the principal deposits. You can see in percentages which regions are the most important. The Krivoi Rog, which is really a single district, has 32 percent; the Urals, plus the Northwest Kazakhstan, have

42 percent; and the others are much smaller.

Now, in spite of the growing dependence on low-grade ores, the Soviet iron ore position appears to be a relatively good one. The U.S.S.R. is able to supply not only its growing iron and steel industry but also the iron and steel industry of its European satellites, which are poor in iron ore. However, because of the increasing use of lower-grade ore, more fuel will have to be used, more coking coal, and processing costs are thus going to increase.

As the demand for special-purpose steels has increased, for non-military purposes as well as for military hardware, the importance of the alloy metals has grown. In this field the Soviet Union is exceptionally well endowed, more so than any other country in the world. It is the world's largest producer of both manganese and chrome. Its two principal manganese deposits are Chiaturi in the Georgian Republic and Nikopol in the south Ukraine, and between them they have one-third of the total world reserves of manganese. The Khrom-Tau chromite deposit, just south of the southern end of the Urals, in Northwestern Kazakhstan, is probably the largest single deposit of chromite in the world.

There are nickel deposits at Pechanga, acquired from Finland as a result of World War II, and also in the nearly Kola Peninsula and in Norilsk, just east of the lower Yenisei, plus smaller deposits in the Urals. These probably make the Soviet Union more than self-sufficient

in nickel. In addition, some of these nickel mines produce some cobalt.

Tungsten, or wolfram, is found in a number of places, especially in Siberia. Outer Mongolia, by the way, has an important tungsten mine run by Russians.

Molybdenum, the only alloy metal in which the United States is in a strong position, is also found in the Soviet Union, although so far as I know there are no deposits which compare to those of Climax, Colorado, our great deposits.

Supplies of vanadium and titanium seem to be adequate for several decades, also.

And China, long the world's leading producer of tungsten, exports it to the Soviet Union and presumably will continue to. North Korea, another satellite, is also an important source of molybdenum.

The strategic importance of aluminum needs no emphasizing. The Soviet Union produced none before 1932. Now it is running Canada a close race for second place. The production in 1957 has been estimated--they are very coy about their aluminum figures--outside as 550,000 metric tons for that year, which is about one-third of the U. S. production. The Seven Year Plan calls for increasing production, almost three times, by 1965.

Do the Soviet Union and the other members of the bloc have the raw materials in sufficient quantities to support such a rapid rise in the production of this light metal? Until very recently bauxite was the only

mineral from which aluminum--or I suppose we should say aluminum oxide--alumina, which are obtained directly from the bauxite--could be extracted economically. High-grade bauxite contains 50 to 60 percent aluminum oxide and is low in silica and iron. Curiously enough, neither the Soviet Union nor the United States, the two leading industrial powers, the two leading mineral-owning powers, are well provided with bauxite. Both are substantial importers of this source of aluminum, although the United States is the more dependent on foreign imports. However, the Communist Bloc as a whole is certainly self-sufficient, for Hungary has some of the world's best bauxite and has the second largest reserves in the world--high quality and lots of it. With the navigable Danube leading to the Black Sea and the Soviet Union, the aluminum plants in the southwest part of the Soviet Union, notably that at Zaporozhye on the Dnepr and that at Yerevan in Armenia, can easily and cheaply import Hungarian bauxite and also aluminum oxide.

It is not clear, at least not from public sources, to what degree the Soviet Union is now dependent on Hungarian bauxite, but the strategic importance of the metal, plus the inadequacy of Soviet bauxite resources, undoubtedly was a primary reason for Soviet insistence on retaining an iron control over Hungary, even though Soviet actions in Hungary have certainly cost Moscow a severe loss of standing in the neutral countries.

Theodore Shabad, who made a careful study of the Soviet aluminum industry for the American trade journal, American Metal Market, believes

that Hungarian exports to the Soviet Union have declined rather sharply since 1956, while at the same time Hungarian exports to Poland and notably to East Germany have increased. However, there is indirect evidence that the Soviet Union, at least the Zaporozhye plant on the Dnepr is still operating with Hungarian bauxite.

Within the Soviet Union, the only source of high-grade bauxite is in the northern Urals, near Serov, where the principal deposits are in a district with a very mouth-filling name, Krasnaya Shapochka, which means Little Red Hat. These deposits run up to 61 percent aluminum oxide, with less than 6 percent silica. But the trouble is, it is a long rail haul, 2,000 miles and more, from the North Ural bauxite to the Zaporozhye plant and to the Yerevan plant.

There is low-grade bauxite also which has been mined for a number of years at Boksitogorsk, southeast of Leningrad, and at several places in the middle Urals, notably at Kamensk, but it is decidedly low grade.

The Hungarian uprising of 1956 apparently put new steam into the Soviet efforts to find additional sources of raw material for the Soviet aluminum industry within the borders of the Soviet Union. They have followed two paths: One is widespread geological exploration for new deposits of bauxite, and the other is the development of processes for economical exploitation of aluminum oxide from other minerals known to contain it, but in lesser quantities of aluminum oxide. Apparently they have achieved success on both fronts. A large new deposit of bauxite

has been discovered in Northwest Kazakhstan, to the southeast of the low-grade iron ore I mentioned earlier. This is the Kushmurun deposit. The Russians claim reserves here almost as large as those of the north Urals, but it is a lower-grade ore. Nevertheless, a large new aluminum combine is being constructed which will be based on this deposit.

Soviet chemists and metallurgists appear to have been successful in perfecting processes for the economic extraction of aluminum oxide from four other aluminum-containing minerals--nephelite, alunite, kyanite, and sillimanite. Nephelite, which seems to be the most abundant in the Soviet Union of the four, has less than 30 percent aluminum oxide and is likely to be very high in silica, up to 43 percent, which presents a real problem. The process for extracting the aluminum oxide from this nephelite is rather complicated and expensive, but, since it also produces soda and potash and Portland cement as byproducts, the cost of the aluminum oxide obtained from this nephelite may be within a permissible range.

The major deposits being exploited are in the Kola Peninsula in the far Northwest, where there are huge tailings of nephelite, which is mined along with apatite, a source of phosphate. Another large deposit is in Central Siberia, the so-called Goryachigorsk nephelite, which is in the Kuznetsk Ala Tau Mountain Range, just on the east side of the Kuznetsk coal basin. This, according to Soviet sources, has more aluminum oxide

than all the bauxite deposits of the country, which gives you some idea of its importance to them. It is to be the source of aluminum oxide for the new aluminum plant now being planned to be constructed at Krasnoyarkjs on the Yenisei River, which, by the way, will be the largest in the world when completed. The planned capacity is 400,000 tons annually of metal.

The minor deposits of nephelite, which you can also see on the map, are down in Armenia, and exploitation of those has commenced. The alunite is being developed in the adjoining Trans-Caucasian Republic of Azerbaidzhan. It is low in aluminum oxide, only about 20 percent. The main kyanite deposit is in the central part of the Kola Peninsula, not very part from the Kola Peninsula nephelite. It would yield, roughly, 56 percent of aluminum oxide after relatively simple concentration. It is remote from the railway and is in rather a harsh sub-Arctic region.

The new aluminum plant which is now under construction near Irkutsk apparently will use, in part at least, sillimanite from Kyakhta, right on the border of Outer Mongolia. It will involve quite a different process.

Well, on balance, the Soviet Union appears to have sufficient raw materials of one kind or another within its borders for an expanded aluminum industry. If its aluminum position were a tight one, it would be difficult to explain why the Soviet Union was exporting aluminum, as it was a couple years ago, in rather large quantities--enough so as to cause a stir on the international aluminum market.

On the other hand, one may question whether Moscow would have followed such a ruthless policy in Hungary if Hungarian bauxite were not essential to at least some part of the Soviet aluminum industry. According to a study made by the Bureau of Mines in 1953, China is the leading country in Asia with bauxite reserves. Reserves were estimated to be slightly larger than the known reserves of bauxite in the Soviet Union. Since much of these Chinese reserves are in Manchuria, it is conceivable that the Soviet Union might import some bauxite or some oxide for aluminum plants in East Siberia.

Taking the Communist Bloc as a whole, then, its aluminum raw-material resources can certainly be considered to be adequate.

The Soviet copper situation is one which also resembles somewhat that of the United States, in that the country is a major producer of copper but is also an importer. This map of copper and tin shows that there are two major copper mining regions in the Soviet Union, one being the Urals and the other being in Kazakhstan and adjoining Central Asia. Two-thirds of the reserves, by the way, are in this latter region, reserves in terms of copper content of the ore. Much of the Kazakh copper, and the Central Asiatic copper, too, is in very large deposits of low-grade ore, very similar to those of Arizona and Utah, but, since it is close to the surface, it is cheaply mined.

Copper is also produced as one of the byproducts of complex ores in the Altai Mountains and also in the Urals. Thirty percent of Soviet

copper comes in this way, you might say as a byproduct, or at least along with other metallis minerals. In 1957 the Soviet Union was probably--I say probably because they did not give us the statistics--fourth among the world copper-producing countries, with a production of about half that of the United States. Of the satellites, only East Germany and Poland have significant production, but probably not enough to meet the needs of their own industries and the other satellites. The defection of Yugoslavia, by the way, was a severe blow to the bloc, because Yugoslavia does have an important copper deposit. It is a major producer.

The overall copper picture, thus, would not appear to be too strong, but also I would not go so far as to say that copper is a major weakness of the Communist Bloc.

The Soviet tin position, on the other hand, would not have to be a very strong one to be much stronger than that of the United States, as we don't have any tin at all, except the small placer deposit in Alaska, which I think for the last two years has been dormant. As a matter of fact, the Soviet Union is the only industrial power—unless China be considered to be industrial--which has tin within its own borders, that is the borders of the homeland. However, the richest deposits are in Northeast Siberia, some of them north of the Arctic Circle, where severe working conditions and poor transportation handicap production. Still, Soviet tin production has shown a steady increase since the war

and is estimated to have been 13,000 long tons in 1957, which makes it sixth in rank among the tin-producing countries. So long as the Soviet-Chinese partnership continues, the Soviet Union can count on China as a source of tin, tin being one of the very few minerals in which China has a surplus production. In 1957 China was the fourth leading producer, with a production estimated at 14,000 tons. There is, however, somewhat of a transport problem, in that most of that is from the Province of Yunnan, which is about as far as you can get in China from the Soviet Union. The probabilities are that the tin which the Soviet Union was dumping a year or so ago on the world market was tin received from China in payment for Soviet exports of machinery.

In lead and zinc the Soviet Union does not appear to be as well off as the United States. Most of the lead and zinc come from the same mine, with the Altai Mountains of Eastern Kazakhstan being the chief source. Southern Kazakhstan also is an important area of production, as you can see. The maritime province in the far east and the north Caucusus also yield both lead and zinc. Zinc also occurs together with copper in the Urals. For that reason it appears on this map as well as on the copper map. It is a byproduct of the copper smelters.

Soviet lead production has increased rapidly since the war and was close behind that of the United States in 1957--310,000 tons compared to our 338,000 tons, metric tons. So it is in third place, Australia being

No. 1.

Zinc production has also increased rapidly. In 1957 the Soviet Union was third in the production of that metal also, with a production of 386,000 tons, coming after the United States and Canada.

The satellites have some lead production. Poland leads, but its production was only 24,000 tons in 1957. So you can see it is very minor.

Here again the defection of Yugoslovia was a severe blow to the Communist Bloc, since it had a production in 1957 of 100,000 tons, making it a major producer.

In zinc production the satellites, in this case Poland alone, by the way, contribute much more to the bloc. Poland's production in 1957 was estimated at 143,000 tons, over one-third of the Soviet figure, which certainly makes it a major producer. And most of that Polish production appears to go to the Soviet Union.

China contributes no lead or zinc to the bloc, although it has some of both minerals. The mining of both appears to be poorly developed.

Writing in 1952, Shimkin concluded that the Soviet sphere, which then did not include China or Yugoslavia, was deficient in lead, and that lead would constitute from 80 to 90 percent of Soviet Russia's hypothetical requirements in 1970.

As to zinc, Shimkin concluded that the production was "clearly inadequate for self-sufficiency at a hypothetical level of consumption

up to 1970, and, even with the full availability of satellite zinc resources, the Soviet reserve position appears doubtful in zinc."

Nevertheless, according to outside estimates, both Soviet lead and zinc production have continued to increase, zinc more rapidly than lead. I suspect that the reason for this improved position is due to the discovery of new sources since Shimkin wrote in 1952.

In the Seven Year Plan, special emphasis has been laid on the chemical industry, as many of you are undoubtly aware. What about raw materials there? Already we pointed out that two of the most important raw materials of the chemical industry, namely petroleum and cellulose, are in abundant supply. Nitrogen? That's simply a matter of electric power, since it is obtained from the air with large uses of electricity. Soviet geologists claim that the Soviet Union has the largest potash reserves in the world, those being in the great carnelite and silvite beds of the upper Kama, just west of the Urals.

In 1957 the Soviet Union was fifth in world potash production. Furthermore, East Germany has the lion's share of the great Stassfurt deposits in Central Germany, which put East Germany third in rank in world potash producers in 1957. Poland is also a significant producer of that raw material.

The Soviet Union also appears to be self-sufficient in phosphates. There are two sources--apatite from the Kola Peninsula, which I have already mentioned in connection with the production of nephelite, both

of them obtained in the same mining operation, and apatite in the chief source of phosphate; also phosphorite, which is much more widespread. The Soviet Union actually was second in rank in world production of this basic chemical, phosphate, in 1957, but still this was only half the U. S. production.

In sulphur the Soviet Union definitely does not seem to be too well off. It can't compare, of course, with the United States because of our fabulously rich deposits in Southern Louisiana, in the coastal region. The chief Soviet sources appear to be sulphur pyrite, mostly in the Urals. There is some production from coal brasses in the Moscow lignite basin, but, so far as I know, there is only one deposit of native sulphur, in the Kara Kum desert in Central Asia. I think the Communist Bloc in regard to sulphur thus could be an uncomfortable one, whereas in the other basic chemical raw materials it seems to be strong.

Obviously I can't consider every mineral, but there is just one more that I would like to mention, namely the diamond. The importance of the diamond in a capability analysis, like this one, is due, of course to its industrial and not to its decorative value. The embargo on shipping industrial diamonds to the Soviet Union really hurt Soviet industry, because of their importance in cutting tools for the machine tool industry, and because until very recently the Soviet Union had no diamonds. But it has them now. After a long search, the types of kimbalite, the blue clay, in which diamonds are found in South Africa, have been found in the

Vilyui Basin of Northeastern Siberia, and the area apparently is very rich in stones, both industrial quality and gem quality. It could be another South Africa. This discovery has filled a very serious gap in Soviet raw material capabilities, and it has correspondingly reduced its vulnerability in economic warfare. It will be interesting to see if diamonds have the same effect on the female half of the Soviet population that they apparently have had on the corrupted sisters of the benighted capitalist world. I didn't see any diamonds on Mrs. Khrushchev in the pictures I saw of her, but perhaps I shouldn't be looking for diamonds there but on Nikita's favorite ballerina. If I find them I'll be sure that human nature has triumphed over Communist ideology.

Well, it is difficult, in concluding, to say anything that you might take in the way of a general overall conclusion in covering such a wide range of natural resources as we have attempted to survey today. However, I think I might say this: Because of the climatic limitations on the Soviet ability to produce foodstuffs to feed a rapidly growing population on the one hand, but on the other hand a great wealth of mineral resources, both in size and in variety, and also plenty of sources for power, it would seem that the Soviet Union may well find it expedient to do what England did at the beginning of the 19th century--in other words, export minerals and manufactured goods, and import the agricultural foodstuffs and agricultural raw materials needed to make up the domestic shortages that they undoubtedly will have in the future.

I suggest that the system of centralized planning and absolute central control over resources and labor, which has made possible the rapid industrialization of the Soviet Union, should enable it also to produce manufactured goods for export in such volume and to sell them at such price as would be necessary to capture any foreign market that they set their eyes on.

Thus I submit that the pattern of natural resources provides a certain compulsion, or at least a certain rationale, for the Soviet regime to embark on a program of economic warfare which fits in admirably with its professed political aims and in which it would have very considerable advantages.

I am sorry I have run over my time. I thank you for your patience.

COLONEL SMITH: Dr. Morrison is ready for your questions.

QUESTION: Dr. Morrison, you indicated the movement to Siberia of industry, to be close to good sources of coking coal. On one of your maps, the one of the forest reserves, you showed quite a number of rivers in both Russia and Siberia. Are any of these rivers of the type that could be developed for hydroelectric purposes? I am not thinking in terms of cost, of course, but of a location that would bring cheap power closer to the concentration of industries than now exists.

DR. MORRISON: I would have liked to have included that in my formal presentation, but I'm afraid if I did I could never restrict myself. It would have to be the subject of my talk. I am sorry I even neglected to bring

along a map, but I think we can have that forest map on again. I think probably many of you have heard of the large hydroelectric power developments which are under way in Siberia. I'll just use this map to point to the rivers. All of you I am sure have heard of the big Bratsk power plant which is under construction on the Angara River, a tributary of the Yenisei, which takes advantage of a drop of about 1100 feet. The Angara drops 1100 feet from Lake Baykal to the Yenisei. A good deal of drop is right at Bratsk. I forget right now the actual head. It will, however, when completed, be the world's most powerful hydroelectric power installation. I think the design capacity now has been raised to 4 million kilowatts of capacity. A twin to that is planned for the Yenisei River, just above the Trans-Siberian Railway, just above Krasnoyarkjs, where the Trans-Siberian crosses.

For a time it looked as though they were giving up these big hydroelectric plants. When Khrushchev made that speech dedicating the big plant above Kubyshev, on the Volga, he said that because of the length of time and the capital that would be tied up in these big hydroelectric projects it would be better to generate electricity with natural gas, oil, or coal. For a time it looked as though they had given up this Krasnoyarkjs project, but now it seems that they are on it again. It is scheduled, if I remember correctly, to be also about 4 million kilowatts. I think it will be a little larger than the Bratsk project, and it will be a high-head plant, an enormously powerful hydroelectric plant.

The Yenisei Basin will be the principal source of hydroelectric power in the Soviet east. The Ob and the Irtysh, its greatest tributary, flow most of their distance, of course, across that flat, low plain of Western Siberia, so there isn't much head. However, there is already a plant on the Ob just above Novosibirsk, where the Trans-Siberian crosses. This already takes care of a rock ledge that crosses just above Novosibirsk. That plant has a designed capacity, if I remember correctly, of about a million kilowatts. Other big plants are under construction, on the Irtysh, in the upper waters.

The Lena also has enormous potential power, but, so far as I know, they are not now planning anything for it because of its remoteness. Now, these big new plants are at, of course, a great distance from the principal load centers, which are naturally in the western part of the country. However, they propose to utilize the power produced in two ways--by building the industries that use power right along with them. I have already referred to the Irkutsk aluminum plant, which will utilize power already produced at an earlier plant built on the Angara, just above Irkutsk itself.

The Krasnoyarkjs aluminum plant will use electricity from the Krasnoyarkjs plant. If I had to guess where the Soviet equivalent of Oak Ridge is, I would say it would be down there somewhere, because, as you all know, the gaseous diffusions method of separating U235 and U238 involve tremendous amounts of power. So this is where I would

DR. MORRISON: Well, of course, the Volga, although it has very little drop from its sources up here northwest of Moscow, nevertheless, because of the volume of water, does have considerable potential, and the biggest power plants in European Russia, and, as a matter of fact, the biggest power plant in the Soviet Union today, are on the Volga. That one I mentioned above Kubyshev is where there is a relatively low head, but, nevertheless, by concentrating it right there at the dam, it can get considerable production. The capacity of the Kubyshev plant is about 2 million 300 thousand k. w. The Stalingrad plant will be the same size, or, I think, a little bit larger. It was due to start production this fall. They are installing the generators and turbines there. So the Volga does have hydroelectric potential in European Russia. The Volga is the principal one, but there is also the Dnepr, which has the oldest of the big Soviet hydroelectric plants, the one that Colonel Cooper helped design.

COLONEL Smith: I wonder, doctor, if you could show us that one slide, the picture of the water resources, and talk about that for just a moment.

DR. MORRISON: Oh, yes. I think you have reference to the use of water for irrigation. I mentioned very briefly the possibility that they could partially solve their food shortage by irrigation. This map, which I used in a lecture here last year, when I spent much more time on agriculture than probably I should have, shows the present irrigated

areas in Central Asia, which is the region, you remember, where there is a large area with a growing season long enough for growing a variety of crops. In fact, this is the cotton belt of the Soviet Union. But practically all crops have to be irrigated. So here crop growing is a matter of irrigation. The areas to be irrigated, are shown here in yellow. The existing irrigation canals and those under construction and projected, and reservoirs in existence and projected, are also shown. You can see that they have some rather ambitious plans. The most ambitious is the diversion of water from the Amu Darya across the Kara Kum Desert to the delta of the Muragab River which can itself produce enough water to irrigate enough land. The first stage of that is already completed. It is a major construction job, an irrigation canal 270 miles in length.

I would suggest that the very size and scope of these enterprises are about as good evidence as you can have of the climatic limitations on agriculture in the Soviet Union. They are diverting so much capital and labor into irrigation projects because of these limitations. They wouldn't do it if they didn't have to. If they could grow crops without irrigating, they certainly wouldn't be irrigating to this degree.

In addition to these projects in Central Asia there are other ones in the southern part of the Ukraine. We think of this Ukraine as a bread basket of the Soviet Union. That might be true of the central and northern Ukraine, but the southern Ukraine, as you might remember from that rainfall map, has less than 20 inches, and it is very variable from year

to year. So that irrigation is necessary in the Black Sea coastal steppes if they are going to have sure production of crops year in and year out in that area.

Irrigation, then, becomes the principal use of water in Central Asia and also, you might say, in southern European Russia. For power, Siberia comes into the picture. There irrigation is not needed.

COLONEL SMITH: Dr. Morrison, we certainly appreciate all the information you have given us today. We will be able to use it throughout the entire course. Thank you very much, sir.