THE RAW MATERIAL OUTLOOK OF THE STEEL INDUSTRY, PARTICULARLY FROM A DEFENSE STANDPOINT

22 October 1952

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Publication No. L53-44

INDUSTRIAL COLLEGE OF THE ARMED FORCES

WASHINGTON, D. C.

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GENERAL GREELEY: It has been said that a modern nation's strength or weakness depends to a very large extent on its iron and coal resources or lack of them. This, of course, is because these two materials are the basic components of steel--steel, that fabulous material without which we could not have our railroads, our ships, our skyscrapers, our bobby pins, and a thousand and one other products of this modern world--steel, too, which is needed for guns, for tanks, for airplane carriers, for ammunition, for bombs, and a host of other items so vitally needed in defense.

Today's subject deals with the materials required for the production of steel. Our speaker is eminently qualified to discuss this subject with us, having spent a very large part of his life in the steel industry. He has been here before. He spoke in April 1950. So, without further ado, it is a great pleasure for me to introduce at this time Mr. Earl M. Richards, Vice president of Republic Steel.

MR. RICHARDS: Two and one-half years ago it was my privilege to appear before this body to discuss "The Steel Industry--Its Growth and Problems." I always will remember that occasion because of the caliber of the audience, their interest and their intelligent discussion. So, it is a pleasure and I consider it a real honor again to stand before the Industrial College of the Armed Forces, this time to present "The Raw Material Outlook of the Steel Industry, Particularly From a Defense Standpoint."

I look upon our discussion today as of a quite important nature; first, because you, being a carefully selected group of outstanding officers, will be expected to be in the forefront in the next emergency; and, second, because I propose to submit recommendations that should be taken seriously and acted upon promptly for the safety of our country.

The materials to be considered are ore, coke, and limestone for the blast furnaces; oil, scrap, and additives for the open hearths; and several nonferrous and ferroalloying metals used elsewhere throughout the steel industry.

First, let us look at ore. Several weeks ago the ore situation was included by the President's Materials Policy Commission in their report "Resources for Freedom." They showed that with 130 million net tons of ore used in 1950, the consumption 25 years later, that is, in 1975, should be 200 million net tons. (Since the steel industry uses gross tons instead of net tons for ore, these figures so converted, become approximately 116 million and 179 million gross tons, respectively.)

Where will we get the ore? I ask this because right now in 1952 its procurement is quite a problem, and here we are talking of 50 percent more in 1975.

You might ask why is it a problem when iron is everywhere; it constitutes almost 5 percent of the earth's crust and 80 percent of all the metals consumed in the United States. You could continue the argument by saying that you could dig up the dirt in the street right in front of this building or out of your back yards, put it in a blast furnace and obtain iron. So where is the problem? All you would say would be true. But we would come face to face with a subject with which you all are familiar--economics. The dirt out of the street and out of your back yard would reduce the blast furnace output to a trickle, and the cost of iron production would be astronomical.

This brings out the point that the iron we take from the earth's crust to make iron and steel economically must be concentrated by nature. In that form, it is known as iron ore. What is iron ore? Chemically pure iron ore is a combination of iron and oxygen, usually either Fe_2O_3 as hematite or Fe_3O_4 as magnetite, with iron contents of 69.94 percent and 72.36 percent, respectively. In nature these compounds are mixed with water and impurities, known as gangue--and as such are known as iron ore.

Well, just what is the iron content of iron ore we use? It varies. Iron ore off the Mesabi Range is considered standard at 51.5 percent in its natural state. Anything much above that is considered very high grade, like 56 percent in Labrador ore and 57 percent in Venezuelan ore to 67 percent to 70 percent, almost chemically pure, in Liberian ore. In the South, the chief ore is from the Birmingham region with an iron content of 34 percent.

To secure a comprehensive picture of the iron ore situation and the steel industry as a whole, today and particularly 25 years hence, let us first take a look at it in retrospect.

In America, the first successful iron enterprise, now being restored, was established at Saugus, Massachusetts, in 1646, just 26 years after the landing of the Pilgrims, and was supplied by a bog ore. Subsequently, other furnaces were constructed elsewhere as in Pennsylvania, New York, Virginia, New Jersey. Being dependent on and restricted by local ore deposits, their output was small--and continued small until the time of the Civil War.

Just prior to and during the period of that war, profound changes began to appear with the first discovery of iron ore in the Lake Superior region and with certain developments which proved to be the seed of the modern steel industry. These developments were: the disclosure in 1856 by Sir Henry Bessemer of his newly invented process of making steel; the development of Mushet in 1857 to make the Bessemer steel usable by the addition of manganese, after the blow; the attempt by Siemens in 1862 to

make open-hearth steel with his regenerative furnace which he had previously developed for glass melting; and the successful efforts of the Martin brothers of France in 1864 to make open-hearth steel from a scrap-pig iron mix in a Siemens-type regenerative furnace.

Since these new methods of producing steel were only in their development stage during the Civil War, that war was fought with iron rather than steel. In 1860 the iron produced in the United States was less than 1 million tons, that is, 919,770 net tons; and more surprising still, steel production amounted to only 2 percent of the iron production, that is, only 13,259 net tons. In fact, in 1863, the middle of the Civil War, the steel production was only 9,044 net tons. The insignificance of this tonnage can be realized by the statement that this entire output of the whole year of 1863 was produced in this country during World War II in less than one hour.

After the Civil War, however, the steel industry grew by geometrical proportions in the ratios of 1, 2, 4, 8, 16, 32, 64, 128, and so on.

Starting in 1860 with a steel production of 13,259 net tons, the steel industry in the United States grew by leaps and bounds, as shown in the following table:

Table 1. Growth of steel industry in the United States

Year	Steel production ingots and steel for castings net tons	Elapsed years to approximately double production
1860	13,259	--
1868	30,000	8
1870	77,000	2
1872	160,108	2
1875	436,575	3
1878	819,814	3
1881	1,778,912	3
1887	3,739,760	6
1897	8,015,792	10
1902	16,740,920	5
1912	35,001,459	10
1929	63,205,490	17
1951	105,134,553	--

Thus, in approximately 90 years, the increase in steel production was almost 8,000 times, and in 1953, we expect to have an ingot capacity of over 120 million net tons per year.

It is important to note that little of this would have been possible without the vast ore bodies discovered in the Lake Superior region and, incidentally, the building of the Soo Locks. The ore ranges are shown on Chart 1, page 20. Their years of discovery were as follows: Marquette in upper Michigan in 1844; Menominee in 1873 and Gogebic in 1883, both in upper Michigan and Wisconsin; Vermillion in Minnesota in 1884; and the great Mesabi of Minnesota in 1890. Note that except for Marquette, all the iron ore bodies were discovered after the Civil War, and you can see how the discovery of this iron ore fitted into the economic growth of the steel industry and the movement of the steel industry westward--with the great growth being after the opening of the huge Mesabi Range. All this development is shown on Chart 2, page 20. Note that in 1890, the year the Mesabi deposits were discovered, the United States iron ore production was 16 million gross tons. See the peak during World War I, the deep sag in the depression year of 1932, and the subsequent rise to 116 million gross tons in 1951.1/

On Chart 3, page 21, observe how much came from the Lake Superior region, amounting to 55.8 percent in 1890, reaching approximately 85 percent in 1920, and continuing near that level to the peak of 86.2 percent in 1942, during World War II. See how this percentage has been slipping in the last 10 years--more about this later. As to the other ore bodies, these are scattered over the United States in the Adirondacks, Alabama, Utah, California, Texas, and elsewhere; and not one anywhere approaches the magnitude of the great Mesabi Range.

This brings us up to the present. Now how do we stand as to the future in iron ore reserves? According to the report of the President's Materials Policy Commission, these reserves are as follows: (Figures are exactly as shown in report.)

Table 2. Iron ore reserves
(Billion long tons)

Region	50 percent iron and over	35 to 50 percent iron	25 to 35 percent iron	Total
Lake Superior	1.6	2.5	60.0	64
Northeast	--	--	3.0	3
South	--	1.8	9.5	11
West	.5	.1	.2	1
	2	4	73	79

1/ Note, on Chart 2, that the tonnage in 1950 is 98 million gross tons, while earlier we saw in the President's Commission's report 130 million net tons. This chart is United States ore production, while the President's Commission's report is ore consumption, including foreign ores. Further, one is gross tons and the other is net tons.

There are, however, some very important considerations to observe from these statistics:

a. The cream of the Lake Superior regions is rapidly vanishing. Of the 79 billion tons listed above, only 1.6 billion tons, or 2 percent, is in the classification of high-grade Lake Superior ore--the only kind on the northern market and known as commercial ore.

b. We will have difficulty to maintain the present production of high-grade ore in the immediate future, let alone to meet the increased needs, because of quality and quantity remaining, as well as the physical ability to get at it.

This means we must find other sources. Where are they? The answer is in the lower-grade ores in the United States, particularly taconites, and rich foreign ores. Let us look at each.

Taconite is a low-grade ore of approximately 25 percent to 35 percent iron content abounding in the Lake Superior region. Compare this with that of 72.36 percent in pure Fe_3O_4, mentioned earlier. This difference means that approximately two-thirds of the taconite ore is impurities or gangue. Even so, it could be used directly in the blast furnace, but we would approach a situation like that of making iron from the dirt in your back yard--an enormous reduction in the output of the steel industry and much increased costs. So to avoid such uneconomic procedure, we must do what is known as benefication of the ore at or near the mine. We must grind the ore to the fineness of talcum powder in order to separate the gangue from the iron oxide. For every 3 tons of ore ground, 2 tons of gangue must be discarded and the remaining one-third agglomerated so it can be transported in suitable shape, as pellets, for introduction into existing blast furnaces. This is essentially an extensive process for manufacturing ore.

To give you a picture of the problem and the magnitude of the taconite development, consider the Reserve Mining Company, in which Republic is a 50 percent participant, located on the eastern end of the Mesabi Range. This company plans to produce ultimately 10 million gross tons of concentrated ore, as pellets, per year. It will call for a new technique to mine and beneficiate this ore, not previously known, the building of a 47-mile railroad, the building of a harbor, and the construction of two new towns in the Minnesota woods. This project requires an investment of over 200 million dollars. This is American free enterprise in operation.

It will require the digging, crushing, and pulverizing of one ton of ore every second of the 24 hours of every day in the whole year, and the loading of a thousand cars and their transportation over 47 miles of railroad to Lake Superior and their return every day of the entire year. So you can see that this is a gigantic operation, and what is more amazing, when completed, it will provide but little more than 5 percent of the ore needs of this country.

The Reserve Mining Company, just discussed, is working only on a type of taconite known as magnetic; so are the Erie Mining Company and the Oliver Mining Company. All three are confining their operations to approximately the eastern 35 miles of the Mesabi Range where these magnetic taconites are located. Now here is one very important point to note; namely, the taconite particles, being magnetic, can be attracted by a magnet, and this property affords a practical and efficient means of separating the ore from the gangue.

On the other hand, the vast majority of taconite, located on the other 65 miles of the Mesabi Range, as well as those in the other ranges of the Lake Superior region are nonmagnetic. This nonmagnetic taconite is a major portion of all our taconites in the Lake Superior region, and it is upon these we ultimately put much dependence. Unfortunately, no commercial process has yet been worked out to treat them, and here lies an important problem for the steel industry and our country.

Any way you turn you can see what an enormous and costly problem taconite development means--whether magnetic or nonmagnetic.

Now let us look at foreign ores. How do they get into the picture? That gets back to the story of making iron out of the dirt from your back yard--economics. If high-grade foreign ores can be brought into the country to make steel as cheaply as, or cheaper than, by taconites, they will be so used. In addition to costs, however, there is the sheer question of needing the tonnage to make up the deficit in our own ore production.

Let me quote to you from the report of the President's Materials Policy Commission:

> "During the next quarter century, there will be marked shifts in the sources from which the steel mills of the United States will draw their supplies of ore. Production from high-grade reserves in the Lake Superior region must eventually decrease; production from taconite may be able to offset this decline, leaving output of the Lake Superior region close to the present level of 90 million tons. Expansion in consumption can be achieved only through larger imports. Shipments from Canada and Venequela in a volume approaching 65 million tons could meet the probable requirements and it is likely that such a volume of shipments can eventually be attained."

To enable you to appreciate this statement, let me show you two graphs outlining the foreign ore situation, past, present, and expected in the future. Chart 4 shows this by tons. You will note how our iron ore requirements must rise to meet the figures for 1975 estimated by the President's Commission. Chart 5 shows this picture by percent. You will note how foreign ores go from 7.7 percent in 1950 to an expected 37 percent in 1975. Incidentally, note the drop during World War II--that

is what the submarines caused and is something to be reckoned with in time of war.

The chief sources of foreign ore are expected to be Labrador, Liberia, Venequela, and Brazil. In this connection, you have heard much of Labrador ore. As shown on Chart 6, this is a newly discovered body of ore in Canada, located in Labrador and upper Quebec about the area of the tree line between Hudson Bay and the Atlantic Ocean. This project, too, will cost close to 200 million dollars to build, requiring a railroad 365 miles long, the building of two towns in the wilderness, a large shipping dock on the St. Lawrence River, and large boats.

You can see for yourself how necessary the St. Lawrence Waterway becomes, and how it is just as much a necessity for Labrador ore as the Soo Locks are for the Lake Superior ore. It also becomes apparent how dangerous it would be to bring this ore to the Atlantic coast for inland shipment in time of war.

With two world wars depleting our ore supply and with future demands ever increasing, the steel industry is keenly conscious of the ore problem facing our country and is trying to do something about it.

What does it all mean?

a. It means that we must beneficiate our low-grade iron ores.

b. It means that we must go to foreign sources to supplement our own ore supply.

c. It means a big investment, higher costs, higher priced steel, and the need for the St. Lawrence Waterway.

d. It means the end to the talk of America's inexhaustible resources. At one time we had enough raw materials to take care of our needs and to supply other parts of the world, but that is no more.

e. It means that we of the United States, comprising 6 percent of the population of the world with 5 percent of the land, who have been trying to help care for the material wants of the other 94 percent possessing 95 percent of the land, should take another good look at that policy. This situation becomes particularly significant when we realize that Europe and Asia together have over half of the known iron ore reserves of the world, whereas North America has only 12 percent, and incidentally, the Soviets also have about the same percent as North America.

f. It means that we now have become, and each year will be increasingly more so, like Great Britain and Germany, where our economy depends more and more on the raw materials of other parts of the world--and all the implications that go therewith.

As to the other major blast-furnace raw materials, that is, coal and limestone, there should be sufficient supply for the future, both for peacetime and for war.

Now let us look at the open-hearth raw materials, particularly oil and scrap.

As to oil, most of the open-hearth furnaces in the United States are built for the burning of oil. To change to coal by way of gas producers or other means would be a major operation. It is my opinion, in event of war, as was true in World War II, the oil requirements would be so allocated so as to permit the steel industry to continue operating with its present types of fuel.

Now let us consider scrap.

You can remember from the last war, and even after that war, the importance of scrap. Bear in mind that scrap used in steel plants roughly can be divided as follows: 60 percent home scrap, or the scrap that keeps circulating in the plant and never leaves it; 20 percent from steel fabricators' plants arising from the current production of steel; and the other 20 percent is old scrap that comes from discarded machinery, wrecked buildings, etc., which I call "steel of the past." It is the availability of this "steel of the past" that determines the excess or shortage of scrap for the steel plants. Mr. Charles M. Parker, of the American Iron and Steel Institute, in his book, entitled "Steel in Action," estimates that the average time for the bulk of such steel to return to the steel plants is about 33 years. Now, when we realize that before many years, we will be entering that part of the cycle where the "steel of the past" will be coming mostly from the 1930 Depression Period, at which time steel production was far below normal, and when you realize that the steel industry by its expansion is ever demanding more scrap, that greater durability has lengthened the life of steel, that alloy-contamination is reducing the amount of the scrap that can go into carbon steel, that a large amount of steel goes into light consumer products that cannot be reclaimed, that the increased use of electric furnaces is demanding more scrap, that much of the steel provided for munitions will never be recovered as scrap, all of these factors point to the high probability that there will be a deficiency of scrap for quite some years hence, at full operations.

Next to consider are the 15 principal nonferrous and ferroalloying metals used in the steel industry, which, in alphabetical order, are aluminum, boron, columbium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, tin, titanium, tungsten, vanadium, and zinc. Of these 15 metals only four--boron, molybdenum, titanium, and vanadium--can have their full requirements met from mines within the borders of the United States. The other eleven must be supplemented, in part or entirely, by foreign sources. Five of these metals--aluminum, copper, lead, tungsten, and zinc--have a substantial part of their requirements

met by the raw material resources of this country; the next three--cobalt, columbium, and manganese--must come almost entirely from abroad; the last three--chromium, nickel, and tin--must come entirely from foreign sources.

It should be thoroughly appreciated that unless those nonferrous and ferroalloying metals are available, we can make few, if any, of our war steels; and without them much of our steel-making capacity would be useless.

Of all these metals, by far, the most important is manganese, and I would like to devote some discussion to it at this time.

As previously stated, the first modern steel was Bessemer. Yet, Sir Henry Bessemer was unable to produce a commercial product until Mushet, in 1857, introduced manganese into the metal. This also later proved to be the case with open-hearth steel. To this day we cannot produce volume steel without it. Bluntly speaking, NO MANGANESE--NO VOLUME STEEL. I cannot emphasize to you too much the importance of this statement.

In time of war, the procuring of manganese presents an extremely serious problem as can be realized from the statements I am about to make:

a. Most of the manganese consumed in the United States is used by the steel industry. It enters the industry via blast furnace ore and via ferromanganese in the steel-melting operations.

b. In the world production of manganese ores, the United States is a very small factor--2½ percent in 1950. In contrast, Russia is the largest producer--40 percent.

c. Ninety percent or more of the ferromanganese produced in the United States is from rich foreign ores.

d. There is not a known large body of high-grade manganese ore within the borders of the United States.

e. On the other hand, we have ample manganese in our low-grade ores. Unfortunately, after several decades of research and effort by the United States Government and others, not a commercial method has yet been developed to process most of the low-grade manganese ore deposits in the United States. Several methods are now in the laboratory and pilot plant stage.

If, through these methods now under study, we can develop the necessary processes commercially, and if we are willing to pay the penalty of using low-grade ores, varying in manganese content from 1½ percent to 12 percent, there is potentially enough manganese in the lean ore

bodies of this country to supply it for over 100 years. But, as yet, we do not have the answer for a commercial process. In nothing I say do I wish to minimize the very precarious position of this country in respect to manganese.

f. The manganese situation in this country has become increasingly serious because our former main source of rich manganese ore has vanished, viz., Russia, as seen in table 3, page 23.

I now have covered the essential raw materials for the steel industry in the United States.

I also have been asked to discuss the steel industry of the Soviet and communistic world in comparison to our own country and the free world--particularly from the raw material standpoint.

In this connection, I want to state that information on Russia and their satellites is difficult to obtain, that I do not pose as an expert on the subject, and that there probably are people in this audience better informed thereon than I am. I will present to you, however, the situation as I have found it from three standpoints:

a. The relative growth of the Soviet steel industry compared to that of the United States.

b. The location of the Soviet's major steel-producing centers.

c. How self-contained are both countries, as well as the communistic world and free world, in respect to raw materials essential to the steel industry?

1. The Relative Growth of the Soviet Steel Industry Compared to That of the United States.

You will note on Chart 7, page 23, that prior to World War II, Russia reached its peak of production of 20,500,000 tons in the year 1939. Thereafter, particularly with the advent of the war, its production dropped, and it was not until 10 years later, in 1949, that it recovered its lost position. Since that time, the increase has been steadily upward further supplemented by the steel-making capacity of its satellites.

More comprehensive comparison probably can be obtained by comparing Russia's production as a percentage of that of the United States, as shown on Chart 8, page 24. You will note that at the beginning of World War I, that is 1914, the production of Russia was 18½ percent of that of the United States. With the war and subsequent internal disorders, the output markedly declined. It was not until 17 years later,

1931, that it regained the same percentage. Then, through the "Commie-cuddling" years of the thirties, Russia's percentage increased at a tremendous rate, averaging over 35 percent with a maximum of 62 percent in the year 1938. With World War II the percentage again dropped and it has never regained that position, being currently 30 percent. One disconcerting fact, however, is to see how rapidly Russia has been gaining on the United States since the year 1942. In that year its output was 10 percent of that of the United States. From there, Russian production has grown consistently and rapidly until now, as previously stated, it is about 30 percent of that of the United States.

To broaden the picture, let us now compare the output of the communistic world with that of the free world. That figure is 22 percent.

2. The Location of the Soviet's Major Steel-producing Centers.

The major steel-producing centers of Russia are shown on Chart 9, page 24. In most of these areas shown, there are steel plants and adjoining ore and coal bodies, either near at hand or within several hundred miles. Between operations in the Ural Mountains and those in Siberia, however, there has been and may still be some long-haul interchange of ore and coal; but, we understand steps have been and are being taken to improve that stiuation. The distance between each of these areas is about equal to that from New York to Denver. Looking at the map, you will note that 35 percent of their production is in the Ukraine area adjoining the Black Sea, 30 percent in the Ural Mountains, 10 percent in Siberia just near the borderline of Mongolia, and 25 percent in scattered areas not shown on this map. While Manchuria's tonnage is not included in the percentages herewith given, we have shown that steel production in Manchuria as representing about 5 percent of that of all Russia.

3. How Self-contained Are Both Countries as Well as the Communistic World and Free World in Respect to Raw Materials Essential to the Steel Industry?

Just how self-contained are the United States and Russia as well as the free world and the communistic world is shown on Table 4, page 25, for 10 major raw materials essential to the steel industry. Note that both sides, in all cases are self-contained in coal and limestone.

Considering the United States and Russia alone, however, we find that the United States is not self-contained in seven of them--that is, iron ore, manganese, aluminum, nickel, chromium, tin, and cobalt. On the other hand, Russia is self-contained in five of the eight, that is, in everything except molybdenum, tin, and cobalt. Note that deficiencies in tin and cobalt are common to both.

676 On the other hand, comparing the free world to the communistic world, the free world is self-contained in everything, whereas the communistic world is lacking in molybdenum, tin, and cobalt.

We should not, however, allow the latter comparison to lull us into a false sense of security because there always are possibilities of political changes, and particularly when a war is on there is always a question as to how much the faraway raw materials can be brought into use. I am inclined to believe that we would be realistic by comparing the resources of the United States with Russia alone. And, in this case, you will see that we have a much greater raw material problem than Russia.

One important difference should be borne in mind; namely, that much of the steel industry in Russia is geared to a war machine. Putting it another way, this country attempts to care for both "butter and guns," while Russia is mostly concerned with guns alone. Do not underestimate the potential of Russia. The Germans did so in the last war.

We then come to the question, What should we do about our deficiencies? And that brings me to the conclusion of my talk where I propose to present to you, recommendations, as I stated at the outset of my talk, that should be taken seriously and acted upon promptly for the safety of our country. These are the recommendations:

a. Go the limit to defend the Soo Locks. Let me say that to a novice in military affairs this defense, when viewed from the deck of an ore vessel en route through the Soo Locks, looks hopelessly inadequate.

b. Build the St. Lawrence Waterway, and start its construction immediately. Let me point out to you that in the "Resources for Freedom" report to the President it is estimated that in 1975 we will need 70 million net tons of foreign ore--and that is more ore than was ever brought through the Soo Locks prior to World War II. While some of this ore would be used on the Atlantic coast, and hence would not go through the waterway, the tonnage herein quoted does give a picture of the magnitude of the expected foreign ore movement. Just as the Soo Locks opened the bottleneck for the ore movement from the West, the St. Lawrence Waterway should open the bottleneck for the ore movement from the East. Furthermore, when you consider the time required to build this waterway, you can see that we will be appreciably along the next 25-year period by the time it is completed--and by that time huge quantities of foreign ore movements should be under way. The opponents to the seaway assert that the Labrador ore, in time of war, could be shipped by rail down to the seacoast plants to supplant the loss of the foreign ore. Let us assume that is so; that is not the whole picture. Labrador can be made to produce many more tons than these eastern plants could take, and the large excess of Labrador ore, so produced, could go to the inland plants, which had been depending upon it in peacetime.

I would not want to say that those opposing this waterway are unpatriotic or do not have the defense and welfare of the country at

heart, but I cannot help but feel that they do not understand this world picture of iron ore and do not realize the absolute necessity of this St. Lawrence Waterway in time of war. And let me say to you men, that all the Joint Chiefs of Staff, the Secretary of State, the Secretary of Commerce, and every President of the United States since Harding--Harding, the economy-minded Coolidge, the engineer-trained Hoover, Franklin Roosevelt, and Truman--all have advocated this waterway; and it behooves you men of the armed forces to insist upon the immediate construction of the St. Lawrence Waterway, in order to avoid the hazard of a serious ore shortage that might occur in a most critical period of an emergency.

c. Encourage the development of magnetic and nonmagnetic taconites and the subsequent building of plants to process this ore. We should not tamper with fate by waiting for a war to do this job on nonmagnetic taconites--we will need this ore. We should protect ourselves with these plants, as well as with Labrador ore.

d. Encourage the stockpiling of a year's supply of iron ore on the south shores of Lake Erie near a railroad head such as at Cleveland or Ashtabula. This stockpile can feed the plants of Ohio and the East in case of a disaster at the Soo. Furthermore, in peacetime, this stockpile could be tapped to overcome ore shortages at the blast furnaces during an abnormally short shipping season or similar circumstance.

The Chicago district could probably best be taken care of by railing directly from the Lake Superior ore mines.

When business drops off, the ore mines should be kept going to build up this stockpile. The product also could be stockpiled from the proposed magnetic and nonmagnetic taconite plants.

e. At the upper lake ports encourage the replacing of all wooden trestle approaches from the rail lines to the shipping docks as well as all wooden shipping docks. It does not take much imagination, when you see these wooden structures, to realize how easily a fire might be started and to picture the damage that could result. The match of a saboteur here would create almost as much havoc as a bomb at the Soo Locks.

f. Encourage the modernizing and enlarging of the Escanaba loading facilities and the expanding of the rail facilities leading thereto. This is the one iron ore loading dock on this side of the Soo Locks, and every possible utilization of it should be made.

g. Encourage the development of our more desirable and large tonnage lower-grade manganese ores and the subsequent building of plants to process them. No word I say can exaggerate the importance of pushing this manganese project into immediate action. In the meantime, the present policy of maintaining a large stockpile of rich foreign manganese ore should be continued.

h. Encourage the stockpiling of all other nonferrous metals used in the steel industry, requiring foreign ores, in part or in total, to insure that, if the foreign sources were cut off, we still could prosecute a long war. This program is very important. In fact, we should encourage the development of foreign ore bodies.

A searching review of the present stockpiling and control program may now be in order. The incentive for consumers of strategic raw materials to prospect for new foreign sources is limited when all or most of the products of their pioneering go into a common pool.

i. The future availability of scrap depends on "the scrap steel of the past." I cannot help but agree with the President's "Resources of Freedom" report that:

> "The share of scrap in the metallic materials fed to furnaces will therefore decline and the share of pig iron will have to rise. This will require a corresponding increase in the supply of iron ore, coke, and limestone. And it will necessitate a substantial addition to investment in facilities for mining, preparing and transporting ore, in coke ovens, and in blast furnaces."

Exporting of scrap should be prohibited. Scrap is just as vital a source of iron units as the ore mines.

j. If it has not already been done, a group of well-informed steel men, in conjunction with corresponding officers from the armed forces, should evaluate carefully all of the available information on Russia's steel position. This study should point out both their strength and weaknesses to form the basis for the future plans of our country.

In conclusion, let me say that you may perfect better tanks, improved artillery, construct atomic-powered submarines, hydrogen bombs, and many ingenuous devices made possible by modern science, but how much will they avail without the backbone of war--steel. First, be sure you will have iron ore, scrap, manganese, and all the nonferrous metals needed to produce your war steels. Without them we are lost.

QUESTION: I was interested in your remarks about manganese. Just about 1948 or 1949 geologists published a great discovery of manganese ore bodies in Brazil. Why hasn't the steel industry gone in much more heavily for developing those Brazilian ore bodies rather than India and the Union of South Africa? Would you comment on that?

MR. RICHARDS: Missions from the United States, government and otherwise, have combed this area. Some steel companies have gone into Brazil in more accessible areas and are extracting the manganese. There are other large bodies in remote and inaccessible places. At the moment it seems more practical to obtain manganese from remote areas like South

Africa and India than in the jungles of Brazil. At the same time Brazil is a foreign source, and, as I said in my talk, it is dangerous in wartime to be dependent on a vital commodity from foreign sources. We must do something with our low-grade manganese within our borders.

We in the industry like to do all we can to prepare for the war situation, but there is just a limit on how much we can do and still remain competitive. To prepare for a war situation almost gets out of our field economically. It means a big investment, but the military people ought to know and plan for it.

QUESTION: You have spoken about the places where the known reserves of iron ore are located, but you said very little about exploration. I wonder if we are not doing some exploration, for instance, subsurface exploration, between these big spots in the Lake Superior region.

MR. RICHARDS: That area has been surveyed many times by the geologists. These explorations are continuing, but since the field has been combed quite well, the rate of discovery is diminishing, and the cost of finding desirable ore bodies is increasing considerably.

Of course, you know there is a lot of material in these areas to which you refer, that is iron-bearing. They are the taconites with the 25 to 35 percent or lower iron content. Our commercial ore is the concentrations by nature in these iron bearing-areas, just like raisins in a cake. I think these big ore bodies of high iron content, the rich deposits, are quite well known.

In Labrador, ore bodies were known in a fashion as far back as 1892, I think it was, but it was not until 1938 that bodies in proved workable quantities were found.

We, in our own company, made a thorough search including magnetic surveys of the entire Adirondacks in order to find ore to supplement that which we already possessed. We found several indications, but not a desirable grade of ore workable today.

Although this country has been pretty well explored, an occasional new high-grade discovery can be expected, but not too frequently. Canada has some spots in the woods that may have some iron ore that we do not know about.

As time goes on we must expect to turn more and more to lower-grade ores as high-grade ores vanish.

QUESTION: Has there been much exploration in Alaska?

MR. RICHARDS: I will have to state that I don't know.

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QUESTION: I have never heard of much of it going on up there in anything but oil and, of course, the gold mining that they have always done.

MR. RICHARDS: I don't know of any. Even if we were to find some, it would almost present the same proposition as bringing in foreign ore.

QUESTION: We have a railroad from Alaska and a highway.

MR. RICHARDS: It at least presents a problem.

QUESTION: With respect to manganese, can you tell us what proportion of the cost of a ton of steel, selling for approximately $150, represents manganese? Secondly, just what quantity of manganese is in a ton of steel?

MR. RICHARDS: The steel industry averages 12 pounds of manganese per ton of steel. So it isn't much. As to the dollar value, I couldn't tell you offhand. It is in the neighborhood of one dollar. It is not a large proportion of the total cost of steel, but in a competitive industry like steel cents are important.

QUESTION: Pertaining to your recommendations, it occurred to me that the majority are such that in normal activities should be undertaken by the industry under free enterprise. If the industry defaults in building up a reserve of high-grade ore for stockpiling, we might then be required to do it under a planned economy. If such a thing is done, it would jeopardize our free-enterprise system. Would you comment on that?

MR. RICHARDS: The industry is functioning satisfactorily for a peacetime economy. Stockpiling right now would be out of the question, as I indicated in my talk, because all ore possible to mine and ship is being consumed. Also, when an ore stockpile could be accumulated it would be primarily for war, and that is a government function.

As far as taking care of our peacetime needs let me say, in the first place, that the industry is working on taconites in the first 35 miles of the eastern range of the Mesabi. There are three companies operating there. The Reserve Mining Company is one that I can speak of, because it so happens that our company owns a half of it. The cost of the total job for 10 million net tons product should be near 300 million dollars. That is a lot of money. We are also in the group developing Labrador ore. Our company has a substantial proportion of that. That is a 200-million-dollar job. We must be careful, however, lest we protect ourselves out of existence if we go much beyond that.

QUESTION: With regard to manganese, I have been under the impression that when manganese is used in the manufacture of steel, a great proportion of it goes out in the slag; that it is essential to the

process of getting the iron out of the oxides. Is that a correct statement? Is the manganese actually in the slag but in a form where it is difficult to extract?

MR. RICHARDS: Let me say that it does go out in the open-hearth slag. I will tell you what happens:

In all our rich iron ores there is some manganese. Much of it goes into the pig iron, and in that form the manganese finds its way into our open hearths. The open hearths put practically all this manganese into the open-hearth slag. The amount of manganese that goes into the open-hearth slag would be, if it could be retained, almost that needed for our steel additions. We do not know, however, just how to get the manganese out of this slag.

I know that the Bureau of Mines is working on projects to extract manganese from the slag. It probably will be costly, but that is one of the problems. There is a lot of work being done at College Park on low-grade manganese ores. Also, the Bureau of Mines in Pittsburgh is working on the problem too. There are low-grade manganese deposits in South Dakota, in Maine, in the Southwest, and in Missouri. It is a problem to develop a satisfactory method to obtain manganese within the boundaries of the United States to run the steel industry. No answer as yet has been developed.

QUESTION: You have answered my question. If I understand you correctly, you say that, if a process were developed, quantity-wise the slag contains the manganese that we need. Is that right?

MR. RICHARDS: I wouldn't say exactly our requirements would be met, but well up into the amount needed is there.

QUESTION: You spoke of the trestles being wooden. I would like to ask a question about that. Who owns the majority of the trestles?

MR. RICHARDS: The railroads.

QUESTION: You spoke about the reserve of 1.6 billion tons of high-grade ores in the Lake Superior region. How much has been taken out to date?

MR. RICHARDS: The amount taken out to date is in the neighborhood of $2\frac{1}{4}$ billion tons.

Of course, you have to remember that our economy is growing. The steel industry has been growing rapidly over the years. What was a year's supply in 1890 is very different from a year's supply today.

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Let us do a little mental arithmetic. Take 120 million tons of ore used in the United States last year, into 1.6 billion of high-grade ore left in the Lake Superior region, and the answer is 13 years. That is a 13 years' supply remaining without allowing for any increased requirements. That isn't a very safe margin.

QUESTION: That figure represents the total recoverable at present, doesn't it?

MR. RICHARDS: Yes.

QUESTION: It does not include the marginal?

MR. RICHARDS: If you mean by marginal, low-grade ore, it does not include that. On the other hand, if by marginal you mean physical limitations, you can look at it this way. You mine this open-pit ore with shovels and you need area for cars and tracks. Now, when you get into the small ore bodies, you begin to be limited by the area into which you can get with the railroad tracks and the area in which your shovels can operate. Because of these physical limitations you cannot obtain as large a tonnage as heretofore.

COL. WING: If there has been so much feeling for the St. Lawrence seaway in these various sectors, including Presidential, where is the primary opposition coming from? Secondly, provided there is a seaway there, would you discuss a little of the economics of the Labrador ores, their cost delivered, and their content compared with the Lake Superior ores that we have been using?

MR. RICHARDS: As to where the primary opposition to the St. Lawrence seaway comes from. The railroads don't like it, the seaports don't like it, and the coal companies don't like it.

The distance by way of the St. Lawrence is 2,347 miles from the Atlantic coast to Duluth. In that whole distance there are only 114 miles that are not navigable, due to the rapids. In fact, there are only 50 miles of the 114 that have to be improved.

Back in the year 1700 a little canal was opened at Montreal, called the Lachine. Since that time a series of six 14-foot depth canals have been built by-passing the rapids. So at the present time you can operate past the rapids in small vessels. The total tonnage carried is about 9 million. Large vessels from the ocean can come inland as far as Montreal and from the Great Lakes down the St Lawrence River to Ogdensburg.

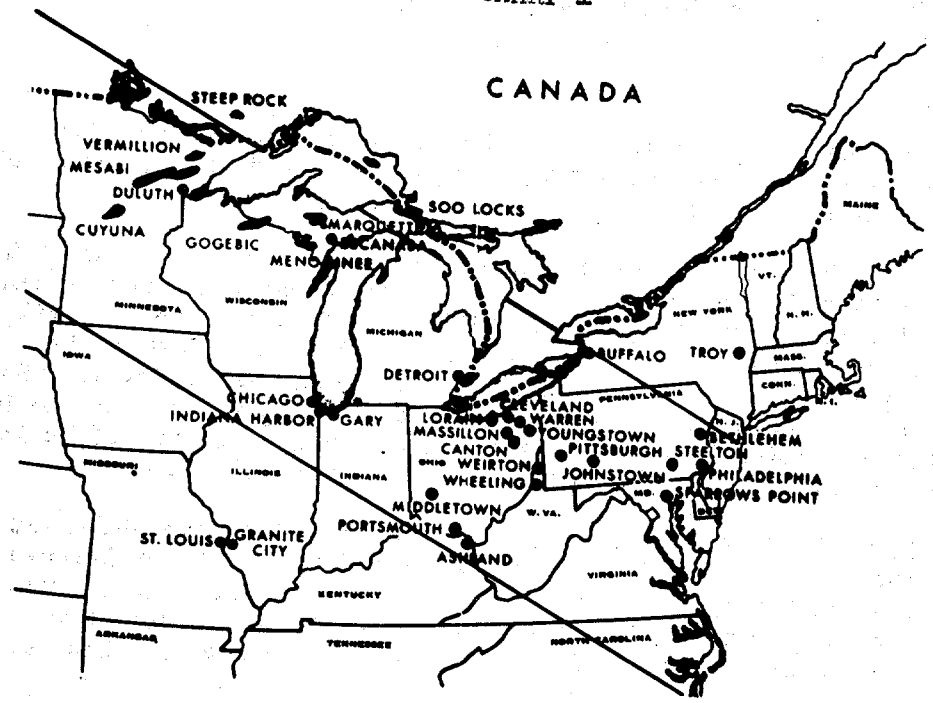
If this canal were put in, all the lake-going vessels could go up to Montreal or Seven Islands. Many sea-going vessels could come up to here. It is said that the 27-foot channel perhaps would not be deep enough. But it will take care of 40 percent of all the sea-going vessels by number and of 20 percent by tonnage. What is the use of installing a Cadillac when a Chevrolet will do the job? Why bring the Queen Mary into the Great Lakes?

Your other question was about the Labrador ore. We are going into that, for one prime reason, and that is that we need it. A lot of other steel companies need it.

These ores cannot compete with the open-pit ores. The open-pit ores up in the Mesabi are just in a class by themselves. But we can bring a limited amount of Labrador ore down, if we have to, by rail, by small canal boat, or big ocean boats, and then a haul over the mountains; and with a limited tonnage we probably can get along. But if this expansion of the steel companies continues, we may have to hunt other places to manufacture our steel where assembly of materials is cheaper. I do not know what the ultimate answer will be.

COL. SMARTT: Mr. Richards, on the basis of the comments heard during the break, I can say that you have really hit the bull's-eye in shooting at the scope of the course this morning in your lecture. It was one hundred percent on the mark. I think that everyone in the auditorium feels that it is one of the top lectures of this year.

CHART 1



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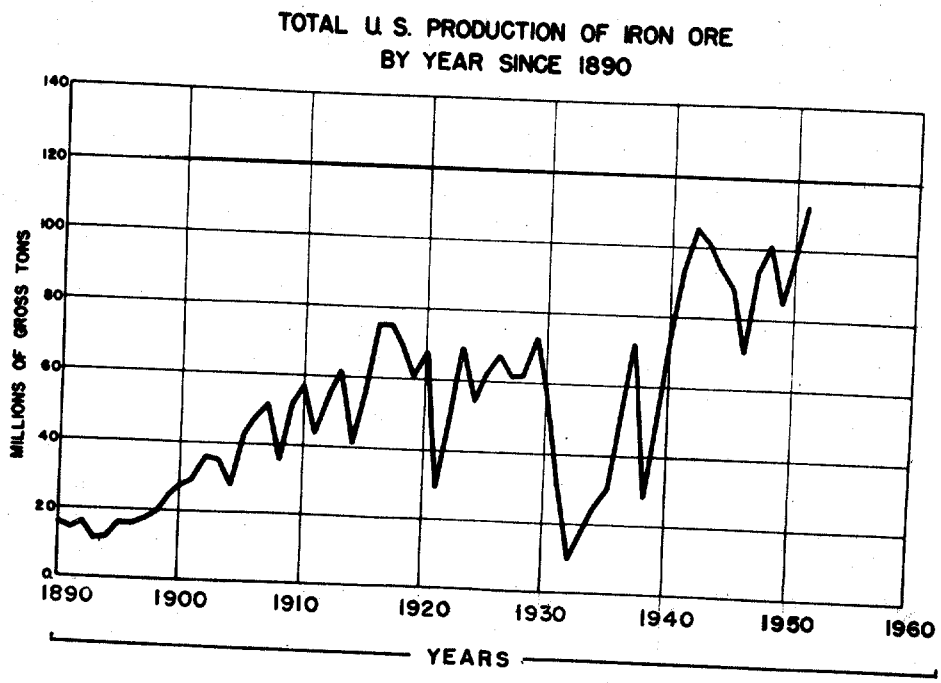

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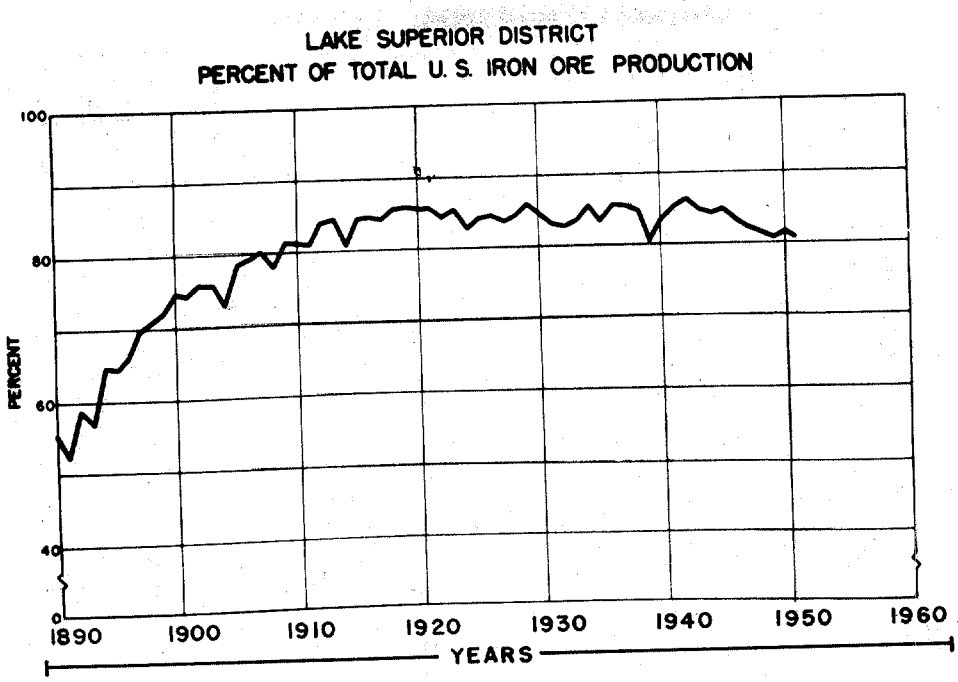

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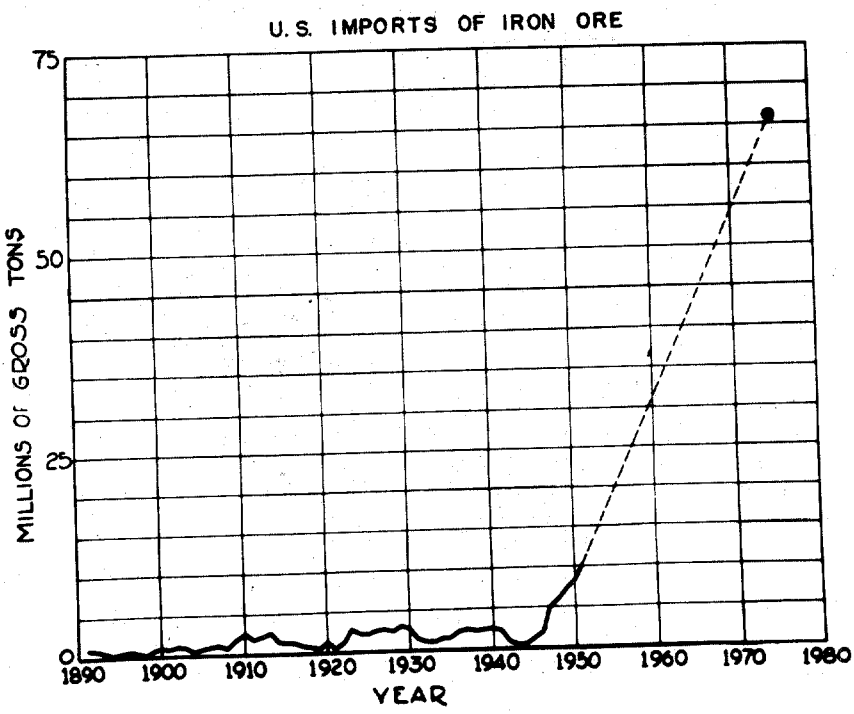

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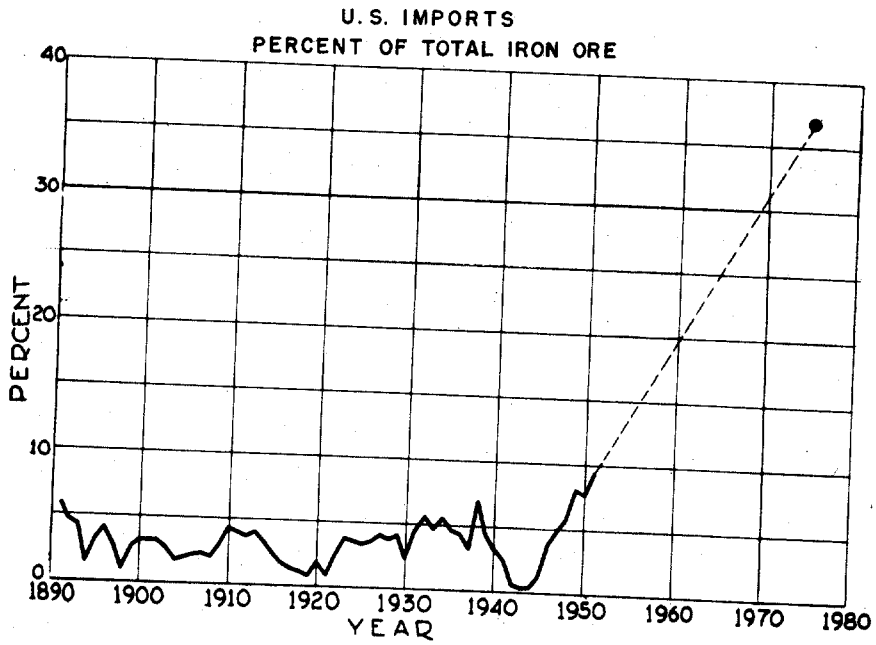

CHART 6

LABRADOR & GREAT LAKES AREA

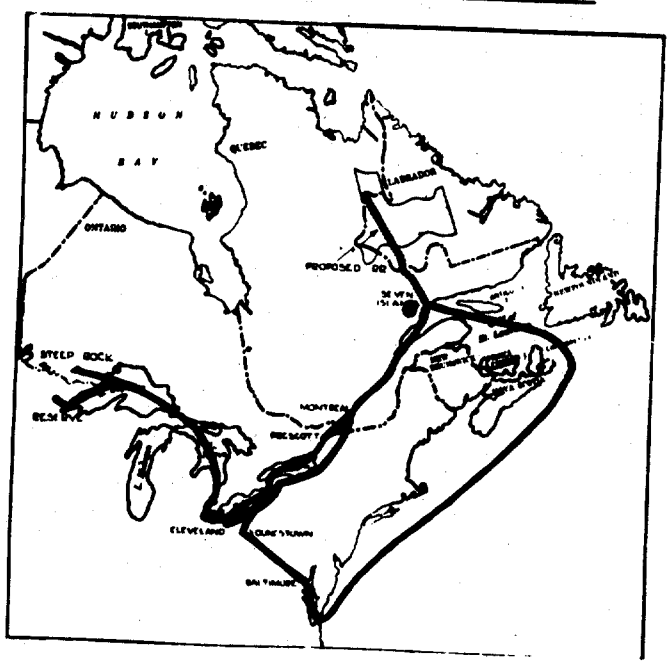

TABLE 3

U.S. IMPORTS OF MANGANESE ORE FOR CONSUMPTION 1937 AND 1950

COUNTRY	PERCENT OF TOTAL 1937	PERCENT OF TOTAL 1950
RUSSIA	41.8	3.6
GOLD COAST	29.2	15.4
INDIA	8.2	36.0
UNION OF SOUTH AFRICA	0.0	24.9
BRAZIL	8.0	6.9
FRENCH MOROCCO	-	1.3
CUBA	12.6	5.4
EGYPT	-	2.8
MEXICO	-	1.8
CHILE	-	0.4
PHILIPPINE ISLANDS	-	0.3
OTHER SOURCES	0.2	1.2
TOTAL	100.0	100.0%

CHART 7

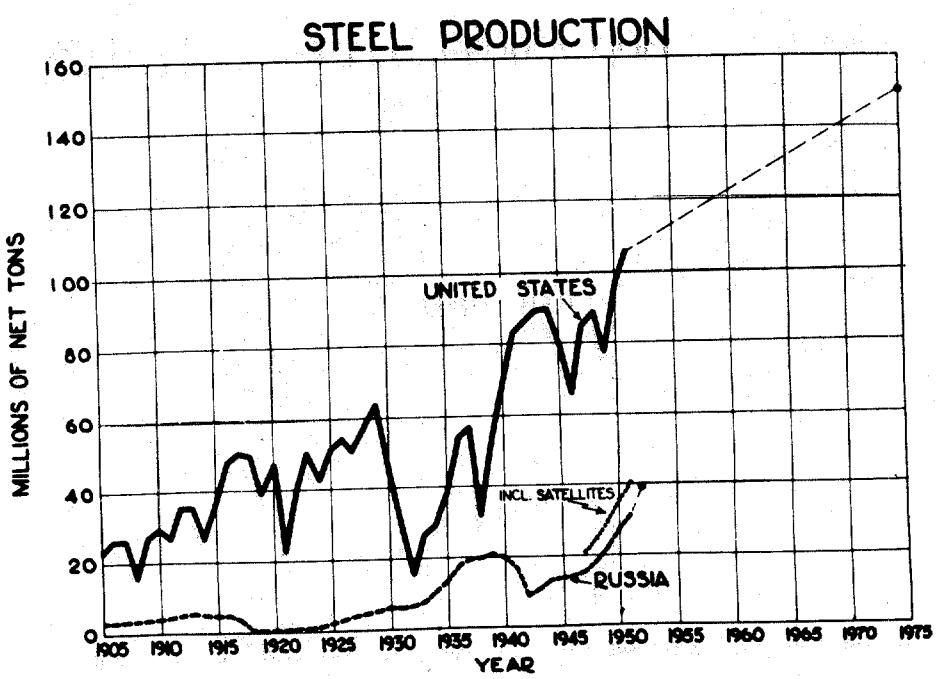

CHART 8

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CHART 9

TABLE 4

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SELF-CONTAINMENT OF RAW MATERIALS

MATERIAL	SELF-CONTAINED U.S.A.	RUSSIA	FREE WORLD	COMMUNIST WORLD
COAL	YES	YES	YES	YES
LIMESTONE	YES	YES	YES	YES
IRON ORE	NO	YES	YES	YES
MANGANESE	NO	YES	YES	YES
ALUMINUM	NO	YES	YES	YES
NICKEL	NO	YES	YES	YES
CHROMIUM	NO	YES	YES	YES
MOLYBDENUM	YES	NO	YES	NO
TIN	NO	NO	YES	NO
COBALT	NO	NO	YES	NO

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