MATERIALS FOR THE PRODUCTION OF STEEL

29 September 1953

CONTENTS

Publication No. L54-30

INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

Mr. Walter H. Wiewel, Vice President in Charge of Sales, Crucible Steel Company of America, was born in Cleveland, Ohio, and educated there. He joined Crucible in the fall of 1948 when the Trent Tube Company, East Troy, Wisconsin, of which he is President, was acquired as a wholly owned subsidiary. Between 1935 and 1944 he held the post of assistant general sales manager of the Jones & Laughlin Steel Corporation. During the war years he served with the Steel Division of the War Production Board in Washington as chief of the Tubing Branch and as vice chairman of the Production Directive Committee of the Division. On leaving his WPB post, Mr. Wiewel joined the National Tube Company in Pittsburgh as assistant to the president. In 1947 he went to the Trent Tube Company. Mr. Wiewel has also been associated with steel companies in the alloy and specialty steel fields, including United Alloy Steel Corporation, Standard Seamless Tube Company and Timken Steel & Tube Company. He is a member of the American Iron & Steel Institute and the American Petroleum Institute. He is also a member of the Board of Directors of Crucible Steel & Rem-Cru Titanium, Inc. Recently he was loaned by Crucible to the National Production Authority in Washington where he headed the Metals and Minerals Branch.

MATERIALS FOR THE PRODUCTION OF STEEL

29 September 1953

COLONEL O'NEILL: This morning we have our third lecture relating to natural resources, "Materials for the Production of Steel." Steel is the basis of our economy. We have a tendency to take it for granted. Today we have an opportunity to learn more about steel and the materials and the additives required for its production.

Our speaker has spent his entire career with the steel industry. He was loaned by his company to the War Production Board during World War II and he again served with the National Production Authority during the Korean emergency. Therefore he is in a unique position to appraise the significance of war steels.

I welcome to the platform and present to the audience Mr. Walter H. Wiewel, Vice President of the Crucible Steel Company of America.

MR. WIEWEL: Gentlemen: I am doubly privileged, first, to be invited to address such a distinguished audience and, second, to have spent a lifetime in such a vital and fascinating industry, about whose material requirements I am to speak today.

Of course I realize that no speaker has ever had anything but a distinguished audience, but I assure you my comments are sincere. During my two and one-half years in the Steel Division in World War II, and again in NPA, I worked with many members of the armed forces. We had many difficult problems but we eventually solved them all. The intelligent cooperation I received from the military men with whom I had to do business during the war production days gave me a very fine opinion of their intelligence, integrity, and ability. For that reason I do consider this audience distinguished, and I am happy to be here.

The Paley Report, with which I am sure you are all familiar, states that four-fifths of all the metal used in this country today is iron and steel. Chart 1, page 2, shows that graphically.

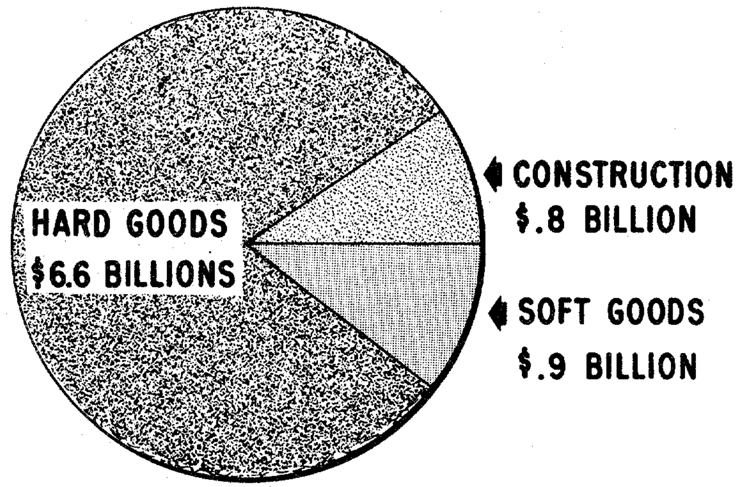
The circle or pie chart at the top is illustrative of the dollar deliveries to the military in the Korean period, showing the great preponderance of hard goods made of steel and using great quantities of steel in the tools and equipment required for this production.

The bar chart at the bottom depicts military requirements for a representative period under the Controlled Materials Plan (first quarter of 1952). It shows that the amount of carbon steel alone

CHART 1

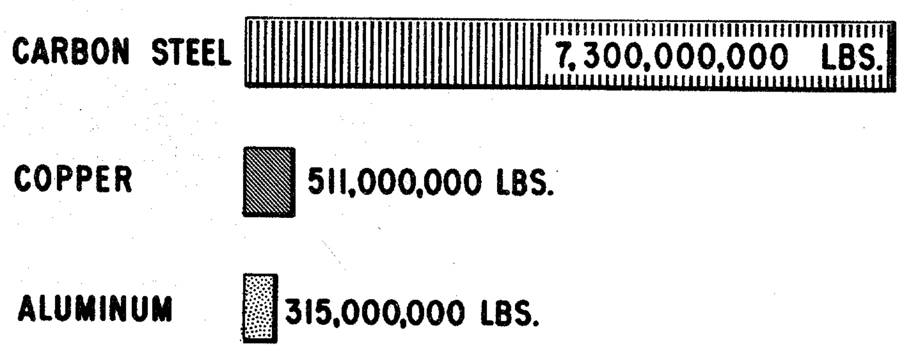
MILITARY IMPORTANCE OF THE STEEL INDUSTRY

DELIVERIES TO MILITARY SINCE KOREA MID 1950 - END OF 1952



TOTAL - 8.3 BILLION DOLLARS

1st QUARTER 1952 - MILITARY REQUIREMENTS OF CARBON STEEL COPPER & ALUMINUM UNDER C.M.P.



exceeded the amounts of copper and aluminum by approximately nine times. Note that this does not include alloy or stainless steels. We are talking about an industry producing the basic material of an industrial economy.

I will now call your attention to chart 2, page 4. This shows a simplified pictographic representation of the kinds of raw materials we use to make iron and steel. We charge iron ore, coke, and limestone in carefully measured amounts into a blast furnace, add tremendous columes of air heated to about 1000 degrees Fahrenheit and cause the coke to ignite and burn. In a very complex series of chemical reactions, the oxygen in the iron ore combines with the carbon monoxide from the burning coke to release metallic iron as a constantly growing pool at the bottom of the furnace. The limestone also melts and forms a molten slag on the top of the iron; it serves to collect the other impurities present in the ore. The burning coke provides enough heat to enable the metallurgical reducing reactions to take place and to melt the iron and the slag. Temperatures in the bottom of the furnace may reach 3600 degrees Fahrenheit.

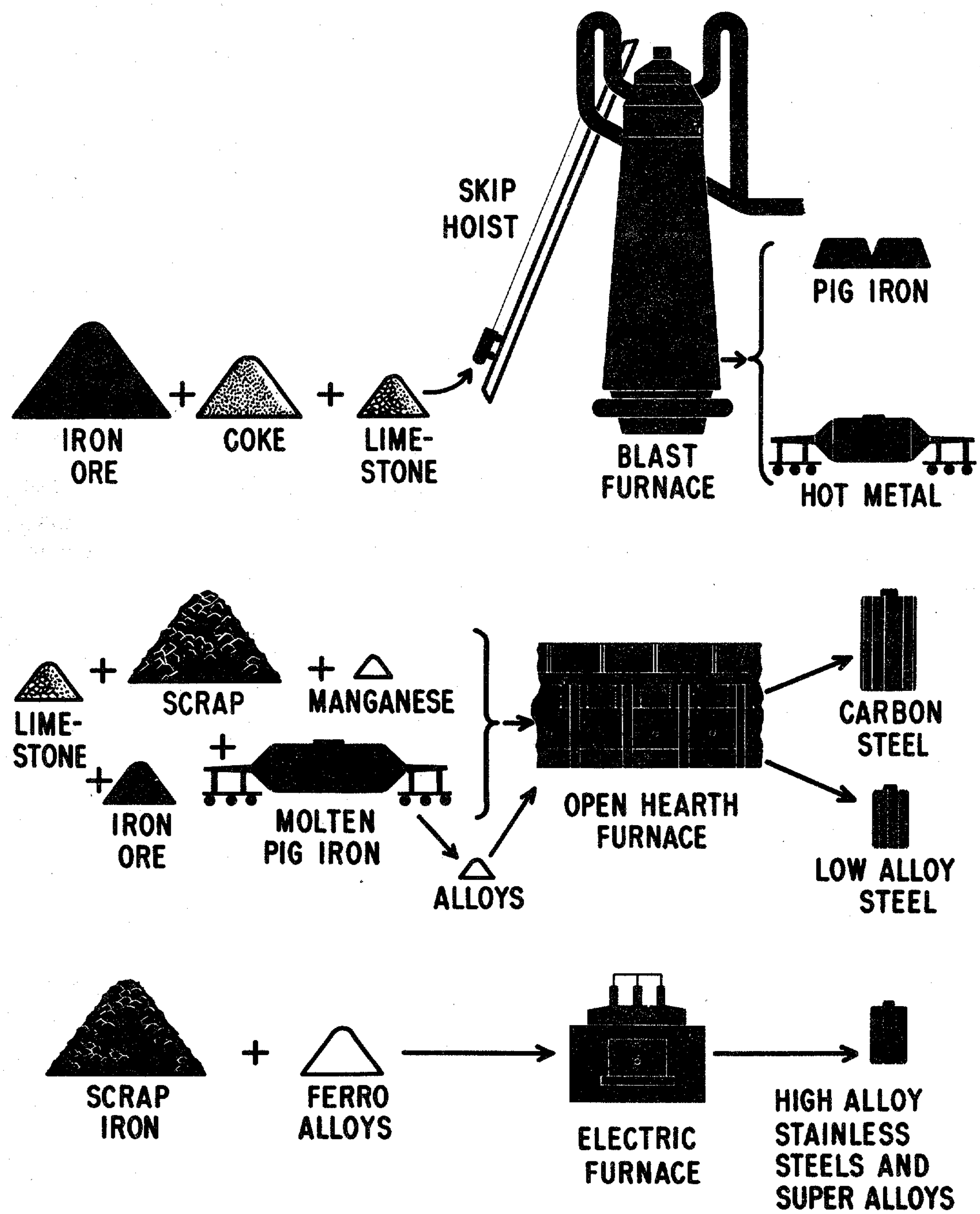
The average furnace will make a cast of pig iron three to five times a day and will tap the slag at more frequent intervals. The largest blast furnace in use today has a rated capacity of 605 tons per cast. That will produce about from 1,800 to 2,000 tons of iron in a 24-hour day. If the blast furnace is operated in conjunction with a steel mill, it is normal practice to keep the iron molten in thermos ladle cars or a hot metal mixer until charged into the open-hearth furnace, rather than to cast it into pigs.

The second row shows the materials charged into an open-hearth furnace--from a tonnage standpoint, the most important steelmaking furnace in use today. In an open-hearth furnace it is theoretically possible to use 100 percent pig iron, 100 percent scrap or any variation thereof; but a normal charge will generally use about a 50-50 ratio. In the standard of the blast furnace capacity in this country, however, the charge of iron is moving up towards 60; and that is particularly true when the price of scrap is high. As the price of scrap comes down, the charge is varied to get the lowest cost consistent with quality.

Limestone amounting to five-eights of 1 percent of the total metallic charge is usually added first; next soft ore is added if molten pig iron is to be used; then scrap is added and the charge "melted down." When the charge is molten, the hot metal from the blast furnace is added. Manganese is usually added just after the hot metal. For alloy steels, the various ferroalloys are added to the bath just before pouring, except in the case of nickel, and in some cases may even be added in the ladle. The normal time for a heat is about 10.7 hours.

CHART 2

HOW IRON ORE IS CONVERTED TO STEEL



The largest open-hearth furnace in use today has a rated capacity of 550 net tons per heat.

The last row shows the charge for an electric furnace where steels usually containing more than 5 percent alloying elements are made. This is the furnace where stainless steels, heat-resisting steels, tool steels, jet alloys, and other specialty steels are made. A charge for an electric furnace will usually consist of carefully segregated scrap, limestone, and one or more alloying metals. The electric furnace enables closer controls to be maintained of the melt and a higher utilization of the ferroalloys. It is a more expensive process than the open hearth, but results in steel of greater purity and uniformity. Larger furnaces which might be more economical seem unlikely as these furnaces use terrific amounts of electric power. There's a lot of work being done in that direction, and some people think electric steel may eventually be made as cheaply as open hearth. The largest furnace in use today has a capacity of 100 tons per heat. (One company has a 200-ton electric furnace on order.)

I have not attempted to show a Bessemer converter because, while it is still used by the industry, its importance has greatly diminished, due primarily to its lack of flexibility. The steel industry today makes at least 259 standard grades of carbon, alloy, stainless, and heat-resisting steels.

We now come to the most important raw material--iron ore. Since the various iron ranges of the Lake Superior district were discovered and development was begun, this district has accounted for the largest share of United States requirements; and even now, after having supplied the United States and our allies in two major wars, it still accounts for 80 percent of our iron ore. Its day of exhaustion is fast approaching, though, for if we continue to take direct shipping ore out of the district at the present rate, the high-grade reserves will be exhausted in approximately 15 years. (Note: The United States Steel Company now owns about 75 percent of all Superior reserves.) Other areas of the United States have substantial tonnage reserves, but these other deposits are not nearly of sufficient magnitude to replace the Superior district.

Steel companies must be farsighted in making provision for their own long-range raw material requirements. At the same time they must forever keep in mind that they are making one of the truly inexpensive commodities available today. (The average price of finished steel, presently about 7.5 cents per pound, is considerably below the price of bread.) Consequently, transportation costs have bulked large in the thoughts of the men responsible for locating mills. In the past, steel mills were located near available sources of both iron and coal in an attempt to minimize these transportation costs--the resulting location usually being a compromise.

Today the newer mills have been located with primary reference to the transportation costs of iron ore and proximity to the market for finished steel. The costs of coal movement are, rightly or wrongly, nor nearly so important today as they were once thought to be. A prime example of this is, of course, the Fairless Works of the United States Steel Corporation. The location of this integrated mill, the largest ever constructed at one time, was selected on the Delaware River to tap the huge eastern market for steel made from water-borne Venezuelan iron ore. The United States Steel Corporation has discovered and is rapidly developing a mountain of iron up the Orinoco River at Cerro Bolivar which has reserves presently estimated at 1.5 billion tons of extremely rich ore.

Bethlehem Steel has for some years imported ore from its mines in Chile and has since 1951 received iron ore in substantial quantities from its concessions in Venezuela. Bethlehem Steel got to Venezuela first to develop its ore properties, and one of the mysteries that the geologists cannot understand is how it happened to miss this great big mountain of iron ore that United States Steel found some years later not too far away from the Bethlehem properties.

Republic Steel has a going ore project in Liberia and has additionally joined with National Steel, Youngstown Sheet and Tube, Wheeling Steel Corporation, and Armco Steel to develop the renowned Quebec-Labrador ore body which may contain as much as 1.5 billion tons. The development of the Quebec-Labrador ore body and the shipment of ore necessitated the building of a 365-mile railroad into the mines from Seven Islands on the St. Lawrence River. To give you some idea of the magnitude of this project, the mining area will eventually encompass some 500 square miles.

Other recent developments include the Steep Rock Lake project undertaken by Inland Steel Company and others. This ore body has a potential of several hundred million tons of iron ore and can use existing Great Lakes ore boats for transportation, as the deposit is located near the north shore of Lake Superior. It is noteworthy that in the development of this property it was first necessary to divert the Seine River and then drain some 121 billion gallons of water from Steep Rock Lake.

There are reports as yet unconfirmed that a large ore body was recently discovered by a Canadian group in Quebec province. This ore body is said to be very near to the new railroad being built to service the Labrador ores and, of course, this railroad as a common carrier would be required by law also to service the new deposit. Thus this new discovery, if true, can probably be developed at a much lower cost than would otherwise be the case, thanks to their competitors' railroad.

Some relatively small amounts of extremely high-grade Brazilian ore are imported--this ore is usually used in open hearths. See chart 3, page 8, for a graphic projection (furnished by the Cleveland-Cliffs Iron Co.) of the increasing use of imported ore. Of course the ascending line contemplates a constant increase in the production of steel, going on to 1980. However, it is important to remember that the inflow of foreign ore does tend to reduce the take from the mines of the Superior district and thereby extends their life.

Much can be done to extend domestic reserves by increasing the amount of concentrating or beneficiating equipment available at existing United States mines, making it possible to tap lower-grade ores which are in ample supply. Relative costs play a major role in determining how much beneficiation will be done, but the higher iron content and consequent decreased volume of these concentrates as compared to direct shipping ore will reduce transportation costs and will give better results in the blast furnace. These savings will tend to offset to a substantial degree the costs of concentrating. (Note the increasing amount of concentrates shown on the chart.)

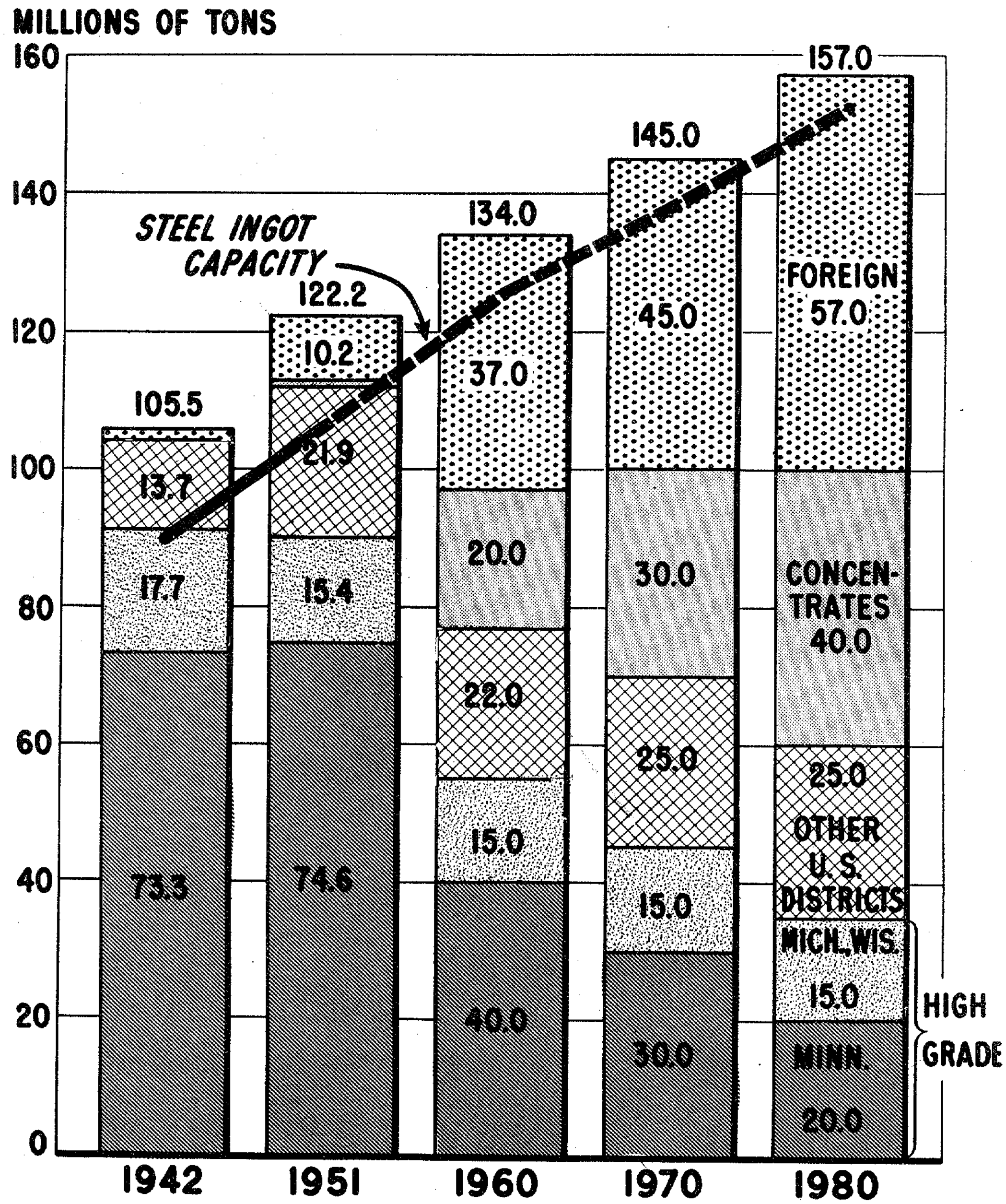
The most important of these lower-grade ores are the taconites, containing from 25 to 35 percent iron, which underlie much of the Superior district. Reserves of this iron-bearing mineral are estimated at 60 billion tons, but present technology can effectively concentrate only the magnetic taconites which represent about one-twelfth of the total, and this only by a complex, expensive operation. It is estimated that eventually 1.7 billion tons of high-grade concentrates may be recovered from the magnetic taconites, but as much as 20 billion tons may be recovered from the nonmagnetic variety. As a matter of fact, geologists don't know exactly how much taconite there is on the range. The amount is astronomical.

Substantial progress is being made in recovery from the magnetic variety and it is expected that by 1960 this material will add as much as 15 million tons of high-grade concentrates a year to the United States supply. That will be, however, after a very substantial amount of money is put into additional concentrating plants. The problem of the nonmagnetic taconites remains, and much technological progress must be made before this mineral can find its way into the blast furnace.

There is a possibility that some of the newer iron smelting processes now under development will enable the economical development of many of the smaller deposits of ore which exist in the United States. The processes which have been experimented with from time to time are, of course, the sponge iron process, the turbohearth furnace, the short column blast furnace, and the rotary kiln reduction of iron ore. I am not qualified to make even a guess that any of them will ever be in practical operation.

CHART 3

POTENTIAL SOURCES OF IRON ORE



The next most important material used in the production of steel is scrap. Iron or steel scrap is essential to efficient, economical steelmaking as it replaces pig iron in open-hearth furnaces and does not drain natural resources--thus it should be considered a vital resource itself.

I might remark here as an ex-bureaucrat that the price of scrap has recently declined from its high price due to a reduced demand as a consequence of the substantially increased blast-furnace capacity. Pressure is being exerted to get permission to export scrap. It is my opinion that scrap should be considered a vital natural resource and its export prohibited until danger of a big war has been eliminated. Our recent scrap shortage is still vivid in the memory of all steelmakers, and we should not take a chance on its appearing again.

About half the scrap used is home scrap, such as croppings, discarded ingot moulds, and so on, produced in the mill. The balance is purchased scrap, usually distinguished by source and, in the terminology of the steel industry, is called either "prompt" or "dormant" scrap. Prompt scrap, amounting to about 40 percent of all purchased scrap, comes from operations in steel fabricators' plants; dormant scrap, about 60 percent, comes from abandoned or discarded machinery, equipment, and so forth. Home scrap and prompt scrap represent no particular problem, but dormant scrap promises to be an issue for a number of years. Estimates of the time required for dormant scrap to return to the mills vary from 20 to 33 years. The industry thus in the near future must depend for nearly 30 percent of its requirements on returns from its own abnormally low production of the depression thirties.

Very little relief can come from steel produced during World War II as much of this was sunk as ships, fired away as ammunition, left abroad to rust, or was used by the people on the other side. Even the long-range future is beclouded to a certain extent because of the large amount of lightgage steel made from consumer goods since the war. Much of this never makes the return circuit to the mills. Our outlook is not too bright for scrap in the next decade.

For coal and limestone, the other basic materials, our position in the United States is good, and as a nation we have no cause to worry at all about the steel industry's requirements, although the grade of coking coal presently available makes some beneficiation almost a necessity.

I might add here, however, that good metallurgical coal, while plentiful from a national standpoint, is growing more scarce in areas adjacent to steel plants. The impact of longer freight hauls makes coal more expensive.

I feel a word here about fuel is appropriate. The four fuels used in making steel are coke oven gas, natural gas, oil, and electricity. Thanks to the substantial expansion of natural gas pipelines, and the enormous gas reserves now known, our gas supply looks good for many years. I am sure that some speaker will discuss the vastly improved crude oil situation with you. I think our reserves are the best they have been in many years, despite the high hazard of exploration. The present tax attitude toward oil development should be continued, as petroleum is the most vital necessity for the manufacture of steel and its use.

The current expansion in electric power production should provide adequate electric power.

Coke production was expanded as pig iron capacity was increased. The supply of fuels for steelmaking seems adequate for the long pull.

There are 10 specialty metals and one nonmetallic element commonly used by the steel industry in the production of alloy, stainless, and heat-resistant steels. Chart 4, page 11, gives a pictorial view of them.

One of these, manganese, is a must for making steel. Manganese combines with sulphur in steel to make it hot workable or rollable. The United States uses about 13 pounds of metallic manganese for each ingot ton of steel produced. In addition to ise use for all steelmaking manganese is also widely used as an alloying metal; in fact, it is the cheapest alloy we have to increase the physical properties of steel.

I should like to discuss briefly the principal qualities imparted to steel by these 11 alloying elements, but I hasten to add that the illustrations I have chosen only touch the surface. Even if I were qualified, a comprehensive treatment would take far more time than I have been allotted. The alloying elements, usually called ferroalloys, are then, in order of the quantity used:

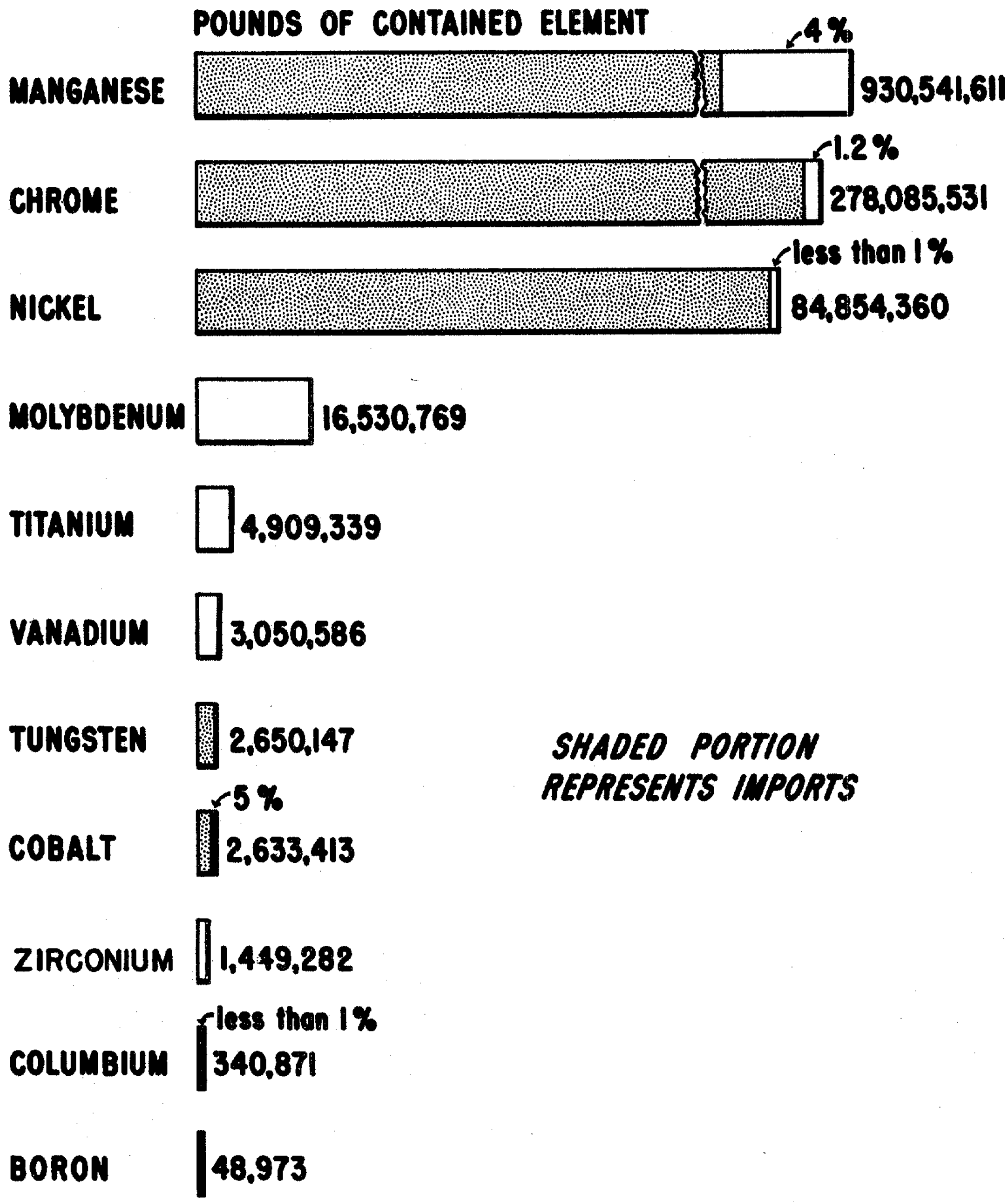
1. Manganese--is used as an alloy to strengthen steel without affecting ductility. It may be used as a substitute for nickel in some alloys. In high percentages (10 to 14 percent) it is used in Hadfield steels, which are uniquely abrasion resistant.

2. Chromium--imparts resistance to corrosion. Small amounts increase strength, toughness, and hardenability. Substantial amounts of chrome, with or without nickel, are used in the manufacture of stainless steels, and combined with nickel and other alloys make up the so-called heat-resistant or super alloy steels. The end uses of this family of steels, of course, embrace aircraft, and are absolutely vital to many military supporting industries.

CHART 4

FERRO ALLOYS CONSUMED BY STEEL INDUSTRY

1952



3. Nickel--imparts strength and toughness without sacrifice of ductility. It gives steel ability to resist high temperatures. It is used with chromium in stainless steel and for steels having a high electrical resistance; also for armor plate, jet alloys, chemical and food processing equipment, and many other military supporting industries.

4. Molydbenum--used as a basic element in high-speed steels, also adds strength and hardness to steel at elevated temperatures. Its principal use is to promote hardenability in alloy steels combined with nickel, manganese, and chrome.

5. Titanium--as an alloy provides soundness and fine grain structure. It improves the machinability of steels and acts as a carbon stabilizer in stainless steels in improve welding. It is sometimes used to deoxidize.

6. Vanadium--increases hardness, improves soundness, and produces a finegrained structure in steel. It is also used in the production of high-speed steel.

7. Tungsten--is used in high-speed steels and hot-work steels. High-speed steel may contain up to 18 percent tungsten. It is important also in high-temperature alloys for jet engine and similar applications.

8. Cobalt--imparts high red hardness to high-speed steel and imprpves oxidation resistance. It is used in steels for jet engine blades or buckets and permanent magnets.

9. Columbium--is used to stabilize carbon in stainless steels for high-temperature use. It improves the weldability of such steels, and add high-temperature strength. It is now restricted by NPA order to military jet aircraft and AEC uses.

10. Zirconium--improves machinability, deoxidizes and desulphurizes steel.

11. Boron--a nonmetallic substitute was recently developed. Small quantities replace other alloying elements to give desirable hardenability characteristics.

Not on the chart, but worthy of mention, is another important metal--aluminum. High-grade steel requires roughly from three-fourths of a pound to 1.25 pounds per ton to be added as a deoxidizer. Aluminum is absolutely essential to quality steelmaking. Its supply is adequate from a steelmaking point of view as the aluminum used is resmelted scrap or secondary metal.

Before proceeding further I thought you might be interested in learning a little of the lengths and expedients to which the companies mining some of these alloying elements have to go. Climax Molybdenum Company owns the world's largest desposit of molybdenum at Climax, Colorado. This mine is located within a few hundred feet of the summit of 12,000 foot Bartlett Mountain. At this altitude there is one-third less oxygen in the air. The miners have to work and live in a company-built town at 1,500 feet above the point where the Air Force requires its pilots to use oxygen.

Recently the general manager of Climax, Jack Abrams, was crossing the country in an airliner without a pressurized cabin. At one point the plane had to climb to 10,000 feet to avoid a storm. The hostess carefully explained this to Mr. Abrams and asked whether he felt dizzy. "Certainly not," he replied. "I've lived at 11,500 feet most of my life." She looked at him for a moment as if she thought he had just escaped from an institution for the kind of people who imagine they reside in a castle built on a cloud. Then she turned on her heel, stomped off, and had nothing further to do with him the rest of the trip.

To get and hold workers Climax has gone to great lengths with wages, recreation, and comfortable living in a community which has two seasons--July and winter. To combat the feeling of isolation, it is now constructing the highest television tower in the world. The antennae are at 13,700 feet, and two and one-half miles of coaxial cable, plus a series of amplifiers, lead the signal down through the mine into the community.

Chart 4 shows by means of shading that the United States is currently dependent on foreign sources for five of these alloying materials. These metals are manganese, chromium, nickel, cobalt, and columbium.

I want to explain here that it was somewhat of a surprise to me to find that we are apparently self-contained so far as tungsten is concerned.

Domestic tungsten ores are in a form called scheelite, and the steel industry can use scheelite. The best tungsten ore is called wolframite, all of which must be imported. Wolfram is required to make tungsten carbide for cutting tools, a very important item for high-production machinery. Wolfram is also necessary to make other items outside the steel industry. The steel industry uses scheelite satisfactorily. High-speed tungsten steel is no longer as necessary as it used to be for the production of high-speed tool steels. The molybdenum steels have replaced much of the tungsten high-speed steels.

Nickel is presently in artifically short supply and subject to complete allocation by the NPA. Nickel, in my opinion, does not present a major long-range wartime supply problem, inasmuch as Canada produces 90 percent of the free world's supply. Also, Cuba produces substantial tonnages which could be airlifted if necessary. At present Cuban nickel is in the form of oxide and is not applicable to the manufacture of many of the high-grade steels, such as stainless steel, super alloys, and so on. The United States needs enough reserve to get over any period of interruption to production, but need not depend, in my opinion, solely on stockpile for wartime supply. This is a controversial subject, but I still believe that.

Cobalt--Although in 1952 the Belgian Congo produced 95 percent of the United States supply, cobalt production in this country is increasing, and I believe it is being actively stockpiled. The quantities involved are small, thus lending it to be used for airlifting or even submarine transport in an emergency.

Columbium--United States requirements represent such a small tonnage that emergency means of transportation should pose no great problem. The two problem metals, then, are manganese and chromium.

Manganese is essential to the production of steel, as has been pointed out. Against estimated United States requirements of 2.4 million short tons of ore, our domestic production can presently account for only a small fraction. United States reserves, while large in the aggregate, are very low-grade and complicated to concentrate. We must, of necessity, rely on imports which, in the main, involve long ocean hauls and therefore will be endangered by submarine activity during wartime.

I spent six months here in charge of the Metals and Minerals Bureau and there was a great to-do, which is still going on, about nickel and some other things but no conservation about manganese. It may be a military secret; if it is, that's fine. I couldn't get anyone to talk about manganese. I was worried about manganese. I think we should have a three-year supply in that stockpile to enable the steel industry to run three years without interruption. I don't know what is being done about manganese. I am sure you gentlemen do or can find out. We are vulnerable as can be unless we have a big stockpile; no manganese--no steel!

There is, however, a bright light on the horizon; there are several processes now in the pilot-plant stage to recover manganese from open-hearth slags, which the United States has in tremendous quantities. These slags contain up to 8 percent manganese and, if full-scale operations live up to the pilot-plant expectations, such manganese could provide 50 percent of our total requirements beginning within two years required to build production plants.

Chromium--United States reserves of this metal are insignificant, producing in 1952 only 1.2 percent of the total requirements. Again large tonnages and long ocean hauls mean wartime dependence on a stockpile accumulated in peacetime. Our only possible relief other than stockpile is to develop some method of mechanical recovery from the huge Cuban laterite deposits. These ores contain about 2.5 percent chromium oxide. If technology can be developed to separate the iron, nickel, and cobalt from these ores, it is possible that a handsome bonus of chromium could result. This would give us a valuable nearby source. Transportation from Cuba even in wartime should not be an insurmountable problem. Work is being done on this problem by private capital, and Monday, 14 September 1953, the Bureau of Mines announced that it had allocated substantial funds for research work toward the recovery of metal values from these Cuban laterite ores. I think this is a valuable project. I hope they stay at it. I hope they are given support.

There are many other materials important in the manufacture of iron and steel, such as refractories, fluorspar, aluminum, copper, tin, and zinc but, as all of these materials are used by other industries and will perhaps be covered by other speakers, I will give them only this brief mention.

The art of metallurgy has always been inspired by the demands of the military for better weapons since the day when the sword made of Damascus steel reigned supreme. Certainly today the impact of military procurement falls most heavily on alloy steels, and hence on ferroalloys, although the total military demand even in a partial mobilization period like the present does take a very sizable portion of the output of all types of steels. Rich alloys designed in conformity with military requirements are particularly in demand. Armor plate containing nickel, nickel bearing stainless steels for aircraft and super alloys, which in their wrought form are generally made in steel mills, all take a heavy toll of alloys.

Chart 5, page 16, shows the sources of some of those materials we have to import.

Super alloys, as the name implies, are extremely rich in alloying elements, usually containing several of the following metals: Nickel, cobalt, chromium, molybdenum, tungsten, and columbium. They find particular use in jet engines for turbine buckets and vanes where ordinary metals cannot withstand the extreme heat and impact of the burning gasses. Inasmuch as an increase of 100 degrees fahrenheit in internal temperatures permits an increase of 20 percent in engine efficiency, these metals provide the key to successful jet operation.

Alloy steels are also widely used in guns, tanks, and naval vessels, as well as in airplanes. The new atomic submarines are designed to have high-strength, low-alloy steel-pressure hulls. Added to essential civilian demand, the military's requirements, when they approach the levels reached just after Korea, mean shortages and controls, at least at the outset. Fortunately, we now have the cumulative experience of two recent periods of emergency behind us so that, if future controls ever become necessary, the mechanism and know-how are readily available and can be rapidly put into effect.

CHART 5

FOREIGN SOURCES OF FERRO ALLOYS USED BY STEEL INDUSTRY

1952

MANGANESE

DOMESTIC	4.4%
INDIA	36.0
GOLD COAST	10.7
SOUTH AFRICA	12.5
CUBA	11.2
BRAZIL	7.3
MEXICO	4.0
ALL OTHERS	13.9
	100.0%

CHROMIUM

DOMESTIC	1.2%
TURKEY	50.0
SO. RHODESIA	19.0
SOUTH AFRICA	9.5
ALL OTHERS	20.3
	100.0%

NICKEL

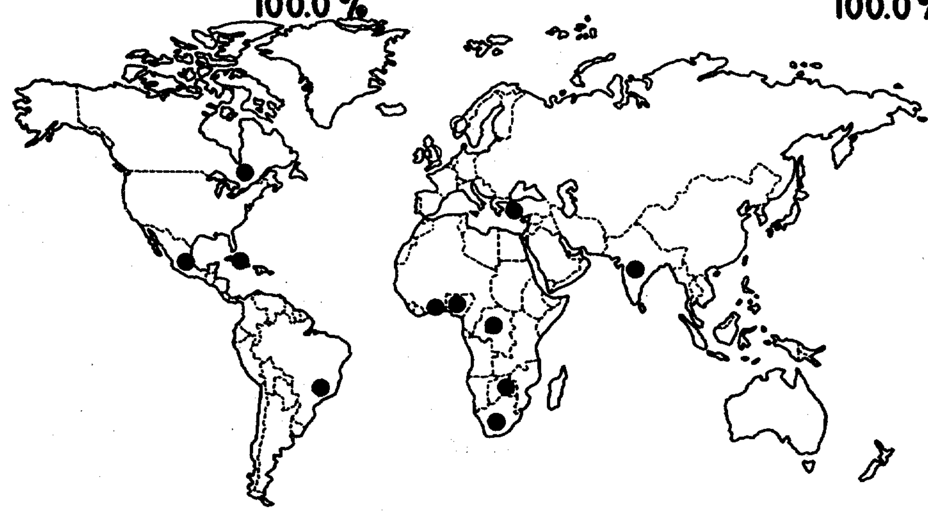
DOMESTIC	0.25%
CANADA	87.50
CUBA	6.50
NORWAY	5.50
U. K.	0.25
	100.00%

COBALT

DOMESTIC	5.0%
BELGIAN CONGO	95.0
	100.0%

COLUMBIUM

DOMESTIC	....
NIGERIA	80.0%
BELGIAN CONGO	15.0
ALL OTHERS	5.0
	100.0%



I have covered the basic problems confronting the United States steel industry from a materials standpoint. It is a subject that I have always felt I knew something about. The constant changes in conditions of war and war materiel present new problems and necessitate new solutions. No one knows what problems will pop up when the next emergency presents itself. Who knows what kind of war the next one will be?

I am on record at NPA in recommending a constant liaison, official in its character, between military planners and engineers, and some people in the basic industries, so that those industries have some advance notice of what they must produce for the military and how much. The steel industry is quite flexible. Witness the astronomical production of plates on sheet mills for the Navy in World War II; also the enormous tonnages of shell steel produced on rail, structural, and billet mills.

Incidentally, the new shell steel specifications, those currently in effect, are much tighter so far as size tolerance is concerned, and most sizes must now be rolled on bar mills. World War II production of shell steel would be impossible under today's specifications. Also, production steel for cold extruded shells will be insignificant unless the process is improved or the specifications relaxed. I mention two of the present known problems which would make quantity production difficult, if not impossible.

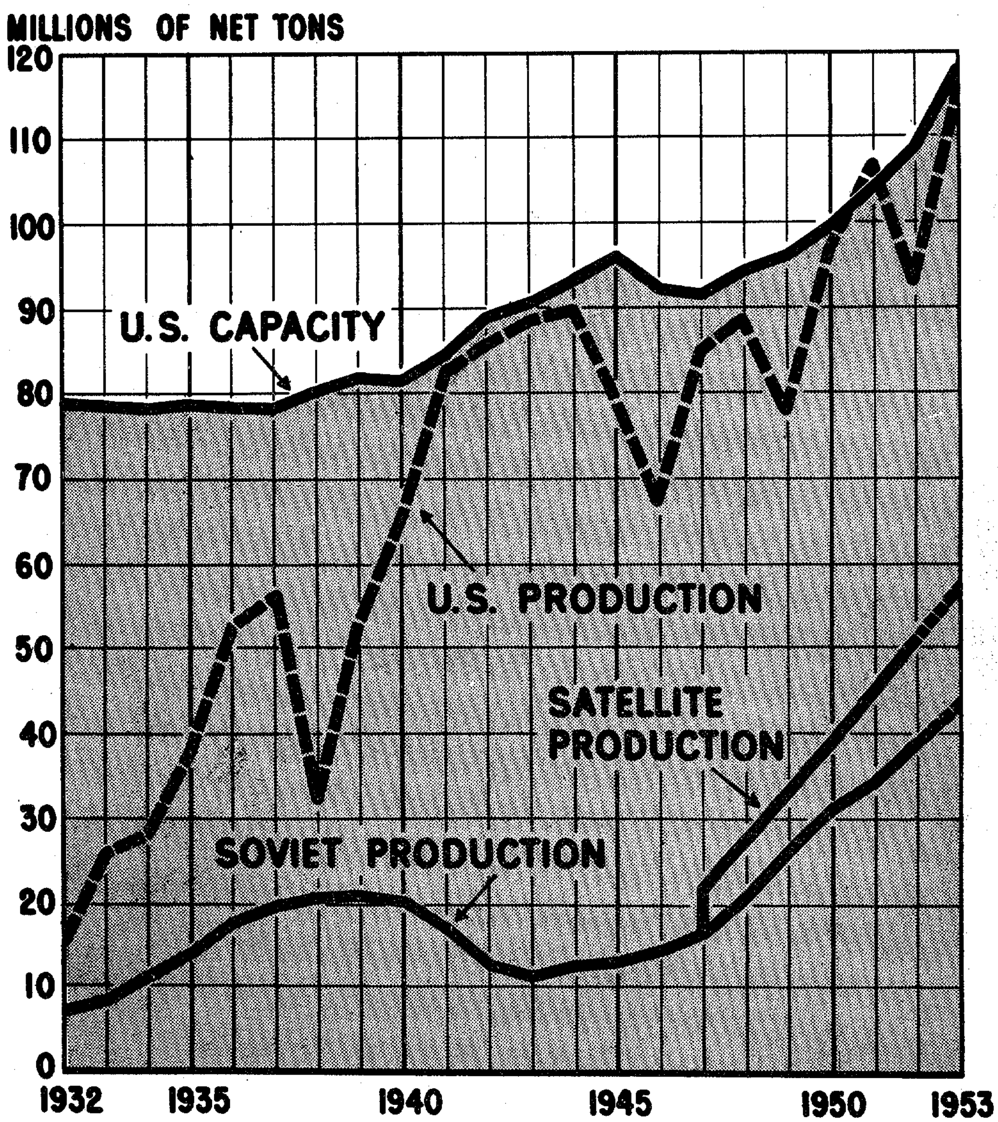
Before going on to my next subject, United States capabilities versus those of the Soviet Union, I must confess that the Iron Curtain provides a very substantial barrier against the transmission of any real knowledge regarding Soviet capabilities.

However, for what little it may be worth, I will try to analyze and compare the statistics of the two nations, so far as we know them. So far as relative capacity to produce steel is concerned, a reasonably accurate picture is provided by chart 6, page 18. This chart shows Soviet production, not capacity, but I feel we can safely assume that, not being subject to the whims of the market place and having a great deal of progress to make, the USSR always operates at substantially full capacity.

On looking at this chart, you will notice that in 1951 United States production slightly exceeded rated capacity, and it occurred to me that you might find it of interest if I digressed a moment to explain how that can happen. Fundamentally, of course, it is a matter of working our equipment a little harder for, in rating steelmaking equipment as to capacity, a liberal allowance is made for "down time" for repair and maintenance. Any reduction in down time therefore means that actual output exceeds rated capacity. We also have certain tricks-of-the-trade, such as using scrap turnings as part of our blast-furnace charge, enabling us to produce more hot metal per open-hearth heat, which reduces the time per heat.

CHART 6

U.S. CAPACITY & ACTUAL PRODUCTION OF STEEL V.S. U.S.S.R. & SATELLITE PRODUCTION 1932-1952



Also, any good operator turned loose, regardless of costs, and that is the way we operate in wartime, can really get it out. The wear and tear on equipment is fierce, but the boys in the plants love to make tonnage.

Getting back to the Russians: As you all know, the Soviet has traditionally denied luxury goods to its citizens and has even forced them to do without or with lessened amounts of those commodities and products which we in the United States feel are necessities of life. The automobile is no longer a luxury. It is an absolutely basic part of our transportation system.

This means that the steel industry in Russia can devote a much larger portion of its output to military goods than ours can do under anything else than full mobilization. However, it should be pointed out that Russia has made big demands on its steel to produce the capital goods it requires, and therefore much tonnage has had to go into structures, railroads, manufacturing plants of all types, and the like.

Also, it is obviously true that steel wears out behind the Iron Curtain too, which requires a substantial set-aside of steel for repair and maintenance. Exactly what part of their steel is available for military end items is impossible to say, but it is obvious that they lack anything like our cushion of available capacity that can, if necessary, be devoted to military items.

Again I would like to repeat that it is difficult, if not impossible, to assay accurately Soviet potential, due to the limited amount of information available. Also, the Soviet land mass is so huge, and such a small fraction of it has been thoroughly explored, that any prediction as to future supplies of raw materials tends to be ridiculous.

In general, the United States and the USSR seemingly have quite similar basic resources, with two important differences from a steel-maker's point of view. Again I refer to manganese and chromium. The Soviet Union has the largest deposit in the world of these two vital elements and the United States has significantly only small potentials at best.

The USSR has an apparent shortage of molybdenum, whereas the United States produces nearly 85 percent of the total world output. Some of us in the steel industry were very unhappy during World War II when we saw the quantities of molybdenum which were being given to the Russians. They received ten times more than they could have used if their steel industry had been running full; so they apparently went into the Korea project with a very handsome stockpile.

Cobalt is short in both countries, with the United States having apparently a higher potential. In addition to our resources, we have been able to stockpile cobalt produced in the Belgian Congo, French Morocco, and Canada, so our position can probably be regarded as definitely better than their's with respect to this important metal.

As for basic commodities, the USSR now is reportedly required to beneficiate the bulk of its iron ore and coking coals in order to maintain production at or near the potential capacity of their plants. Transport in Russia is not nearly so good or efficient as here, and newer deposits of iron and coal have, unfortunately for them, all been widely separated, placing a heavy drain on their rail facilities.

The United States has always been profligate in its use of alloying elements, whereas, from the evidence obtained from captured equipment, Russia has utilized them only where absolutely necessary.

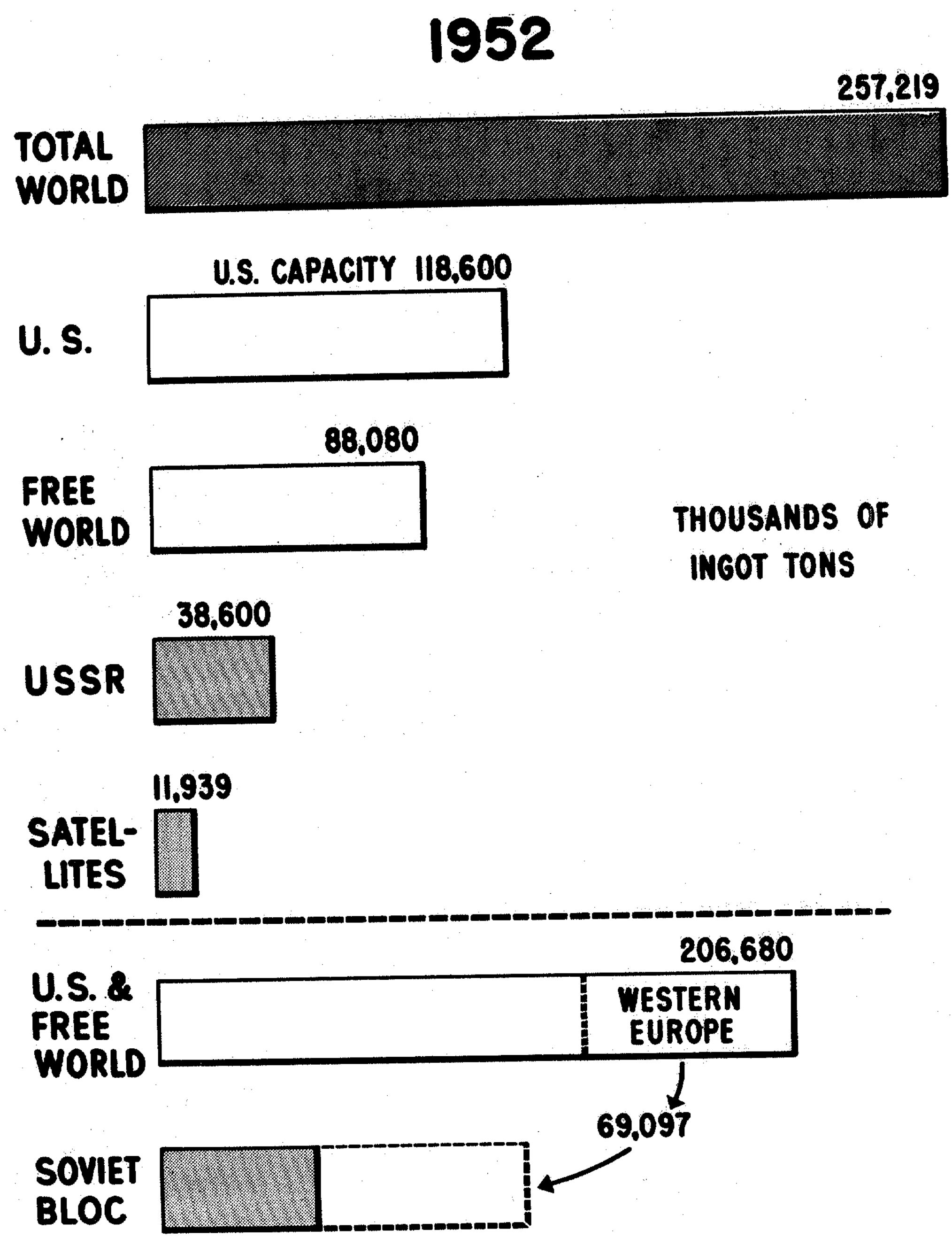
Chart 7, page 21, shows world steel capacity at the end of 1952. It should be noted again that the assumption is that production in that year equaled capacity, except in the case of the United States where industry was struck for two months. That year was one of the peak years for world steel demand. We assume everybody ran full if they could.

Looking at this chart, the United States has 45 percent of world capacity and the rest of the free world has another 35 percent. Against this the Soviet bloc can muster only 20 percent. However, if these figures give us a feeling of complacency, remember that the Soviet can probably absorb all of western Europe's capacity shortly after the outbreak of war, provided it is left intact, and thus could raise their own share to as much as 47 percent of the total world output. At the very least, they could deny our access to this important tonnage. Against this the United States and the rest of the free world would have 53 percent--a good portion of which might be neutral. This then becomes a pretty even split and is certainly cause for serious consideration, if not outright alarm. The proviso, "if left intact", then becomes urgent. I shall come back to that later in my recommendations.

I would like to present at this time a series of recommendations which, while not all-inclusive, will, I believe, assist in improving the security of this country against enemy attack. Many of these cover very familiar ground, but certainly such serious considerations merit repetition. For convenience, I have divided these into three categories: Actions for industry to take, actions to be taken by government and industry jointly, and government actions.

CHART 7

WORLD STEEL CAPACITY



7

To start with industry's role, I believe that we in the steel industry should encourage further the use of foreign ore, not to the point of dependence--that would be economically impractical--but only as a means of conserving our Lake Superior deposits for the potential emergency when enemy submarines may make ocean transport extremely hazardous, if not impossible.

The steel industry should also make every possible effort to guard itself against sabotage from within, and should immediately take the measures recommended by civil defense officials and the military to minimize the effect of possible enemy air action. I am quite sure that after the tension passes it is difficult to continue the screening and supervision and watching of vital equipment as we do in wartime. Successfully guarding against sabotage is a terrific problem, and one which is probably being neglected.

As for the sphere of joint government-industry participation, it seems to me that there are at least three very fertile fields for such combined endeavors.

Technological--both government and industry should encourage and assist to the fullest, both basic and applied research in the field of utilization of low-grade ores, with particular emphasis on the nonmagnetic taconites. The areas shown on the chart we displayed a while ago I hope will entirely change our dependence on foreign ore so that it is almost entirely eliminated in case of war, if we use those taconites in a reasonably economical manner. There are such enormous tonnages up there, it is a tremendous possibility.

So far as I know, the only government assistance toward the development of taconite ores is the granting of accelerated amortization on several plants during the last two years. It would seem to me that this is one field where government research of a substantial nature is justified. It could possibly do a lot of good and accelerate the success of this project. It will be solved some time; the only question is the time element.

Both should assist vigorously in the development of processes designed to make the United States less dependent on foreign sources of manganese. This would take into account the recovery of manganese from open-hearth slags as well as the utilization of United States low-grade ore deposits.

Both government and industry should work diligently to devise methods for the recovery of the chromium, nickel, and cobalt values awaiting exploitation in the huge Cuban laterite deposits. These ore bodies lying in the Western hemisphere could well be the answer to our prayers in the chromium-cobalt area, as they are close enough to our own shores to reduce the submarine menace to a minimum.

Conservation--the second joint effort is a negative one, but it is perhaps the most fruitful of them all, reserving the critical alloys for only those applications where the need makes their use essential. Don't misunderstand me--I mean only good, common-sense conservation. It is extremely important for the military metallurgist, with the full cooperation of his fellow scientists from industry, to design "conservation" right into his specifications. Both industry and the military need to be constantly reminded of the urgent need for this approach, and joint efforts in every possible media should lend encouragement to the utilization of substitutes and severely condemn profligacy.

We need not worry about industry conserving expensive alloys. We are constantly working to reduce the alloy content in steel simply to reduce the cost and expand the market. Designers of military equipment, however, are notoriously extravagant. They should learn that conservation is also very important to them.

Destruction--the military, with an assist from the steelmakers, could lay plans to penalize any Russian advance in western Europe. No one knows better than the steel mill people how vulnerable a steel mill is to destruction by concerted action or even by inaction. They have learned this lesson when plants have been struck and emergency measures were required to avoid costly damage. Industry could easily demonstrate to select military groups how readily a steel mill may be wrecked by intelligent action, and very quickly.

I call your attention again to chart 7. If we can, when necessary, take action to deny western Europe's steel capacity to the enemy, we can still maintain much of our absolute advantage of capacity and, by the same token, materially reduce the enemy's ability to continue his offensive. I feel that, while this last possibility may be well known and already provided for, we in the steel industry would be remiss in not calling it to the attention of our armed forces.

Now for what the Government itself must do--first and foremost, it must provide maximum possible security for the locks at the "Soo." That's axiomatic; I hated to mention it. I go up there once in a while, and it is a very interesting section of the country. This is, of course, elementary and I won't labor the point except to point out that in 1952, out of a total of 97.7 million gross tons of iron ore shipped by all districts in the United States, approximately 75 million gross tons, or 78 percent, came through the "Soo," and thus the importance of these vital locks cannot be overemphasized.

The St. Lawrence Seaway, if completed, would provide easy and cheap access to the Quebec-Labrador ore deposits and would lessen our dependence on the Superior district and consequently on the Soo Locks. I realize the political situation involved, and that the military services can't do it all by themselves; but sentiment for the St. Lawrence Waterway is growing, I think, all over the country. It would make shipments in large ore boats possible and safe over land-locked, easily protected waterways, and would all but eliminate the possibility of submarine activity against these ore boats. The Government should therefore cooperate fully with the Canadians in promptly commencing construction of this projected waterway.

Stockpile--the United States should constantly review its stockpile objectives and their accomplishment in the light of technological progress and military assessment of dangers. Particular attention should be paid to manganese and chromium, but thought should be given to the need for stockpiles of iron ore (or pig iron) and scrap (or synthetic ingots). In stockpiling semifinished goods rather than basic raw materials, manpower, electric energy, and capacity are also stored to add to the mining manpower, mine capacity, and shipping already saved with the raw material.

It is, however, obviously apparent that unrestricted stockpiling when both civilian and military demand is high can and has caused serious economic consequences to the Nation; hence stockpile accumulation should be most heavy when demand slackens off. This reduces the economic effects, lowers the cost of acquisition, and stabilizes the commodity markets, thereby keeping mine output at desirably high levels. Of course, a maximum acquisition rate is an initial requirement until substantial progress towards the ultimate goals has been achieved.

It is my opinion that the stockpile objectives should be re-examined. I think many of them are unrealistic. I think nickel is a good example.

Another worthwhile government activity is that of stockpiling vital spare parts. This applies to other industries besides ours.

We believe some government agency, preferably the military, should require each producing plant to microfilm the drawings of all plant layouts, including all service lines, drawings of machinery, and all equipment of a vital nature. These microfilms should be deposited by the Government in a safe place for emergency use. If destruction by an enemy is a real danger, certain vital spares such as turboblowers for blast furnaces, turbogenerators, rotors for blooming mills, strip mills, and other mills, and motor generator sets, many of which are interchangeable, should be acquired by the Government and stockpiled for emergency installation in the event of destruction by sabotage or by enemy action.

The time required to build electrical units is so long that any destruction of vital parts means the steel mill is out of production for months, unless spares are available. It is worth thinking about.

I realize it is a very complicated and difficult thing. I understand that the Germans had a plan by which they could put refineries and other plants back into operation in a time that surprised all of us.

In conclusion, I want to leave the encouraging thought with you that the United States has a tremendous accumulation of economic fat and if a true austerity program should ever have to be invoked, our ability to supply our military needs would be virtually astronomical.

To you of the military, who are most aware of the real measure of our peril and who are assigned the primary responsibility for our security, I say you must lead, must supply the initiating force to direct our steps into the paths leading to maximum national security.

The American people have never yet failed to measure up and, with proper leadership, will still manage to rally and defeat their enemies, however severe the initial blow. But the kind of leadership we urgently need is the kind that, within sensible security limits, keeps our people aware of the real, true measure of their peril and intelligently directs their efforts towards the goal of national security. That leadership, gentlemen, is yours by choice and assignment.

I thank you very much for your attention.

COLONEL O'NEIL: Mr. Wiewel is ready for your questions.

QUESTION: I really have three questions, Mr. Wiewel. The first has to do with the scrap problem as it might relate to Soviet steel production. What is their situation with regard to scrap steel?

MR. WIEWEL: Of course I will have to answer the question categorically. I don't know, but I don't think their scrap situation is very good. Steel has not been used in every-day existence in Russia the way it has here, so obviously its return scrap, what we call dormant or long-range scrap, cannot be substantial. Its current scrap is in direct ratio with the amount of steel that is fabricated, cut up, and made into things. Soviet steel production has been so low for so many years; it is just emerging from an agricultural society where steel has not been particularly important. Obviously the Soviet scrap situation cannot be very good for a while.

QUESTION: My other two questions are relatively brief. With regard to the total United States capacity production, what is the industry percentage of purely military steel requirements, and what percentage is roughly for automotive steel requirements?

MR. WIEWEL: Well, I think that during the recent Korean episode the direct military took between 10 and 15 percent of the steel production.

I don't recall what the military supporting tonnage was because it was rather late in the period that this B classification was assigned. The B priority was assigned so the people who bought steel for military supporting end uses could classify it as military supporting. There was quite a while in the last two years when we did not know how much steel produced was military supporting. As I recall, the total direct military tonnage was about 15 percent at the peak. My memory isn't very good on that. That's my impression. I think some of you know the figures better than I do.

QUESTION: Mr. Wiewel, you said you were close to the control situation for quite a while and you indicated that could be reinstituted if necessary. I wonder if you will comment on your personal opinion of the efficacy of that or an improved control system.

MR. WIEWEL: That's a complicated subject. The CMP worked, of course, very well. In the War Production Board days, we were operating under an entirely different policy. I was very unhappy the way it worked in the in the recent experience I had in NPA. That was because we were operating in a dual economy. We had certain orders from Congress that certain civilian industries had to have certain treatment. We were walking a tight rope all the time between taking care of the military, which we all felt was what we were down there to do, and making this compromise of keeping certain industries going.

During World War II if a man was not in an essential military business, he didn't get any steel. It was too bad for him but there was nothing we could do about it. The rules did not permit us to take care of the luxury industries.

I have always felt that a controlled economy will not work, and I think our recent experience demonstrated that. We had plenty of complaints from the military, and many of them were justified, but they were nothing compared with the squawks we had from the jewelry manufacturers and consumer goods manufacturers of purely luxury items.

A totally controlled economy is difficult. It may run for a while when people are scared to death, but sooner or later their needs get so strong they want to ball up the system. In total warfare, where there's only one objective--that is to win a war--the attitude we had in World War II, it works fine. I think the military people were pretty happy with it after we got it rolling, when we began to understand it and got it working.

It was a very difficult situation for us in NPA in this last episode because of this continually necessary consideration for certain civilian end items which we knew were as unnecessary as could be, except to keep labor employed.

QUESTION: Mr. Wiewel, you mentioned as a result of the lowered price of scrap that there was activity or an attempt to export scrap at this time. Would you tell us where the potential high-price markets for this scrap might be?

MR. WIEWEL: I understand Europe is still willing to pay a good deal more for scrap that we are and I think Japan will pay more for scrap than we do; it is obvious. I have been away from that particular situation for quite a while, but this fact is self-evident. If the scrap dealers want permission to export scrap, you can decide right off the bat they can sell it abroad for more than they can get for it here. That is not abnormal. The price of scrap goes up and down. The scrap dealers buy for a low price and hold it. The industry turns around, the demand is strong, the price goes up, and they sell it for a profit.

That's a normal function of the scrap industry. The scrap dealers don't like to hold scrap too long. They don't like to see the price going down. It may go down some more, as steel prices recede, until scrap sells at a price where it is in competition with pig iron; then people are going to increase in charge of scrap in the furnaces and the price strengthens.

QUESTION: Mr. Wiewel, you mentioned the denial of the steel capacity of Europe in the event that capacity was overrun. That subject had some research in Europe and the scientists who were making the study concluded that, because the manufacturing area is so widely dispersed, it would not be feasible to deny these areas. I can't reconcile those things in my mind. Would you discuss that a little further? There may be a key in there that we missed.

WE. WIEWEL: I understand it is difficult. It depends on the type of plant. There are two or three pieces of equipment in every steel mill that if destroyed, the plant will be crippled. One thing to be done is very simple--shut the furnaces down when there is molten steel in them and let it freeze. It takes months to dig that out. Then there are key motors, big electric motors, that drive the mills. Even with the highest kind of priority I think it takes from 8 to 10 months for GE or Westinghouse to build one. If the motors are destroyed, the steel plant does not operate.

It is a very simple matter. I don't mean to say we could destroy these mills quickly so that they would never operate again, but it would be quite a job, and I think they would be out of business for a year or more for complete production. Every mill has two or three key spots--they could pick out those spots in the mill and destroy them. We could retard the use of the European steel industry for a substantial period. Eventually, the war lasting long enough, they could come back in operation.

QUESTION: I am wondering a little about the relationship between the petroleum industry and the steel industry. How dependent is our petroleum industry on steel in wartime for expansion?

MR. WIEWEL: It just happens that I recently got some information which surprised me, I talked to one of my old friends who was the director of purchases at one of the big oil companies. He showed me a chart of his company's purchases. If I can remember the figures correctly, including transportation facilities and marketing facilities, but excluding tankers, I think his chart showed that 60 percent of total purchases went into the steel industry.

The petroleum industry is absolutely dependent on steel for pipelines, drilling equipment, all of the tools. Of the equipment in the refineries, probably 95 percent is steel pipe, tubing, structural, plates, and so on. The petroleum industry is one of our best customers. The tonnage is substantial. Their biggest single item is steel, a large percentage of their purchases.

I didn't answer your other question. The automobile industry, as it goes up and down, has taken from 12 to 25 percent of the steel capacity--22 to 25 percent was reached last year. That is abnormal and probably will never be reached again.

QUESTION: Mr. Wiewel, you mentioned the import of ore. Am I correct that the east Coast facilities for physically handling imported ore are somewhat limited and somewhat centralized in a few locations?

MR. WIEWEL: I think that's right. Most of the ore I think comes in at Baltimore and Philadelphia, and of course Sparrows Point, from South America. I don't know about ore loading docks anywhere else. That is specialized equipment. I don't think there's any in New York. I think it is limited in its scope.

QUESTION: I would like to go back to the Soo Locks proposition. Assuming there was no water transportation of ore from Minnesota, or above Minnesota, what would be the estimated increase in the price of steel if all the ore had to be shipped by rail to the refineries in the East?

MR. WIEWEL: I don't recall the freight rate on ore to the producing districts. Of course if they are Chicago, Cleveland, Pittsburgh, and so forth, it would be substantial. I think 15 or more dollars a ton would be a very conservative increase, because the handling problem is much more expensive and it can be done only with government action, actually, commandeering railroad cars and right of way--train priority. We would probably have to haul ore all the year round, which means handling frozen train loads. That's very expensive. That is a terrific job.

QUESTION: Mr. Wiewel, in your discussion of shortages you mentioned that when you were chief of the Metals and Minerals Branch you had difficulty getting people to discuss the shortage of manganese. I wonder if you would expand on that. It would appear to me you would have to bar your door to people who would want to discuss that subject.

MR. WIEWEL: The industry people were interested in it. What I meant was, I couldn't find anybody in the government circles. I can't expand on it. It was never discussed. The only thing I was told was, "We are in good shape on manganese." I doubt it. I must speak without knowledge of the facts. I had quite a bit of stockpile information while I was on that job, but I didn't get any on manganese.

I am speaking without a really good knowledge of the facts. We should have a big ferromanganese stockpile in this country. I may be entirely wrong in thinking we do not have it. It is so vital that it is one material we can have too much of rather than too little.

QUESTION: I was wondering, if it is not giving away trade secrets, whether I might ask how the titanium development is in comparison with its competitive metals--for example, at one time, aluminum was hard to produce because its costs were so high. By that I mean the costs were so high in comparison with steel. I understand titanium is now becoming somewhat competitive, or will be sometime in the future. I wonder if you will comment on how far along that development is.

MR. WIEWEL: Compared to the present price of aluminum, it is not very far along. Crucible has a titanium subsidiary. I happen to know something about the titanium business. The future possibilities for titanium are fantastic. In no way could it become a competitor, from a price standpoint, to anything else--aluminum, steel--in the near future.

We get about 20 dollars a pound for sheets and about 12 dollars a pound for billets. The titanium industry is in the same position as the aluminum industry was long before Hall discovered his cheap method of making aluminum. Sponge at present sells for five dollars a pound; that is what we buy it for. I am reliably informed there is very little profit for the sponge makers in it. Their production is being improved. I am sure their costs will eventually come down.

The informed people in the industry think that titanium will not be used in tonnage for civilian end uses until some other genius like Hall comes along and develops some entirely new method of winning titanium from the ore and reduces its price.

For some things like military aircraft and some pieces of equipment in chemical plants, it is worth what it costs, because its properties are so unusual that you can disregard cost and still use it.

But so far as its being a competitor to aluminum, that's a long way off; but, it's coming. I think the scientific mind in this country and the numbers of people that are searching for this very attractive goal are such that some snake doctor one of these days is going to come up with something and we will have a moderately priced titanium.

It doesn't have to compete with aluminum when the market widens. The first thing it will compete with successfully is steel. It is so much lighter and the physical properties that can be developed are so wonderful that it will attack stainless steel and high-strength steel before it will aluminum.

QUESTION: On the subject of titanimm further, what about our potentialities? What about our resources to produce titanium in the quantities required?

MR. WIEWEL: I think it is one of the most plentiful metals in our hemisphere. There are simply enormous deposits of titanium; that's one thing, if we ever learn how to make it cheaply. I don't know whether it is the third or fourth most plentiful metal in our country. Between the United States and Canada, we definitely have titanium galore.

QUESTION: With our present production methods, is it economically feasible to produce quantities of titanium such as we might require in a future emergency?

MR. WIEWEL: No; it would mean the expenditure of millions and millions of dollars to produce relatively small quantities of titanium sponge and titanium metal. The present production is small. I don't know how much we will need in an emergency. That goes back to the designer of military parts. But it would take quite a while to build up our tonnage. I think some of you gentlemen know that sponge is the bottleneck. I think the plan now is to have from 30,000 to 35,000 tons by 1956 or 1957. In my opinion they won't have it by that time, because it is difficult and they have been too slow starting. Quantity production of titanium probably will await some cheaper and better process for its refinement from the ore into sponge or titanium itself.

COLONIEL O'NEIL: Mr. Wiewel, in behalf of the college, I thank you very much for a very interesting lecture. You have given us a lot of good material for our discussion groups this afternoon. You hit the button on the head as to the scope of this lecture this morning. Thank you very much.