IRON AND STEEL MATERIALS

4 October 1950

CONTENTS

Page

INTRODUCTION--Colonel M. T. Smartt, USAF, Member of the Faculty, ICAF 1

SPEAKER--Dr. Donald M. Fraser, Chief Geologist, Bethlehem Steel Company..... 1

GENERAL DISCUSSION..... 8

Publication No. L51-28

INDUSTRIAL COLLEGE OF THE ARMED FORCES

Washington, D. C.

Dr. Donald M. Fraser was born in Ordway, Colorado, 1 June 1903. He received his B.A. and M.A. degrees from the University of Oregon and his Ph.D. degree from Columbia University, after which he joined the faculty of the Department of Geology, Lehigh University. For many years he was a consulting geologist specializing in iron and steel materials. He has been with the Bethlehem Steel Company since 1941. During recent years, he has visited prospective raw material properties in various parts of the United States, Canada, South America, Mexico, Europe, and West Africa. His present position is that of Chief Geologist, Bethlehem Steel Company. He is a member of the Geological Society of America, Mineralogical Society of America, American Institute of Mining and Metallurgical Engineers, American Iron and Steel Institute, and Sigma Xi.

IRON AND STEEL MATERIALS

4 October 1950

COLONEL SMARTT: Gentlemen, this morning we have the first of a series of five lectures on resources. Colonel Hickey has already pointed out to you the importance of natural resources in industrial mobilization.

The steel industry is the backbone of our industrial machine, and one of the basic industries upon which the rebuilding of our military machine will so largely depend. In your studies in industrial mobilization the question of steel will be ever-present. It will confront you in production, allocations, priorities, and again in economic potential.

Since steel plays such a prominent part in our mobilization plans, it is necessary that we give consideration to the natural resources required for its production. We are fortunate this morning in having as our speaker the chief geologist of the Bethlehem Steel Company, who will speak to us on the subject, "Iron and Steel Materials."

It is a pleasure to welcome back to this platform and to introduce to you, Dr. Donald M. Fraser. Dr. Fraser.

DR. FRASER: Colonel Smartt and gentlemen: It is an honor and a privilege to be able to speak to this group. I have attempted in my talk in previous years to give a few statistics in connection with some raw materials. However, I have found I was often wrong. They are available, for the most part, in trade journals--"Engineering and Mining," "Mining and Metallurgy"--or the publications of the Bureau of Mines. Many of the statistics I quoted should have been brought up to date from those publications or periodicals, but I always relied on Mr. Melcher and his associates in the Bureau of Mines, who previously were in attendance. So, naturally, I hope you will not ask me many questions about statistics. I used to tell my students, when I was teaching at Lehigh, to look up these things for themselves. That is always the recourse when the instructor does not know what it is all about.

The basic raw material, as we all know, is iron ore. You cannot make steel without iron ore, limestone, and coke or coal although in past years charcoal was used, and even shells, to replace the limestone. We might first review some of the present sources, domestic and foreign, some of the potential foreign sources of iron ore, and some of the potential domestic sources.

At the present time the Lake Superior district is still the big producer of iron ore in this country. There are still many open-pit deposits being worked in the Lake Superior district that have considerable reserves. But those are not so large, potentially, for future supplies as they have been in the past.

When we are dealing with the depletion of iron ore, it does not necessarily mean the United States is going to be deficient in iron ore for future generations, but it is going to be deficient in the deposits from which production can be quickly increased. I think that is a very important point. I am not so sure it has been emphasized enough. The supplying of iron ore in the future is not going to be easy. With increasing demands we can see that most of the producing mines are going to be taxed to capacity. We will need all the mines that are going to be found in the next few years.

The biggest production of iron ore comes from the Lake Superior district, with smaller amounts coming from the west coast, the Rocky Mountain district, the Southeast, and the Northeast. There are many potential sources in Canada. You have heard of the Labrador-Quebec development; however, this operation will require the building of some 300 or 400 miles of railroad. In addition, it is in a district in which there will be climatic difficulties. We do not know when the iron ore will be coming out of that easterly area via the Seven Islands location on the St. Lawrence River. But it will certainly be several years. Among other Canadian deposits is the mine at Steep Rock Lake which is being worked at the present time. It has a large reserve.

The iron ore used in this country approaches approximately 100 million tons a year. Bethlehem is now going into operation on a deposit in Venezuela that has taken us 10 years to develop, and where we have a reserve probably not exceeding 100 million tons--in other words, approaching a one-year supply for this country. The new find of the United States Steel Company, in which its representatives believe they have something in the neighborhood of 500 million tons, is a big deposit but will not supply the entire demands of this country except for a short period of time. With these thoughts in mind you can appreciate the fact that although foreign ores are important to the steel industry we still rely in large measure on domestic sources of supply.

In the future we can all look toward the development of taconites. Recent publications have indicated that the problems of the taconites have been solved, but a lot of work still needs to be done. Several different companies, approaching it from different angles, have worked on the problem. To put the taconites properly into operation requires a very expensive and complicated plant, which takes a long time to build.

Its capacity can be increased only by putting up an additional plant and not by putting more tonnage in an already built plant. Therefore taconites are not going to be a very satisfactory replacement for the open-pit deposits.

Other sources in the United States for future supplies are not very widespread from the areas in which mines are now operating. Recently we have done some work on an iron ore deposit in eastern Pennsylvania. Information on it has not yet been released, but I think we do have something that is pretty good. Because it is so close to our plant--it is within the eastern part of the country--we believe it is going to be very helpful as an additional source of supply once we get it into operation.

Now let us turn to some of the foreign sources. At the present time iron ore is coming in from Chile. In the last few years close to 3 million tons per year have been shipped in from there. There are also some small quantities of iron ore coming in from Brazil. We are starting production in Venezuela and in recent years have purchased between one and two million tons of iron ore per year from Sweden. This will continue to come in as long as transportation is possible. We are now purchasing iron ore from Sierra Leone, West Africa, and two or three of the North African deposits. Bethlehem can use more foreign ore than any other company due to the location of its plants, especially the Sparrows Point plant at Baltimore. United States Steel is putting up a plant near Camden, which means it will be in the market for foreign ores. While some foreign ores will be used, in most instances the supply will be cut off or sharply curtailed in the event of war.

Do not forget that iron ore, also limestone, and some of the ferroalloys, which are very important raw materials, may not be in sufficient quantities to meet the demands a generation or two hence. So that all the work being done at the present time is not coming any too soon.

The various problems connected with the treatment of iron ore sources might be mentioned briefly. For example, taconites can be ground and the iron ore separated by magnetic methods. The resultant product is a very fine-grained iron ore, or iron oxide, which cannot be fed directly into the blast furnaces because it would choke up the blast furnaces. Many times it is too fine-grained even to be fed in quantity to a sinter bed. A simple mechanical thing such as not being able to get sufficient draft may be very serious when you are dealing with large tonnages of materials.

We have tried to pelletize fine ores, produced by magnetic separation from the ground taconites, by putting the moist ore through a rolling drum, which rolls it into a ball. These balls are heated to drive off the moisture and harden them into pellets. Although the resulting pellets are

surprisingly resistant, they will not stand extremely rough handling such as occurs in transferring ore from cars to ship or from ship to cars.

Now it sounds like a simple problem, but really it is not. You are dealing with something that will run into millions of tons. Unless you have a simple operation, one that is not going to fail you in an emergency some other method must be devised. One of the most recent ones is to extrude or force the finely ground ore out like toothpaste from a tube. In the case of some ores, they are almost self-cementing when forced out under pressure. When one thinks of forcing a large tonnage out of a 1.5- or 2-inch opening it is apparent that a continuous, rapid operation is necessary. Extrusion and pelletizing are two processes for handling finely ground ores, which are being studied at present.

There are many problems connected with handling low-grade ores. I have dwelt on this more than in previous years because it is a simple thin to say we have plenty of iron ore at the present time; but we also have to think in terms of where are our future reserves and how can they be made usable.

Let us shift now to a brief consideration of coal. The coal supplies in this country are simply enormous; however, the supply of metallurgical coal is not. Metallurgical coal has to have a low-ash content. It has to be low in sulphur, too. We like to have it less than 1.5 percent sulphur; in fact, we prefer to have it less than one percent.

The coal, of course, can be treated. Some of the sulphur is lost in the coke ovens, but not all of it. The smaller the percentage of sulphur that goes into the furnace, the better the operation. The supply of good metallurgical coal is not unlimited. We are far better off, of course, than most countries in the world; but for efficient operation, free of difficulties, we want the best materials available. Studies are being carried on at the present time concerning the beneficiation of high-sulphu coals. We hope, with the optimism that is always present in this country, that the problem will be solved. I think it will be although it is not an easy one.

Let us now turn our attention to limestone. You all know that limesto is abundant throughout the United States, especially in the East. The entire great valley extending from New York State through eastern Pennsylvania, Virginia, and down to Alabama is underlaid with limestone, but we are having a deuce of a time finding stone of suitable quality. It is not just a matter of getting the limestone. Some operations require dolomite (high-magnesium carbonate), while others need high-grade calcite (calcium carbonate), and both demand stone low in silica and sulphur.

The supply can be increased if we go to lower-grade material. But as soon as you do that, you cut down on the volume of production from your furnaces. There are problems involved even with a simple thing like limestone. So far as the blast furnace operation is concerned, it is to our company's interest and the industry's interest to furnish the best materials available.

Of the entire series of ferroalloys I know we are all interested probably foremost in manganese. It is a subject uppermost in the minds of industry, of the country's defense forces, and of politicians, too. At the present time industry is obtaining most of its manganese from foreign markets. Most of the manganese comes in from foreign countries. In time of emergency a number of smaller sources in this country go into production because the price goes up and it is possible to work a small, low-grade deposit by beneficiating the ore.

At present the big shipments come from India and Africa, both South Africa and the Gold Coast, and a little from North Africa. With reference to the supplies from India, the transportation lines will be most difficult to handle in event of war. The Russian supplies, which formerly were received in considerable quantity, have been practically cut off.

We have been forced to turn to other supplies because we, in this country, do not have enough manganese. Brazil has several deposits. There is one practically in the center of South America which is quite large, containing 30 to 40 million tons of manganese. However, it has one bad geographic feature--it requires 1,700 miles of river haul or 1,200 miles of railroad haul over railroads that are not in first-class condition. Furthermore, it has certain chemical difficulties in that it has a 4-percent content of alkalies, that is, soda and potash. Possibly 25 percent could be used in furnaces in the making of ferromanganese, but any greater percentage of alkalies would react with the refractory materials, necessitating the relining of the furnace in a short time. As you can see, gentlemen, it is not a very desirable source.

There are several other sources in the central part of Brazil--Minas Geraes, one example--but they are being retained by the Brazilian Government for their own use.

Bethlehem is now working on a deposit in Brazil just north of the Amazon, within one degree of the Equator. We have been down there nearly a year diamond drilling and have put in thousands of feet of diamond drill holes. We do not know as yet whether in the end we will have anything that will justify the expense. It will take 130 to 140 miles of railroad. It is in pretty rough, jungle country, so railroad construction would be difficult. Therefore we must have a large deposit in order to justify our going in for it. We do think it is going to be good. This ore will come out by railroad near the port of Macapa on the north bank of the Amazon

about 170 miles from its mouth, and then be shipped by boat to the United States. We hope that supply line could be maintained during an emergency. It is good manganese and may develop into one of the most important sources of supply for this country within the next few years.

I might add that the Indian manganese is abundant, so far as we know, although I have never been there. It is quite difficult to get the manganese out because of the mixed up railroad situation in India. In other words, there will be several changes in one strip of road--a small or narrow gauge may become broad gauge and then change back to narrow all before you finally get to the coast. You may know a good deal more about that than we do. The information we have is picked up from people who have been there and from railroad guides. It would be a difficult thing for an American company to go in there at the present time and try to develop the raw material. During a war what chance would you have? We think we had better concentrate on the Western Hemisphere.

Then the question comes up: What are the sources of manganese in the United States?

Well, there are three outstanding, large low-grade possibilities in the United States: One in Aroostook County, Maine, where the ore would require chemical treatment in order to obtain the manganese; one at Batesville, Arkansas, where the ore is scattered through decomposed material in such small concentrations that it is not efficient or economic to work; and one at Chamberlain, South Dakota, where many tons would have to be worked in order to produce a small tonnage of manganese. Those sources may well be worked in the future, but at the present time they are not economic.

Now, so far as the Aroostook County deposit is concerned, there is nc process that will efficiently recover the manganese on a large scale. Remember, it is one thing to have a laboratory experiment produce the desired result, but quite another thing to produce it in terms of tens of hundreds of thousands of tons.

The manganese picture is still a serious one. It has been serious for years. Stockpiling is going on but we do not have a sufficient reserve for any long-term activity unless we can bring in additional supplies from foreign countries.

Let us now swing to another one of these metals. Let us take up the sources of nickel. That is fairly satisfactory. Nickel from the International Nickel Company in Canada is obtainable. This company can increase its production somewhat. During the late war the Nicaro people produced nickel in Cuba, using as raw material an iron ore that contained around one percent nickel. They recovered the nickel by reduct

then leaching with ammonia. So that nickel can be obtained from Cuba through the renovation of that plant, or possibly building additional ones if the International Nickel's Canadian sources were forced to their limit and could not satisfy demand. Nickel is, of course, one of the important ferroalloys, but it is not so critical as some of the others because of the supply available from this continent and Cuba.

Cobalt is also produced in Canada, but the biggest source of supply comes from the Belgian Congo. I was trying to recall what tonnage of cobalt is used, but I do not remember. You will have to refer to some other source to find that out. It is in terms of a few thousands of tons.

The possibilities of producing cobalt in the United States are not good. We produce some cobalt in crude form in the sulphides that are concentrated in one of our mines in Pennsylvania. We do not refine the cobalt. Cobalt is one of the ferroalloys the supply of which would have to be watched pretty carefully in order to assure us sufficient quantities for an emergency.

Molybdenum is in a fairly satisfactory position with production by the American Molybdenum Company and the Climax Molybdenum Company. The increase that would be necessary in time of war may be met, but it would require someone far closer to these companies than I am in order to tell you just what percentage of increase could be brought about. I imagine up to a certain point the increases could be met by the molybdenum companies; beyond that it would require much more extensive installation and possibly would not be done in a reasonable period of time.

Tungsten, which is supplied to us chiefly from China and that general southeastern Asiatic district, is an important ferroalloy. Fortunately, the domestic supply is increasing. In connection with some of the states in the western part of this country, tungsten sources have been uncovered and production is increasing.

Again we are faced with a situation of trying to use the same materials that have been used in the past. During the Second World War a number of suppliers of special installations were forced into different ferroalloy combinations and they found that some of those so-called substitutes were far better than the alloys they had been using.

I am not sure that is prevalent in all industries as much as it is in the steel industry, but I am inclined to think so. Once you get a process working, it is difficult to get the operations people to make a change. The research people may feel confident a change is desirable, but it is not an easy thing to get the operators in the company to make the change.

There are other ferroalloys, but I do not know a great deal about the use of them, the way in which they are handled in the electric furnaces or in the open-hearth furnaces. The operations vary from plant to plant. For instance, on the raw materials with which I am acquainted, I know the operations within our own plants vary in the use of them.

I feel that I am not going to be able to help you much on many of these metallurgical questions. I do not think I have much more to add.

Thank you.

QUESTION: Doctor Fraser, would you tell us a little about the role of scrap in the production of iron and steel?

DR. FRASER: I should have mentioned that.

The scrap picture has been one that has been governed, in effect, by the dealers in scrap; in other words, it is governed by the price rather than the demand. More scrap will naturally be used as the price comes down. Whereas a couple of years ago we had hoped to obtain a large supply of scrap from foreign ports, say Japan, China, the South Pacific district, very little has come in. It is a question of getting it togethe transporting it to a port, and shipping it. I know that two years ago we were using, I think, about 23 million tons of scrap. Frankly, I do not know the figure now, but I would judge it is somewhere between 20 and 25 million tons of scrap. It is not a serious problem at the present time.

However, with the continuance of maximum production the situation in connection with furnace scrap is going to become serious. The scrap is being used up faster than it is being made. Unless there is some additional source of supply the total tonnage of scrap is going to be decreased. That will in turn require more of the high-grade ores. You see, the scrap is fed in large tonnages into the open-hearth furnaces. The only substitute for that is to use high-grade ore. You cannot efficiently put low-grade ore into an open-hearth furnace. That does not mean the stopping of the operation entirely, but it does mean its curtailment. If you do not have enough of the high-grade ore, you do not produce as much open-hearth steel. Much of the ore that comes from the Lake Superior district is not suitable for open-hearth furnaces.

You have in all probability heard of lump ore. Well, that is typical open-hearth, charged or feed ore. And one of the reasons why we are so pleased with the deposit in Venezuela is that we have had several drill holes going down 400 feet, with an average of 69 percent. Now when you realize that pure hematite or magnetite runs from 70 to 72 percent and we have several drill holes averaging 69 percent, or over, of practically pure iron ore (iron oxide), which is excellent for open-hearth ore, you can see why we are so encouraged.

The scrap picture is one in which, with continued maximum production, the supply of scrap is going to be decreased and we will have more and more demands on the better grades of iron ore. How long that will continue before there is a real pinch, I do not know. That is one of the reasons it is so important that we have our operation in Venezuela ready to produce as soon as possible. That will take the place of some of the scrap for our furnaces; also, it will make it available for other companies.

QUESTION: Not too long ago there was a picture in one of the papers showing a man beating on a fender with a sledge hammer, apparently with no effect. The fender was made of plastic.

That leads me to my question. I do not know whether it is appropriate to ask a representative of a steel outfit, but what effort is being made in industry, so far as you know, to substitute other materials for steel, particularly when you are in this critical stage that you envisage?

DR. FRASER: Well, the answer is that practically all these steel substitutes are produced in very small quantities. At the beginning of World War II even aluminum was produced in fairly small tonnages. Of course, as time went on production was increased tremendously and as it increased, uses for aluminum increased accordingly.

In many cases there is a double answer to your question. One is that the tonnage of the material is small; for example, with the plastics, lighter metals, and many of these other substitutes. Second, there are other uses for those materials. Usually, the demands for the material are as great as they are for steel. The big tonnages of steel go into structural steels, rails, sheets, and things of that kind. The small tonnages go into very important products, such as tool steels, special electric steels, and the raw material necessary for the high-speed tools. Incidentally, I noticed in the paper this morning they are already anticipating a shortage of high-speed tools--tooling machines like these multiple-drill boring machines, and similar things. So that we are confronted immediately with shortages. But the use of those substitute light metals, say aluminum, magnesium, and so forth, will have little effect upon the big tonnages of steel.

QUESTION: The question I have relates principally to the taconites. You described this process of separating the iron by some magnetic means. To what extent will the use of this lower-grade ore increase the final cost of steel in the future, particularly as it relates to the transporting of that ore to the place where it is to be used?

I would like to add one little subquestion to that, if I may. This separation of the iron that you described, in the form of powder or small pieces, is that done in the Lake Superior region before it takes its boat ride, or is it done later?

DR. FRASER: I will answer the second half of your question first and get that off my mind.

It is done in the Lake Superior district as close as possible to the source of raw material in order to eliminate the charge for transporting a high percentage of waste material. I will give just one illustration: Taconites run from 20 percent up to 35 but mostly around 25 percent. So you see you are really dealing with something of rather low grade.

Referring to the other part of your question--I am not sure I clearly understand what you have in mind--the powdered material may be magnetic, in which case it is separated by a magnetic method; or it may be nonmagnetic, in which case the ore is given a reducing roast and is then sent to the magnetic separators. All of those processes take both time and equipment. The production of taconitic materials is bound up unavoidably with a number of processes that are very slow.

The cost factor was one that I left out of this discussion. Of course any company in any industry in peacetime is interested in the economics of the situation. We are trying to get all these processes that have to be applied to the production of taconites down to the point where they can be used and at the same time meet the present market price. Iron ore at the Lake Superior port has gone up about 50 percent as against the price before the war. When the price of treating taconites meets the cost of the other available ores, you can use it if the process is satisfactory. However, there is an important angle to that. The processes are not very satisfactory even at a greater cost. We are still not at the point where we can go in and install a large plant for production. We are getting close; we think it is about solved. However, it still is not accomplished The cost will have to meet the cost of the raw materials.

QUESTION: Doctor, could you tell us some of the possibilities of the titaniferous ores?

DR. FRASER: The titaniferous ores are abundant in Canada and the northern part of the United States; that is, there are several great deposits of titaniferous ores that are measured in terms of tens of millions of tons. There is a unique deposit at Allard Lake, in the northern part of the St. Lawrence River, which is now being worked on by Kennecott Copper and New Jersey Zinc to produce titanium.

Titanium, as you know--probably you have seen many references to it--is a relatively light metal with great tensile strength. When I say that, I have about gone my limit because I do not know the specific uses for the titanium metal. I only know that, where you need small diameters for

things like wires, rods, or shapes, titanium is an excellent material because of its great strength, which exceeds that of steel. It is one of those new metals that as the cost goes down new uses will be found for it. I do not know enough about the high conductivity and behavior of titanium under high temperatures to discuss them.

COMMENT: I believe there is one point you might profitably explain to this group, Dr. Fraser, and that is the specific use for the ferroalloy materials and their possible interchangeability.

DR. FRASER: I only wish I could do so. Earlier I made one comment to the effect that some of the substitutes that had to be used during the war resulted in a better product than was produced from previously accepted ferroalloys. Again, I am not qualified to speak on what was produced or what uses prevailed in the ferroalloy field. I just do not know much about it.

Anticipating some of the questions that might come up outside the field which is immediately mine, of furnishing a company with sufficient natural resources to keep it running, I talked with some of the people in our company and they immediately asked me if I understood all the ifs, ands, and buts involved. Frankly, gentlemen, I do not know enough about it. I am not even sure that for a group who has not made a special study of it, our experts would be of much use. For one thing, they would immediately get to using very complicated scientific terminology, explaining all about the molecules, and so on, all of which would be interesting if you understood it.

QUESTION: Dr. Fraser, is there any connection between the location of the steel plants on the west coast that were developed during the last war and the availability of raw material in that area, or was it for other reasons that they were located there?

DR. FRASER: I should say that is a debatable question. However, I can give you the picture as I see it.

The supplies of raw materials on the west coast are fair regarding iron ore; that is, no big deposits but several that would approach 20 to 30 million tons.

The sources of coal are very unsatisfactory. Coal in Utah and Oklahoma, as sources of fuel, has been transported to the plant in California, which is very inefficient and uneconomical. Over the last thirty years we have made several studies of the possibility of installing blast furnaces on the west coast. All those studies have come up with the answer that now is not the time to do it.

There are coal supplies in Alaska and British Columbia, but for the most part the noncoking coal is not very abundant. Most of the coking coal is badly scattered. I inquired about the shipping season in the Pt. Barrow district where coking coal is reported and was informed that a government boat was sent in, but before it could unload and get out again it was locked in for the winter. We decided it was not a very satisfactory shipping situation.

Apparently there are some coal supplies available in the North, but the supply of raw materials for the west coast plants is not satisfactory.

QUESTION: I was wondering what the possibility is for the expansion of iron ore or the steel industry in the Rocky Mountain area, particularl around Lake Geneva, the big plant up there in Utah where they are close to coal supplies? What is the possibility of developing iron ore deposits in that area?

DR. FRASER: Iron County, Utah, has several hundred million tons of iron ore in reserve. Limestone is also available.

The difficulty there, though, is the long haul of the finished produc to the market. That all comes down to the economics of transporting the finished product in any large quantity. Now if you are referring to the putting in of an additional blast furnace, there is not a sufficient market within a reasonable distance to use it. It would have to be haule east, pretty far east, or down to the Gulf region, places like that. Th is quite expensive. All in all, it is a sizable item.

QUESTION: Is it cheaper to haul the raw material than it is the finished product?

DR. FRASER: No. You would never haul the raw material to the East. It is costly to haul raw material long distances. When we send material west, as we do to the west coast, they go by boat. It is well to remember that we can haul iron ore from Chile cheaper than we can haul it from, say, southern Virginia. Some of the transports we use may not look like much alongside a battleship, but they were very effective. Ou record time for loading a 26,000-ton ship is 40 minutes, but I hasten to add that it took a little longer to unload once it got to Sparrows Point

COLONEL WATERMAN: As long as we are on the subject of geographical locations, there has been considerable clamor in the New England area fo a basic steel plant up there. I wonder if you would comment on the economics of that?

DR. FRASER: I saw recently where Rhode Island had been finally chosen by representatives of the New England committee as the location for a basic steel plant. They are looking forward, I think, to the time when they will be able to obtain ore coming in from the Labrador-Quebec district.

We put it into the same category as the South American countries. We do not think it will be economic; it may work out. But they certainly are not going to take over. I am confident Bethlehem, United States Steel, and a half dozen of the other companies are not going to pull out of New England and let this new plant serve the area. They are going to be in the position of competing with other companies, especially Bethlehem.

QUESTION: You gave us a little insight into the cost factors for example, between processing the scrap steel and the high-grade ore. Now, would it not be profitable to pay a little higher price for getting this scrap steel?

DR. FRASER: I cannot be specific on the cost, but I can tell you this: At the present time the practice indicates scrap is desirable. We pay up to $45 a ton for scrap, whereas lump ore brings less than half that price. Although the lump ore has decreased in price, even then it is not more than one-half or one-third as valuable as scrap.

Scrap will be used whenever it can be obtained, even at the higher price—up to a certain point. There again sometimes a process or a method in the operation will go on even beyond the economic point of change simply because they hope they won't have to change the whole process. A 1,200-ton furnace will use about 3,000 tons of raw materials during a 24-hour period. And when you are feeding that material into a furnace you do not want to change your operation very much if you think the change is going to cause a hanging up or a breaking down in the procedure.

QUESTION: In your talk you mentioned a factor which is of considerable interest to us in another course we are taking now, that is, the inherent conflict between the research man and the production man. In the chemical industry, as an example, I think the research man has been able to carry his reporting channels clear up to the chairman of the board or the president of the company. In the steel industry, have they been that successful, or would you care to comment on that?

DR. FRASER: Yes, I would like to comment on it because I can see both sides.

The research department is continually working in the various plants in an effort to devise better methods. For example, in some operations they have shown that a change of as little as one-tenth of one percent can make a big difference in a finished product, which will eventually affect the cost. The average operational man hasn't any use for such falderal as long as the thing is operating reasonably successfully. In some instances where they have been forced to try new things, they just hope something else will go wrong so they can blame it on the change that was made. I do not for one moment want to make that as a blanket accusation. That would be giving the wrong picture.

On the other hand, the research man, if he is an experienced man, realizes what the problems of the operating man are. But there are not many of the well-trained, aggressive, capable young fellows who can see that something should be done. They have not yet learned that you have to take your time about some things and cannot force a change immediately.

I might add there is very close liaison between the research department and the top "brass" of Bethlehem. Those people have a chance to get their problem right up to the top level where it can be considered.

COLONEL SMARTT: Dr. Fraser, on behalf of the Commandant and the studen body I thank you for a very interesting discussion this morning on "Iron and Steel Materials."

DR. FRASER: Thank you, Colonel.

(22 Nov 1950--650)S.