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PROBLEMS AND TRENDS OF THE IRON AND STEEL INDUSTRY

by

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Colonel Jordan has done the usual Army trick of starting a man off with all that he can carry plus a little more. The recitation of all the things that I have done that I should not have done in the past puts me in a deep hole to begin with, and I am not sure that I am going to be able to get to the top of that hole before we get through here this morning. I hope, however, that you will forget what has been and let your final judgment be on the basis of what is.

At all events, I have to take exception to one thing Colonel Jordan said and that is that any credit is due to me for the war plan. I thought we had it agreed in his office just before we came in here that I would take whatever blame there may be for weaknesses or defects in details of that plan and that the credit would go to the other three men, so if you will make that revision in your mental recollection of these introductory remarks it will be very satisfactory to me.

I have taken the liberty of bringing down to you this morning certain pages of statistics, not with the idea that I am going to burden you with the recitation of those statistics and comment on all of them but because in that folder is a group of statistical tabulations that will provide you the background for a number of the topics that I want to discuss a little more in detail as we go through this morning's consideration. I put them on paper in order that you might have them as a part of your own possession to look back at and refresh your recollections of what we say about them this morning.

You may wonder why I picked out the particular dates that appear in the left-hand columns of various of those tables. I have deliberately chosen dates that are related to major activities of Army interest. The first date you will note, 1898, precedes the Spanish-American War. Immediately following is the date of 1900. Between the two you have a means of gauging the effect of war demand during that period on conditions of activity in the steel industry. Then we come to 1913 and 1919, which obviously explain themselves on a corresponding basis. Following that I have jumped to 1929 to give you the high point of

activity in the steel industry up to the present day: 1932 the low point of the depression period; and 1935 and 1936, the two years of latest date that may be of interest to you.

In the first table I have given you certain general statistics relating to the industry which will help to orient you with reference to the magnitude and activity of this basic industry. Of course I do not need to explain to you that the steel industry is quite as important in time of peace as it is in time of war, or quite as important in time of war as it is in time of peace, whichever way you want to put the ideas together. It is an industry that involves the investment of tremendous sums of money and that investment of money is one of the principal problems of the industry.

Perhaps I should interrupt myself there to tell you that when I was talking to one of the men in the industry about speaking to you on the subject of "The Trends and Problems of the Iron and Steel Industry", he said: "Hell! That is easy. All you have to do is tell those fellows that the trend is backward and the problems are insoluble." If you want to dispose of it briefly, you have a complete answer there. I am not sure, however, that I fully subscribe without any qualification to that summarization of the situation. It is true that the trend of activity is downward at the present time and there are some very tough problems facing the industry, but it has always had tough problems. That is one reason why it is a very interesting industry to be connected with.

I want you to note particularly in connection with the huge investment in the industry set forth in the first table of the pamphlet, the comparatively small amount of annual earnings, even in a year like 1936 which was not such a bad year. It represents about 4½% on the investment. In other words, without doing any work at all and putting your money in the savings bank you come out about as well as you would in the steel industry in a good year and better than in a poor year.

The value of products sold is one item which helps to explain why the return on the investment is small. Steel is a low priced product, in spite of all that some of our forthputting economists would have you believe. I suppose why some people think of steel as a high priced product is

because we talk about the price of steel per ton and we do not buy anything else per ton. We buy rubber, sugar, flour, lard, and all those things by the pound and the price is figured in cents, but when we talk about dollars per ton for steel it looks like a high price. As a matter of fact, steel sells at 2¢, 2½¢, 3¢ a pound, and is a low priced metallic product. You cannot find any other metallic product in that price category. That is another idea to put along with some of these general ones that will help to orient you in your consideration of the industry.

I would like to have you look at the table at the bottom of page one. I want to make a few remarks about these tables before we leave them. Note the consumption of materials per ton of pig iron produced - that is, they are the raw materials for pig iron production - and especially note that there has been relatively little change in the relationship of the materials going into the production of pig iron over a period of almost forty years, which is the length of time covered by this table. There has been a little reduction in the amount of iron ore used; a little corresponding increase in the amount of scrap used; a little reduction in the amount of limestone involved; and a little reduction in the amount of coke consumed. Those are the measures of increased efficiency in the operation of the blast furnace, but nothing spectacular.

In the next table on the second page I have given you the relationship between capacity to make steel, which is the second process in the operation, the production of raw steel, the production of finished steel products, and the relationship between finished steel production and raw steel production, showing the diminishing yield of finished products from the raw form. We start out in 1898 with more than 90% of the raw steel still appearing in the finished form in which it is sold to the user. Then we come down to the present time and find that there is barely more than 70%. We have an increase of twenty points in the percentage scale there in the amount of loss of steel in the processes of manufacture. That is one of the very striking trends in the steel industry over the period shown. That trend is due to a combination of factors, one factor being a change in the balance between the kinds of products that are being made from steel now as compared with those made thirty or forty years ago.

In the earlier days, at the beginning of the century, a preponderant part of the tonnage of products made from steel ingots, which is the name we apply to raw steel, was in heavy items such as rails, plates, structural shapes, and articles of that sort; today a constantly increasing percentage is in the more highly finished items such as tin plate, sheets, hot strip, wire, etc. In order to produce those more highly fabricated articles a much larger percentage of the steel that comes out of the furnace in the form of an ingot is lost as scrap at one place or another in the operation as it goes along.

If you will skip the next table on that page for a moment and look at the table at the bottom of the page you will see an illustration of the point that I was just making - the shift in the balance among the principal classes of rolled steel products over the years, the tendency of the items at the right-hand side of that table to increase in proportion to the items at the left-hand side, the left-hand items being the heavy products and the right-hand items being the lighter, more highly finished products that I mentioned.

Coming back to the second table on page two, I would like you to note the decreasing percentage of pig iron entering into steel making. That is a second very significant trend in the industry. Of course the converse of that is the increasing percentage of scrap going into the manufacture of steel, because you have to get your metal from somewhere. The metal comes from two sources: from pig iron and from old scrap. Forty years ago very little scrap went into the steel furnace, less than ten percent. Today very close to fifty percent of the metal going into the steel furnace comes from scrap. That is one reason why there has been lately such a tremendous general interest in the heavy export movement of scrap to countries like Japan, Great Britain, and Italy, the tonnage this year running in excess of three million tons, possibly it will reach four million tons before the end of the year, and the agitation from various sources to restrict the exports of scrap on the ground that it is material that we need for our own industry and should be conserved for that reason.

There are other figures in the pamphlet which you can look at for yourselves as occasion offers, and then at the end there is a map, which really is a school map, that I

took the liberty of putting in because it gives you a bird's eye view of the geographical distribution of the raw materials: coal and ore, going into the production of pig iron, and the location of blast furnaces. On the reverse side of the map the location of the steel-making furnaces, and an approximate indication of their capacities, are shown. So much for that set of figures, which will provide you the factual or the statistical background for various of the points that I want to make in this discussion.

In taking up the trends and problems of the steel industry I am not taking refuge in the idea that the trend is downward and the problems are insoluble. Trying to do something with the points that are involved, I want to run over certain broad items that I will indicate to you at the outset so that you may have them all in mind. In the first instance, I want to comment a little more on certain general characteristics of the industry; second, more details in regard to materials and products of the industry; third, the labor factor in the industry, which latterly has been one of the most absorbing of all the questions with which the industry has had to deal; fourth, the matter of products and their uses; and then finally a summarization of what may be called the outstanding current problems with which the industry is dealing. There is not necessarily any close tie between some of these topics and others but they seemed to me to be the items in which you are likely to be most interested from the angle of approach that you have to the steel industry.

The general characteristics of the steel industry I would like to enumerate, perhaps at the expense of repeating what I have already said in part.

The fundamental importance of the industry.

It seems to me beyond all question that there cannot be a profitable economy and a growing successful economy in the United States, using economy in the sense of the old political economy, if there is not a successful and growing steel industry, if for no other reason than the one reason that the products of the steel industry are so far reaching in their applications in all of the forms of industrial activity. When you talk about agriculture, mining, forestry, manufacturing, or whatever other kind of activity the people of this country might profitably engage in, products of the

steel industry are fundamental either in furnishing materials or supplies for carrying on all those phases of industrial activity. It is just as evident and indispensable a part of a successful and advancing economy as it is indispensable in the carrying on of military operations or the conduct of warfare. You might just as well set your mind to the problem of how you would carry on a military campaign if you were limited to wooden lances and bows and arrows as to figure how you would carry on a complex political economy without the products which the iron and steel industry makes available.

In order to provide what the country requires in the way of iron and steel in different forms and in the different quantities which may be demanded from time to time, a huge industry has been called into existence. There have been times, not very far back, when there was a tendency on the part of a good many people not connected with the industry to talk about surplus capacity in the steel industry, trying to create the impression perhaps that management in the steel industry had been unwise in expanding its facilities to a point that would not be justified by the needs of the country. I doubt if anybody who looks at the record dispassionately with reference to peace time requirements can arrive at that conclusion fairly, and I am quite sure that your friends who prepared the war plan would fully subscribe to the idea that the capacities are not at all in excess of what would be needed for the successful prosecution of a first-class military campaign.

The capital investment involved in making this industry possible is on a different scale from the capital investment in almost any other manufacturing industry with which you may come in contact. There are certain perfectly obvious reasons for that condition. I want to stress the problem of capital investment because it is an aspect of the industry which too many people are disposed to pass over and not give due weight in considering the trends and problems that the industry has to face. Steel mills or steel plants cover very large areas. If you have an opportunity to visit one you will get first-class preparation for the forced marches that military men sometimes find themselves compelled to take. I do not know of any harder work than to inspect steel plants. The forty mile jaunt that one of our former presidents prescribed for military men is child's play compared with day in and day out inspection of steel plants.

You cannot put steel-making equipment on the second floor of a building; you cannot carry on a steel-making operation in a loft building. It has to be on the ground, it needs something solid underneath it. Therefore, steel plants cover square miles. They stretch out for miles lengthwise. You must have a good industrial property site for a steel plant for one reason if for no other, and that is that you require a very large supply of water to make steel. You cannot run a steel mill without an adequate supply of water, and the requirement runs into millions of gallons a day for even a moderate sized steel mill. Therefore, your plant ordinarily is located along a river bank or close to a lake shore, and you know from your general principles of value of industrial sites that those are ordinarily the high priced pieces of land for industrial purposes.

The plant equipment also is tremendously expensive because of its massive character. I suppose it is a conservative figure to say that a modern mill for rolling rails would cost not less than four million dollars, probably closer to five million dollars. You might operate that rail mill from December until June in most years and have nothing for it to do the rest of the year. The big continuous hot strip mills, which probably you will have a chance to see if I judge rightly from what Colonel Jordan told me, can cost anywhere up to twenty or twenty-five million dollars. There are ten of those now operating in the United States and those are only to satisfy current new customer requirements for quality and quantity of hot strip and sheet products. You do not deal in small figures when you are dealing with the steel industry. You have to be prepared to spend almost as some of our Government alphabetical agencies spend, if you will pardon the reference.

Supplies of raw materials are very important in a fundamental industry like this. It seems to be essential to have control of raw materials: coal and ore, and the investment therein is also heavy. You cannot take the risk of being at the mercy of the open market because a fractional advance in the cost of materials has to be reflected in a very substantial advance in the cost of the product, and the market's irregularity as a result of such fluctuations would probably be disastrous to the consumers of steel products.

There are something over three hundred companies in the steel industry in the United States. Only about a third of those make their own raw steel, the remainder buy it and process it. There are something over four hundred plants making steel products scattered all over the United States, the general locations being indicated on the map that I gave you. I think if you will count closely on that map you will find that those locations are distributed among twenty-eight of the states, which means that to a very surprising extent the different parts of the United States have some share either in producing materials or in making products in the plants of the steel industry.

So much for the general characteristics of the industry, out of which the two really vital points that I want to leave with you are: first, the problem of investment; and second, the magnitude of the operations on which the industry is conducted.

The materials and products of the steel industry.

Fundamentally we are independent of the rest of the world for the common materials of the steel industry: ore, fuel, and limestone, which is used as a reducing agent, or as we say "a fluxing stone." That does not mean that we do not import iron ore, because we do. We import iron ores from Cuba, from Chile, from Newfoundland, from Algeria, and from Spain - when they are producing in that country. But, you cannot make steel according to present day methods merely with iron ore, coal, and limestone. There are other materials that are necessary. Manganese particularly is needed in making ordinary steel to act as a reducing and cleaning agent in the steel-making process, and of manganese we have relatively little. However, I will confess frankly that that is a point on which you get differences of opinion. There is a well known lobbyist here in the District who has been insisting for the last eighteen years or more that there is all the manganese that the United States needs in this country if the Congress will only put a high enough tariff on imported manganese to keep out the foreign competing product. At the same time, I think the people in the Bureau of Mines would say that the supplies of manganese ore in the United States are too limited to make it justifiable to exhaust them for peace time uses, that if they are to be used at all they ought to be conserved

for use in time of great emergency when supplies of manganese from the outside would not be readily available. We really depend on the outside world, therefore - Russia, Brazil, India, South Africa - for an important steel-making material, one that is fundamental and indispensable in the present processes of manufacture.

I think some of your military people have been actively interested in the possibility of building up a reserve stock of manganese ore (or of ferromanganese, the form in which it ordinarily is used) for no other reason than to have that as a cushion to lean on in time of emergency, and there is some real merit in that suggestion.

We also depend on the outside world for several of the very important alloying materials which are growing in importance in the manufacture of special steels. Nickel, which is an important element in the corrosion resisting and stainless steels, occurs only rarely in the United States; there is no commercial production of importance in the United States. We depend on the outside, principally Canada and New Caledonia for our nickel. We are poor in chromium. We have no tin for coating of thin sheets to make tin plate. I have listed the various alloying materials on the last page of the little folder that I gave you, in order that it would not be necessary to go into detail about all of them in the discussion, and to give them to you in a permanent form so that you might directly appraise the extent to which a basic metal-making industry, the iron and steel industry, is not self-contained within the limits of the United States.

There is far too frequently emphasis upon the ability of the United States to live without the rest of the world. If you tried it only for a short time you would be very uncomfortably embarrassed. The extent of supplies available of our basic materials: coal and ore, is great enough so that we need to give no immediate concern to that part of the question. It is true, however, that the percentage of iron in the ores being used is diminishing steadily. I believe there has been a drop of about eight points on the percentage scale in the iron content of ores coming from the Lake Superior district over the last forty years. We are progressively retreating to the use of poorer ores - not poor in the absolute sense but poorer than some ores that we formerly used. That is one of the problems the

industry is facing - the progressive adaptation of its manufacturing processes to the use of materials that are not quite up to the level of those that they originally had.

Along with that point we may put the question of the use of scrap. Scrap is now, as I pointed out, about 50% of the source of metal in steel. As you increase the use of alloying materials in steel you of course increase the likelihood of finding alloy steel in your scrap, so the problem of alloy-bearing metal in scrap supply is a problem that a good many people are trying to figure the answer to. If you are going to make steel you need to know what you are putting into it. If you do not believe that, get Colonel Jordan to give you some of the specifications that are written for steel by the Army and by the Navy. They are the cleverest people we have to deal with at the present time in knowing precisely what they want, insisting on getting it, and then checking up afterward to be sure that they did get it. If you will read those specifications you will get some idea of the closeness of accuracy to which the steel maker has to work. Whatever he puts into his furnace by and large he is going to take out in steel, so if you do not want a nickel-bearing steel or a copper-bearing steel or steel with chromium in it you do not want to put in any scrap that has a copper content or a nickel content or a chromium content, etc. Therefore, the question of quality of scrap and the character of scrap is a very large and alive problem in the steel industry at this moment, and it is getting more so all the time.

We have had a lot of conversation latterly on the question of scrap supply, among those who furnish and those who use scrap, as to the merits of this export business that has been attaining such proportions in 1937. Whatever the merit of the current discussion may be, the fact remains that there is a perfectly huge reservoir of potential scrap in the United States. You have some in this building. There is some in every structure in which steel has been used. I am not predicting that this building is likely to be torn down promptly and that the steel contained in it will be sent back to the furnace, but everything that is made of steel is sooner or later a potential candidate for remelting. According to best estimates, there are at least seven hundred and fifty million to eight hundred million tons of steel in use in

the United States at this moment. Therefore, you may say that over a period of years, and it is on the period of years that there is difference of opinion I will admit, you have a potential scrap reservoir of say three-quarters of a billion tons of metal to go back into the furnace.

What the average life tenure of steel may be in its different uses varies very widely. In a tin can it is only as long as it takes to get it from the mill to the can opener; in an automobile it is perhaps seven years; in a railroad freight car it may be twenty years; in a steel skyscraper it may be forty years or it may be more; in the Brooklyn Bridge we have still a pretty usable structure that is running on beyond fifty years. The length of time over which the material comes from a furnace and then gets back to the furnace to be remelted and remade into steel is a very variable one, but there is always to be kept in mind the fact that there is that potential reservoir of metal running to three-quarters of a billion tons which can come back again and be re-used

It can be re-used in any number of ways. I do not know how many different kinds of steel products there are. The number varies as stated by different individuals all the way from twenty thousand to a hundred thousand. It does not seem to me to make very much difference what the number is if you will remember that the art of steel making has been developed enormously in the last thirty years and it is now practicable for the steel makers to fit their operations to almost any conceivable kind of specification which a prospective user desires to have filled.

Let me illustrate that by one or two points: The commonest form of steel is what we call "plain carbon steel." In a way that is a redundant term because steel itself is an alloy of iron and carbon and theoretically at least there cannot be any such thing as steel without carbon in it; therefore to say "carbon steel" is sort of a redundancy. The percentage of carbon, however, varies widely in different kinds of steel. It is a common thing to specify carbon content on a percentage scale ranging between .10 and .20 percent of carbon in the steel as finished and furnished to the user. What does that mean? That means that when your steel is done and you have a block of it that weighs a ton, carbon will be so

uniformly distributed through that block weighing a ton that sampling it anywhere, the carbon content will show a percentage ranging between two and four pounds out of two thousand pounds.

That may seem like a fair degree of refinement, of accuracy, but there is a still better one. Let us take the case of sulphur. Sulphur, unfortunately, occurs in most fuels so that, even if you do not have sulphur in the ore, you will get some sulphur in the molten metal from the fuel. Sulphur is undesirable in most steel because it tends to make it brittle and not as tough under stress as steel should be. It does not take a large percentage of sulphur in steel to impart those undesirable qualities, therefore it is customary to specify a very low percentage of sulphur, very commonly as low as .04, which means eight-tenths of a pound of sulphur in two thousand pounds of metal.

I do not believe any of you ever saw or ever will see a prescription druggist working on medical prescriptions who could work to any finer degree of accuracy than would be represented by refining steel to the point where it would have not more than eight-tenths of a pound of sulphur in two thousand pounds of metal, and mind you now this is not being done in terms of pound units but it is being done in furnaces where you may have a hundred to a hundred and fifty tons of metal at one time. Therein is one of the most significant of all the trends in the steel industry at present - the ability to manufacture with dependable accuracy to a multitude of various requirements of all kinds of users. It is making steel far more flexible in use and far more effective in its various uses than it ever was before.

Labor.

Now something about the labor question. I shall have to hurry a little because I have used more time than I figured on using up to this point. Maybe I am somewhat like one of our illustrious politicians who is described as being tremendously interested in the sound of the human voice - when it is his voice.

Concerning the labor problem, I do not need to tell you of the problem with regard to organization of the employees in the steel mills. If you have not seen enough of that in the newspapers over the last year it is because you have not read the newspapers.

There are two aspects of the labor question in the steel mills that are really very important. One of those is the question of supply and the other is the question of skill. You probably have heard a good deal about so-called technological unemployment. What it is I do not know. If there is any in the steel industry it has been carefully and very successfully concealed. I have been fooling around in the steel industry more or less for eighteen years. There are more people employed in the steel industry today than there ever were before and the steel industry today is one of the most highly mechanized of all the industries that we have. It would not be possible to operate the steel industry as it is carried on today if it were not highly mechanized. The problem of handling a hundred tons of metal ore, a hundred and fifty tons of metal coming out of a furnace is not a job to be done by hand labor. The problem of manipulating a chunk of steel in a fifteen ton ingot, and a fifteen ton ingot is not uncommon, is something that can be done only by mechanical means. The problem of operating a continuous strip mill where you start in at one end with a piece of raw material in the form of an ingot and come out at the other end with a strip or a sheet issuing in the finished form at a speed anywhere up to fifteen hundred feet a minute is something that can be done only by a high degree of mechanization.

The trend toward mechanization has been one of the outstanding things in the steel industry over the last thirty years and especially over the last ten years. It has been carried as far as human ingenuity has been able to carry it, and many men are still working at the problem to try to carry it further. But, as much as they mechanize the industry they still find it necessary to employ more and more people, as a result of which in August of this year the number of employees in the steel industry exceeded six hundred thousand for the first time in recorded history. In 1929, which is the big year that I have shown for you on these statistical tabulations, the total number of employees in the steel industry was certainly not more than four hundred and fifty thousand. So with all the

mechanization that has gone on, a lower output in 1937 than was turned out in 1929 has required the employment of almost thirty percent more people than were employed in the previous year. And, that labor must be skilled labor. That is the second point.

There is very little unskilled labor in the steel industry. We made a calculation sometime ago to cover that point, getting the figures from representative large producers to cover enough of the industry so we felt sure that we had an adequate sample, and the figures that we worked out show that only between seven and eight percent of the employees of the steel industry were of the unskilled sort, the shovel, the wheelbarrow type of worker; that all the others, in excess of ninety percent, required some degree of training, background, and experience adequate to do the job that was required of them. Depending upon the kind of job, it is figured that anywhere from three to five or even seven years of semi-apprenticeship or background of training is required to produce an operative in the steel industry who is sufficiently skilled to perform the most exacting of the operations that the mills carry on. It takes time to recruit labor of that sort. It is not a job that can be done over night. Consider the significance of that fact in the light of efforts to curtail hours of work in a day and working days in a week and you can find yourself readily facing a situation in which the steel industry might not be able to operate at capacity because of lack of adequately trained labor, and the time when the steel industry needs most to operate at capacity is when capacity is most needed - that is, in time of emergency.

There is a real problem in the adequate supply of skilled labor in the steel industry. In that problem one finds one reason why some producers in the industry have not looked with favor on complete unionization of the industry. They have grave doubts about the ability to continue the efficiency and the effectiveness of production that they have been able to develop in the steel industry if complete unionization were brought about. That, however, is a debatable question on which different people have different opinions. We could talk probably for a week and not change any of those opinions because they are of the sort which have deep roots.

Use of products from the steel industry.

Now a word about the use of products from the steel industry. Most of the products that the steel industry makes do not go direct to the ultimate user. They are what the economist calls "producers' goods" as distinguished from "consumer goods." Only a few of the products of the steel industry belong in the latter category: for example, nails, barbed wire or farm fence. A few items of that sort, representing a minor part of the total tonnage, commonly go direct to the user, but basically the steel industry is a maker of producers' goods and for that reason many of the self-annointed reformers of industry fail, at least in part, to appreciate that they cannot apply to the steel industry the rules that they think will work most successfully in some other lines of business. Partly, if not mainly, because of this characteristic of the products of the industry the distribution of steel products in the market is done almost entirely directly between the producer and the purchaser.

In selling material from a steel mill to a railroad or to an automobile manufacturer or to a producer of industrial machinery, etc., there is no intermediary. It is a direct transaction between the producer and the purchaser. The wholesaler, the distributor, and the middleman figure only to an unimportant degree in the marketing and distribution of steel products. There are three or four exceptions to that statement and only three or four. There are jobbers or wholesalers handling steel products in the wire group such as nails, fence, and barbed wire, scattered all over the country. Most of the pipe that goes into dwellings and office buildings is also handled by distributors or jobbers. Certain items of flat steel like galvanized roofing and siding, and the formed products such as eaves trough and down spouts and things of that sort are also handled by distributors.

However, taking it by and large there is no intermediary between the steel producer and the consumer. It is a direct transaction, and that simplifies to a considerable extent the whole commercial problem in the steel industry. It tends, although it does not always work out that way, to lessen the chances of overstocking of material in secondary hands. It tends to bring

production schedules much more closely into harmony with consumption schedules, for ordinarily the producer of steel makes steel against orders and only against orders. There is very little production for stock on the part of the steel mill. It is hardly practicable to make steel for stock because a steel maker cannot readily guess what particular kind of steel may be in demand. Therefore, he must operate against orders, and it is only insofar as the purchaser over estimates his requirements for steel that there is an accumulation of stock beyond current requirements. For that reason the balance between production and consumption by purchaser is a very close one in the steel industry, and if it gets out of balance insofar as the matter of production and consumption alone are concerned, it can quite quickly be brought back into balance because there isn't any great excess being piled up.

Right along beside that fact comes another point that I want to touch on and that is the application of a familiar principle of economics. It is the old classical economic theory of elasticity of demand with fluctuating price, the theory being that if you have one hat and the price of hats goes down far enough you will have two hats, or if you have no hat and the price of a new one is too high you will not have any hat at all. At a sufficiently low price you will eat a lot more beefsteak than you will eat at a higher price. I suppose if you could buy a beefsteak dinner for ten cents you might have a beefsteak dinner every day, but if beefsteak dinners were ten dollars each you probably would not have one once a month. That is an illustration of elasticity of demand with fluctuating price. The operation of that principle depends upon the ability to use something else when the price gets beyond the stretching point of elasticity in your demand. The existence of substitute or dispensable materials is fundamental in the application of that principle, and it is a principle that relates chiefly to consumer goods. We go without because we do not like the price or because we can use something else.

There is not any real elasticity in demand with fluctuating price for steel products. If you knock ten dollars a ton off the price of steel you do not create any new uses for it. It is now being used in all those places where it is desirable or practicable to use it

and if you put ten dollars a ton on the price of steel you can cease to use it but there is not anything else you can use in its place because you do not have substitute materials in adequate quantity at a price to take the place of steel. I would like particularly to emphasize the significance of that principle in the steel industry because there are so many outside commentators on industry who would like to have you believe that in the present situation, for example, with the steel industry operating at about forty-eight percent if steel makers would go out and knock five dollars a ton off the price the mills would promptly be operating at sixty-five percent.

I can tell you, however, as a matter of practical experience and record that with the steel industry operating at forty-eight percent of capacity if you had the power to knock the price down five dollars per ton between now and tomorrow morning hell would break loose tomorrow. There would not be any more demand for steel at five dollars a ton less because everybody would be waiting until it was down seven fifty a ton and when it got down to seven fifty a ton they would be waiting for it to be ten dollars a ton less. You cannot stimulate demand for a producers' good commodity as long as there is any prospect that the price is going lower, but you can very quickly stimulate demand for a producers' good commodity when there is a certainty that the price is not going lower and a very strong likelihood that the price is going higher. That is operating the classical economic principle in reverse and at high speed.

Problems.

There are so many problems in the steel industry that one could write a book about them. One of the most prominent of all the problems today in the steel industry is the development of new steels to meet special requirements. You have all heard of the corrosion resisting and stainless steels. They are in their infancy. The amount of work that is being done on them is perhaps as great as that being done on all other kinds of steel put together - the so-called nickel chromium and high chromium steels for very important uses in general industrial applications and very important uses in military applications, if I am correctly informed. Along with those are the new family of so-called low alloy high tensile steels, the steels of

great significance for use in moving objects where the overcoming of inertia, in getting motion under way, and where the less weight or maintaining high speed is important after objects are in motion. The low alloy high tensile steels as used notably in railway equipment at the present time are perhaps the newest of all the groups in the steel industry, and they hold out most interesting prospects for use of steel because of the strength that is attained without adding weight. In the past it was necessary to add weight to get strength; now it is almost paradoxically the case that strength can be attained with reduction of weight.

An enormous amount of work is being done in perfecting the physical qualities of steel, such as surface finish and internal structure. Twenty-five years ago steel was made by the mile and sold by the piece. You took what you could get and were supposed to be thankful that you could get it at all. Now you tell the manufacturer that you want it thus and so; that it is to be minutely accurate, with reference to tolerances. Thus the thickness from edge to center of a wide sheet, sheets seventy-six inches wide, is not supposed to vary more than .002 of an inch on a micrometer scale, and quality must be such that the surface is perfect for enameling, for coating with various kinds of compounds. Steel that will draw cold under a die subjected to a pressure of one hundred fifty to two hundred thousand pounds or even more and come out perfectly formed, such as some of the absurd looking fenders that we see on present day automobiles, represents metal flowing in the cold state and flowing so readily and so uniformly that when it is finished the thickness of the formed product is the same as the thickness of the sheet that went into the die.

Internal structure, grain size.

If you look at the broken fracture of a piece of steel you get the impression that it is granular. If you look at a section of polished steel under a microscope you see that those granular parts are of various sizes and shapes. The art of steel making is being developed to satisfy the desires of customers to have grains of a uniform variability, no grain sizes beyond a certain dimension and none under a certain dimension, the grain size will fall along a prescribed line - guaranteed grain size! It would have sounded impossible, ridiculous, and unnecessary only a few years ago. Now it is an accepted part of the practice of the industry.

To do those things involves money; it involves research; it involves expenditure of capital funds, as indicated by the fact that in the last three years, 1935, 1936, and 1937, the new money put into the providing of equipment has been approximately six hundred and fifty million dollars. During those three years the net earnings of the steel industry have been not more than about three hundred and fifty million dollars at the outside. In other words, new capital requirement has been nearly twice as much as all the net earnings of the industry over these last three years, and these three years followed some years that showed no profits at all. And there, perhaps, is the biggest of all the problems that the steel industry now has to face - the problem of improving processes, advancing the art of making steel and products from steel, and providing the facilities to keep that art going as the progress of science shows the way in which it is to be done.