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WORLD INDUSTRIAL CAPACITY

8 October 1947

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PUBLICATION NUMBER L48-18

THE INDUSTRIAL COLLEGE OF THE ARMED FORCES

WASHINGTON, D. C.

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WORLD INDUSTRIAL CAPACITY

8 October 1947

MR. BUTTS: Captain Northington and gentlemen, it was my pleasure to be associated with Dr. Turner in the fall of 1941 and the spring of 1942. I later found that it was a privilege as well as a pleasure. At that time export control, you remember, was in effect. It seemed that there was some justification for controlling those exports at that time, particularly to Japan, and so economic potential came into the picture.

It was the first time, so far as I know, that any definite program had been determined or measures taken to, we will say, estimate as of that time the economic potential of certain areas. Dr. Turner laid out the first broad program of procedure for the economic potential of Japan, and then for Manchuria and North China, and later for the occupied areas.

Painstaking historian, he was not content, as I suppose most historians are not, with the current situation, and began to look for precedents for the determination of possible future estimates. So it was no surprise that very shortly thereafter, Beijing made a world survey of mines and the strategy of their location, he was bold enough to predict the progress of the war with a minimum number of assumptions. And I can say that that document became an elbow opinion, so to speak, at Military Intelligence.

Our subject this morning, as it is stated in the weekly bulletin, "World Industrial Power or Output," may be slightly mislead; but I am sure that Dr. Turner with his experience will add greatly to our knowledge and to the importance of the subject of economic potential. It is my pleasure, gentlemen, to introduce to you Dr. Elmer E. Turner, Professor of History at Yale University.

DR. TURNER: Captain Northington, my friend Butts, and gentlemen: It is really a great pleasure for me to return and wander for a few moments in the kind of branch field where once I just pulled a few bushes and picked a few berries. I am returning for this tour to talk to you more or less in the frame of reference which existed for me

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when I left this work. Obviously, I am not up to date, so I must tell you briefly the frame of reference in which I am going to speak. I believe I have suggested it, somewhat, in the paper that I have written, which I understand you will receive.

My experience with this work was under war conditions. My interest, which was presented to me from the outset by General Maxwell, and subsequently by General Wedemeyer, who at that time was with the Joint Strategic Committee, was that of assembling economic material and interpreting that material for war planning. Consequently I come to you this morning, not necessarily for an academic discussion of world industrial production, but for a consideration of world industrial production and the factors relating to it which in my judgment are relevant to the larger problem of war planning.

Now, I assume that possibly that must ultimately be your outlook. Whether it is at the moment is another matter, but it seems that ultimately your kind of work must look toward the organization and perfection of national defense. Consequently, if I take an overtly war-planning outlook, it is not because I come from Yale, which has been dignified as being a center of armamentism, but because of my background, energetically in the field where you people are most actively engaged and in which I am an alumnus.

I have written a short paper. You will probably find nothing in it that is immediately relevant to what I am talking about this morning, because this lecture is one thing and the paper is another thing. I have written in it certain general propositions with respect to the way in which economic factors, or, as the phrase is *vita voa* now, war potential, should be considered with reference to war planning. I have taken in that paper what may possibly seem from the standpoint of military men at certain levels a very aggressive position; because I have criticized the Japanese and German war planning for having failed to take into account factors relative to war potential.

When you take into account the factors relative to war potential you must consider them in two ways. You must take into consideration the factors relative to your own war potential and also the factors relative to the war potential of that power which for the purpose of planning you consider your enemy; and between the relationships among these various factors you have to arrive at certain determinations as regards action.

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The point of view I have taken in the paper is that military actions at the outset of a war should be oriented in terms of what the situation is with respect to the development of war potentials of the two warring groups in the course of the war. In other words, I am saying that the first military action in a war should be directed toward the creation of a situation in which the war potentials of the two belligerents will be developed in such a manner that your war potential will become increasingly advantageous, and the war potential of the enemy will become steadily less advantageous.

Now, to conceive military action at the outset of a war being taken with reference to the development of such a situation between two combatting war potentials is probably going further than that has been the case in the past; and it certainly is going further than either the German General Staff or the Japanese General Staff went in planning the recent wars. I take it that we can agree that these two bodies of professional military men planned these wars, and that their opponents did their planning in the main after these plans had been set in motion.

I have set forth in the paper some considerations about technology. Now, by "technology" I mean means of action; I mean the means of production; I mean the means of communication and transport; I mean the means of violence. I don't know whether or not you military men are accustomed to grouping weapons along with the means of production. Technology is not just the means of production; there are also the means of production, means of communication, means of transportation, and then the means of violence, because technology includes all those means.

You have to consider your whole economy in terms of these means of action because your economy has to turn out an equipment that includes all of them. Your economy also operates with such an equipment. The demands for natural resources and the demands for labor all arise in connection with technology in all its diverse parts. I am sure all of you gentlemen, much more acquainted with the military organization that I am, know it is the means of violence, a bomb here, a spade there, and everything in between, that enter into the determination of the organization of that part of the labor force you put into the Army; and, of course, I regard the men put in the Army as part of the national labor force.

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That is, in a total national organization for war, labor must be allocated for food production, for transportation, for the production of raw materials, for the production of semifinished goods, and for the production of finished goods, as well as for turning out the materiel of the war effort. You have to operate the whole economy in order to produce the war material which is the equipment of the personnel of the war effort. That is why the Armed Forces are only the part of the labor force actually directed toward military action. It may not be flattering to the prestige of military men to see the whole war effort in the organization of the national labor force. But you have to draw your Armed Forces out of the labor force and integrate the labor force so that the whole technological organization will be directed toward serving it as the national spearhead.

What I tried to say in the paper is that the technological apparatus determines, on the one hand, the kind of industrial organization you have to set up and, on the other hand, the productive effort of the whole apparatus. So you are ultimately brought, it seems to me, to the consideration that the fundamental war potential is the capacity to produce in every field for purposes of supplying this national spearhead. Thus, at the very outset of war you must ask yourself, What is the economic war potential of the enemy? What is your own economic war potential? What military action at the outset of war would so affect the military situation so that as the war moves from one step to another, the situation of your war potential will be favorable and that of the war potential of the enemy will be unfavorable? It seems to me that, if we analyze the course of the two great wars fought in the twentieth century, we see clearly that military action, as determined by this factor, ultimately affected pretty clearly the outcome of the war.

I would like to speak to you this morning about the current situation in the world concerning industrial production, that is, war potential.

I am not going into the theory this morning of measuring war potential. I think as a practical matter, you have a number of factors to consider with respect to particular conditions that exist in the countries that you are setting in possible belligerent groups. Consequently, whatever theory you have, you have the

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problem of practical application of it in particular instances; and that means that you probably have to make a special adaptation of your theory to take into account these social circumstances. This view leads me to the problem, this morning, not to take up general considerations but to confine my attention to certain aspects of particular situations.

You have been told that I am an historian. An historian is a man who considers things in time sequence; that is, "It happened like this. You are here today, here tomorrow, and here at a still later time." Most historians stop their studies in the past. The difference between them and me is that I do not stop in the past; I come up to the present. I say that if certain things are happening, certain other things are likely to happen. That makes me, probably, a prophet as well as an historian.

But it was actually in those terms that we people in the Board of Economic Warfare in the winter of 1941 and the spring of 1942 wrote the document, to which Mr. Butts has kindly referred, in an attempt to project from the situation in the spring of 1942 what the situation would be for our country if this or that situation occurred as a result of military action affecting war potentials. We tried to make a prediction. We laid out three possible contingencies. Although possibly one never can prove it, we can know that that kind of thinking was significant at that time in the development of the American war effort. But, anyway, I have told you the frame of reference of my thinking. Frankly, I am discussing the situation this morning with reference to the circumstances that exist in 1947.

The first generalization I would like to make on the basis of history, with very meager illustration, is this: The centers of power throughout history have moved over the surface of the earth as the centers of production of wealth have moved. The original centers of political power rested upon surplus food. They developed in subtropical river valleys. These areas, these centers of power, were very meager centers, and they did not operate at very great distances. At first thirty, forty, or sixty miles was the greatest area in which their concentrated power could be effective.

This situation remained true certainly until copper came, somewhere in the neighborhood of 7200 B.C., or possibly a little later. With the coming of copper, war took on characteristics that we have known until our present day. I have at times in the past defined war as simply the capacity to put men into motion for destructive purposes. The whole operation has been, since the coming of copper down to the present time, a matter of organization to produce and move metals for destructive purposes.

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# LESSON 10

Well, now, of course, we are at the point where possibly we are not going to move metals any more. If we are moving atomic bombs, we are moving the crude energy of the universe though we do have metals behind it. If we are moving disease germs, we are not moving metal. We can move them without metal at all. If we are moving radioactive gases, maybe we will have to have some metal with them. So we may be at the beginning of an era in the history of warfare where this whole generalization that war is determined primarily by ways and means of putting metal in motion for destructive purposes may not apply. But I think maybe I can do nothing more than suggest that you probably should still keep your minds on the metals; and certainly for this discussion I shall.

After the coming of metal there never were sufficient supplies of metal to arm more than relatively small bodies of men. The capacity to produce metal was extremely limited, but you can see that those men who were armed with metals were technologically superior to people who did not possess these metals, and that for combat purposes they had a superiority. As we trace the history of warfare from the coming of metals down to our very own time, in order to ascertain what happened, you have to find out first, who has had the superior weapons and, second, who has had superiority in producing and moving the metals necessary for making the weapons.

The first great empire, the Egyptian empire, was based on bronze and the horse, but not the armored horse. They weren't producing enough bronze to arm horses. They had bronze for spears and for arrowheads, but not for arming horses. The efficiency of weapons of bronze was greater than those of copper. They were harder and sharper. With the mobility given by the horse, you got the first extended political organization in the world.

The Assyrian Empire, which was the last and the greatest of the empires based on mere food surplus, was really built on iron ore. At one time the Assyrian emperor possessed 800 tons of iron. That is not much iron today, but it is an awful lot when you have all the iron there is.

Where did the Assyrians get this iron? They produced it in the Armenian Highlands, and with it they created the first infantry force armed with iron. They then sent this infantry force first into areas around about—to the East, North and West—to seize all the metal they could find. Then they sent them on east and into north-eastern Iran to seize the source of the horse supply; and with the horse and the iron, they had at hand the two basic means for moving metals about.

There is one difficulty with horses--a horse doesn't float. We had the same difficulty with tanks during the late war. Tanks didn't float. If tanks had floated, the course of the late war wouldn't have been as it was, because the Germans would have gotten across the English Channel. Tanks didn't float and horses didn't float; so you had two problems of power--land and sea.

With the Greeks, the building of ships was the source of military superiority, based both on metals and ships. The rise to power of the Athenian empire was based on shipping, together with command of the timber and metals of Macedonia which the Athenians were able to get hold of.

The Roman Empire was really based on iron mines. Rome utilized the iron from the mines of Tuscany to manufacture weapons to sell to the enemies of Carthage, after they had been incited to insurrection. Then Rome organized her own power, developed a navy, and proceeded to make war against Carthage. Having done that, she built up an industrial potential for war in Italy which could extend all over the Mediterranean basin.

It is interesting to note that the Greeks and the Romans used their metal for the infantry. The Roman legion was a definite military organization for the purpose of giving peculiar mobility to men armed with the short sword. The legion was organized in such a manner that the men were thrown one after another into the front line, so that you had a steady, constant movement from the general ranks of the legion into the ranks of what I suppose you would call the firing line. It was the internal mobility that gave the legion its fighting power.

But ultimately the legion faced another kind of mobility in the heavy horsemen of the Sasanian Persians. The Persians put iron around the horses as well as around the men. When the Roman legion ran up against the heavy armored horsemen, there was more weight, there was more metal, there was more drive, and the legion was broken up.

In the last phase of the Roman Empire period, after Constantine, the heavily armored horseman displaced the infantryman. The heavy armored horsemen of this sort dominated the military history of Europe, and of Asia for that matter, from the time of the Sasanian Persian Empire until the time of the Mongols.

Mongol power was based on the iron mines of the Lake Baikal region. In their conquests of eastern Asia the Mongols seized the smiths and the miners. They didn't kill them. They carried them home and put them to work on iron, which they made mostly

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into points for arrowheads. Every Mongolian horseman carried a special, double quiver of these iron-tipped shafts and lead a second horse. The second horse went along as the food supply. If a horseman should get hungry, he would open up a vein in the horse, take a cup of blood, and drink it. This was a combination, especially when you had quilted armor, designed for high mobility.

The Mongols had a composite bow of bone and wood—a short bow—with which they were able to project the iron tipped, relatively heavy shaft on the enemy from on horse back. They did it in volleys. They had a formation with the mobility of the Roman legion; that is, the horsemen would come up to the front, fire, and go back—a constant rotation up and back—so that there was a steady volley from these armored horsemen on the enemy.

I mention all of this to you because each one of these developments illustrates in one way or another the basic principle that has affected warfare—the movement of metal for destructive purposes. The strategic organizations of armed forces have been adaptations of this basic principle, depending on the technology that existed at a given time for handling metal and for moving metal about.

Gunpowder provided new propulsive power for metal. But since its coming, the relationship of mobility and metals we have just sketched has not changed. It centered around, on the one hand, the manufacture of metals which are used to direct explosives and, on the other hand, the manufacture of the explosives themselves in order to get more propulsion.

One of the most interesting things to me in this development was the difference in range between what today we call the rifle and the field gun. Success in warfare for almost two centuries turned upon the differences in these ranges. The original musket, of course, came in the fifteenth century. By the sixteenth century its range was about 100 yards, that is, the distance at which you could tell where you were going to hit. When you got beyond 100 yards, you couldn't tell whether you were going to hit anything or not. But the musket was good against horses, and, horses, except for subsidiary purposes, lost military significance.

Then the field gun was developed for purposes of bombarding the infantry. Cannons were originally used only against fortified positions. It was not until between 1525 and 1550 that there were battles in which field guns played a part.

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But they were not field guns as we know them now because they had no mobility. It was not until the seventeenth century, the time of Gustavus Adolphus, that you really encounter mobile field guns. As you probably know, his first field guns were very peculiar weapons. Copper sheets were rolled into a barrel, and iron bars were laid on the outside to strengthen the copper barrel. Then leather thongs were wrapped around the whole thing. That is not a very potent gun from the standpoint of handling explosives, but you can carry it around; you can move it; you can put it in position and then move it to another position in the course of a battle. In other words, it was a means of introducing relatively high mobility. Gustavus Adolphus seems to have won almost all of his battles because of this advantage.

In the eighteenth century the musket outranged the field gun with the result that the field gun couldn't break up the infantry formations any more. The infantry formations went into battle in a series of ranks using volleys in order to get increased fire power.

In Napoleon's day the field gun outranged the musket. He took advantage of a mobile field gun which he could move over the battlefield and break up concentrations of infantry that couldn't reach him with musket fire. He won most of his important battles that way. He didn't lose any battles until the enemy got onto that system and began setting up formations on the battlefield which couldn't be broken up by his artillery fire.

That system lasted, in the main until the battle of New Orleans where General Jackson used the Kentucky rifle. This rifle had been developed in Pennsylvania by German craftsmen who had emigrated there. They used heavy sporting rifles and developed a gun that was accurate at 500 yards. When the English landed at New Orleans, they ran into Jackson's riflemen who picked off the British artillerymen before they even got their guns in firing range. In 1850, of course, there came the final triumph of the field gun over the rifle. But it was not actually clear until 1904 or 1905, in the Russo-Japanese war when the gun became definitely superior in range.

I have given attention to the means of violence for this reason: The means of violence in order to be properly produced must have back of them a whole economy, a whole system of production. That is, you can take the arms that you use and you can analyze those arms in terms of quantities of metal—so much steel, so much alloy steel, so much

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nickel, so much copper—and then you can take explosives and analyze them in terms of so many other substances. So, if you are going to make a war effort that demands so many arms, you can compute these materials, you can identify the processes their production requires, and you can estimate the labor force and the machinery you must have. The machines, in the second place, demand more material, and you can compute that.

So you can analyze the whole array of requirements until ultimately you get to the raw materials and where they come from. You have a whole sequence of operations. Your war effort on the battle line—in terms of the projections of violence against an enemy is a function of the total organization from where your army is, back through every step of supply to the obtaining of raw materials. For a predicted war effort, you can work out in pretty clear mathematical terms what is required for virtually every stage of its development. You can set food requirements and you can determine how much of your population, considered in relation to the means of cultivation you are going to have to retain in agriculture. In other words, you can set your basic margin of safety of economic production, and proceed from that estimate to all others.

In the late war we didn't approach our margin of safety of production because our technological superiority and economic organization, together with the military planning that used them, turned out to be so much more effective than even we had suspected we could make them, and so much more effective than the rest of the world suspected they could be that everybody was startled. As a result we certainly had no appreciation of the inherent military power there was in the American national economy when the war broke out.

One important thing has happened in technological development that must be pointed out before we consider the present scene. Down until the invention of the Bessemer steel process in the 1850's there was no means of manufacturing metal in sufficiently large quantities to arm a whole nation. From that time back to the invention of copper the military force of a nation was a very specialized segment of society. That is, throughout most of the period the military arm of a people was a class, recognized as a class, maintained as a class, and exercised power as a class. With the French Revolution, the armies began to be popular, made up of the rank and file of the people. Of course, that happened earlier to some degree but during the French Revolution genuine national armies were created.

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The coming of the mass production of steel with the Bessemer process after 1850, provided the means of arming national armies. It changed warfare greatly, but it did not alter the basic principle involved. Still, that principle was metal in motion. So industrial production became the basic support of warfare.

For example, take coal--and I shall say more about coal in a little bit--world production of coal in 1820 was 20 million tons. World production of coal in 1900 was 779 million tons; world production in 1936 was 1.4 billion tons. In other words, twice as much was being produced in 1936 as in 1900, and almost thirty-eight times as much was being produced in 1900 as in 1820.

The same increase took place in the case of copper. In 1800 world output of copper was 10,000 tons; in 1900 it was about 500,000 tons; in 1936 it was two million tons.

It is what has happened to metals and the vast expansion of their production and use that provides the background for the organization of military effort today, and that, consequently, establishes the basic circumstances as regards the organization of production, the computing of war potential, and the development of any war effort.

I have already mentioned the mass production of steel. There have been three revolutions in the production of steel since the Bessemer process was introduced. The Siemens-Thomé or open-hearth process produced nickel steel that gave us new types of guns, and a greater output. In the 1880's came manganese steel. This was not necessarily military steel; it was industrial steel. It improved the quality of steel for every one of its uses. So that once the production got under way, there was a steady expansion of output; and countries with manganese became increasingly more important.

As a matter of fact, I take it all of you are more or less aware of the fact that England is a declining power in the world. This decline began with the introduction of manganese steel. Until its introduction, England possessed in England all the important materials for the manufacture of steel. England's role of real world power coincides with the period of time when she possessed in her own homeland all the materials for the manufacture of steel and had built up the technology for the production of that steel.

## Industrialized

After 1880, with the coming of manganese steel, which meant higher-quality steel, and which England had to produce, if she produced it at all, with imported manganese, other countries began to have an advantage over her. Then the Germans, with the Siemens process and the use of manganese, began to make very rapid advances, which carried them by 1900 to a point where they were producing more quality steel for industrial and military purposes than the English were able to produce—or did produce.

One other revolution occurred in steel manufacture since then; namely, the development of alloy steel by the use of tungsten, cobalt, molybdenum, vanadium, and other alloys. World War II was fought on the basis of alloy steels. It is the capacity to produce alloy steels that now determines not only the efficiency of an industrial establishment but also the effectiveness of a military establishment.

We are now on the edge of the next revolution in steel. If you people are following the contention between the United States Steel Corporation and Mr. Kaiser and the people in the National CIO, you will realize there is something fundamental at the base of this contention that is somewhat different from what is said by either Mr. Kaiser or the CIO. The thing that is really at stake is the introduction of the oxygen process, the oxygen blast, in the manufacture of steel. The utilization of the oxygen blast apparently will increase very greatly the output of existing facilities. The existing blast furnaces, with the oxygen blast, will turn out much more steel than they turn out now with the present methods.

Now, what do you do, facing up to this situation? Do you invest a lot of capital building new blast furnaces, or do you wait and see whether the oxygen process is really going to be successful. Well, United States Steel, possessing blast furnaces, says, "We won't build any more blast furnaces; we will wait and see whether the oxygen process is going to work." Apparently it is going to work; and, if it does, there will be a very greatly increased output of steel on the basis of the existing blast furnaces. This is a technological change in the production of steel that may greatly alter the capacity of the existing apparatus to produce.

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As these technological changes have affected production in different countries and have made necessary the obtaining of different raw materials, they have affected the development of war potentials of the various countries. That brings us to the consideration of what are the basic factors affecting distribution of industrial production over the world.

It is possible to visualize the world in terms of areas of concentrations of industrial production and consequently of areas of war potential. It is possible to identify these areas as they exist now and to suggest why probably they are likely to remain as they are. If you can imagine that this blackboard is a map of the world, I will just sketch for you the situation as regards the present concentrations of industrial production and the potential development of industrial production.

We start from where we are, in eastern USA and Canada. That is the greatest of these concentrations. The next one is the English Midlands; next is the Ruhr, the Saar, Lorraine, Belgium--the area of western Europe; the next one is Silesia, Czechoslovakia, Poland; the next one is the Ukraine; the next one is the Ural region; and the next one is the Kuznetsk Basin and the Baikal area.

The one in the eastern USA and Canada is the largest. This one, the English Midlands, has an outmoded technology. The first one, of course, is the most advanced as regards present-day technology.

The Ruhr-Saar area is a disorganized one at the present time. It is one about which present German politics are focused. The fourth one, Silesia, Czechoslovakia, and Poland are now in Russian hands. This one also, the Ukraine, which Russia holds, was devastated during the war. So far as we can tell it is being rebuilt with an advanced technology. This one, in the Urals, is new and up to date. The Kuznetsk Basin is a new one; its plant is now being built.

The present war potentials of the world really rest upon these areas. These two (USA, Canada, and England), as you know, are joined together. What happens to the Ruhr-Saar is all important. The Russian ones are joined together.

Now, we have, potentially at least, certain others. We have India; we have Manchuria and North China; we have South Africa. These, together with the ones noted above, are actually all the areas of the world that present students suggest can become centers of truly high industrial production.

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This analysis takes into account the availability of coal and iron ore, where these two raw materials can be brought together with the least effort so that the cost of producing power and energy is at the lowest point. In other words, it is easier to concentrate labor and food than it is to bring raw materials together; and these are the areas in the world where it is possible to bring these together at the lowest possible cost. These are consequently the areas, and the only areas as things stand with the present technology, of relatively high industrial development.

Certain areas in the world have coal but no iron. Certain other areas in the world have iron but no coal. In other words, certain areas are likely to be exporting areas of iron and certain areas that may be exporting areas of coal; but the areas mentioned above are the only ones where you can expect high industrial production. They exist now, and there is no reason to believe there will be any others in any predictable future that we need concern ourselves about.

The question is then the alignment of these areas in a possible war. The areas that are in the hands of Russia are, of course, all young. These three (Ukraine, the Urals, and Kurnetsk) are at the moment, let us say, in the embryonic state. They are just getting really started. In a sense, therefore, these new ones have an advantage because they can start with the current technology of production and move forward on the basis of utilizing the most advanced techniques.

These first two, America and England, can either hold their positions in techniques, or keep themselves up to date, or become outmoded. In other words, excessives interested in protecting the existing capital investment in these areas, may tend to decrease their war potential in relation to those of other areas.

Suppose you look at the present-day world in terms of politics and war as we tried to do in the Board of Economic Warfare in the spring of 1942. What would you see in these terms, and what would you do, and where are the problems of planning? Suppose you group together the countries which would constitute our alignment, our first team. In that, of course, you would have the United States, Great Britain, Canada, Australia, New Zealand, the Union of South Africa, British Africa, French Africa, Belgian Africa, Latin America, and Japan.

Our team would have an approximate population of just under 600,000, and we would have in our hands 60 percent of the capacity for producing energy useful for industrial and military purposes. We would have a steel capacity of just over 122 million tons.

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Now, if you look at the other team, which includes the Union of Soviets, Albania, Bulgaria, Czechoslovakia, Finland, the Russian zone of Germany, Hungary, Poland, and Romania—I have hooked on Manchuria as of minor league possibilities in this situation—you see a population of about 425 million, let us say. You have a fourth, 25 percent, of the world's energy resources that can be used for military and industrial purposes, and of the world's steel output you have 35 million tons. These figures are based on computations for 1952.

You have these two teams. What do you have in mind that may be recruited? The first thing you have is Marshall-Plan Europe—Austria, Belgium, Denmark, Germany (Western zone), France, Greece, Ireland, The Netherlands, Sweden, Spain, Portugal, and Switzerland. They may not all be actually in the Marshall Plan but they are all hooked in. These people are still in the minor leagues; they haven't been signed up. There is a lot of competition for signing them up. When you get them, what do you get? You get just over 270 million people; you get 6 percent of the world's industrial energy useful for military purposes; and you get 76 million tons of steel, more, in fact, than you get from the USSR, but not nearly so much energy. This is a very important group because of its location.

Let us look at the rest of the world. I didn't divide the rest of the world up quite the way you would suppose. I picked out Iran and Turkey. Iran and Turkey are Moslem countries, but they are not in the Arab bloc. Furthermore, both countries are crucial from our point of view. One is on the Mediterranean and the other on the Indian Ocean. We may group them separately or together, because they enter into military planning more from the point of view of their strategic and geographic positions in relation to our alignment with the power structure than they do in terms of what might be called their economic potential factor. Here we have a population just over 36 million. We have about one-fifth of one percent of the world's industrial and military energy, and we have zero steel output. Now, obviously, you are not going to line these people up for reasons of war potential.

It is true that there is oil in these countries, and oil in the immediate situation is important; but in reference to long-range determinations it would seem that oil is a secondary matter. As you perfect technology, it may overcome a deficiency of some natural products as Germany demonstrated. So you don't have to make oil a decisive factor in your long-range decisions.

# L E C T U R E

The next group is the Arab bloc. Here we have Algeria, Egypt, Iraq, Morocco, Saudi Arabia, Syria, Trans-Jordan, and Tunisia. I didn't include Palestine because it is difficult to tell about it. What you do about it more or less determines what the Arab bloc does. Does the Arab bloc join one side or the other side? Of course, it is in the position right now of saying, "Don't do this or we won't play with you." That is a political factor. What do you get from an economic point of view? You have about 60 million people. So far as industrial energy for war potential is concerned, outside of oil, you have zero; and as regards steel production, you have zero, although a steel plant is now being set up in Egypt. It will be about five years before it will be running. The Arab bloc, like Iran and Turkey, is important only with reference to the political alignment: that is, the geographical situation in which the two great war potentials will function.

Then comes the Far East. I have included in the Far East India, Burma, China, Indo-China, Indonesia, Malaya, and Siam. Here we have a population of 265 million--eight percent of the world's industrial energy potential. Here in India, and only in India, do we have any significant amount of steel, about 2.25 million tons, and we have one of the ultimate potential industrial areas; but it is an incipient one at the present time.

Now, suppose you consider this computation of war potentials in terms of the statement I made at the outset--that the primary military moves in a war should be those which affect the situation in such a fashion that your war potential develops advantageously and the enemy's war potential is disadvantageously placed. Obviously, in accordance with this principle what to do is perfectly clear at the present moment. Take those figures I gave you and shift the Marshall-Plan Europe to the Soviets. The Soviets then would have, not a war potential superior to ours, but one that is, on the basis of the geographical factors entering into it, fairly well concentrated and sufficiently close to ours so that you could expect to carry on a very long and hazardous military operation in order to dislodge it.

Furthermore, you should note that if the Soviets seize Marshall-Plan Europe the Russian industrial areas would combine continentally--the Kuznetsk Basin, the Urals, Ukraine, Poland, and Marshall-Plan Europe. This means that a Russian army in any one of these areas could be supplied from the area itself. An eastern army could be supplied from the East and a western army from the West. Of course, in western Europe, the people are politically divided. Suppose the Russians occupy the great cities of western Europe. How do you get them out of these cities? Do you use an atomic bomb on the western European cities--Rome, Madrid, Paris? Do you blast them out? We are up against another factor here--the political support of our friends while we are destroying their most precious possessions.

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The Russian military potential is distributed geographically in such a fashion that Russian armies could be supported independently at the various points where Russia might want to make her military effort or offer resistance. We must organize, then, on the basis of this area (U.S. and Canada), and upon the development of England. The eastern group is a doubtful one, because Manchuria and North China may like the Ruhr, be in the Ruhr group right away. We have to organize, on the basis of the rest of the world, a military effort which actually will have behind it a great part of the world's resources, not only a great part of the technical training, and superior technological equipment, but whose potential must be transported over very large areas by air and sea and must be concentrated against armies which have behind them a potentially spending industrial production.

I am just a professor and haven't any business talking about these things. These things belong to other people, but I am also an historian. I have been an historian for a very long time, and being an historian is a very peculiar thing. This is a kind of substitute for being an emperor. When you get to be an historian, you figure out, What did those leaders do wrong? So the historian doesn't just rule a particular situation; he rules all the time.

I have said enough to you, I think, in the hour in which I have spoken to indicate, roughly at least, the way I think about these things. Whether that way is of any positive use or not to you, I cannot tell. At least it can have a negative use by possibly telling you that it is not the way to think about these things. Thought has always a positive and a negative use. What I have proposed is either the thing to do or what I have said makes you very certain it is not the thing to do. In either case I have been kindly complimented by having had an opportunity to talk to you.

M.R. BUTTS: These officers insist that I apologize to Dr. Turner for having suggested 45 minutes. I am sure that the time he has gone over these 45 minutes has been one of the most interesting expositions of economic potential that we have had in our course. I still apologize for even suggesting a shorter period.

I just spoke to Dr. Turner and told him of our customary question period. Please don't limit your questions. Dr. Turner is ready for them.

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QUESTION: Dr. Turner, I am working on iron. I notice in some of the authorities given that we are facing a new factor, that is, the nationalization of the iron industry, with respect to the attainment of self-sufficiency both for peace as well as war within the various nations, thus throwing out the usual basic price or profit factor and, at any cost to the national economy, developing this industry. Can you give us any light on that?

DR. TURNER: Do you mean England is doing that, Russia is doing that, or we are doing that? Who is doing that?

QUESTION: The authorities I read didn't name countries, but they stated it was a trend that has been established within the nations of the world interested in power politics.

DR. TURNER: That is a little vague, but I think I can say this: In terms of all steel, which are the steels requisite for the highest military effort, there is not, on the basis of raw material supplies existing in any nation, a single nation in the world that can be self-sufficient. That means, on the other hand, that nations which seek self-sufficiency must seek self-sufficiency for a limited period of time by a process of stockpiling. For instance, the United States is not manganese. If we are going to be self-sufficient in steel, we have to acquire either access to foreign sources of manganese so that we will be sure of them all the time, or we have to stockpile it if we are going in for nationalization. Russia, on the other hand, is short on nickel. She took over the Petsamo mines in order to get some supply. She is short of nickel. There is she going, to get that nickel? We are very short of tungsten.

If we will look at this from the point of view of self-sufficiency in war, it is quite obvious that we must have a very highly developed government program for the purpose of controlling raw materials. That is, of course, what nationalization means. Your question would furthermore imply to me this: that if you are accepting the possibility of war within a relatively predictable future, as a war planning organization must, you have to lay out a program for obtaining the basic raw materials for steel.

Now, any such program, as I conceive it, would have three parts: (1) economic, that is, by stockpiling, making sure of economic sources of supply; (2) it would be diplomatic, it would be a program in diplomacy, assuring yourself of certain political advantages so you can get part of your supplies from other countries; and (3) in certain respects it would be military. That is such a plan must include the assumption that at the outset of war, military action must be

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taken that would contribute to the supply of basic materials, not only contribute to our supply, but by firm military action deprive the enemy of the possible use of such materials.

It is for that reason in part that we act into this situation over the Marshall Plan. If the Soviets can get western Europe and have its military potential, they put themselves into a position for a great and protracted struggle. Possibly without that Soviet achievement the struggle would not be so difficult from our point of view, because there would be a much greater prospect of concentrating in western Europe the power that could meet consolidated Soviet defence there, provided action were taken in other places to draw off other forces. But you are right as regards the nationalization tendency. If you take a war outbreak, you must do that sort of thing.

QUESTION: I don't think it is right to say that Great Britain as a steel-producing power is fading out of the picture. We have out-of-date equipment; but, if what we have heard about the oxygen process is everything we hoped for, I think you have anticipated equipment too. We are fairly well up in alloy steels, and I think that the vanadium steels are much more useful. That brings me to my question. In assessing these economic potentials, how do you take account of the technological skills of the people who are running the plants? Would you say a word on that?

DR. TURNER: You put your finger on what is the absolute heart of this whole matter as regards the organization of a nation for war. You are right about England. Technologically England demonstrated in the last war that she had the earmark of technological superiority. England's weakness has been not only the technological cut-off date of her mass production, but also in the fact that steadily she has become more dependent upon other areas in the world for these materials.

I note that the British point of view counts all materials in the other places in the rest of the Empire. That is all right politically, but from the military and geographical point of view, in strategic terms, that is not all right, because you have to command some things before you set them to England. From the American point of view, it is the American job now to command those materials so they can get to Britain. I don't want to be unflattering to the British, because I have a very high regard for them. When you add up the Empire as the Empire and England as England, the Empire is one thing and England is another. The technological superiority England possesses is concentrated in England.

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But how do you measure technological superiority? On a mass basis I can see two things. On the critical basis of effective advance in technology and keeping on top of it, I can point to—and you can test this statistically in terms of a general mass basis—the things. I think you can point to the proportion of people living in cities as an index of a nation's possessing the technological skills required to operate a most advanced technology. England is on top of the world as to people living in cities.

Now, as regards the other side, which is the side of science and the adaptation of science to military uses the only thing you can do there is to go into an analysis of the quality of scientific research in universities and industrial laboratories. That is something you cannot test on a mass statistical basis. I don't know how to measure it at that top level. It is undoubtedly true, when you look at what happened in the atomic sphere, that the English were in the lead there. I wouldn't claim anything for America in atomic energy except having had available economic wealth and engineering skill. We began to produce apparatus on the basis of scientific results that had been reached by the English and other Europeans. Whether we remain in first position or possibly in a secondary spot at the top level of scientific and technological advance is another question, but we certainly have not been at that point yet.

On the other hand, the American war effort here was fundamentally possible only because we had a working class that was acquainted with an advanced technique. Moreover, they were technically minded in the sense that they would take this apparatus, and if it did not do what they wanted it to do, they could do something with it themselves to make it operate in the situation they were in.

Now, that is quite a different situation from what you will find, for instance, in China. The Chinese obtained an American airplane from here which they planned to build one of their own. They took the plane apart and made other parts just like those in the American plane. They got the parts built and put them together, but they didn't get the airplane to fly. They just don't have the skill. The Hindus are like that. The Russians have been like that but are not now.

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As an index of technological level we can accept the proportion of people living in cities as a good index. But that is really no answer. You have put your finger on the greatest fundamental problem.

QUESTION: South America has been conspicuous by its absence in this discussion. Would you comment on the lack of significance or importance of South America in war potential?

DR. TURNER: Of all the continents, South America is the poorest, particularly in energy materials. South America has almost no coal. It has its oil located in regions where the oil is more important to other countries than to South America. It has water power, but water power is significant for high industrial development only when combined with basic resources. So the point about South America is this: South America can achieve only a secondary industrialization with only light industries. If the Latin American countries develop heavy industry, it is likely to be upon the basis of special favors offered to them by the United States for the purpose of creating in certain countries there the basis of a little military potential for the United States, as we did with Brazil.

Brazil will export iron ore; Venezuela, oil and iron ore; Chile, Bolivia, and Brazil, certain metals. That is, the combination of things just isn't right to get high industrial development at a cost that can make those countries truly significant at the top level of military potential. That is the general picture that we see to see.

QUESTION: In your studies that relate to 1952, did you consider capacity as projected?

DR. TURNER: We considered it as projected.

QUESTION: That leads me to my question. In considering economic potential, would you care to comment on the relationship between capacity and actual production figures?

DR. TURNER: You mean, can we set up projected capacities? Can we arrive at them? Can we achieve them? Is that what you mean?

QUESTION: There are unused capacities and standby capacities in obsolete condition. Do we count on that capacity?

DR. TURNER: Yes. We can count on that capacity with reference to a military situation. That is, if we say the military position is going to be like this, you can count on that capacity.

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If there is any one difference between the way I have thought about this and the way some other people think about it, it is this. that I always try to think of how your economic potential must operate in a military situation, in a, b, c or d situation. It is capacity with reference to a given set of political and military factors that we must consider, and we have to project the situation in terms of what those factors may be predicted to be.

We can add up all the statistics from now to doomsday on iron ore, tin, copper, and all the rest of them, these may be great volumes of statistics, and they may all be very well, but they don't mean a thing until we project them into the relationship as they will have in a power situation. It is the power situation as projected in terms, the terms of violence that determines the war effort we can make.

QUESTION: How do you evaluate then the psychological situation? We know there are certain satellite countries. There is a whole of a difference between Finland, Czechoslovakia and Yugoslavia, between Austria and Bulgaria. They are all satellites. They are all under Russia at the moment. However, under given circumstances what would be the psychological reaction of these Russian satellites that are basically favorable to the Western way of life?

DR. TURNER: Don't say they are completely that way. Don't say they are basically favorable. Let us say a considerable portion of their population is basically favorable. Some of the rest of them are not favorable. What I am sayin' is that in each of those countries there would be civil war the next mornin' after this thing breaks. In that kind of situation, the Russian secret police will be right at hand and any partisans that oppose them the next mornin' will be liquidated into fast. So we can't count on them as doing much for us. I am just hard boiled about this. I am going to have to be on the spot to save our partisans.

QUESTION: Then by this liquidation process which probably would happen a certain amount of potential would decrease?

DR. TURNER: That is right.

QUESTION: But not all would be liquidated.

DR. TURNER: No.

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QUESTION: Let us say a large segment of the population favors the western way of life. They could sabotage that war potential to a great extent by slowdowns and in other ways.

DR. TURNER: We saw that in the Nazi effort to occupy Europe. Of course, all that kind of operation depends more or less on how tough you are. We will have to consider, I will grant you that, in these countries. It is impossible to compute its ultimate effect. Therefore, in that kind of game I play the table the way it falls. That is, I have to wait and see what happens in a situation. Then, when I wait and see, maybe there is something I can do if I have planned in such fashion as to make certain types of forces available for action here and there. But you can't count on that with reference to a real estimate of economic potential. I think all you can say is, "Well, now, if Finland drops out, what happens?" Well, nothing happens if Finland drops out. If Yugoslavia drops out (on the other hand, Yugoslavia won't drop out) nothing happens in the whole picture. The only thing that would really matter is where all western Europe goes.

I paid my respects to the psychological point in the paper I have written. I think the psychological factor is a good thing for people to worry about, but I think it is a much better thing to pay no attention to when you get down to fundamentals, because in the long run that man has the best morale who has the best weapon.

COLONEL GODARD. Doctor, may I carry on beyond 1952 and ask you a question relative to our own iron supply. According to my reading, the Mesabi Range will run out fairly fast. I have seen several references--maybe not secret, but they are guarded references--to a huge deposit of iron beneath a Canadian lake fairly close to the Mesabi Range. Do you know anything about that deposit of iron or can you throw any light on that?

DR. TURNER: I will tell you quite frankly that I have read the same thing and I have talked to a couple of metallurgists and an economic geologist. There is iron ore under the lake; there is an awful lot more of relatively low-grade iron ore in the whole Mesabi Range that has to be extracted, as I understand it, by a double process--they are building a plant now to do that double processing; there is an enormous iron ore supply in Labrador and Newfoundland which is just being opened up. So, unless we use them up too fast, we are going to have iron ore enough at hand to keep the Pittsburgh and Cleveland area going for a while; but it will involve certain technological improvements, that probably, have not yet been made.

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QUESTION: With reference to the question concerning the occupied countries, do you think the dismantling of the steel mills, rolling mills, and other institutions in that area would ever be a mistake?

DR. TURNER: Not necessarily so. It depends on who gets them.

QUESTION: Apparently only one power, Russia, is getting them in reparations.

DR. TURNER: That is right. In other words, we should have said, "A couple of years later we are going back to fight Russia; so we are not going to give them anything at all." In the Marshall Plan we are going in and building these areas up again. Russia has got the machinery out, and we are going to build up these plants again. We helped build the Russian potential at home and now we are going to build these areas up again. Then we will quarrel about them.

QUESTION: On your chart on the board your areas are iron and coal together?

DR. TURNER: Iron and coal.

QUESTION: Now does the future development of atomic energy as a source of power add to or amplify that picture?

DR. TURNER: That is a nice one, isn't it? Well, I will make this one general statement: Atomic energy will not affect the distribution of the basic industrial regions of the world. I say this for this reason: It apparently is not predictable at the moment that there will be sufficient uranium ore to build really great sources of atomic energy that can be used generally for industry. What is likely to happen, apparently, is that, where other sources are not available, atomic energy can be used for relatively high-cost production of very necessary materials. It may also be used for certain means of transportation, and so forth. But for general use for all kinds of industrial production, probably no.

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I think there is one thing that might be said in connection with the uranium picture, and that is that it may be outruled fairly soon. I mean, you may possibly get beyond atomic energy. There are a couple of prospects along that line. One of them, of course, is the cosmic ray. The cosmic ray is raw energy on its own. If there is any way found to extract that out of the outer atmosphere as it comes in raw, you are really off. The other one, of course, is just a concentration of old-fashioned solar energy as it comes from the sun.

Now, there is only one point I would make with reference to such speculations. You had better keep an open mind. That is the last word I have to say to you. You had just better keep an open mind and don't freeze this thing, because you just can't tell. But what you have to do, on the other hand, is, when you keep that open mind, to remember that you can't base your planning on speculations. You have to come back to these relatively bedrock fundamentals. Then let me say lastly, as I said at the outset, it is not enough to add these things up. You have to project your total into what they would mean in given military situations.

(24 October 1947—450) S/to

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