WORLD COAL RESOURCES

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CAPTAIN WORTHINGTON: Gentlemen, in our studies of materials we have had two talks on petroleum. Now we take up a new subject—coal. We are very fortunate in having Mr. Thomas L. Hunter, Chief of the Coal Economics Division of the Bureau of Mines, to tell us the story of coal. Mr. Hunter.

MR. HUNTER: Captain Worthington and gentlemen, I feel quite honored in being asked to come here. From the little that I know about your College I think it is one of the most marvelous things I have ever heard of. Certainly during the past war, when all kinds of difficulties were encountered in getting things started, a group like this would have been of the greatest value in saving time.

Such a group will be of inestimable value if another emergency arises. There is going to be some time lost in any event, even if we have the experts to help us, such as in getting people oriented, and so forth. But it seems to me that a group of men like you, who are trained and educated with a broad knowledge in all the principle fields, is going to save an awful lot of time, because you will be able to expedite the coordination of many complex matters.

I wasn't able to participate much in the coal problems during the past war because I was in the service also, but I kept in rather close touch with the situation. I knew about the many great problems in getting coal produced, and how basic and essential coal was to the military program. Undoubtedly if there had been a large group of men such as you available to call on at the beginning of the emergency countless days could have been saved in getting programs under way. And every day, as you know better that I, is very valuable in times of national emergency.

I know we are not going to be able to touch upon everything here this morning that you will be interested in. But, Captain Worthington and gentlemen, if any question comes up that I may not answer today, or if, as you get along in your studies and in your review of the materials that I have left with or sent over to you, you have any further inquiries, I will be very glad to receive any list of questions in order that we may get the answers for you if they are available. Also, I will be glad to talk with you as individuals if you would like to come over to the Bureau. The information in our files is available to you. I think this is one group that should have full cooperation from all sources, for all kinds of information, and for help in any way whatsoever.

We deal in our division with an awful lot of statistics. Generally statistics are terribly dull and dry and I get very much bored with them myself, especially when heard from a lecture platform. So I hope you will excuse me if I start quoting them once in a while. I will try to keep that to a minimum.

There is much that can be said regarding the importance of coal in its relation to our national economy, whether during peace or war. Accordingly, I ask your indulgence if I stray occasionally from the more strategic aspects.

One of the prerequisites to a favorable war potential of any basic commodity is a reasonably healthy and going operation, during peacetime, of the industry which produces that commodity. So, before going into some of the specifics regarding coal, I want to refer, briefly, to its general economic significance. Of greatest single importance, of course, is bituminous coal. The most important factor behind the leading position of the United States as a great Nation and industrial power of the world is coal. The abundant supply and utilization of this natural energy resource is the keystone to our vast commercial development, to our further economic potential, and to the high standard of living of our people. The economic and social welfare of our Nation is inextricably tied to it. It is the same the world over, nations without available supplies of coal have remained predominatly agricultural economies. And even today, those nations which do not have or cannot utilize their coal resources, or which cannot get supplies of coal, are being held back seriously in their rehabilitation programs, a factor which gives rise to serious political problems as well as economic ones.

I think that coal, in its relationship to political problems and ideologies, is of very great significance, especially to a group like this, many of whom no doubt will spend much time in the years to come in legations and embassies as military attaches or advisers.

Because coal is energy and energy is the prime essential to industrial and economic well-being, which in turn directly influence social trends and the acceptance of political doctrines and ideologies, coal is truly of very great strategic importance. This is particularly so in Europe where coal is extremely precious today.

Coal reaches directly or indirectly into almost every phase of our own daily lives and national well-being--the energy that powers our industrial machines and supplies approximately one-half of the electric energy consumed in the U. S., the manufacture and processing of our vital steel supplies, the manufacture and preparation of our clothes, food, farm implements, automobiles, trains, ships, planes, explosives, and countless other items. Upon the orderly production and distribution of coal rests the employment, health, and prosperity of many millions of people. Serious interference with the economic and social well-being of any peoples, wherever they may be, quickly brings political repercussions and makes the affected peoples easy prey for those who would change the existing system, whether they be constructive critics or demagogues.

There are very few laymen who realize the great importance of coal, not only as it is used directly in industry, but in the form of its many by-products and their strategic importance in time of war. I think as you look over the chart entitled "Coal Products Tree," showing the by-products of coal, and later when we discuss the by-products, you will realize that the importance of coal by-products was demonstrated very ably during this past war.

We have other vital and important energy resources also--waterpower, petroleum, and natural gas--but coal alone still supplies approximately one-half of the total energy derived from our natural resources. Practically all industries in our country depend to some extent on coal as a source of fuel and energy or as a source of raw material. It is important to point out that although coal has given way to petroleum and natural gas in recent years, in the long run the irreplaceable and limited reserves of gas and oil very probably will throw the burden of supplying energy back on coal, until such time as it is replaced by nuclear generation. Some authorities say that our present petroleum resources will be exhausted in less than 25 years and that our present natural gas resources will be seriously depleted in less than 50 years. With regard to these reserve figures there is always controversy. You may already have heard from some experts on oil, petroleum, and gas, or you may hear from them later. We could get into a lot of debates on just what our reserves are. At any rate, regardless of these controversies, we know that our reserves are short. From the long-range point of view they are seriously short in this country. As compared with these smaller reserves of petroleum, gas, and oil, the coal reserves are estimated at more than 2,000 years' supply. Although much of the vast coal reserves are of the poorer grade coals, these coals do lend themselves very well to some of the new technological processes for the development of new types of energy.

For a quick indication of the importance of bituminous coal and lignite to our national economy here are just a few statistics on coal consumption by some major classes of consumers, comparing 1936 with 1945: Electric power utilities increased their consumption from 40 million tons to 72 million tons and in 1945 used approximately 13 percent of the total coal consumed; for Class I railroads consumption rose from 86 million to 125 million tons and accounted for about 23 percent of national consumption; by product coke ovens rose from 63 million to 87 million tons and accounted for almost 16 percent of total consumption; retail deliveries rose from 84 million to 121 million tons and accounted for almost 22 percent of national consumption; and "other industrials," which cover the wide assortment of American industries from the large automobile industry to the small "home-town" plants, rose from 109 million to 127 million tons and accounted for approximately 23 percent of national consumption in 1945.

In addition to its major uses, coal is strategically important to the production of a wide range of important chemicals, explosives, plastics, pharmaceuticals, dyes, paints, fertilizers, synthetic rubber, and aviation gasoline.

And just a word about the importance of stock piles. Because there are neither facilities nor finances to permit large-scale storage by consumers generally, as insurance against an interruption of their fuel supply, it is essential that coal production and stocks be maintained at reasonable levels. For that reason the size of the Nation's coal stock pile is very important, especially during emergencies.

Serious interruptions in the production and distribution of coal can cause great damage to the economy, health, and welfare of the Nation even in peacetime, and so are of even greater seriousness in times of national emergency or war. During our coal crises, the coal-hungry nations of Europe cannot understand, and temporarily, at least, become extremely impatient with our democratic processes which permit interruptions in the production and supply of the most vital material to their economic systems.

Because of the interdependence of industries, interruptions of only a few days or a few weeks in the production and distribution of coal can cause serious work stoppages in many industries. A 30-day interruption can cause much damage to our industrial structure, and interruptions of from 60 to 90 days could virtually paralyze all our industries, strangle our economy, and bring about demoralization and irreparable damage that would blight our national economic and political life for many years.

Conversely, the overproduction of coal, resulting from excess capacity, brings on cutthroat competition that results in chaos and severe financial loss to the industry, which adversely affects the national economy, exerts downward pressure on labor standards, and causes wanton waste of our coal resources, including the precious reserves of our better grade special-purpose coals which are rapidly being depleted. This matter of wasting our resources of better grade coals during peacetime competition will have a direct bearing upon the strategic importance of coal during future national emergencies. More will be said about this when I touch upon our coal reserves.

Referring again to coal stocks and interruptions to production, have had some pretty close calls, especially during the big strikes.

We have not been able to keep up-to-date statistics on coal stocks in the hands of consumers and retail dealers since early this year because our funds were cut pretty seriously by Congress and we have had to furlough a lot of personnel and discontinue many of our services in the Bureau of Mines. We have not been able up to this moment to get

into the current situation with regard to stock piles in this country. But I would hazard a guess that there are not much more than 32 days' stock of coal on hand at the present time. That may sound like a lot, but it is only one month's supply, and is an over-all average. Some people may have a supply for only a few days and others may have for 70 days. Many people depend upon day-to-day supplies of coal. If our industrial level of activity moves along without any interruption or slow-down and we were not to get any coal for the next 32 days, or even 40, our national economy would be very seriously imperiled. And that is in peacetime. You can imagine how serious that would be during wartime.

From shortly after World War I to World War II, the coal industry suffered such a severe depression, accompanied by excess capacity, overproduction, ruinous competition and heavy financial loss to the industry, reaching as much as a 50 million dollar deficit in one year, that Congress and successive administrations tried hard and seriously to find the solution to the problems which kept this key industry in a state of chaos and chronic depression. In my opinion one of the most important things in the war potential is having a healthy peacetime industry. If there is not that, it takes too long to get the thing going when we run into a national emergency. Now that World War II is over, the coal industry again is over-expanded far beyond normal peacetime requirements. The serious problems that were alleviated by wartime production will return again, when the present heavy export market abates, magnified because of the distortions and changes created by war needs, unless constructive action is taken to prevent or minimize their severity.

BITUMINOUS COAL AND LIGNITE

Prior to the turn of the centry the bituminous coal industry grew with great rapidity, almost doubling its production every decade. Peak production prior to World War II was reached in 1918, with 579 million tons. However, from 1920 to the early 1930's the general trend was downward, having reached a low of approximately 310 million tons in 1932. The steady, normal growth of the industry not only had come to a halt, but was replaced by capacity far in excess of normal requirements, which resulted in severe depression in the industry even while the rest of the Nation was experiencing great prosperity.

Production averaged approximately 385 million tons per year during the 1930's, and the industry continued to lose money until stabilization under the Bituminous Coal Act of 1937 brought the industry out of the red in 1940 and 1941. Under the influence of heavy war requirements, production increased steadily to a peak of approximately 620 million tons in 1944, the all-time high. In 1945 production dropped to approximately 578 million tons, and in 1946, a year of two major strikes in the

industry, production declined to 532 million tons. As a result of the current railroad coal car shortage it is estimated that production of bituminous and lignite in 1947 will approximate 603 million tons.

As an aside, you may have seen something in the papers these days, and will be seeing more later, about threatened fuel shortages this winter, particularly in coal. I don't know that there is going to be a coal "shortage", but the situation is going to be very tight. There just are not enough open-top railroad cars to go around for everything. During the miners' ten-day vacation this summer the railroads naturally had to use their coal cars for other things, like heavy equipment, road-building materials and such. So the cars were diverted to meet the requirements of other industries.

Once those coal cars get out of the coal trade, it is worse than pulling teeth to get them back into coal, because they are being used for other important commodities on off-line railroads and some of these railroads just do not send them back promptly. As a result, at the present time there is a serious coal car shortage.

The domestic situation is very tight. We have a very heavy export program in helping in the rehabilitation of Europe. Our domestic requirements are very heavy. Because of the coal car shortage we have had to deduct about 7 million tons from a previously estimated 610 million tons production for 1947. I mention this simply because it is another factor that men like you will have to consider in the case of another emergency, that is, seeing that coal cars are available.

The railroads are getting new cars right along, but the old stock that they used during the war is getting in very bad shape. I think that at the present time old cars going out of service exceed the number of new cars coming into service. One factor in the war potential, it seems to me, is to get a lot of good rolling stock available to carry all of the needed commodities.

Regardless of fluctuations in production, however, high capacity remains. Although production in 1945 was 578 million tons, in 261 days of operation, the capacity of the industry under 280 days of operation would have been 620 million tons, and under 308 days of operation would have been 682 million tons.

The nature of the industry is such that a certain degree of over-capacity is essential. Primarily this is because of the highly seasonal nature of the coal industry. It must be able to meet the peak demands during the colder months and to meet the fluctuations in industrial activity. Because of the great expense involved in maintaining idle or only partially utilized mines, when the market is slow there is a

necessary urge to sell coal even at uneconomical prices so as to keep the plant going in order to lessen the burden of overhead costs. Because of maintenance costs and the heavy expense of rehabilitating mines once they have been closed, it is sometimes less expensive to continue production and sell coal at a loss than to close down the mine. During periods of low production there is a downward pressure on prices and on labor standards, and a tendency towards some wasteful producing methods, as a result of the mad scramble of operators trying to keep their mines going in order to benefit from the cost advantages that are reflected in volume and steadiness of output.

Everybody knows it is not good business to sell something for less than it costs to produce it. That is one of the serious things about the coal business. If you study the history of the coal industry year after year you will find that as a whole it has suffered many millions of dollars loss simply because it is more economical at times to sell below cost than it is to close down a mine and then reopen it. But that combined with deliberate cutthroat competition when there is a predominantly buyer's market, has a very devastating effect on the national economy.

The major contribution to excess capacity is the large number of mines. In 1945 there were over 7,000 mines which produced over 1,000 tons per year, scattered over about 30 States and Alaska. Because of the widespread nature of the industry and the complex factors involved, the industry does not lend itself well to the combination of ownership among a comparatively few large concerns, as is the case in many other major industries. There are some large companies in the industry, however. In 1945 approximately 20 percent of the mines produced more than 82 percent of the production.

The all-time employment high in this industry was in 1923 when 705,000 men produced 565 million tons of coal. The high in employment during World War II was in 1942 when 462,000 men produced 583 million tons. It is significant that in 1944, the all-time peak year of production, 620 million tons were produced by only 393,000 men. In fact, employment in 1944 and 1945 was lower than in any year since 1902. Aside from the serious manpower shortage during the war itself, the principal cause of decline in the number of employees as compared to the maintenance of high production has been the steady increase in mechanization, strip mining, and in mining methods and techniques.

From 235 strip mines in 1931, with a production of 19 million tons, or 5 percent of total production, stripping has increased to 1,370 mines in 1945, with a production of 110 million tons, or 18 percent of total production. Mechanical loading has increased from 13.5 percent of underground production in 1935 to 56.1 percent in 1945. It would have been impossible to meet the high levels of production during the war without this heavy increase in strip mining. Whereas strip production was only

43 million tons in 1940, it was 110 million tons in 1945. It is hoped that if we ever again need a sharp increase in coal production over a brief period that we will have coal reserves that can be stripped readily. If the demand during peacetime denudes us of a substantial portion of our available stripping reserves, our war potential would suffer very greatly.

Turning to reserves and conservation, because of the ever-present requirement to operate the mines to the fullest extent possible, in order to minimize overhead costs and to make a return to the investors, there necessarily is considerable waste of coal in the productive processes. Statements to the effect that the U. S. has coal reserves that would last over 2,000 years, representing about half of the world's deposits, can be very misleading. Many bituminous seams which provide our better by-product and quality grades of coal, and which are reasonably near their markets, are comparatively near exhaustion. The greatest portion of our vast reserves are of the lower-grade lignite and subbituminous coals which are located in the western portion of the U. S. There are very few high-grade mines in the western section of the country. The heavy concentration is in the Appalachian area, in the industrial East.

Ways must be found to mine more cheaply the better-grade coals, which are costly to produce, and to utilize more of the lower-grade coals.

For many years around 70 percent of bituminous coal has been produced in the Appalachian area, which stretches from Pennsylvania and Ohio to Northern Tennessee, and which contains the better grades and a wide variety of coals. Our principal industrial areas lie nearby. Next important in production is the Midwest where 20 percent of the Nation's bituminous coal is mined. Illinois is the big producer, followed by Indiana, West Kentucky and Iowa. Other bituminous areas are in Alabama and areas west of the Mississippi, known as Southwest, Rocky Mountain, and Washington. Alaska also is a coal producer, having had five mines in production in 1945 which produced 298,000 tons. You probably all know that a big portion of the Alaskan production goes to the Army.

The distribution and marketing of coal involve a maze of complex factors which affect the economy of the industry. Coal moves from the thousands of producing units in the industry by rail, truck, lake, and tidewater to millions of consumers who burn hundreds of different sizes and many kinds and grades of coal, all designed to satisfy the special requirements of many different types of consumers, such as special quality coals for the steel industry and stoker sizes for domestic consumption. Every sizable consuming section of the country receives coal from a number of widely scattered producing fields. This all gives rise to many local and regional problems and to numerous interstate conflicts,

With the ending of war requirements, the reconversion of American industry, the heavy demand for coal for the rehabilitation of Europe, and the rapid strides in the development of synthetic liquid fuels from coal, this industry is on the threshold of a new era. Prospects for the future can be bright if some way can be found to bring this nationally widespread and vital industry into a well-balanced group, including both management and labor, which will bring order to the production, distribution, and marketing of coal.

The crux of the problem is whether a satisfactory level of operations can be obtained by the industry. This will depend on the ratio of coal requirements to productive capacity of the mines. If requirements are relatively large, there is a better chance for prices that will yield costs plus a reasonable margin for the industry as a whole and for the preponderant number of mines. But if requirements are relatively low as compared to capacity, and the industry is unable to effect some kind of balance, then the price situation may deteriorate even with the existence of prosperity in the remainder of the economy. Certainly it is of strategic importance to national defense that the industry be reasonably stable so that it can maintain its plant and continue to make improvements that will permit its rapid adaptation to any national emergency.

ANTHRACITE

The principal anthracite mining regions are located in the northeastern part of Pennsylvania. Production of anthracite climbed steadily through the years until 1917 when it reached a peak of 100 million tons. From World War I until 1939, when output began to increase under the pressure of world events, anthracite production declined steadily, due principally to competition from bituminous coal, coke, heating oils, and gas. The consistent decline dropped production from the high of 100 million tons in 1917 to only 46 million tons in 1938. Under wartime requirements production rose to almost 64 million tons in 1944, which also was the peak production in bituminous, and declined to 60,700,000 tons in 1946. It is highly improbable that anthracite production can be maintained at this level, and any serious decline in its production can have a serious impact on any program for national defense. We must not lose sight of the importance of anthracite because of its strategic location. It is near to the industrial centers of the East.

In addition to supplying the normal fuel requirements of millions of people living in the densely populated industrial Eastern States and Canada (a large number of whom were employed in vital war industries), the Anthracite industry was called upon during World War II to increase its output substantially to provide heat for thousands of additional homes which were unable to obtain a normal supply of fuel oil and coke

because of shortages in these fuels for heating purposes and the difficulties in coastwise and overland transportation. While anthracite is used mostly in heating homes, hotels, and public buildings, it also is used to a considerable extent by railroads, public utilities, and industrial plants. Military installations used substantial quantities for space-heating and cooking.

Besides supplying the increased demands in this country the industry shipped large quantities of anthracite to Canada to replace other fuels, especially gas and oil, the use of which was restricted sharply in that country. Exports of anthracite to Canada increased from 2.5 million tons in 1939 to 4.5 million tons in 1946. They will approximate 5 million tons in 1947.

Among the most strategic importances of anthracite is the fact that by being geographically located near the industrial, heavily populated eastern areas of the country, it can serve the dual purpose of substituting for vitally important oils and coke when necessary and at the same time help materially in keeping up civilian morale by providing necessary heat.

It was realized early in the war that the total supply of fuels available for space-heating purposes would not be sufficient to meet the demand. While the production of anthracite was increasing to meet the demand, heating oils and domestic coke continued in short supply. Under these circumstances it was necessary that the anthracite industry make up as much as possible for the shortages of these competitive fuels. It took a lot of work and cooperation by the Solid Fuels Administration for War, the Anthracite industry, and the Bureau of Mines to assemble essential data and make allocations of anthracite between producers and wholesalers and to work out an equitable distribution of available supplies to retail dealers throughout the U. S. and Canada. Retail-dealer requirements were computed monthly and, on the basis of production, the retail dealers received a determined percentage of their 1942-43 receipts, plus any adjustments necessary to meet local emergencies.

One of the things that must be faced in carrying out emergency programs is a tremendous amount of paper work. It is almost overwhelming. Widespread but coordinate knowledge of the necessary facts on the part of the responsible officials will help to get things moving with a minimum of paper work. It is in this respect that men with your broad training can help substantially.

In the event that you are interested in knowing more of the details regarding the distribution of Pennsylvania anthracite, the data I have assembled for you includes copies of a report showing distribution by States and key cities during the coal year 1 April, 1945 through 31 March, 1946. Pennsylvania anthracite was shipped to 34 states, a

the District of Columbia, the Dominion of Canadan, and other foreign countries during this period. The report shows that 87 percent of the total distribution was destined to the highly populated New England and Middle Atlantic States.

Anthracite is facing stiff competition from heating oils, gas, coke, and low volatile double-screened bituminous coal. Competition of these fuels was keen before the war and will be more so in 1947 and in the immediate years ahead because of high prices necessitated by the high costs of production. High prices will inevitably turn many anthracite consumers to heating oils and gas. The use of long-distance pipe lines to transport natural gas into the primary market of anthracite will cause the industry to lose several million tons of business, thus hastening the decline in production and employment.

Gradual depletion of low-cost strip pits and the rapid exhaustion of culm banks will require the industry to mine more costly deep mine coal. As this change in source of coal occurs, over-all mining costs will increase considerably, thus necessitating higher consumer prices and greater vulnerability to competitive fuels. Markets already have been so seriously affected in the Eastern States, with serious impacts on production, that were we to have another war which would require the substitution of anthracite for oil and gas, it is questionable whether or not the industry could increase its production sufficiently to carry any substantial part of the added load without considerable expense and delay. The reason for this is the difficulty in keeping up development work and keeping water out of the operations with declining production. This fact should be seriously considered and known to those who have to do with our national defense system. I keep coming to that. One of the most vital things, regardless of our resources position, is to keep the mining industry on a reasonably good operating level during peacetime. Otherwise our efforts in an emergency are slowed maybe a year or two before we hit the maximum of efficiency.

Reserves of anthracite calculated on the basis of 1946 production should last about 150 years. While this figure of total reserves would seem to indicate no immediate problem, reserves in certain sections of the anthracite region, particularly in the vicinity of Scranton and in parts of the Eastern Middle field, are virtually exhausted and present serious employment problems for mine workers living in the communities affected. Employment in the anthracite industry dropped from a peak of 180,000 men in 1914 to 77,000 men in 1946.

SOLID FUELS ADMINISTRATION FOR WAR

Despite most difficult wartime problems affecting the production and distribution of coal, the American mining industry, in collaboration with the Solid Fuels Administration for War, supplied tremendous quantities of solid fuels required by war plants to turn out munitions and equipment.

Incidentally, if some of you are particularly interested in methods of control, there is a wealth of data in our files pertaining to the Solid Fuels Administration for War. There is a very complicated maze of details in administrating a program of distributing a product where it does the most good, both for the war effort and for private consumers.

Files of this nature should always be maintained in such a manner that groups of men like you can readily avail themselves of the records if ever the need comes again for similar controls. Since the Solid Fuels Administration for War has been dissolved, a lot of these records are being transferred to my division for reference purposes. I am going to make a special point of seeing that everything that comes to us is properly catalogued, analyzed, and filed so that it will be readily available. I will be glad to cooperate with any of you who are specializing in that particular field.

During 1943, 1944, and early 1945, the Nation's fuel requirements soared to new heights, creating record-breaking demands for bituminous coal, anthracite, and coke. Lack of manpower and other handicaps, including mine strikes, prevented the coal mining industry from increasing production sufficiently to meet the full requirements of war industries and domestic users and necessitated adoption of a coordinated program to distribute current production to those who needed it most. Every possible measure was taken to increase production and distribute mine output so as to avoid distress to domestic consumers and impairment of industrial activity. During this period, it was necessary to issue thousands of directives diverting coal shipments to industrial consumers and retail yards in dire need of fuel and to excercise general control over distribution of the scarcer types of solid fuels.

In addition to other perplexing problems, the most serious problem was the drain of skilled mine manpower into other industries and into the Armed Services, thereby constantly reducing mine productive capacity. Upon the men who remained in the mines, whose average age increased from about 32 years to about 45 years, fell the task of stepping up mine output. While these older men did a remarkable job, they were unable to mine sufficient coal to fill requirements. As a result, requirements had to be met in part by utilizing the reserves of bituminous coal above ground in consumers' stock piles. From the 86 million tons of bituminous

coal in these stock piles at the start of 1943, some 30 million tons were withdrawn to meet current needs during the calendar year, and an additional 6 million tons were withdrawn in 1944 before consumption fell below production and permitted the addition of fresh reserves to the depleted stock piles.

We cannot go into details but you can imagine that the physical problem of just lifting stockpiles and redistributing them is a tremendous one.

The interruptions to production and the fact that the stock reserves were unequally spread about the country made the problem of distributing the available coal supply extremely complicated. Coal distribution, even in peacetime, is a complex job. Grades, types, and sizes of coal vary widely, and consumers' burning equipment likewise varies. Some consumers cannot operate without certain coal; other consumers, because of long use and tradition, are accustomed to particular coals. With the shortages of manpower affecting mines unequally, radical shifts had to be made in the distribution of the output of mines throughout the country to make sure that consumers requiring special coals, such as the steel industry were able to get them and that consumers generally got enough of some kind, grade, or size of coal for essential needs.

Before the coordinated program of necessary balancing factors could be fully developed and effectuated, one local crisis after another had to be surmounted. While much of the S.F.A.W. effort had to be devoted to handling immediate and specific problems, nevertheless, prior to the close of 1943, it was possible to inaugurate broader-gage plans and by the spring of 1944, the entire distribution program had been put on a long-range basis. As a result of advance planning involving estimates of production and requirements, and the establishment of basic distribution patterns which permitted producers and industrial consumers alike to schedule their operations intelligently, the distribution program was carried out with very great success despite consistent fuel shortages. The coal industry itself performed an excellent war job. All conditions could not be foreseen, however, so that many particular situations arose which required special handling.

I understand that some of your problems are in estimating future requirements for various commodities and materials. We can sympathize with you because the problems that you get into in accurate forecasting are very great.

Examples of problems other than manpower were the shortage of by-product coke for the steel industry, which resulted from decreased output from supplying mines coupled with increased steel requirements; the need for increasing the flow of coal via the Great Lakes to move a year's

supply to upper lake docks before the seasonal close of navigation; and supplying coal to industries with insufficient stock piles.

In order to prevent interruption of vital war industries and undue hardship to civilians, S.F.A.W. frequently had to exercise special controls over distributions, such as limitations of retail deliveries to set percentages of previous receipts, and preferential shipments to the most important users first, such as for by-product and special purpose coals. The shortage of high-grade Appalachian bituminous coals became so acute by August 1944 that the S.F.A.W., in order to protect wartime steel production, ordered the diversion of some 1,680,000 tons, over a period of several months, to steel and coking plants from industrial plants using it for generating steam. Special embargoes and emergency distribution measures had to be effected because of bad weather conditions, such as the heavy snowfall in January 1945 which hampered rail transportation in many Eastern States, including freezes in rail terminals and of coal in cars. Distribution regulations had to be revised constantly to meet the changing situations. Among other controls required during the war were controls over stockpiling, the requirement for domestic consumers to file declarations of stocks on their premises with their retail dealers, and the requirement of industrial consumers to file reports with their mine suppliers as to their total requirements and the amounts ordered from other mines.

Production increased from 460 million tons in 1940 to 582 million tons in 1942; climbed to a new high of 590 million tons in 1943 and continued on to a new all-time peak of 620 million tons in 1944 in spite of the drop in employment to 393,000 from 462,000 in 1942.

The end of hostilities in Europe found the U. S. with a serious deficiency in high-grade coals, a continuing manpower shortage in the mines, also handicapped for lack of equipment and replacement parts for machinery, and the continued need for regulation of distribution in order to speed the fall of Japan and prevent hardship to consumers. Shortage of manpower, the most serious wartime problem of the coal industry, was not relieved for many months. After the victory over Japan, coal requirements receded slightly. Then followed a wave of strikes. Production losses became serious. Before the end of the year, the Nation's coal supply was cut by strikes. Special-purpose coals were critically short. When relief came to the national market, pressure was brought for more export coal. The liberated nations of Europe had to be supplied. S.F.A.W. was called upon for quantities of lower-grade coals for this need. At the same time, scarce and higher-grade coals had to be held from export.

When the S.F.A.W. was getting ready to liquidate in the spring of 1946, the strike in the bituminous coal industry that began on 1 April

precipated a fuel emergency that put the Nation's reconversion from a war to peace economy in a precarious position. As a result, at the request of the industry itself, S.F.A.A. was continued beyond its intended liquidation date. Fortunately, this kept available the means for minimizing the impact of the strike on our economy. With the exception of a 2-week truce during May, the strike continued until 3 June after the Government had taken over the mines and had established a new Coal Mines Administration. Formal possession of the mines was taken on 21 May.

By 1 June stocks had dwindled to about 31-1/2 million tons - much lower than at any time during the war. This was a serious threat to our reconversion. On the eve of the strike, S.F.A.A. froze coal on the mine tracks, at weigh scales and tidewater loading piers and immediately issued restrictive distribution orders in the interests of national health and welfare. The frozen supply was so limited that none of it could be released to general industries, even those relying on day-to-day deliveries... instead, preferences were given to public utilities, railroads, hospitals, food processing plants, and other essential users. Many industries retarded or even sus,ended operations... among the latter were large steel plants which banked their ovens early. Many cities ordered brownouts. If the strike had lasted another 30 days, the Nation would have suffered a severe economic shock.

Not many people realize the problems involved in getting coal to the northwest territory. Most people probably think that it moves in railroad cars. Instead, the greater portion of it goes by vessels on the Great Lakes, and must be moved during the Lake navigation season. If they don't get their coal requirements before the lakes freeze over, then we have a really intensified coal car shortage problem, because of the extremely long rail hauls involved, which adds to the turn-around time of cars. This in turn slows down coal production because mines cannot produce coal without cars to dump it in.

I have been amazed at the number of people who think that coal can be stored at the mines. Although some anthracite is stored at mines, such storage is not customary in the bituminous and lignite mining industry. Not only are there little or no facilities at the mines for storing and re-handling of coal, but there are many kinds of coal that just will not store very long. There may be isolated cases where coal has to be dumped at the mines, but that is not the general thing. That is one of the principal reasons why it is important that the mines be kept operating with a reasonable degree of steadiness. On top of these were numerous emergencies for supplying coal for domestic heating purposes to make up for diversions of coal to other uses, the decline in firewood supply, conversions to coal by users of oil and gas, and war-created population shifts. In the winter of 1943-44, the supply of

bituminous coal for the Nation's railroads, which ordinarily consume 23 percent of the bituminous output, ran perilously low several times, and required emergency action and the substitution of lower-grade coals than previously burned.

EXPORTS

Shortly after the defeat of Germany, appeals for American coal came from the liberated nations of Europe. Mining had been seriously disrupted by the war on the European continent. Manpower was short and food was scarce for those available for work. Transportation in the liberated countries was in chaotic condition, canals upon which coal was carried in peacetime were impassable, and railroads and rolling stock were in disrepair. Investigation disclosed that the greatest possible quantities of coal from the U. S. would have to be shipped to Europe in order to aid public utilities and essential industries and to alleviate extreme hardship for the peoples.

The rapid increase of strip mining in this country during the war provided a peacetime surplus of low-grade coals, usable but not in demand by American buyers, which, with some run-of-mine sizes and some anthracite fines, could be shipped to Europe without causing undue hardship in this country. A small quantity of special-purpose coals for gas plants was permitted to be shipped. Exports increased in volume. The level of shipments reached more than 2 million tons in March and, except for interruptions of strikes, has continued at increasing rates.

Total exports of bituminous coal and anthracite from the United States in 1946, including shipments to Canada, reached an all-time high of 48 million net tons. The previous record-year was 1926 when 39 million tons were exported. The principal reason for the large exports in 1926 was the coal strike in Great Britain in that year, necessitating large shipments to Europe by the United States. Shipments of bituminous coal alone to Europe in 1946 totaled 16 million net tons, whereas the contribution of anthracite was two million tons. Shipments to Europe in the first several months in 1947 indicate that shipments for the entire year will far exceed those of 1946.

The principal reason for our large shipments of coal to Europe is the inability of Great Britain and the continental countries to increase their production to the levels prevailing prior to the war. The coal-mining industry in Great Britain and Europe has been beset with major difficulties of all kinds including lack of coal-mining equipment, devastation of the mines and shipping facilities by war, insufficient food for the miners, and a general low morale existing among the peoples.

In 1946, the United Kingdom produced only 181 million metric tons as compared with 244 million tons in 1937; France produced 49 million tons as compared with 45 million tons; western Germany, which excludes the Russian occupied zone and the former Upper and Lower Silesian fields, produced 114 million tons in 1946 compared with 369 million tons for all of Germany in 1937; Poland, which now controls the former German Upper and Lower Silesian coal fields, produced 47 million tons of coal in 1946 as compared with 36 million tons in 1937 without the German mines.

As an aside: Poland is making great headway in her production of coal. She is the only country besides the United States that is doing so. The situation looks very favorable for the Poles to continue exporting coal, because, as long as they continue with heavy exports into western Europe, they can get American dollars.

Opinions of various European authorities differ considerably as to the length of time before the coal industry of Europe will attain its prewar production level. It can be said, however, that it will be a number of years, in all probability, before this level is atttained.

At this point I want to give you the percentages of world coal reserves by countries. (See following page.) You can see from this table that the large coal reserves are in this country and in Russia. Russia had about 31 percent as compared with America's 47 percent.

These, of course, are known and estimated reserves. I doubt that this taken into consideration much of the undoubted coal reserves in Asiatic Russia, about which, I think, there has been very little information ever assembled. Certainly none of it is given out to other countries.

I have also had duplicated some maps showing the location of the coal fields of Europe. These maps will show the principal coal-producing fields of central and western Europe, and also of Russia and Japan. I will leave them, and Captain Worthington can have them duplicated in any number you want for your working papers and notebooks. There also are tables showing the production figures for the principal coal-producing countries of the world from 1927 to 1946. There is a wealth of information for those of you who are going to be especially interested in European coal production and European coal resources.

COKE AND COAL CHEMICALS INDUSTRY

The coal carbonizing industry has been recognized, for many years, as one of our country's most essential industries both in peace and war. It achieved this prominence through its primary function as a supply source of special fuels and chemical raw materials. The record of

Probable world coal reserves 1/

(Millions of metric tons)

Country	Date to which estimate refers	Probable total coal reserves	Probable total brown coal (lignite) reserves	Coal equivalent of brown coal (lignite) reserves 3/	Probable total coal and brown coal (lignite) reserves in coal equivalent	Percent of total
United States	1946	2/1,879,700	851,800	439,100	2,318,800	46.9
United Kingdom	1937	174,501	-	-	174,501	3.5
Germany	1938	106,373	56,758	12,613	118,986	2.4
U.S.S.R.	1937	1,443,268	211,093	70,364	1,513,632	30.7
Poland	1930-35	91,000	5,500	1,222	92,222	1.9
France	1937	10,000	500	167	10,167	.2
Czechoslovakia	1938	28,410	12,393	7,290	35,700	.7
Belgium	1935	11,000	-	-	11,000	.2
Netherlands	1913	4,474	-	-	4,474	.1
Japan (proper)	1932	16,218	473	158	16,376	.3
Union of South Africa	1935	205,394	-	-	205,394	4.2
China (incl. Manchuria	1933	236,068	-	-	236,068	4.8
Canada	1946	90,572	37,393	12,631	109,203	2.2
All others	1913-38	72,625	60,533	20,796	93,421	1.9
Total		4,375,603	1,236,943	564,341	4,939,944	100.0

1/ Sources: U. S. Department of the Interior; Germany, France, Czechoslovakia, and Union of South Africa--Reichskohlenrat 1938; U.S.S.R.--The Coal Resources of the U.S.S.R., International XVII Geological Congress, 1937; China-Proceedings of the Fifth Pacific Science Congress, 1933; Canada-Report of the Royal Commission on Coal, 1946; other countries--Statistical Year-Book of the World Power Conference, No. 3, 1936.

2/ Includes anthracite, bituminous, and subbituminous coal converted to calorific value equivalent of 13,000 B.t.u.'s per pound.

3/ Conversion factors of brown coal and lignite to coal equivalent; United States, 1.94:1; Germany and Poland, 9:2; Czechoslovakia, 17:10; other specified countries, 3:1, "all others" 2.9:1.

development in the coke industry follows closely the pattern of growth in the iron and steel industry because the bulk of the by-product and beehive coke produced in the United States is used as metallurgical fuel in that industry. Normally about 70 percent of the total annual output of coke is consumed in blast furnaces and iron foundries, 20 percent for domestic heating, and 10 percent for other industrial purposes which includes nonferrous smelting, the manufacture of water gas, chemical processes, and other miscellaneous uses. This ratio is subject to change, depending on the demand for coke in the iron and steel industry. For example, in the depression year of 1932, the iron and steel industry consumed 44 percent, whereas in 1945 blast furnaces and foundries used 80 percent of production.

In 1944 under the terrific pressure of war and the high industrial tempo, the output of coke reached an all-time high of 75 million net tons. A total of 105 million tons of bituminous coal was charged into the coke ovens in 1944 in the manufacture of coke, gas, tar, ammonia, light oil, and other products. These coal products had a value of more than 700 million dollars at the producers' plants. In 1946 the coke industry was beset with interruptions caused by work stoppages in the steel and bituminous coal industries; total production for the year amounted to only 65 million net tons.

In the early days of coke manufacture, the principal source of metallurgical fuel was the beehive coke oven. Since 1910, however, the number of beehive ovens has steadily declined, meanwhile, by-product coke ovens steadily increased in number. In response to wartime demands for coke from the steel industry and for coal chemicals such as benzol, toluol, and phenol, the by-product industry expanded considerably.

On 1 January 1946 there were 14,510 by-product ovens located at 88 plants with an annual coke capacity of 71,400,000 tons. Beehive capacity totaled 8 million tons. This potential maximum annual coke capacity of the by-product coke industry, assuming that all conditions are favorable and all ovens active, is sufficient to meet normal industrial coke requirements.

COKING COAL

In the early days of the coke industry in the United States, high-grade bituminous coking coals were plentiful and their selection for coke oven use was a minor problem. The demands for coke and chemical raw materials in World War I aroused and stimulated interest in the investigation of the reserves, characteristics, and properties of our coking coals. During that war the increased demand for coke reached a critical stage, and the shortage of high-grade coking coals necessitated the use of coals of inferior quality and of different coking characteristics from those previously used. The period of prosperity following

World War I brought much progress and development in the by-product coke industry. Methods of testing coal and coke were improved, construction and design of by-product ovens improved, and the search for satisfactory coking coals was continued. Much blending of high, medium, and low volatile coals was done.

The large requirements of coke for metallurgical purposes in World War II made it necessary to operate existing ovens at maximum capacity and to construct additional coking capacity. Efforts to meet urgent requirements of maximum coke production made conspicuous the weak and vulnerable points of quality of coking coals. Large tonnages of coal, especially Pocahontas low-volatile coals, which are very high grade for making good metallurgical coke, are being used as industrial and domestic fuels instead of low-grade coals. A long-range, properly coordinated program for the practical conservation of these high-grade coals for the production of metallurgical coke deserves serious consideration. Some of the finest seams of high-grade coking coals are nearly exhausted while others are seriously depleted or have short-life expectancies. The life of the famous Connellsville coking coals in Pennsylvania has been estimated at only a few decades, and that of the Pittsburgh bed in Pennsylvania and of the smokeless coals of southern West Virginia in beds of present workable thickness and quality at less than 100 years. The heavy demands for steel and coke during the war have made the situation with respect to good coking coals quite serious. More information is needed on coking reserves and more research is necessary on the adaptability of poorer grade coals for metallurgical coking purposes. This is a very important problem indeed with regard to future supplies of coking coals for the steel plants in Utah, California, Colorado, and other Western States. Certainly it is of strategic importance, for numerous reasons, for the Nation to be able to spread its steel manufacturing industries throughout various sections of the country. New technology must be developed, including advancements in washing and preparation processes and in the blending of coals. The Bureau of Mines is proceeding as much as it can in this direction.

There is one problem which I think is important, and I don't know how it can ever be brought to a head--that is, everybody wants this scarce, high-grade metallurgical quality coal. Many want it not for metallurgical purposes but for use in their furnaces for space heating. It is clean, good heating coal and much of it is smokeless. There are smoke-prevention programs in some of our large cities--and they all want their people to use the high-grade, low-volatile coals from southern West Virginia for space-heating purposes. Those are some of the most valuable coals in the world for steel-making purposes.

My own personal opinion is that some way should be found for preventing smoke other than using these smokeless coals. I think some program should be sponsored by somebody to find a way of conserving our valuable metallurgical coals. They should not be dissipated up the chimney for space-heating purposes.

There is a great demand in Europe for these high-grade coals also. They need them in order to get their steel plants going over there. But again, I think that both in Europe and America there should be some sort of control against the dissipation of these high-grade coking coals for other than coking purposes.

COAL CHEMICALS

High temperature carbonization of bituminous coal in coke ovens is one of the principal processes for obtaining coal chemical materials. Gas, tar, ammonia, and light oil are the principal groups of coal chemical materials. Technological developments in recent years in the manufacture of plastics, synthetic rubber, explosives, dyes, pharmaceutical preparations, and synthetic drugs have increased the markets for benzol, toluol, xylol, naphthalene, phenol, cresylic acid, and pyridine. There has been considerable expansion in tar refining facilities at coke-oven plants in recent years to meet the increasing demands for the various tar derivatives. Additional applications for the tar derivatives are developing and the production of creosote oil, tar acids, tar bases, and pitch is rising steadily.

The importance of chemical materials both in peacetime and war cannot be over-emphasized; for example, toluol is a prime ingredient of explosives, benzol is vital in the manufacture of aviation gasoline and synthetic rubber, and tar derivatives are widely used in the manufacture of dyes, drugs, and other pharmaceutical preparations.

Few people realize the wide variety of products obtainable from coal by carbonization in the modern by-product coke oven. For your information in this respect, I forwarded to you copies of the "Coal Products Tree" which lists a wide variety of coal by-products, from moth balls and perfumes to insulation, roofing, fertilizers, and TNT.

SYNTHETIC LIQUID FUELS

Before closing I want to mention what to me is the most important strategic development in fuel technology in many years, that is synthetic liquid fuels. There is much concern today about the rapidly diminishing proved petroleum reserves. Possibilities of large scale production of synthetic liquid fuels from coal, oil shales, and other substances give us some degree of comfort, particularly in view of the fact that these fuels are of high octane content and are very well suited to aviation purposes and for automotive use.

The Bureau of Mines, under authority of Congress, is going forward actively in the development of these synthetic fuels, including laboratory research and development work and pilot-plant tests needed to guide the design of the demonstration plants. Priority is to be given to orders placed by the War and Navy Departments. In the interest of national defense it is imperative that this country avoid too great dependence on foreign sources of such a vital material as oil. This can be assured only by developing means of producing synthetic liquid fuels from our plentiful supplies of coal, oil shale, and agricultural and forestry products. This is the place where our huge resources of low-grade coals out west can be used to very good advantage. They are highly suitable for some processes in developing these synthetic liquid fuels.

Even though all possibility of another war could be eliminated, economic considerations would require this country to develop processes for producing liquid fuels synthetically. These alternative sources of liquid fuels would place a ceiling on the price of imported oils so that we would not be at the mercy of foreign countries as we were for our rubber supplies before our synthetic rubber industry was established.

It is estimated that the coal and lignite deposits of the United States could supply all liquid-and solid-fuel requirements at present rates of consumption for the next 1,000 years. In general, all ranks of coal, including anthracite and lignite, may be used for the production of synthetic fuels.

With regard to European developments of synthetic liquid fuels, the two principal processes for producing these fuels from coal were developed in Germany and that country reached a peak production estimated at 40 million barrels a year of synthetic oil and gasoline before allied bombing reached the stage where their destruction exceeded German construction and repair efforts. Before the war Germany gave little encouragement to the processing of oil shale, but when efforts to seize Caucasian oil fields had failed and the Rumanian refineries were bombed , an attempt was made to further develop oil-shale plants taken over in Estonia. After the Russians took over the Estonian plants, Germany worked feverishly to utilize the low-grade oil shale of Wurttemberg.

Details of new developments in Germany and the occupied countries since the beginning of the war were not available to American technicians until our victory in Europe provided an opportunity to visit the famous German synthetic oil plants. Following closely behind the armies, oil teams composed of American and British experts examined what remained of the badly bombed German plants, collected records and research documents, interrogated operating and research personnel, and sent back samples for examination in our laboratories. Seven Bureau of Mines representatives were among the 25 American investigators.

These investigators found that some important new developments had been incorporated in the large German plants, especially in refining motor fuels and in converting the primary products to a variety of necessary materials, such as lubricants, fats, soap, and margarine. However, a tremendous amount of research and development work had been done on improved processes which had never been put into commercial operation because of the pressing demand for oil and gasoline for war, which prevented shutting down the plants long enough to make the necessary changes. In some cases new plants were bombed out before they could be put into operation.

The location and seizure of a great volume of German research documents are probably the most important achievements of the oil mission. These data are being used extensively in the development of synthetic liquid fuels in this country. As Russia seized much similar information, plus plants, she undoubtedly is doing much work in this field also.

In addition to governmental development of synthetic liquid fuels, private industry is beginning to spend millions of dollars in further development, such as the joint 120 million dollar program of the Consolidation Coal Company of Pittsburgh and the Standard Oil Company of New Jersey.

One closing point with respect to these synthetic fuels: Russia seized a lot of German installations and a great many of the technical personnel in them. She also is doing a great deal in this field.

I have tried to consolidate this report as much as possible, and hope that it will be helpful to you.

I want to say again that I appreciate this opportunity to meet with you. If there is anything that I have not presented or cannot bring out here, do not hesitate to get your questions to us. We will be glad to get the answers one way or another if it is in any way possible.

I might say also that within the next few weeks I hope we will be a little more stable in our own activities, then we are going into a further study of not only world coal resources, but world coal production. We are going to study that because we think it is important. I don't think too many people can be working on it. When we get our information togetner, I will be very happy to make it available to you.

CAPTAIN WORTHINGTON: We are open for questions.

QUESTION: How much coking coal do the Russians have? Do they have a lot or a little?

MR. HUNTER: I am sorry not to be able to tell you. That is one thing we too would like to know.

You probably have found out that information about anything Russian is extremely hard to lay your hands on. I am going to do a little collaborating with some of the group from the United Nations this year, and I hope I will be able to get some information from them. As I say, I think this group should have all the information possible to get along those lines. If I get the answer to that question, especially, I will send it to you.

CAPTAIN WORTHINGTON: Thank you very much, Mr. Hunter, for your talk and the information you have given us.

(24 October 1947--450)S.