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THE PROBLEM OF COAL SUPPLY.*

BY

EDWARD W. PARKER,

Director, Anthracite Bureau of Information,
Wilkes-Barre, Pa.

THE subject assigned to me for discussion this evening by your secretary, and my friend, Doctor Owens, "The Problem of Coal Supply," is somewhat misleading, for I think I shall be able to show in a very few words at the outset that the problem in our fuel troubles is not one of supply but of production, transportation, and distribution.

The total area in the United States underlain by anthracite, bituminous coal, and lignite is about 460,000 square miles. Practically all of the anthracite is found in a relatively small area in the northeastern part of Pennsylvania. The productive part of this region is less than 500 square miles in extent, less than 0.11 of 1 per cent. of the total coal field, but the anthracite production to the close of 1915 has amounted to 2,626,500,000 tons, or nearly one-fourth of that of the entire United States.

The most important of the bituminous coal fields from a present producing standpoint, and so far as the quality of the coal is concerned, is the Appalachian region, extending from the northern part of western Pennsylvania and eastern Ohio to the central part of Alabama. The highest grades of bituminous coals (or

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what we generally term semi-bituminous, because of their high carbon, low volatile, and consequently "smokeless" quality) occur along the eastern border of this region. The principal coking coal fields are also east of a line drawn through the centre of the region from north to south, as are likewise the better grades of steam coals and the Cumberland or Georges Creek (Maryland) smithing coals. Among the other higher grade coals well known to the coal trade that are produced on this eastern border of the Appalachian region are the Clearfield (steam), Connellsville (coking), Youghiogheny (gas), Somerset (steam), Pocahontas and

Production of coal in the United States by states.

New River (steam and coking), Jellico (domestic), Clinchfield (steam), and Warrior (steam and coking).

The coals of the interior province, extending from eastern Michigan on the north to Texas on the south, are of wider extent than those of the Appalachian region, but are decidedly inferior in quality to the coals of the Appalachian province. They possess little or no coking quality, though some of them, like the block coal mined near Terre Haute, Ind., have been used raw in iron furnaces. This quality of coal is largely already worked out. The combined contents of the Appalachian and interior provinces is something over 1,000,000,000,000 tons, of which a little more

than half is in the Appalachian fields and a little less than half in the coal fields of the interior states.

The coal fields of the Great Plains and Rocky Mountains far overshadow all the more easterly fields in extent and ultimate productivity, but in quality the most of the contents are much below even those of the interior province. There are some true bituminous coals, and two or three places where the bituminous coals have been locally changed to anthracite, but they are for the most part lignites and sub-bituminous coals, the latter being a grade between the true lignite and true bituminous coal. The Rocky Mountain and Great Plains coal fields embrace some 178,022 square miles and are estimated to contain 2,350,000,000,000 tons, or about two-thirds of the total supply.

The productive coal fields of the Pacific coast are principally in the state of Washington, but the output is relatively small, and, as crude oil from California is the principal fuel in that section, they are hardly pertinent to this discussion.

It is estimated that the total original contents of these great coal fields, lying at depths not exceeding 3000 feet from the surface, were something over thirty-five hundred and fifty billion short tons, exclusive of Alaska, from which we have taken, to the close of 1916, about 11,500,000,000 tons, and assuming, as we do, that for every ton of coal produced one-half a ton has been lost, the exhaustion has amounted to 17,250,000,000, or, in other words, in a century of mining we have exhausted just about one-half of one per cent. of the original supply. At the rate of production in 1916, and assuming that we shall continue to lose half a ton for every ton mined, the storehouse still contains enough to last something like four thousand years. It does not look as if the problem were one of supply.

It must be remembered, however, that when we are speaking in these great figures of thousands of billions of tons as the total of our coal supplies, the great bulk of them consists of low-grade bituminous coals, and lignites which are contained in the Gulf, the Great Plains, and the Rocky Mountain provinces. Practically 70 per cent. of the total reserves are in these provinces, all of which are west of the Mississippi River. Only 15 per cent. is represented by the higher grade coals—the anthracite of Pennsylvania and the semi-bituminous and bituminous coals of the Appalachian region, and another 15 per cent. by the medium grade, non-coking coals of the Mississippi Valley states. And, moreover,

it is upon these higher grade coals, of which we have the least in quantity, that we are making the heaviest drains. Of our total production at the present time, about 70 per cent. is from the anthracite fields of Pennsylvania and the bituminous coals of the Appalachian areas, 20 per cent. is from the states composing the interior province, and less than 10 per cent. from the great fields of the farther West.

Still, when we consider that even in these more rapidly exhausting areas in the East the quantity of coal yet remaining is about a thousand times the drain made upon it in 1916, we can hardly say that the problem is one of supply—certainly not of supply at the source. Even in the anthracite region, comparatively small as it is, and whose annual output to-day is equal to

WORLD'S PRODUCTION OF COAL IN 1912

what our total production of coal was in 1881—thirty-five years ago—there still remains 80 per cent. of the supply that was there when mining began. Anthracite, as you all doubtless well know, is now almost entirely a domestic fuel. It had at one time quite a vogue as a blast-furnace fuel, but that has passed. It is still used to some extent in the manufacture of gas and as a locomotive fuel for the first-class passenger trains of the anthracite carrying roads. Otherwise it is hardly known as a fuel except in domestic stoves and ranges and in the heating and operation of office buildings, hotels, and apartments, which is practically domestic use. Probably the first pinch will come in the high-grade semi-bituminous coals, the great bulk of which lies along the eastern border of the Appalachian coal field. They are relatively scarce, representing less than 2 per cent. of our total resources, and it is upon these that the drain is being made at a rapidly in-

creasing rate. Campbell, of the Geological Survey, in his introductory chapter to a report on the coal fields of the United States says that these will be the first exhausted, and that such exhaustion may occur in the not very distant future. These are our best steaming coals, and their exhaustion will be a greater calamity to the country than the loss of all the anthracite, for coal of this kind has a greater efficiency and is adapted to more diverse uses than anthracite. We are rapidly consuming the cream and leaving the skim milk.

As I have said, practically all of the anthracite, or hard coal, as it is frequently called, which Nature has provided for the use and comfort of the people of the United States is found in a small area (less than 500 square miles) in the northeastern part of Pennsylvania. It has been estimated by geologists that when Nature had completed her task of depositing the coal, the contents of the field were about 16 times more than they were when man first began to mine and use it. These deposits, like those of other coals, passed through the various stages of forest growth, peat formation, lignite or brown coal, and then into bituminous coal. After these came tremendous earth movements by which the beds, formerly nearly horizontal, were bent and folded into mountains and valleys and the bituminous coal was changed to anthracite. The heat, and the pressure which caused it, during this period of stresses drove off the gases contained in the coal (and which produce the smoke when bituminous coal is burned), while the pressure itself compacted the material into the lustrous, dense, hard coal we know as anthracite.

After the mountains and valleys were formed, they were for millions of years subjected to the destructive wear of frosts and cutting streams, and finally were spread over by great glacier flows that came down from the north, so that by far the greater part of the mountains, containing most of the coal, were ground off and washed away until only remnants lying in the bottom of the great folds and containing only about 6 per cent. of the coal originally deposited were left for man to use. Nature seemed to regret her former generosity and took away the greater part of her gift. She was as wasteful as man is when in burning the fuel he gets only from 5 to 10 per cent. of the energy contained in the coal.

The conditions under which the vegetable débris was originally grown and deposited and the heat and pressure to which different

parts of the coal region were subjected were not everywhere absolutely the same, and so we find that there are some considerable differences in the qualities of the resultant anthracite. Where the heat and pressure were less the transformation was less complete. In these areas the coals are not so compact and are free-burning, but where Nature's action was stronger the change was more pronounced and the coals are harder and burn out somewhat less rapidly than the free-burning coals. All of them burn without smoke, however; all are clean and nice to handle; all are

Coal supply of the United States - 1000 cubic miles.

practically free from dust, and all are absolutely safe in the stove, furnace, or cellar.

Anthracite, as it comes from the mines, is a confused mixture of large and small coal, rock, slate, bone, and dirt, which must pass through an elaborate process of manufacture before it becomes the article of commerce with which the consumer is familiar. The impurities of rock, slate, bone, and dirt must be separated from the coal, and the coal itself must be screened into the various sizes desired by the consumer, the pieces that are too large being broken up and made into marketable sizes. The fac-

tories in which this work is accomplished are known as "breakers," although the object is to secure the largest quantities of domestic sizes of clean coal with as little breakage as possible.

The percentages of the different sizes obtained vary somewhat throughout the several districts or regions, according to the character of the coal and the mining conditions, the average for the entire region being approximately, of prepared or domestic sizes (including lump and broken coal), 60 per cent., pea coal 12 per cent., and the smaller, or steam, sizes 28 per cent.

Conditions in the bituminous coal industry are widely different from those that control the production of anthracite. In the first place, the manner of occurrence, and consequently the methods of mining, are not the same. For the most part, the coal beds of the Appalachian and interior provinces lie relatively flat. There has been some movement, and some faulting, as the geologists say, but it has been chiefly in the way of elevation and depression, and none of these fields has been subjected to the same folding action as has occurred in the anthracite region. The mountains and valleys of the Appalachian bituminous fields are due to the influence of cutting streams, and where the coal lies above water level considerable quantities have been carried away, but, compared to the losses in the anthracite region, those in the bituminous fields have been relatively insignificant. In the interior province, where the country is low and flat, the coal beds are below water level and intact, except along the northern and western edges.

The mining problems in the production of bituminous coal are simpler than in the production of anthracite, and there is little or no preparation, the only process of "manufacture" being the passage of the coal over screens that may separate it into three or four sizes, usually three—lump, nut, and slack. And this is by no means general. A large part of the product is sold as mine-run, dumped from the mine cars into the railroad cars.

Bituminous coal is chiefly an industrial fuel—anthracite a domestic fuel. According to the report of the United States Geological Survey, 28 per cent. of the bituminous production is used for railroad fuel, 33 per cent. by the industrial steam trade, 15 per cent. in the manufacture of coke, and 16 per cent. for domestic use and small steam trade. The probability is that, out of the 502,518,682 short tons of bituminous coal produced in 1916, not much more was used for domestic purposes than there

was of anthracite, whose total production was 87,578,493 short tons, equivalent to 78,195,262 long tons.

I think I have shown that the great problem with which we are wrestling to-day, the problem of providing enough fuel, is not with the supply at the source. We must look for the trouble somewhere else. In the first place, I suppose it is hardly worth while for me to say that stupendous changes have taken place in the country within the last twelve months. It seems hardly possible to realize at the present moment that little more than a year ago the production of both anthracite and bituminous coal was in excess of the demand. Millions of tons of anthracite were in the storage yards of the big producing companies, and the problem the operators were then trying to solve was that of getting rid of the surplus and of the output that the mines were continuing to produce. Because of interruption to the normal ocean transportation and inability to secure vessels, the terminals of the great railroad systems became congested with freight consigned to the European countries that are now our allies, and cars that should have been engaged in bringing coal to market were tied up under load with no place to discharge. As a consequence of this situation, the coal in the yards of dealers gradually disappeared, as comparatively little fresh coal was coming in to take its place. The scarcity of equipment due to the congestion at tidewater terminals was more seriously felt in the bituminous coal fields than in the anthracite region. Bituminous coal has to be moved from the mines as fast as it is produced. If there are no railroad cars in which to load it, the mines must shut down until a supply of cars is at hand. So, too, if the markets are glutted and there are no buyers, production must stop, or at least be slowed up, until the surplus disappears. The great storage yards of some of the larger anthracite companies serve as an escapement or balance-wheel to that industry, but the bituminous mines are denied it. The difficulties in storing large quantities of bituminous coal vary with the kind of coal. Some of them have a tendency to ignite spontaneously when heaped in large piles, while all of them deteriorate somewhat rapidly on exposure to the atmosphere through the loss of volatile gases. Many kinds of bituminous coal also "slack," producing fine coal that is of inferior quality as fuel. The production of the different sizes or grades of anthracite is at a practically unchanging ratio. The proportions of egg, stove, nut, pea, etc., are about the same, year in and year

out, but the market demands vary radically. During the winter season, under normal conditions, the demand for the domestic sizes naturally increases over that of the summer, so that it usually occurs that during the summer months considerable quantities of these sizes go into storage, to be picked up and sent to market when cold weather approaches. It frequently happens that in the winter months the steam sizes are in excess and they go into the storage piles to take the place of the domestic coal shipped out. When the demand for all sizes falls below the ratio of production, the surplus goes to the storage yards, the mines are kept going and the miners are kept employed. It is cheaper in the long run to pay for the extra handling and suffer some loss in degradation than to shut down the mines.

Susquehanna Coal Company, Shamokin Division, Shamokin, Penna. Concrete block house for some of the Cameron Colliery employees.

Now, in the early part of 1916, as I have said, there were some millions of tons, mostly domestic sizes, of anthracite in storage, but this, like the coal in the dealers' yards, gradually disappeared, and then it suddenly dawned upon everybody that there was practically no coal in sight and that the householder, the manufacturer, the public utilities, and the railroads found themselves dependent upon the day-by-day production of the mines. Then came the long, cold winter that necessitated the continued use of coal for household heating purposes fully a month after furnace fires are usually abandoned. This condition was particularly in evidence in the Northwest, and the surplus of several hundred thousand tons of coal that is generally carried over from one year to another was entirely consumed. Moreover, lake navigation was more than a month later than usual in opening up, and the water carrying season has been shortened that much.

That section of the country is, in consequence of this and of other complications in lake traffic, in a much worse condition than other sections of the country that can be reached by all-rail haul in the winter.

Then came the long-deferred, but finally inevitable, entrance of the United States into the world war. Munition plants and other factories which had for two years been working overtime to supply the entente Allies doubled their energies, and the demand for coal and coke increased in proportion. Plants that in normal times were operated eight, or at the most ten, hours a day began working three shifts of eight hours each. I have been told that in the city of Bethlehem the demand for, and employment of, labor has increased so much beyond the places to accommodate them that one bed has been made to serve three shifts for as many men.

Our coal mines have for many years had a capacity for production of about 50 per cent. more than their annual output. That is to say, that in 1915, for instance, when they turned out something over 530,000,000 tons, they could have produced with the same complement of men and with a sufficient supply of cars about 800,000,000 tons, for the average number of days worked was only 209. By working 300 days in the year and eight full hours a day this figure could easily have been attained.

That they have not been able to meet the demand upon them has been due primarily to two causes, the more important of which has been the failure of the railroad companies to perform the extra service such a result demanded. Whether it was due to lack of foresight or whether it was due to causes beyond their control, the result is the same. They have not been able to respond to the call for cars or for the motive power the changed conditions required. Possibly locomotive and car builders have been too busy supplying foreign demand at highly profitable prices to accept orders at the prices which our railroad managers thought they could afford to pay, but, however that may be, the production of coal has been badly handicapped by lack of car supply. Operators have cried "Cars, cars!" but they say there are no cars, and many mines in the bituminous regions have been able to work only three to four days in the week for want of railroad cars. How serious this situation is may be judged from the report of a conference recently held between members of the National Association of Coal Operators and the Fuel Admin-

istrator, at which the statement was made that for the ten days prior to the conference the reduction of coal output below capacity had not been less than 400,000 tons per day.

I speak now of bituminous coal, for it is bituminous coal and its product, coke, that are needed for manufacturing fuel. Anthracite has not been subjected to the same untoward conditions. The anthracite carrying roads have more satisfactorily responded to the demands upon them and have transported to market during the first nine months of this year the heaviest tonnage ever produced in the same length of time. The shipments from the anthracite mines from January 1 to September 30 this year have amounted to 57,778,000 tons, exceeding the shipments in the corresponding period in 1916 by 7,850,000 tons and beating the previous high record, made in 1911, by more than 6,400,000 tons.

The question then naturally arises, Why, if the anthracite mines have produced such a greatly increased quantity this year, is there such a general shortage of coal through the anthracite consuming territory? I am not going to say that this shortage is psychological, but I do believe that there is more coal in the cellars of consumers to-day than ever there has been before in the history of the country. The trouble has been in the distribution, not by the mining companies nor the railroads, but to consumers. The available supply of coal for the coming winter is concentrated in comparatively few cellars. During the spring and summer of this year the anthracite operators, through their publicity organization, advised consumers to take warning from the experience of 1916 and to lay in their supplies early in the summer, and, in order to stimulate early buying, put into effect the customary spring and summer discounts, though they were convinced—and events have since proved—that all of the coal could have been sold at full circular price. Undoubtedly, most of those who could afford to, and who were forehanded, took good advice, and their cellars are stocked with a winter's supply, but also undoubtedly, and very unfortunately, the people of less means—and they are the more numerous—were misled by newspaper reports that when the government got in its work on the coal operators, coal carriers, and coal dealers there was going to be a great slashing of coal prices. Small consumers only had to wait and they would effect a material saving on their coal bills. Well, the Federal Trade Commission made a pretty exhaustive inquiry into the anthracite situation, with the result that when the President, on

August 23, announced the mine prices for anthracite, he practically adopted the Reading circular. The Federal Trade Commission not only investigated mine costs and prices; it also investigated and is still investigating the costs and profits in the conduct of the retail coal business. It found, it is true, that in some cases dealers had been exacting unreasonable profits, but the business as a whole was not doing injury or injustice to the public, and there has been no general slashing in the retail prices of anthracite. It was largely the poorer classes that were misled by these reports, and it is they unfortunately that point the modern moral of a certain parable with which you are all familiar—

Concrete City, Delaware, Lackawanna and Western Railroad.

their lamps, otherwise their coal bins, are unfilled. I am optimistic, however, and believe that we will get through this winter without much suffering, even among the poorer classes. Those who have their cellars full will not have to buy any more, or at least will have to buy very little coal, to see them through. As I have said before, more attention is being paid just now to the Northwest, in order that as much coal as possible may be sent to that section before lake navigation is closed by ice. After that pressure is removed, greater consideration can be given to the more southerly markets, and they will to a large extent be taken care of.

And let me here speak for a moment of the manner in which the anthracite production has been distributed from the mines.

The Anthracite Bureau of Information, maintained at Wilkes-Barre by the anthracite producing companies, and with which for the past two years I have been connected, has compiled some statistics of the distribution of the output in the last two years to four leading markets—New England, New York City, Philadelphia, and the lake ports of Buffalo and Erie. These statistics show that the shipments to New England for the first eight months in 1916 were 5,790,237 tons; this year they have amounted to 6,455,941 tons, the increase being 665,704 tons, or 11.5 per cent. The shipments to New York have increased from 12,666,650 tons to 13,912,384 tons, a gain of 1,245,734 tons, or a little less than 10 per cent., while to Philadelphia were sent, in 1916, 4,186,698 tons, and in 1917, 4,927,992 tons, the increase being 741,294 tons, or 17.7 per cent. On the whole, it can hardly be said that Philadelphia has any just cause for complaint. The lake ports had not fared so well, but even there there is no actual diminution in shipments, and by the time the lakes are closed it is believed that even the shortage due to the unusual consumption in the spring months will have been more than made up. I think the showing regarding the distribution to these markets is quite convincing that the increase of 16 per cent. has been equitably distributed.

Anthracite, as I have said, is now almost exclusively a domestic fuel, the relatively small amounts consumed by railroads and gas companies not being important factors under normal conditions, but, owing to the inability of the bituminous mines and the coke ovens to meet the demands put upon them by the manufacturing industries of the country, extra demands have been made upon the anthracite mines. In some cases powerful influences have been brought to bear seeking to compel the anthracite interests to divert their product from its legitimate and customary channels, in order to relieve conditions that have developed chiefly through the failure of the transportation companies to supply the needed cars to the soft coal mines, and not the least of the difficulties with which the operators are contending at the present time is the protection of their regular trade.

The entrance of the United States into the world war has placed additional obligations upon the operators of coal mines, both anthracite and bituminous. The munition and other plants that, while the United States was still a neutral, were manufacturing war materials for the Allies now have a preferred place in

the distribution of coal, because they are making the guns, the shells, the ammunition, the clothes, and other equipment for our own army and navy. They cannot be allowed to shut down; they must be provided with fuel. And then the government itself has become a very important purchaser and consumer of coal, and its demands have absolutely first call upon the output of the mines. The forts and cantonments in which our national army is being concentrated and trained must be kept constantly supplied with the coal necessary for heat and cooking. The demands from these are principally for anthracite, and to give you an idea of what

Concrete City house.

this amounts to, I may state that the requirements of one of these cantonments alone for the month of November amounted to nearly 12,000 tons. The Navy Department also required considerable quantities of anthracite, though its principal demands are for bituminous coal; in fact, while the anthracite tonnage required for all the government departments may be stated in thousands or hundreds of thousands, the demands for bituminous coal will run into the millions.

Even Nature seems to be determined to add to the demands made at this particular time upon the mines, as if their burden

was not already sufficient. I refer to a condition that has developed in Ohio and which should be relieved if possible. The failure of the natural gas supply is a serious matter to the people in that section. Most of the homes in the country and in the smaller towns are equipped with base-burning stoves, in which anthracite or natural gas can be used, but which are not adapted to the use of bituminous coal. And from them has come a Macedonian cry it is impossible not to heed. With the supply of natural gas cut off, unless the people can secure anthracite, it means the discarding of their base-burning stoves and the substitution of bituminous coal burning stoves to an extent which the stove dealers and manufacturers are not prepared to supply. It presents one of the most serious phases of the problem of coal supply.

The labor situation is another serious phase of the problem. Attracted by the higher wages being offered by munition and other manufacturing establishments, men have deserted the coal mines by the thousands. The call for men for the army and navy has taken other thousands from the mines. The average number of men employed in the anthracite mines under normal conditions is from 175,000 to 180,000. Reports to the Anthracite Bureau of Information show that the average for the last few months has been only a little more than 150,000 men. This means a shortage of nearly 25,000 mine workers, and yet in two recent months, June and August, the shipments have exceeded 7,000,000 tons, the only two instances in the history of the region—a really remarkable record. It is well, however, to sound a note of warning. The anthracite mines are at the maximum of their capacity. Any further depletion of the labor must result in a decreased output, and the problem will not be one of coal supply but of getting along with less. That may not be impossible. We have been accustomed to a bountiful supply, and at prices less than the people of other countries pay for their fuel. We have been profligate in its use, and it is now time to undertake a reform. You who are still living at home and not in a hotel or apartment may do your bit in helping to solve the problem of coal supply. The heating of your home should be brought down to a practical basis of efficiency. You should ask yourself whether or not you are getting a dollar's worth of heat for every dollar's worth of fuel you consume. Probably you are not. The fault may be with your stove or furnace or with the kind of

fuel you are using, or with your method of regulating the stove or furnace. Quite frequently that same faithful old stove or furnace is unjustly blamed, and it is in reality the method of regulation that is at fault.

Sometimes the combustion chamber is not sufficiently filled, or it may be too full. The top of the fire-brick linings in the range, cylinder stove, or hot-air furnace and the bottom of the feed-door opening into steam and hot-water boilers are the definite gauges by which you should judge the height of the fuel bed. Always fill the fuel space of your stove, furnace, or boiler accordingly, heaping the coal slightly in the centre. The fuel space should be filled twice a day in winter weather. The last time should be as late at night as is convenient. By feeding small quantities of anthracite to the fire several times a day, with attendant shakings, you lose in both economy and comfort. Shake the grate only until a bright light shows underneath, and do this only twice a day. Further shakings permit unconsumed coal to pass through the grate-bars. When the furnace is filled at night the fire should be checked or damped down and be ready to give a quick heat in the morning. Steam or hot-water boilers should have the fireplace filled with coal at least to a point level with the bottom of the feed-door opening, and one feeding should be sufficient for twelve hours if the drafts are properly adjusted. Once in the morning and once in the evening are the only times when attention is necessary under normal weather conditions. Ashes should be shaken down just before the furnace or stove is refilled with fresh coal. Keep the ash-pit empty. Do not let the ashes bank up under the grate. This not only prevents the proper circulation of air needed for combustion, but also tends to warp the grate-bars. Removing the ashes regularly once a day, even if only a small amount has fallen, is the best plan.

Efficient management of domestic stoves and furnaces will go far toward solving the problem of domestic fuel supply.