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RESULTS OF PURCHASING COAL UNDER GOVERNMENT SPECIFICATIONS

BY

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WITH A PAPER ON

BURNING THE SMALL SIZES OF ANTHRACITE FOR HEAT AND POWER PURPOSES

BY

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RESULTS OF PURCHASING COAL UNDER UNITED STATES GOVERNMENT SPECIFICATIONS.

By JOHN SHOBER BURROWS.

INTRODUCTION.

Since the Government has been purchasing coal on the basis of its heating value a growing interest has been manifest in this important subject and a demand has been created for authentic information concerning the results accomplished. In response to this demand the results of the Government's purchases of coal under the heat-value specifications for the fiscal year 1907–8 have been assembled in this bulletin, and other information has been added which it is hoped will tend to promote a better understanding of this method of purchasing fuel. The list of the contracts, with abstracts of specifications for the current fiscal year, presented on pages 19–21, should prove of special interest to prospective bidders on future government contracts, as it shows the places for which coal is purchased on the specification plan and gives approximately the amounts of coal required annually. In this connection it should be remembered that a number of additions not definitely known at the present time will increase this list of government consumers for the coming fiscal year (1909–10).

On pages 38–44 will be found a paper by D. T. Randall, on the burning of small sizes of anthracite, which is published here because of its importance in emphasizing the economy of using in government plants the smaller and cheaper sizes of anthracite in preference to the larger and more costly sizes.

THE GOVERNMENT AS A COAL CONSUMER.

The United States Government purchases annually from $6,500,000 to $7,000,000 worth of fuel. This includes the cost of delivery and in many cases the cost of stowage. Each department purchases the coal through the purchasing officers of its respective bureaus. The Navy, War, Treasury, Interior, and Commerce and Labor departments are the larger consumers of coal in the aggregate. Much of the coal used by the Government must be delivered by wagon, which limits

this business to dealers having hauling facilities. This is especially the case in the city of Washington, where coal is purchased principally for the heating of public buildings.

The Treasury Department is a large consumer of coal delivered in wagons, as fuel for the post-offices, custom-houses, United States court-houses, marine hospitals, and other federal buildings located in the cities throughout the country is purchased under this department. The coal for the Revenue-Cutter Service is also purchased by this department.

The Navy Department is a large car-lot consumer as well as a purchaser of large cargoes of coal for foreign delivery. The Bureau of Supplies and Accounts of this department purchases the larger quantities for the ships of the navy and the car lots for use in the navy-yards.

The War Department makes purchases for the many forts and army posts in the United States and foreign possessions, and for the ships in the army transport service. The car-lot consumers are the arsenals under the Chief of Ordnance and the engineers of the army engaged in river and harbor improvement and other construction work.

Coal for use in the Canal Zone, Isthmus of Panama, is purchased by the Panama Railway Company of New York, f. o. b. at an Atlantic port in the United States; coal at the present time is being shipped from Norfolk and Newport News, Va.

The Department of Commerce and Labor purchases coal for the vessels of the Coast and Geodetic Survey and for the Immigration Service. At the Ellis Island immigration station, New York, 10,000 tons, mostly bituminous coal, are purchased annually. Fuel for the lighthouses is purchased by this department, the service being divided into sixteen districts and separate contracts made for each; these contracts range from 1,000 to 13,000 tons and are for anthracite and bituminous coal. The Bureau of Fisheries is a consumer of anthracite and bituminous coal in small lots, delivered to the cars of the service and to the experiment stations throughout the country.

The Interior Department is a large consumer of coal in Washington, where it purchases coal for the Government Hospital for the Insane amounting annually to 20,000 tons of bituminous and 1,000 tons of anthracite. Outside of Washington this department's most important contracts are for coal to be delivered to Indian schools.

Most of the coal purchased is used for warming public buildings and for power purposes, though small quantities of blacksmith's or forge coal and coke are bought. The larger individual contracts are for bituminous coal and the small sizes of anthracite; the larger sizes of anthracite are, as a rule, purchased in small lots and delivered mainly by wagons.

GENERAL PLAN FOR COAL PURCHASES.

NATURE OF SPECIFICATIONS.

Government specifications are drawn with a view to the consideration of price and quality. For manufactured articles and materials of constant and uniform quality they generally can be reduced to a clear statement of what is desired. For coal, however, the variation in character makes this impracticable.

This lack of uniformity is the feature recognized and provided for in the coal specifications prepared by the Geological Survey. Under these specifications, bidders are requested to quote prices on the various sizes of anthracite, a definite standard of quality being specified for each size, and to furnish the standard of quality with price for bituminous coal offered. Awards are then made to the lowest responsible bidder for anthracite and to the bidder offering the best bituminous coal for the lowest price, the proper award being determined as shown further on. (See pp. 29–31.) The specifications become part of the contract, and the standards of quality form the basis of payment for coal delivered during the life of the contract. For coal delivered which is of better quality than the standard, the contractor is paid a bonus proportional to the increased value of the coal. For deliveries of coal of poorer quality than the standard, deductions are made from the contract price proportional to the decreased value of the coal. The actual quality and value of coal delivered is determined by analysis and test of representative samples taken in a specified manner by agents of the Government and analyzed in the government fuel-testing laboratory at Washington. The necessity of paying for coal on a sliding scale was fully discussed by D. T. Randall in a recent paper.[a]

ADVANTAGES OF PURCHASING UNDER SPECIFICATIONS.

The advantages of this system of purchasing coal may be briefly summarized as follows:

(1) Bidders are placed on a strictly competitive basis as regards quality as well as price. This simplifies the selection of the most desirable bid and minimizes controversy and criticism in making awards.

(2) The field for both the Government and dealers is broadened, as trade names are ignored and comparatively unknown coals offered by responsible bidders may be accepted without detriment to the Government.

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[a] The purchase of coal under government and commercial specifications on the basis of its heating value: Bull. U. S. Geol. Survey No. 339, 1908.

(3) The Government is insured against the delivery of poor and dirty coal, and is saved from disputes arising from condemnation based on the usual visual inspection.

(4) Experience with the old form of government contract shows that it is not always expedient to reject poor coal, because of the difficulty, delay, and cost of removal. Under the present system rejectable coal may be accepted at a greatly reduced price.

(5) A definite basis for the cancellation of contract is provided.

(6) The constant inspection and analysis of the coal delivered furnishes a check on the practical results obtained in burning the coal.

HISTORY OF BUYING COAL FOR GOVERNMENT USE UNDER SPECIFICATIONS.

A few years prior to the adoption of the present system the necessity for a uniform standard in the purchase of coal became apparent to a few of the government departments, and the plan of purchasing on the heat-value basis was introduced. It proved successful, especially in the Treasury Department, under which purchases are made for the post-offices and other public buildings throughout the United States. The Treasury Department had at that time a well-equipped laboratory and was thus enabled to do all of the necessary testing. Other departments were unable to follow the example of the Treasury because of lack of information and proper facilities. In 1904, at the Louisiana Purchase Exposition, at St. Louis, the Geological Survey began a comprehensive study on a practical scale of the utilization of coal, J. A. Holmes being placed in charge of the work. These investigations are still in progress at Pittsburg, Pa., and they have resulted in making authentic information of great practical value available to the public as well as to the government departments.

This work led up to the development of a general and uniform specification plan for purchasing the government fuel supply. In an act making appropriation for the fiscal year 1907, Congress recognized the importance of a more careful supervision of the Government's purchase of coal and charged the Geological Survey with the testing of coal for government use.

The part of this act relating to government fuel purchases is as follows:

* * * *Provided*, That in examinations, hereby authorized, of fuel materials for the use of the Government of the United States, or for the purpose of increasing the general efficiency or available supply of the fuel resources in the United States, the Director of the Geological Survey may have the necessary materials collected from any part of the United States where they represent extensive deposits; and it shall be the duty of the Director of the Geological Survey to have examined, without charge, the fuels required for use by the Government of the United States, and to give these examinations preference over other work. * * *

After this legislation, President Roosevelt, in a letter to the National Advisory Board on Fuels and Structural Materials, brought to the attention of that body the need of an efficient and uniform basis for the purchase of coal. As a result of this action a specification form was drafted by engineers in the employ of the Government and approved by the board in March, 1907. Contracts based on this specification went into effect July 1, 1907, the beginning of the fiscal year 1908, and the results obtained are shown on pages 31–37. Before an attempt was made to draft this specification form, the general fuel-testing investigations carried on at St. Louis, Mo., were supplemented by analyses and tests of a large number of samples of coal being delivered under contracts to buildings in Washington and elsewhere, and this work formed the basis for the standards set in the specifications.

For about half of the first year (1907–8) D. T. Randall had charge of the inspection and analysis of coal delivered under these specifications. About January, 1908, the writer took charge of the coal inspection section, with G. S. Pope as principal assistant on inspection, G. O. Spitler as chemist in charge of laboratory, N. H. Snyder, E. J. Billings, and P. M. Riefkin as inspectors, and J. D. Davis, chemist, as assistant to Mr. Spitler. These men were employed from the beginning, and are largely responsible for the development of a systematic routine in the handling of this work.

At the beginning of the present fiscal year, 1909, it was found advantageous to make some slight changes in the specification forms, and it is possible that other revisions may be made for the coming fiscal year. These changes, however, do not affect the general scheme.

VALUE OF COAL AS A FUEL.

The purpose of burning coal under boilers is to abstract the heat for developing power, for drying various materials, or for warming buildings. The most valuable coal, therefore, is that which gives up the most heat to the boiler for a given weight burned.

Coal is now burned for power purposes in gas producers and boiler furnaces. For coals and lignites high in moisture or high in ash, the gas producer, used in connection with a gas engine, is best adapted to develop power. But for the generation of steam, which can be used for heating as well as for power purposes, a more convenient method is to burn the coal in a specially constructed furnace under a boiler.

The aim in the purchase of coal for any power plant should be to obtain a fuel which will produce a horsepower for the least cost, all things being considered, such as the equipment, the price of coal, and the cost of labor and repairs. Experiments have been made which seem to indicate that almost any fuel may be burned with

reasonable efficiency in a properly designed apparatus. The recognized requirements are as follows:

A supply of fuel fed to the furnace as uniformly and continuously as possible.

An air supply slightly in excess of the theoretical amount required for complete combustion.

A sufficiently high temperature to ignite the gases which are driven off from the fuel.

A complete mixture of these gases with the air supplied before they reach a cooling surface, such as the shell or tubes of a boiler.

Some of the factors which may influence the commercial results obtained in a boiler are cost of the coal, as determined by price and heating value; care in firing; design of the furnace and boiler setting, size of grate, etc.; formation of excessive amounts of clinker and ash; available draft; size of the coal (uniformity of size is desirable).

The value of a coal is indicated by the number of heat units it contains. This heating value is expressed in terms of British thermal units[a] (abbreviated B. t. u.) per pound of coal, and is determined by means of a special apparatus called a calorimeter.

When coal is mined it contains more or less moisture. It is exposed to the air in shipment and may either dry out or be drenched by rain. The moisture in the coal delivered is worthless to the purchaser and really costs him a considerable amount in freight and cartage and in the loss of the heat absorbed during its evaporation in the furnace. If all coal contained the same proportion of moisture, or if the moisture in coal delivered by a given dealer were constant in amount, the purchaser's problem, so far as this factor is concerned, would be simplified.

Under present conditions the moisture is an important element in the valuation of a ton of coal. It is evidently necessary to consider the coal just as it is received in order to determine its value to the consumer, but chemical reports should be made on the basis of both the "dry coal" and the "coal as received." The dry-coal basis is convenient for comparing several coals in regard to the relation of each element to the others; this is important because the moisture in the same coal varies from day to day. The dry-coal basis is also convenient for comparing the performance of boilers when burning the same or similar coals. Of several coals having a similar composition, the one which has the least moisture and the least ash will generate the most steam when burned under a boiler.

Ash is made up of earthy matter and other impurities which will not burn. In commercial coals its proportion may range from 4 to 25 per cent. Coals containing small percentages of ash are most

[a] The British thermal unit is the amount of heat required to raise the temperature of 1 pound of water 1° Fahrenheit.

valuable, not only because of their correspondingly higher heating capacity, but because there is less resistance to the free and uniform distribution of air through the bed of coal. The labor and cost of managing the fires and of handling the ashes are also correspondingly less and are items to be considered in the choice of a coal. With the ordinary furnace equipment there may be a considerable loss of efficiency and capacity through a large percentage of ash. With some kinds of equipment it has been found that as the ash increases there is a decided drop in both efficiency and capacity. In some experiments made to determine the influence of excessive amounts of ash, coal containing as high as 40 per cent would generate no steam when fired on a chain grate, and therefore the efficiency and capacity of the plant would be zero.[a] Such coal is not only worthless, but involves a direct expense, due to the cost of handling it. Whether the result would be similar with equipment other than a chain grate has not yet been determined. However, coals so high in ash that they are unsuited to boiler furnaces can be utilized in gas producers.

The volatile part of some coals, shown in the analyses, may be all combustible, but it generally contains some inert matter. The amount of this varies in different coal deposits, and the variation makes it impossible to determine the heating value of the coal from the proximate analysis alone. Moreover, not all coals having the same proportion of volatile matter behave alike in the furnace. It is important to know both the chemical composition and the British thermal units in order to determine the value of one coal as compared with another for the same purpose.

Of two coals of different character, the one which contains the higher proportion of fixed carbon is most easily burned so as to give the maximum efficiency. However, if the coal containing the higher volatile matter is properly burned in a suitably designed furnace it may be made equally efficient.

Sulphur may be present in the free state, or, as is more common, in combination with iron or other elements. Other impurities with sulphur often form a clinker which shuts out the air and increases the labor of handling the furnaces. It is possible, however, to burn coals containing up to 5 per cent of sulphur without particular difficulty from clinkers. A little steam introduced under the grate will relieve much of the trouble. Clinker may be due to other causes than sulphur, as any constituents of the ash which are easily fusible may produce it. There is need of further investigation to determine the influence of sulphur and the elements which comprise the ash on furnace fires and combustion.

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[a] Abbott, W. L., Some characteristics of coal as affecting performance with steam boilers, a paper read before the Western Society of Engineers, Chicago, Ill.

The size of the coal influences the capacity of any given equipment, owing to its effect on the draft. With a poor draft fine coal can not be burned in sufficient quantities to maintain the rated capacity. If thin fires are resorted to, the efficiency is usually lowered as a result of an excessive supply of air through holes in the fire. As a rule, when dust and very fine coal are fed into the furnace they either check the flow of air or are taken up by the draft and after being only partly burned are deposited back of the bridge wall or pass up the stack, to the annoyance of the people in the vicinity of the plant. If this dust is completely burned in passing through the furnace there is of course no loss of fuel. It has been found that coal of a uniform size is most satisfactory, as it does not pack so closely as a mixture of sizes.

In general it may be said that in any market the coal obtainable at the lowest price is the most economical, provided the furnace equipment is suitable. If the furnace is not so designed as to permit the use of the cheaper coal, it should be changed.

The results of tests tend to show that, other conditions being equal, coals of similar composition are of value in proportion to the British thermal units in the coal as received—a basis on which, indeed, all coals may be valued approximately. It should be remembered, however, that the value of a coal for any particular plant is influenced by the fact that all furnaces are not equally suitable for burning the many grades of coal. Aside from this factor, coals may be compared in terms of the British thermal units obtained for 1 cent, or on the cost per million heat units.

In the purchase of coal, then, attention should be given to the character of the furnace equipment and the load; the character of coal best suited to the plant conditions; the number of heat units obtainable for a unit price; the cost of handling the coal and ash; and the possibility of burning the coal without smoke or other objectionable features.

CONTRACTS FOR THE FISCAL YEAR 1909.

GENERAL CHARACTER.

The current contracts for coal purchased on the heat-value specification basis have been arranged alphabetically by cities in the table on pages 19–21, which will serve as a guide for bidding on 1910 contracts. These contracts are all drawn on the specifications which follow (pp. 14–18).

Two classes of coal are recognized and differentiated in the specifications, namely, anthracite and bituminous. By anthracite is meant the coal mined in the counties of Susquehanna, Lackawanna, Luzerne, Carbon, Schuylkill, Columbia, Sullivan, Northumberland, and Dauphin, of Pennsylvania. By bituminous is meant varieties of coal

other than anthracite, including the several grades of semibituminous and semianthracite.

The anthracite specifications provide definite fixed standards of quality for each size. These standards so far have been based on the percentage of ash in dry coal. In this connection it is well to know that the term "dry coal" means coal free from moisture, as determined by drying a small sample at 105° C. It is obvious that the percentage of ash in dry coal will always be somewhat higher than in the undried sample.

The specification for bituminous coal is intended to give a clear description of the coal desired by the Government, and to secure a definite statement of the quality of coal offered by the bidder, with a view to using such standard as a basis for payment in connection with the stated price per ton.

The specification limits which are drawn in the interest of plant economy are wide enough to permit the use of the output of any mine or group of mines, provided proper care is exercised in mining and picking out slate, bone, etc. With these points in mind, it is only necessary for the bidder to select coal that will meet the description given and permit deliveries within the limits set.

It is not expected that all deliveries will be absolutely uniform or agree exactly with the standard established by the contractor, but it is necessary that all deliveries shall be within the limits set by the Government.

The standard established by the contractor should, however, be such as to require the least possible correction in price on account of variation in heat units and ash.

The heating value, expressed in British thermal units, of coal containing approximately the same percentage of ash is essentially a direct measure of the actual value to the purchaser, and for this reason the specification for 1908–9 provides for an adjustment of payment in direct proportion to the variation in heat units in the coal as received. As the coal is weighed when delivered, and the payments are based also upon the price per ton, it is necessary to determine the heating value of the coal in the condition in which it is received, containing whatever moisture may be present at the time.

Under this plan neither the contractor nor the Government will gain or lose by change in the moisture content of the coal between the time it is weighed at the mine and the time it is weighed on delivery. The price per ton will be correspondingly lower if the coal is wet and higher if the coal is dry.

A further correction in payment is made for variation of the ash in dry coal in order to take account of the cost of handling additional fuel and ash and its effect on the capacity of the boiler and furnace.

FORM OF ANTHRACITE SPECIFICATIONS.

In determining the award of the contract consideration will be given to the quality of the coal offered by the bidder, as well as the price per ton, and should it appear to be to the best interests of the Government to award the contract for supplying coal at a price higher than that named in lower bid or bids received the award will be so made. The right to reject any or all bids and to waive defects is expressly reserved by the Government.

DESCRIPTION OF COAL DESIRED.[a]

Bids are desired on the coals as follows:

——— tons white ash furnace anthracite coal.
——— tons white ash egg anthracite coal.
——— tons white ash stove anthracite coal.
——— tons white ash chestnut anthracite coal.
——— tons white ash pea anthracite coal.
——— tons white ash buckwheat No. 1 anthracite coal.
——— tons white ash buckwheat No. 2 anthracite coal.
——— tons white ash screenings anthracite coal.
——— tons red ash anthracite coal.
——— tons red ash anthracite coal.

These coals may be delivered from the car without being screened, but must be reasonably free from dust and fine coal.

To receive consideration bids must be based upon the following percentages of ash for the various classes of coal:

	Per cent of ash in dry coal.
Furnace	10
Egg	10
Stove	12
Chestnut	14
Pea	16
Buckwheat No. 1	18
Buckwheat No. 2	18

Coal with less ash than the standard will be paid for at a higher price and vice versa, in accordance with the provisions for payment.

DELIVERY.

The coal shall be delivered in such quantities and at such times as the Government may direct.

In this connection it may be stated that all the available storage capacity of the coal bunkers will be placed at the disposal of the contractor to facilitate delivery of coal under favorable conditions.

After oral or written notice has been given to deliver coal under this contract a further notice may be served in writing upon the contractor to make delivery of the coal so ordered within twenty-four hours after receipt of said second notice.

Contractor will be allowed to deliver coal during the usual hours of teaming, or between 8 a. m. and dark.

Should the contractor, for any reason, fail to comply with the second request the Government will be at liberty to buy coal in open market, and to charge against the contractor any excess in price of coal so purchased over the contract price.

[a] This information will be given by the Government as may be determined by boiler and furnace equipment, operating conditions, and the local market.

SAMPLING.

Samples of the coal delivered will be taken by a representative of the Government.

Wherever practicable the coal will be sampled at the time it is being delivered to the building. In case of small deliveries, it may be necessary to take these samples from the yards or bins. The sample taken will in no case be less than the total of one hundred (100) pounds, to be selected proportionally from the lumps and fine coal, in order that it will in every respect truly represent the quantity of coal under consideration.

In order to minimize the loss in the original moisture content the gross sample will be pulverized as rapidly as possible until none of the fragments exceed one-half inch in diameter. The fine coal will then be mixed thoroughly and divided into four equal parts. Opposite quarters will be thrown out, and the remaining portions thoroughly mixed and again quartered, throwing out opposite quarters as before. This process will be continued as rapidly as possible until the final sample thus obtained will be contained in the shipping can or jar and sealed air-tight.

The sample will then be forwarded to the chemical laboratory.

If desired by the coal contractor, permission will be given to him, or his representative, to be present and witness the quartering and preparation of the final sample to be forwarded to the government laboratories.

Immediately on receipt of the sample it will be analyzed and tested by the Government according to the method adopted by the American Chemical Society, which involves the use of a bomb calorimeter. A statement of the result will be mailed to the contractor on the completion of the test.

CAUSES FOR REJECTION.

It is understood that the coal delivered during the year will be of the same character as that specified by the contractor.

Coal containing more than 1 per cent of sulphur, an excessive amount of dust and fine coal, or a percentage of ash in excess of the maximum limits, indicated in the following table, will be subject to rejection:

	Per cent.
Furnace coal	14
Egg coal	14
Stove coal	16
Chestnut	18
Pea	20
Buckwheat No. 1	21
Buckwheat No. 2	21

PRICE AND PAYMENT.

Payment will be made on the basis of the price named in the proposal for the coal specified, corrected for variations in ash as shown by analysis above and below the standard as indicated by the following tables:

Corrections in prices of coal on account of variations in per cent of ash from the standard in dry coal.

FURNACE AND EGG.

Per cent of ash in dry coal.								
6.01 to 6.50	6.51 to 7.00	7.01 to 7.50	7.51 to 8.00	8.01 to 12.00 inclusive.	12.01 to 12.50	12.51 to 13.00	13.01 to 13.50	13.51 to 14.00
Cents per ton to be added.				Standard contract. price.	Cents per ton to be deducted.			
24	21	18	15		15	18	21	24

STOVE.

Per cent of ash in the dry coal.										
7.51 to 8.00	8.01 to 8.50	8.51 to 9.00	9.01 to 9.50	9.51 to 10.00	10.01 to 14.00 inclusive.	14.01 to 14.50	14.51 to 15.00	15.01 to 15.50	15.51 to 16.00	16.01 to 16.50
Cents per ton to be added.					Standard contract price.	Cents per ton to be deducted.				
27	24	21	18	15		15	18	21	24	27

CHESTNUT.

Per cent of ash in the dry coal.									
9.51 to 10.00	10.01 to 10.50	10.51 to 11.00	11.01 to 11.50	11.51 to 12.00	12.01 to 16.00 inclusive.	16.01 to 16.50	16.51 to 17.00	17.01 to 17.50	17.51 to 18.00
Cents per ton to be added.					Standard contract price.	Cents per ton to be deducted.			
27	24	21	18	15		15	18	21	24

Corrections in prices of coal on account of variations in per cent of ash from the standard in dry coal—Continued.

PEA.

Per cent of ash in the dry coal.										
12.51 to 13.00	13.01 to 13.50	13.51 to 14.00	14.01 to 14.50	14.51 to 15.00	15.01 to 17.00 inclusive.	17.01 to 17.50	17.51 to 18.00	18.01 to 18.50	18.51 to 19.00	19.01 to 19.50
Cents per ton to be added.					Standard contract price.	Cents per ton to be deducted.				
15	12.5	10	7.5	5		5	7.5	10	12.5	15

BUCKWHEAT.

Per cent of ash in the dry coal.											
14.51 to 15.00	15.01 to 15.50	15.51 to 16.00	16.01 to 16.50	16.51 to 17.00	17.01 to 19.00 inclusive.	19.01 to 19.50	19.51 to 20.00	20.21 to 20.50	20.51 to 21.00	21.01 to 21.50	21.51 to 22.00
Cents per ton to be added.					Standard contract price.	Cents per ton to be deducted.					
12	10	8	6	4		4	8	14	21	32	48

BITUMINOUS COAL SPECIFICATION.

With respect to delivery and sampling, the bituminous coal specification is essentially the same as that for anthracite; so that portion of the specification will be omitted. The description of the coal desired is given by the Government for each contract, in the blanks provided on the form, and maximum amounts of ash, volatile matter, sulphur, dust, and fine coal (through one-eighth inch round-hole screen) are specified.

The remaining and important parts of the specification are as shown below.

CAUSES FOR REJECTION.

A contract entered into under the terms of this specification shall not be binding if, on practical service test of reasonable duration, the coal fails to give satisfactory results by reason of excessive clinkering, or a prohibitive amount of smoke.

It is understood that the coal delivered during the year will be of the same character as that specified by the contractor. It should, therefore, be supplied, as nearly as possible, from the same mine or group of mines.

Coal containing percentages of volatile matter, sulphur, and dust higher than the limits indicated on page 2 [of the specifications], and coal containing a percentage of ash in excess of the maximum limits indicated in the following table will be subject to rejection.

For coal which has been delivered and used for trial, or which has been consumed or remains on the premises at the time of the determination of its quality, payment will be made at a reduced price, computed under the terms of this specification.

Occasional deliveries containing ash up to the percentage indicated in the column of "Maximum limits for ash," on page 4 [of these specifications], may be accepted. Frequent or continued failure to maintain the standard established by the contractor, however, will be considered sufficient cause for cancellation of the contract.

PRICE AND PAYMENT.[a]

Payment will be made on the basis of the price named in the proposal for the coal specified therein, corrected for variations in heating value and ash, as shown by analysis, above and below the standard established by the contractor in this proposal. For example, if the coal contains two (2) per cent more or less British thermal units than the established standard, the price will be increased or decreased two (2) per cent accordingly.

The price will also be further corrected for the percentages of ash. For all coal which by analysis contains less ash than that established in this proposal a premium of 1 cent per ton for each whole per cent less ash will be paid. An increase in the ash content of two (2) per cent over the standard established by contract will be tolerated without exacting a penalty for the excess of ash. When such excess exceeds two (2) per cent above the standard established, deductions will be made from price paid per ton in accordance with the following table:

Ash as established in proposal (per cent).	No deduction for limits below—	Cents per ton to be deducted.							Maximum limits for ash (per cent).
		2	4	7	12	18	25	35	
		Per cent of ash in dry coal.							
5	7	7- 8	8- 9	9-10	10-11	11-12	12-13	13-14	12
6	8	8- 9	9-10	10-11	11-12	12-13	13-14	14-15	13
7	9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	14
8	10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	14
9	11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	15
10	12	12-13	13-14	14-15	15-16	16-17	17-18	.....	16
11	13	13-14	14-15	15-16	16-17	17-18	18-19	.....	16
12	14	14-15	15-16	16-17	17-18	18-19	19-20	.....	17
13	15	15-16	16-17	17-18	18-19	19-20	20-21	.....	18
14	16	16-17	17-18	18-19	19-20	20-21	21-22	.....	19
15	17	17-18	18-19	19-20	20-21	21-22	.....	.....	19
16	18	18-19	19-20	20-21	21-22	22-23	.....	.....	20
17	19	19-20	20-21	21-22	22-23	.....	.....	.....	21
18	20	20-21	21-22	22-23	.....	.....	.....	.....	22

LIST OF CONTRACTS.

The following list gives details of contracts that have been entered into for the present fiscal year:

[a] The economic value of a fuel is affected by the actual amount of combustible matter it contains, as determined by its heating value shown in British thermal units per pound of fuel, and also by other factors, among which is its ash content. The ash content not only lowers the heating value and decreases the capacity of the furnace, but also materially increases the cost of handling the coal, the labor of firing, and the cost of the removal of ashes, etc.

List of government coal contracts for fiscal year 1909.

Consumer.	Department.	Location.	Amount of contract.	Kind of coal.	Size of coal.	Abstract of specifications.					Payment based on—
						Volatile matter.	Ash (dry coal).	B. t. u. (as received).	Dust.	Sulphur.	
			Tons.			*Per cent.*	*Per ct.*		*P. ct.*	*P. ct.*	
Botanical Gardens	Under Library of Congress.	Washington, D. C.	350	Anthracite	Furnace		10				Ash.
Do	do	do	20	do	Chestnut		14				Do.
Bureau of Education	Interior	do	100	do	Furnace		10				Do.
Civil Service Commission	do	do	250	do	do		10				Do.
Congressional Library	Congress	do	3,700	do	do		10				Do.
Buildings of War Department	War	do	450	do	Egg		10				Do.
Do	do	do	375	do	Stove		12				Do.
Do	do	do	20	do	Chestnut		14				Do.
Do	do	do	400	do	Furnace		10				Do.
Freedmen's Hospital	Interior	do	900	Bituminous	Run of mine	20	10	13,900	15	1.5	Ash, B. t. u.
Do	do	do	200	Anthracite	Buckwheat	6	16		0	1	Ash.
Do	do	do	50	do	Egg	6	10		0	1	Do.
Do	do	do	200	do	Pea	6	14		0	1	Do.
Government Hospital for the Insane.	do	do	20,000	Bituminous	Run of mine		7.5	14,300			Ash, B. t. u.
Do	do	do	1,000	Anthracite	Stove		12				Ash.
Government Printing Office	Congress	do	9,000	do	Egg		10				Do.
Howard University	Interior	do	300	Bituminous	Run of mine		10	13,900			Ash, B. t. u.
Do	do	do	400	Anthracite	Furnace		8				Ash.
Do	do	do	100	do	Egg		8				Do.
Do	do	do	100	do	Chestnut		12				Do.
Do	do	do	50	do	Stove		10				Do.
Isthmian Canal Commission	do	do	125	do	Furnace		10				Do.
Land Office (Old Post-Office)	do	do	5,000	do	Buckwheat		18				Do.
Do	do	do	3,600	Bituminous	Run of mine		8	14,200			Ash, B. t. u.
Agriculture buildings	Agriculture	do	3,600	Anthracite	Furnace		10				Ash.
Do	do	do	20	do	Egg		10				Do.
Do	do	do	250	do	Stove		12				Do.
Do	do	do	2,000	do	Buckwheat No. 2.		18				Do.
National Museum	Under Smithsonian Institution.	do	1,200	do	Furnace		10				Do.
Do	do	do	80	do	Egg		10				Do.
Do	do	do	30	do	Stove		12				Do.
Do	do	do	30	do	Chestnut		14				Do.
National Zoological Park	do	do	1,200	do	Furnace		10				Do.
Do	do	do	80	do	Egg		10				Do.
Do	do	do	30	do	Stove		12				Do.

List of government coal contracts for fiscal year 1909—Continued.

Consumer.	Department.	Location.	Amount of contract.	Kind of coal.	Size of coal.	Abstract of specifications.					Payment based on—
						Volatile matter.	Ash (dry coal).	B. t. u. (as received).	Dust.	Sulphur.	
			Tons.			*Per cent.*	*Per ct.*		*P. ct.*	*P. ct.*	
National Zoological Park	Under Smithsonian Institution.	Washington, D. C	30	Anthracite	Chestnut		14				Ash.
Do	do	do	300	Bituminous	Run of mine		9				Do.
Naval Observatory	Navy	do	600	Anthracite	Furnace		10			1	Do.
Pension Office	Interior	do	1,200	do	do		10				Do.
Post-office	Post-Office	do	6,000	do	Pea		16				Do.
State, War, and Navy buildings	State, War, and Navy	do	4,500	do	Buckwheat No. 1.		18				Do.
Soldiers' Home	War	do	5,600	Bituminous	Run of mine	22	6	14,300		1.5	Ash, B. t. u.
Do	do	do	460	Anthracite	Furnace		10		0		Ash.
Do	do	do	350	do	Stove		12		1.5		Do.
United States Geological Survey	Interior	do	600	do	Furnace		10				Ash.
Bureau of Engraving and Printing.	Treasury	do	8,000	Bituminous	Run of mine		5.70	14,600			Ash, B. t. u.
Treasury	do	do	1,500	do	do		5.70	14,600			Do.
Do	do	do	1,500	Anthracite	Rice		18				Ash.
Winder Building	do	do	400	Bituminous	Run of mine		5.70	14,600			Ash, B. t. u.
Post-office and courthouse	do	Baltimore, Md	2,550	do	do		6.50	14,300			Do.
Custom-house	do	do	350	Anthracite	Screenings		18				Ash.
Post-office and subtreasury	do	Boston, Mass	1,500	Bituminous	Run of mine		7.12	14,257			Ash, B. t. u.
Do	do	do	3,000	Anthracite	Screenings		12	12,650			Do.
Court-house	do	Brooklyn, N. Y	3,500	do	Buckwheat No. 2.		18	11,150			Do.
Post-office	do	Buffalo, N. Y	1,250	Bituminous	Over ¾-inch bar		6.50	14,000			Do.
Navy-yard	Navy	Charleston, S. C	3,000	do	Run of mine	22	7	14,500		1.5	Do.
Appraisers' stores	Treasury	Chicago, Ill	8,500	do	2 inch by ⅞ inch		10	11,442			Do.
Custom-house	do	Cincinnati, Ohio	3,000	do	Run of mine		5	14,600			Do.
Custom-house, court-house, and post-office.	do	Detroit, Mich	1,600	do	do		6.10	14,000			Do.
Do	do	Kansas City, Mo	2,000	do	1¾ inch, screened.		11.81	12,894			Do.
Do	do	Louisville, Ky	1,850	do	Over 1¼-inch bar.		6	14,000			Do.
Court-house and post-office. post-office.	do	Milwaukee, Wis	1,200	do	Through ¾-inch bar.		9.04	13,192			Do.
Custom-house and post-office	do	Minneapolis, Minn	600	do	Over 2 inch		14.78	12,257			Do.
Light-house tender, seventh and eighth districts.	Commerce and Labor	Mobile, Ala	3,000	do	Run of mine		2.24	14,780			Do.
Custom-house	Treasury	New Orleans, La	1,300	do	Over 2 inch		6	14,000			Do.

Mint	Treasury	New Orleans, La	800	Bituminous	Over 2 inch		6	14,000			Ash, B. t. u.
Panama Railroad Co	Panama Railroad Co	F. o. b. steamers, Newport News, Va.	100,000	do	Run of mine			14,600			B. t. u.
Do	do	do	40,000	do	do			14,000			Do.
Barge office	Treasury	New York, N. Y	500	Anthracite	Pea No. 1		14.89	12,181			Ash, B. t. u.
Appraisers' warehouse	do	do	2,500	do	Screenings		18	12,000			Do.
Do	do	do	2,500	Bituminous	Run of mine		8	14,000			Do.
Court-house and post-office	do	do	11,000	do	do		8	14,000			Do.
Custom-house	do	do	4,000	Anthracite	Buckwheat No. 2.		18	11,150			Do.
Panama Railroad Co	Panama Railroad Co	F. o. b. steamers, Norfolk, Va.	260,000	Bituminous	Run of mine			14,600			B. t. u.
Navy-yard	Navy	Norfolk, Va	12,000	do	do	22	5.5	14,500		1	Ash, B. t. u.
Court-house and post-office	Treasury	Omaha, Nebr	1,700	do	do		11	12,000			Do.
Appraisers' stores	do	Philadelphia, Pa	350	Anthracite	Pea		14.05				Ash.
Court-house and post-office	do	do	350	Bituminous	Run of mine		6.87	14,279			Ash, B. t. u.
Do	do	do	2,800	Anthracite	Barley		14	11,000			Do.
Mint	do	do	4,000	Bituminous	Run of mine		7.80	14,000			Do.
Frankford Arsenal	War	do	1,000	Anthracite	Buckwheat		17				Ash.
Do	do	do	5,000	Bituminous	Run of mine		5	14,000			Ash, B. t. u.
Navy-yard	Navy	do	16,000	do	do	17	a 7	14,250		1.7	Do.
Rock Island Arsenal	War	Rock Island, Ill	1,000	Anthracite	Egg		6.72				Ash.
Do	do	do	300	Bituminous			4	13,400			Ash, B. t. u.
Do	do	do	5,000	do	Run of mine		13.2	11,100			Do.
Springfield Armory	do	Springfield, Mass	5,000	do	do		7	14,000			Do.
Custom-house and post-office	Treasury	St. Louis, Mo	4,500	do	Over 3 inch		12	12,000			Do.
Court-house and post-office	do	St. Paul, Minn	1,450	do	Over 1 inch		8	13,300			Do.
Custom-house	do	Toledo, Ohio	500	do	Over 3 inch		4.45	14,900			Do.
Watertown Arsenal	War	Watertown, Mass	4,000	do	Run of mine		8	14,300			Do.
Do	do	do	300	Anthracite	Furnace		10				Ash.

Including sulphur, 8 per cent.

AWARD OF CONTRACTS.

An important point which seems not to be thoroughly understood in purchasing coal on the basis of its heating value is the manner of making awards. In order to show how the lowest bid is determined, the proposals for supplying coal to the federal buildings under the Treasury Department have been selected as representing the widest range of coals and conditions throughout the country. This information was assembled by J. E. Woodwell, who was formerly in charge of coal purchases for the Treasury Department.

All bids are received on official proposal blanks, in sealed envelopes, in response to advertisements inserted in the daily papers. These proposals are opened at a specified time, in the presence of all those who desire to attend, and awards are made as soon thereafter as possible.

The attention of coal dealers is directed to the form of newspaper advertisements, many of which do not call for coal alone. An example of such an advertisement is as follows:

POST-OFFICE DEPARTMENT,
Washington, D. C., March 11, 1908.

Sealed proposals will be received at the office of the purchasing agent of this department until 2 o'clock, p. m., Wednesday, April 15, 1908, for furnishing stationery (including paper, wrapping paper, cards and cardboard, copy books and blank books, tags, drawing materials, inks and mucilage, pens and penholders, pencils, erasers, knives and shears, typewriters and supplies, duplicating devices, computing machines, rubber goods, and miscellaneous supplies); rubber stamps, and inks, pads and racks for same; numbering machines, seals, etc.; copying presses; furniture, carpets, etc.; baskets, buckets, and boxes; dry goods; twine and cordage; hardware and trucks; leather and leather belting; electrical supplies; paints, oils, chemicals, and glass; lumber; fuel, ice, etc.; forage and household supplies, as they may be ordered for the use of the Post-Office Department or any branch of the postal service from time to time during the fiscal year beginning July 1, 1908; and ending June 30, 1909. Blanks for proposals, with specifications and instructions to bidders, will be furnished upon application to the purchasing agent for the Post-Office Department, Washington, D. C.

C. P. GRANDFIELD,
Acting Postmaster-General.

The following is a complete summary of the Treasury Department proposals, showing the delivery point, tonnage, character of coal desired, maximum limits of ash, volatile matter, and sulphur, all as specified by the Government; together with data furnished by the bidders as to the commercial name of the coal offered, name and location of mine, designation of coal bed, sizing or screening dimensions, guaranteed British thermal units in the coal as delivered, and percentage of ash in dry coal.

Schedule of proposals for coal, United States Treasury Department, fiscal year 1909.

City.	Tons of 2,240 lbs.	Description of coal.	Specified limits.			Bidder.	Commercial name of coal.	Location of mines.	Coal bed.	Screened.		Heating value of coal as received.	Ash in dry coal.	Price per ton.		Cost per 1,000,000 British thermal units.	
			Ash.	Volatile matter.	Sulphur.					Through.	Over.			Bid.	Adjusted to lowest ash offered.	Comparative.	Actual.
			Per ct.	*Per ct.*	*Per cent.*							*British thermal units.*	*Per cent.*			*Cents.*	*Cents.*
Baltimore	2,550	Coking, run of mine.	8	22	1.5	A	Jenner	Somerset County, Pa.	Upper Kittanning.			14,250	7.50	$3.18	$3.20	10.025	
						B	Stineman	South Fork, Pa.	Miller			14,300	7.00	3.50	3.51	10,957	
						C	Imperial	Cambria County, Pa.	Moshannon			14,000	7.00	3.20	3.21	10,236	
						D	Orenda	Boswell, Pa.	C'			13,500	7.00	3.29	3.30	10.913	
						E	Georges Creek	Maryland	Pittsburg			14,300	7.50	3.45	3.47	10.833	
						F	Cambria	Cambria County, Pa.	Miller			14,300	6.50	3.19	(a)	9.9588	9.9588
						G	Sugar-loaf	do	do			14,300	7.80	3.31	3.336	10.414	
Boston	1,500	Coking, run of mine.	8	22	1.5	A	Beech Creek	do				14,257	7.12	4.43	4.4702	13.997	13.872
						A	New River	New River District, W. Va.				14,658	5.11	4.73	(a)	14.406	
						B	Pocahontas					14,600	8.00	5.10	5.1578	15.771	
						C	New River	Fayette County, W. V.				14,500	8.00	4.95	5.1078	15.368	
	3,000	Anthracite screenings.	18	9	1	A						11,934	14.15	2.63	2.673	9.9992	
						B						12,650	12.00	2.80	(a)	9.8814	9.8814
Buffalo	1,250	Youghiogheny or equal.	11	35	2.5	A	Shawmut	Elk and Jefferson County, Pa.	Freeport		¾″ bar	13,500	8.00	2.90	2.93	9.6892	
						B	Webster	Ehrenfeld, Pa.	Miller	Run of mine.		14,279	6.87	3.65	3.6574	11.434	
						C	Reynoldsville	Punxsutawney, Pa.	Lower Freeport.		¾″ bar	14,000	6.50	3.00	(a)	9.5663	9.5663
Chicago	8,500	Illinois, Nos. 1 and 2, washed nut.	10	38	2.5	A	Pawnee	Pawnee, Ill		No. 1 and No. 2 mixed.	2′ by ⅞″	11,442	10.00	3.15	3.22	12.563	12.290
						B	Shellbark	Marion, Ill	No. 7	No. 3		11,646	8.60	3.25	3.2920	12.619	
						C	Indiana nut	Ehrmandale, Ind.	Third vein	2½″	⅞″ r. o.	11,481	16.60	3.36	3.5620	13.851	
						D	Illinois nut	Springfield, Ill	do	3″	1″	10,575	13.40	3.40	3.5380	14.936	

[a] Standard.

Schedule of proposals for coal, United States Treasury Department, fiscal year 1909—Continued.

City.	Tons of 2,240 lbs.	Description of coal.	Specified limits.			Bidder.	Commercial name of coal.	Location of mines.	Coal bed.	Screened.		Heating value of coal as received.	Ash in dry coal.	Price per ton.		Cost per 1,000,000 British thermal units.	
			Ash.	Volatile matter.	Sulphur.					Through.	Over.			Bid.	Adjusted to lowest ash offered.	Comparative.	Actual.
												British thermal units.	*Per cent.*			*Cents.*	*Cents.*
Chicago	.....	New River, Georges Cr., etc.	8	22	1.5	E	New River	McDonald, Fayette County, W. Va.	Sewell	.....	3″ bar	14,700	6.50	$5.60	(a)	17.007	.....
Cincinnati	3,000	New River or equal.	8	22	1.5	A	do	On Loup Creek, Fayette County, W. Va.	do	Run of mine.		14,800	5.00	2.93	(a)	8.8381	8.8381
						B	Jenner	Somerset County, Pa.	Upper Kittanning.	do	.....	14,500	7.00	2.85	2.89	8.8978	.....
						C	New River	McDonald, W. Va.	Sewell	do	.....	14,700	6.00	2.94	2.96	9.0102	.....
Detroit	1,600	Coking, run of mine.	8	22	1.5	A	Pocahontas	Mercer County, W. Va.	No. 3	do	.....	15,000	5.36	3.65	3.6762	10.941	.....
						A	Kanawha	Smithers, W. Va.	Kanawha No. 2.	do	.....	14,000	6.10	3.00	3.0410	9.6971	9.5663
						B	Pocahontas	McDowell County, W. Va.	.....	do	.....	14,400	5.00	3.72	3.7390	11.591	.....
						C	do	do	.....	do	.....	14,400	5.00	3.85	3.8690	11.994	.....
						C	Thacker	.....	.....	do	.....	14,400	5.00	3.35	3.3690	10.444	.....
						D	New River	McDonald, W. Va.	Sewell	do	.....	14,700	6.00	3.75	3.7890	11.507	.....
						D	Meadow Brook	Kanawha County, W. Va.	.....	do	.....	14,000	8.00	3.20	3.2790	10,456	.....
						E	Quenmahoning.	Jerome, Pa.	.....	.....	1″ bar	14,245	6.50	3.77	3.8190	11.969	.....
						E	Cabin Creek	Decota, W. Va.	.....	.....	1″ bar	13,800	7.50	3.24	3.3090	10.704	.....
						F	Georges Creek	Maryland	.....	Run of mine.		14,477	8.00	3.75	3.8290	11.807	.....
						G	Pocahontas	West Virginia	.....	.....	1½″ bar	14,277	4.05	3.58	(a)	11.194	.....
Louisville	1,850	Coking, run of mine.	15	42	2.5	A	Pittsburg	Monongahela River, Pa.	.....	3″	3″ sq. o	14,360	4.20	2.77	(a)	8.6115	.....
						B	do	do	Thin vein	.....	1½″ bar	14,000	6.00	2.65	2.686	8.5650	8.4503
						C	Fox Ridge	Bell County, Ky.	.....	.....	1½″ bar	13,300	10.00	2.50	2.616	8.7809	.....

						D	St. Bernard	Hopkins County, Ky.	No. 9			11,500	13.50	2.25	2.436	9.4565	.....
						E	Cross Mountain.	Viva, Ky				13,500	7.00	2.80	2.856	9.4444	.....
						F	Straight Creek	Straight Creek, Pineville, Ky.		Run of mine.		13,750	6.00	3.20	3.236	10.5060	.....
						G	Regal	Campbell County, Tenn.		No. 2, run of mine.		13,000	5.00	3.00	3.016	10.3520	.....
						H	Pittsburg	Bell Bridge, Pa.		50 per cent lump.	50 per cent nut.	13,673	8.11	2.95	3.0282	9.8872	.....
Kansas City	2,000	Cherokee screened lump or equal.	15	....	.....	A	Cherokee deep shaft lump.	Cherokee and Crawford counties, Kans.			1¾″ r. o.	12,894	11.81	4.368	(a)	15.123	15.123
						B	Cherokee	Crawford County, Kans.	Fuller		¾″ r. o.	12,000	12.00	4.10	4.1038	15.267	.....
Milwaukee	1,200	Youghiogheny or equal.	11	35	2.5	A	Youghiogheny screenings.	Youghiogheny district, Pa.		¾″ bar		13,192	9.04	3.50	(a)	11.844	.....
						B	....do	....do				13,466	9.67	3.50	3.5126	11.645	11.603
Minneapolis	600	Youghiogheny or Zeigler.	11	35	2.5	A	Pocahontas	West Virginia		1″ bar		13,800	9.00	4.75	4.794	15.509	.....
						A	....do	....do		Run of mine.		14,200	7.00	5.32	5.324	16.738	.....
						A	Youghiogheny lump.	Monongahela River, Pennsylvania.	Thin vein		1″ bar	14,000	8.00	5.32	5.344	17.041	.....
						B	Pollard	Williamson County, Ill.		6″ or 3″	3″ or 1½″ r. o.	12,250	9.00	4.55	4.594	16.742	.....
						C	Zenith Youghiogheny.	Westmoreland County, Pa.			2″ bar	13,380	6.80	5.70	(a)	19.018	.....
						C	Zeigler	Franklin County, Ill.		6″	3″ r. o.	12,250	9.60	5.15	5.206	18.973	.....
						D	Empire lump, Ill.	Peoria County, Ill.	No. 5		2″	12,257	14.78	3.95	4.1096	14.968	14.387
						D	Zeigler	Franklin County, Ill.		6″	3″	12,257	8.40	4.80	4.832	17.574	.....
New Orleans	800	Pratt lump or equal.	10	35	3.0	A	Pratt	Jefferson County, Ala.			2″ bar	14,000	6.00	3.40 3.25	(a)	10.841 10.363	10.841 10.363
	1,300					B	....do	....do	Pratt		4″ bar	14,000	9.00	3.45 3.28	3.51 3.34	11.192 10.650	....
						C	....do	Pratt City, Ala.			1½″ r. o.	14,000	8.50	3.65	3.70	11.798	.....
New York	2,500	Coking, run of mine.	8	22	1.5	A	Acme bituminous.	Clearfield County, Pa.		Run of mine.		13,980	7.90	3.87 3.78	3.8906 3.8006	12.424 12,137	....
	11,000					B	Webster	Ehrenfeld, Pa.	Miller	....do		14,279	6.87	3.75 3.85	(a)	11.724 12.455	....
						C	Clearfield	Clearfield, Pa.		....do		13,970	8.00	3.875 3.76	3.8976 3.7826	12.455 12.088	....
						D	Somerset	Somerset County, Pa.		....do		14,000	8.00	3.28 3.43	3.3026 3.4526	10.531 11.009	10.459 10.938

a Standard.

Schedule of proposals for coal, United States Treasury Department, fiscal year 1909—Continued.

City.	Tons of 2,240 lbs.	Description of coal.	Specified limits.			Bidder.	Commercial name of coal.	Location of mines.	Coal bed.	Screened.		Heating value of coal as received.	Ash in dry coal.	Price per ton.		Cost per 1,000,000 British thermal units.	
			Ash.	Volatile matter.	Sulphur.					Through.	Over.			Bid.	Adjusted to lowest ash offered.	Comparative.	Actual.
												British thermal units.	*Per cent.*			*Cents.*	*Cents.*
New York	2,500	Anthracite screenings.	18	9	1	C	Anthracite screenings.	Pennsylvania				12,000	18.00	$2.70	2.7932	10.392	10.045
						A	do	do				12,000	13.34	2.82	(a)	10.491	10.491
	4,000	No. 2 buckwheat, anthracite.	18	9	1	C	Pittston	Pittston, Pa.				11,150	18.00	3.10	(a)	12.412	12.412
Brooklyn	3,500	do	18	9	1	C	do	do				11,150	18.00	3.38	(a)	13,533	13.533
New York	500	No. 1 pea, anthracite.	16	9	1	C	Mid Valley	Lehigh Valley, Pa.				12,181	14.89	4.46	(a)	16.345	16.345
Omaha	1,700	Cherokee screened, lump or equal.	15			A	Cherokee	Englevale, Kans.		Run of mine.		12,000	11.00	4.41	4.47	16.630	16.406
						B	do	Weir, Kans.	Weir City		1¾″ r. o.	12,000	13.00	5.24	5.34	19.866	
						C	Benton	Benton, Ill.		Run of mine.		13,200	8.00	5.50	5.56	18.804	
						C	Fleming	Fleming, Kans.			do	12,200	13.00	5.00	5.10	18.662	
						C	do	do			1½″ r. o.	12,200	13.00	5.50	5.60	20.492	
St. Louis	4,500	Coking, run of mine.	12	43	3	A	Ruby	St. Clair County, Ill.			1½″ bar	10,500	12.00	2.04	2.1252	9.0149	8.6735
						B	Staunton	Staunton, Ill.	No. 6		3″ r. o.	12,000	12.00	2.43	2.5152	9.3571	9.0402
						C	Cantine	Cantine, Ill.	No. 6		3″	11,000	12.00	2.32	2.4052	9.7614	
						D	O'Fallon	O'Fallon, Ill.	Belleville		2″	11,000	16.75	2.19	2.3702	9.6193	
						B	Gillespie	Gillespie, Ill.	No. 6		1¼″ r. o.	12,061	7.74	2.53	(a)	9.3646	
						E	B. B. lump	St. Clair County, Ill.		2″	⅛″	10,500	12.00	2.17	2.2552	9.5884	
						F	Donk	Maryville, Ill.			2″ r. o.	11,000	12.00	2.35	2.4352	9.8831	
St. Paul	1,450	Youghiogheny or Zeigler.	12	35	2.5	A	Zeigler	Franklin County, Ill.		6″ r. o.	3″ r. o.	11,324	10.98	5.25	5.3096	20.932	
						A	Youghiogheny	Westmoreland County, Pa.			2″ bar	13,180	8.62	5.87	5.8798	19.915	
						B	do	Pennsylvania	Second pool		1″ bar	13,300	8.00	5.38	(a)	18.058	18.058

Toledo	500	New River, Georges Creek, etc.	8	22	1.5	A	New River	Fayette County, W. Va.		3″	1¼″ r. o.	14,700	7.00	4.25	4.3058	13.077	
						A	Jackson Hill	Jackson, Ohio		1¼″	1¼″ r. o.	13,511	8.00	4.15	4.2258	13.963	
						B	New River	Fayette County, W. Va.			3″ bar	14,500	6.50	4.30	4.3458	13.380	
						C	Pennsylvania smokeless.	Somerset County, Pa.	C′		3″ bar	14,877	4.55	4.03	4.0368	12.113	
						C	Berwind smokeless.	West Virginia	Pocahontas No. 3.		4″ bar	14,997	4.21	4.26	(a)	12.681	
						C	New River	Fayette County, W. Va.			3″ bar	14,700	6.50	4.37	4.4158	13.411	
						C	Pocahontas	Mercer County, W. Va.	Pocahontas No. 3.		3″ bar	15,000	4.67	4.48	4.4892	13.361	
						C	do	do	do	2¼″	1½″ bar	15,000	4.67	4.03	4.0392	12.022	
						D	C. C. & B. Pocahontas.	McDowell County, W. Va.	Pocahontas	3″ bar		14,900	4.45	3.95	3.9548	11.849	11.834
Philadelphia	4,000	Caking, run of mine.	8	22	1.5	A	Henriette	Cambria County, Pa.	"B" or Miller			14,500	6.00	3.60	3.62	11.145	
						B	Webster	Ehrenfeld, Pa.	do			14,279	6.87	3.35	3.3874	10.590	
						C	Acme	Clearfield County, Pa.				14,000	7.80	3.14	3.1960	10.191	10.012
						D	Moshannon	do	D			13,915	6.00	3.24	3.26	10.458	
						E	Oakland	do				14,000	7.50	3.50	3.55	11.062	
						F	Empire	do	Miller			14,300	6.00	3.50	3.52	10.989	
						G	Moshannon	do				14,220	5.00	3.38	(a)	10.611	
						H	Imperial	Viola, Pa.	D			13,900	7.00	3.20	3.24	10.407	
						I	Nantyglo	Cambria County, Pa.	B			14,100	8.00	3.25	3.31	10.480	
						I	Pennsylvania No. 8.	do	E			13,700	8.00	3.19	3.25	10.591	
						I	Star	Twin Rocks, Cambria County, Pa.	Miller			14,200	6.00	3.20	3.22	10.123	10.060
						J	Priscilla	Cambria County, Pa.				14,500	6.50	3.98	4.01	12.346	
						J	Clearfield	Clearfield County, Pa.				13,500	8.00	3.73	3.79	12.533	
						J	do	do				13,500	8.00	b 3.23	3.29	10.879	
						J	Priscilla	Cambria County, Pa.				14,500	6.50	b 3.48	3.51	10.806	
						K	Empire	do				14,300	6.00	3.50	3.52	10.964	
Washington	8,000					A	Munns	Huntington, W. Va.	Fulton & Barnett.			14,200	7.00	3.98	4.02	12.638	
	2,000					B	New River	Fayette and Raleigh counties, W. Va.	Sewell			14,600	5.70	3.35 3.55	3.364 3.564	10.287 10.898	10.243 10.855

a Standard.

b With strike clause.

Schedule of proposals for coal, United States Treasury Department, fiscal year 1909—Continued.

City.	Tons of 2,240 lbs.	Description of coal.	Specified limits.			Bidder.	Commercial name of coal.	Location of mines.	Coal bed.	Screened.		Heating value of coal as received.	Ash in dry coal.	Price per ton.		Cost per 1,000,000 British thermal units.	
			Age.	Volatile matter.	Sulphur.					Through.	Over.			Bid.	Adjusted to lowest ash offered.	Comparative.	Actual.
												British thermal units.	*Per cent.*			*Cents.*	*Cents.*
Washington	.....	.....	.....	.....	.....	C	Imperial	Clearfield County, Pa.	Moshannon	.....	.....	13,900	7.00	$3.25 3.55	3.29 3.59	10.591 11.530	....
						D	Cambria	Cambria County, Pa.	Miller	.....	.....	14,400	7.00	3.34 3.56	3.38 3.60	10.479 11.161	....
						E	New River	Robins, Fayette County, W. Va.	Fire Creek	.....	.....	14,630	6.50	3.40 3.70	3.43 3.73	10.467 11.382	....
						F	Sugar Loaf	Twin Rocks, Cambria County, Pa.	.....	.....	.....	14,000	7.00	3.55 3.98	3.59 4.02	11.448 12.819	....
						G	Webster	Ehrenfeld, Pa.	.....	.....	.....	14,279	6.87	3.55	3.5874	11.216	.....
						G	Admiralty	West Virginia	.....	.....	.....	14,600	5.00	3.50	(a)	10.702	.....

a Standard.

In order to make a proper award of contract it is necessary to reduce the proposals to one common basis for comparison. This may be done in several ways, but the method chosen in this case is to first adjust all bids upon a given lot of coal to the basis of the same ash percentage by selecting the proposal which contains the lowest percentage of ash as the standard. Each per cent of ash content is assumed to have a value of 2 cents per ton, the amount of penalty which is exacted under the contract requirements for 1 per cent deficiency. The proposal prices have all been adjusted in this manner and are tabulated in the table. On the basis of the adjusted price, allowance is then made for the varying heating values by computing the cost of 1,000,000 British thermal units. In this way the three variables of calorific value, percentage of ash, and basic price per ton are all merged into one figure, the comparative cost of 1,000,000 British thermal units, by which one bid may be readily compared with another.

For example, take two bids received for coal in Boston, Mass., as follows:

Bid.	Coal.	British thermal units.	Per cent ash.	Price per ton.
A	New River	14,658	5.11	$4.73
B	Pocahontas	14,600	8.00	5.10

The percentage of ash in A is taken as a standard of comparison and the ash in B determined as 2.89 per cent higher. Each per cent of ash difference from the contract standard is rated at 2 cents difference in price per ton; 2.89 per cent of ash is valued at $0.02 × 2.89 or $0.0578; B is therefore increased to $5.1578 per ton. The two bids are then on an equivalent basis, so far as ash is concerned, as follows:

Bid.	British thermal units.	Price per ton.
A	14,658	$4.73
B	14,600	5.1578

The heating values being different, it is desirable to compute the cost of 1,000,000 British thermal units in each case by the formula:

$$\frac{1{,}000{,}000 \times \text{price per ton}}{2{,}240 \times \text{B. t. u.}}.$$

In the case of A this gives

$$\frac{1{,}000{,}000 \times \$4.73}{2{,}240 \times 14{,}658} = \$0.14406,$$

and in the case of B gives

$$\frac{1{,}000{,}000 \times \$5.1578}{2{,}240 \times 14{,}600} = \$0.15771,$$

the results being the cost of 1,000,000 British thermal units.

The necessity for having such a basis of comparison is evident from an examination of the bids for coal to be delivered in St. Louis. In this case 7 bids were received with guaranties of British thermal units from 10,500 to 12,061 and of ash from 7.74 to 16.75 per cent, while the prices ranged from $2.04 to $2.53 per ton. Notwithstanding such apparent discrepancies, the comparative cost of 1,000,000 British thermal units ranged only from 9.0149 to 9.8831 cents.

Another interesting case appears as the result of the competition in Philadelphia, in which 16 proposals are based on heating values ranging only from 13,500 to 14,500 and on ash from 5 to 8 per cent, with prices more variable and ranging from $3.14 to $3.98 per ton. Two of these proposals appear nearly equally advantageous, and the relative suitability of the two coals for use in the down-draft furnace with which the boilers are equipped will be determined by actual trial of a test quantity of 50 or more tons.

In 8 cases out of 23 it was found more advantageous to award the contracts to bidders other than the lowest if price per ton alone were considered.

An examination of the table should dispel any doubt as to the general applicability of the specifications to a wide range of coals delivered in different localities under varying conditions. Twenty-three coals—low-grade anthracite, low- and high-volatile bituminous, and semi-bituminous coals—are represented, mined in ten States—Pennsylvania, Maryland, West Virginia, Ohio, Illinois, Indiana, Kentucky, Tennessee, Alabama, and Kansas.

Coal from Pennsylvania, Kentucky, and Tennessee competes in Louisville; from West Virginia, Maryland, and Pennsylvania in Detroit; from West Virginia, Ohio, and Pennsylvania in Toledo, etc., and falls within the specification limits especially fixed in each case.

While a rating in comparative British thermal unit value enables the making of an award to the best economic advantage, in certain instances other factors than the mere theoretical heating value may have considerable weight. This is especially so where any uncertainty exists as to the suitability or adaptability of an untried coal to the actual plant conditions of furnaces, grates, draft, labor of handling coal and ash, storage facilities, etc.

In some plants, where boiler capacity is limited, grate area small, or draft weak, only the best grades of coal can be burned, and it is therefore desirable to take bids on a general specification, so that the result of making radical changes in the boiler plant to take advantage

of the coal which will give the best economic return may be determined.

In some places it has been found desirable to test the market in more than one class of coal. In Chicago, for instance, two specifications were issued, one applying to Illinois or Indiana washed nut coal and the other to West Virginia or Maryland semibituminous coal. This action was taken in order to determine whether a change from coals high in moisture and ash and relatively low in British thermal unit value as well as price, to high-grade coals at the higher price commanded in that locality, would be justified.

It goes without saying that the relative facilities, competency, and responsibility of the competing firms must also be recognized in making awards.

RESULTS FOR FISCAL YEAR 1907-8.

A series of tables which follow show the results of purchasing coal under the anthracite and bituminous specification during the year 1908.

A careful study of these tables will give a better idea of these results than any description. The tables have been arranged in two sections, (1) several tables covering anthracite, and (2) one general table covering bituminous coal.

ANTHRACITE DELIVERIES.

The anthracite tables for deliveries in Washington present the information in great detail, in order to show clearly the conditions as they existed from month to month throughout the fiscal year.

The general average of ash for the year as compared with the previous year is as follows:

General average of ash in anthracite.

Size.	Ash in dry coal (per cent).	
	1906–7.	1907–8.
Furnace	10.44	10.00
Egg	10.57	10.83
Stove	.....	12.05
Pea	16.04	16.23
Buckwheat	18.05	15.93

The most notable improvement in the coal used during the fiscal year 1907-8 over the previous year was in the buckwheat, and this is considered especially important because of the naturally high ash content of this size of anthracite and the fact that this size replaced furnace coal at the State, War, and Navy building. These general

averages are somewhat misleading, however, because they might be taken to mean that there were no wide departures from the specified standards. This is not the case, as will be seen from the following tables.

In this connection it should be remembered that the apparent discrepancies in the cost per ton for the year as compared with the average ash, which in many coals show no departure from the minimum limits allowed above and below standard, are due to the change in ratio of penalties and premiums for the greater differences from the standard.

Two tables are shown for furnace anthracite, the first for contracts on the ash and British thermal unit basis, the second for contracts on the ash basis alone.

Single tables are shown for the other sizes of anthracite used in Washington, and one table has been prepared to cover anthracite contracts outside of Washington.

Furnace anthracite delivered to two buildings in Washington, D. C., 1907–8.[a]

[Standard, 12,800 British thermal units per pound as received; 10 per cent ash in the dry coal.]

	Agricultural main building.				Weather Bureau.			
	Tons delivered.	Per cent ash.	British thermal units per pound.	Cost per ton.	Tons delivered.	Per cent ash.	British thermal units per pound.	Cost per ton.
1907.								
July	11	9.11	12,951	$5.75	40	7.93	13,132	$5.98
August	39	9.41	12,843	5.70	50	9.59	12,845	5.70
September	21	8.20	13,117	5.82	45	9.12	12,935	5.74
October	252	9.95	12,922	5.73	36	9.96	13,122	5.82
November	142	10.07	12,884	5.72	72	7.56	13,188	6.00
December	325	9.55	13,020	5.78	70	12.24	12,658	5.47
1908.								
January	550	10.12	12,924	5.74	30	10.16	13,138	5.83
February	350	9.60	13,000	5.77	100	9.92	13,243	5.88
March	325	11.58	12,670	5.62	100	9.34	13,196	5.86
April	300	10.56	12,909	5.73	50	11.39	12,687	5.63
May	150	9.95	12,992	5.77	.....	.....	.....	.....
June	100	9.67	12,851	5.70	25	8.85	13,014	5.77
Total	2,565	.....	.....	.....	6.18	.....	.....	.....
Average	.....	10.14	12,912	5.73	.....	9.69	13,035	5.80

[a] 3,000 tons at $5.68 per ton delivered to both buildings.

Furnace anthracite delivered to buildings in Washington, D. C., 1907–8.

[Standard, 10 per cent ash in the dry coal.]

	Congressional Library. (3,600 tons at $5.72 per ton.)			Pension Office. (1,200 tons at $5.84 per ton.)			National Museum. (1,200 tons at $5.75 per ton.)			Geological Survey. (600 tons at $5.84 per ton.)		
	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.
1907.												
July	1,024	9.44	$5.72	66	9.44	$5.84	.....	.....	.....	20	9.32	$5.84
August	496	8.59	5.72	.....	.....	.....	.....	.....	.....	15	10.32	5.84
September	.....	.....	.....	25	9.78	5.84	126	8.78	$5.75	30	12.15	5.69
October	.....	.....	.....	150	9.40	5.84	.....	.....	.....	39	11.56	5.84
November	310	8.73	5.72	150	10.35	5.84	125	9.15	5.75	65	9.51	5.84
December	268	9.03	5.72	.....	.....	.....	124	10.05	5.75	61	11.05	5.84
1908.												
January	550	10.16	5.72	150	10.90	5.84	70	10.10	5.75	93	10.74	5.84
February	242	10.17	5.72	150	14.24	5.57	200	10.11	5.75	72	11.76	5.84
March	.....	.....	.....	150	10.58	5.84	100	9.65	5.75	48	13.65	5.60
April	552	10.08	5.72	.....	.....	.....	.....	.....	.....	38	10.53	5.84
May	.....	.....	.....	25	10.48	5.84	.....	.....	.....	33	12.85	5.66
June	.....	.....	.....	25	10.67	5.84	.....	.....	.....	12	8.61	5.84
Total	3,442	.....	.....	891	.....	.....	745	.....	.....	526	.....	.....
Average	.....	9.49	5.72	.....	10.90	5.79	.....	9.65	5.75	.....	11.17	5.80

	Mills Building. (450 tons at $5.80 per ton.)			Canal Commission. (450 tons at $5.80 per ton.)			War Department. (439 tons at $5.80 per ton.)			Botanic Gardens. (300 tons at $5.80 per ton.)[a]		
	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.
1907.												
August	.....	.....	.....	.....	.....	.....	155	8.75	$5.80	.....	.....	.....
October	50	11.94	$5.80	20	9.00	$5.80	.....	.....	.....	.....	.....	.....
November	75	9.73	5.80	24	11.21	5.80	.....	.....	.....	142	8.81	$5.62
December	.....	.....	.....	.....	.....	.....	.....	.....	.....	22	11.81	5.44
1908.												
January	98	13.09	5.59	25	11.05	5.80	60	10.49	5.80	23	11.64	5.44
February	81	11.03	5.80	30	8.11	5.80	.....	.....	.....	20	11.63	5.44
March	.....	.....	.....	27	8.68	5.80	50	9.98	5.80	48	9.92	5.56
Total	304	.....	.....	126	.....	.....	265	.....	.....	255	.....	.....
Average	.....	11.52	5.73	.....	9.55	5.80	.....	9.36	5.80	.....	9.76	5.50

	Civil Service Building. (250 tons at $5.84 per ton.)			Freedmen's Hospital. (100 tons at $6.35 per ton.)			Bureau of Education. (100 tons at $5.84 per ton.)		
	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.
1907.									
July	30	10.39	$5.84	.....	.....	.....	.....	.....	.....
September	20	9.19	5.84	.....	.....	.....	.....	.....	.....
October	20	9.92	5.84	.....	.....	.....	20	6.74	$6.05
November	30	12.91	5.66	.....	.....	.....	.....	.....	.....
December	37	12.35	5.69	15	9.10	$6.35	.....	.....	.....
1908.									
January	23	8.90	5.84	.....	.....	.....	34	11.14	5.84
February	30	13.41	5.63	20	12.97	6.17	.....	.....	.....
March	20	10.01	5.84	.....	.....	.....	.....	.....	.....
April	20	8.16	5.84	.....	.....	.....	20	10.88	5.84
June	20	10.39	5.84	.....	.....	.....	.....	.....	.....
Total	250	.....	.....	35	.....	.....	74	.....	.....
Average	.....	10.86	5.79	.....	11.31	6.26	.....	9.88	5.91

[a] Six per cent ash (dry coal) standard.

Egg anthracite delivered to buildings in Washington, D. C., 1907–8.

[Standard, 11 per cent ash in the dry coal.]

	Government Printing Office. (9,000 tons (unscreened) at $5.82 per ton.)			Government Printing Office. (1,000 tons (screened) at $6.35 per ton.)			War Department. (450 tons at $6.40 per ton.)			Freedmens Hospital. (100 tons at $6.60 per ton.)		
	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.
1907.												
July	465	10.64	$5.82	250	11.43	$6.35	15	7.45	$6.64	.....	.....	.....
August	353	9.44	5.82	88	10.05	6.35	103	9.21	6.40	25	10.57	$6.60
September	354	9.52	5.82	112	10.32	6.35	15	11.75	6.40	25	11.13	6.60
October	341	9.18	5.82	25	8.85	6.50	17	8.45	6.58	100	10.27	6.60
November	711	11.17	5.82	175	11.53	6.35	10	8.59	6.55	.....	.....	.....
December	915	11.43	5.82	.....	.....	.....	82	9.46	6.40	50	11.10	6.60
1908.												
January	670	10.75	5.82	200	11.67	6.35	49	10.61	6.40	.....	.....	.....
February	835	11.05	5.82	.....	.....	.....	55	11.72	6.40	30	12.34	6.60
March	767	11.15	5.82	.....	.....	.....	45	12.07	6.40	.....	.....	.....
April	675	11.25	5.82	.....	.....	.....	13	10.05	6.40	.....	.....	.....
May	175	11.84	5.82	570	11.08	6.35	21	9.76	6.40	.....	.....	.....
June	475	10.60	5.82	.....	.....	.....	10	10.12	6.40	.....	.....	.....
July	[a] 470	10.89	5.82	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	7,206	.....	.....	1,420	.....	.....	435	.....	.....	230	.....	.....
Average	.....	10.82	5.82	.....	11.12	6.35	.....	10.08	6.42	.....	10.85	6.60

[a] Completing coal ordered in June.

Stove anthracite delivered to buildings of the War Department[a] in Washington, D. C., 1907–8.

[Standard, 13 per cent ash in the dry coal.]

	Tons delivered.	Per cent ash.	Cost per ton.
1907.			
July	100	11.34	$6.55
October	2	10.46	6.73
November	106	12.23	6.55
December	2	11.11	6.55
1908.			
January	5	11.62	6.55
February	100	10.94	6.70
March	2	9.79	6.76
June	25	10.85	6.70
Total	342	.....	.....
Average	.....	11.45	6.64

[a] 359 tons at $6.55 per ton.

Pea anthracite delivered to Post-Office building[a] in Washington, D. C., 1907–8.

	Tons delivered.	Per cent ash.	Cost per ton.
1907.			
July	23	16.16	$4.42
August	97	16.18	4.42
September	355	16.30	4.42
October	419	16.44	4.42
November	376	16.14	4.42
December	619	15.90	4.42
1908.			
January	566	16.06	4.42
February	534	16.69	4.42
March	549	16.20	4.42
April	329	16.84	4.42
May	249	16.11	4.42
June	300	15.63	4.42
Total	4,416	.....	.....
Average	.....	16.23	.....

[a] 6,000 tons at $4.42 per ton.

Buckwheat anthracite delivered to buildings in Washington, D. C., 1907–8.

[Standard, 18 per cent ash in the dry coal.]

	Land Office. (5,000 tons No. 1[a] buckwheat at $3.58 per ton.)			State, War, and Navy Building. (4,000 tons No. 1 buckwheat at $3.52 per ton.)			Treasury Building. (2,500 tons No. 2 buckwheat at $3.25 per ton.)		
	Tons delivered.	Per cent ash	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.	Tons delivered.	Per cent ash.	Cost per ton.
1907.									
July	430	14.22	$3.74	239	15.49	$3.60	.....	.....	.....
August	200	14.58	3.72	391	13.41	3.68	.....	.....	.....
September	151	14.97	3.72	.....	.....	.....	.....	.....	.....
October	377	13.64	3.76	302	15.15	3.60	44	15.40	$3.33
November	492	14.38	3.74	568	15.15	3.60	338	16.69	3.25
December	552	15.58	3.68	391	14.91	3.62	202	14.27	3.37
1908.									
January	335	16.47	3.66	788	15.56	3.52	218	16.26	3.25
February	579	17.13	3.58	406	16.41	3.52	.....	.....	.....
March	190	16.51	3.58	546	16.19	3.52	393	19.61	3.25
April	.....	.....	.....	259	16.25	3.52	.....	.....	.....
May	.....	.....	.....	.....	.....	.....	45	17.40	3.25
June	.....	.....	.....	200	16.65	3.52	.....	.....	.....
Total	3,306	.....	.....	4,090	.....	.....	1,240	.....	.....
Average	.....	16.51	3.71	.....	15.47	3.56	.....	17.13	3.28

[a] 19 per cent ash.

Anthracite contracts outside of Washington, D. C., for the fiscal year 1908.

City.	Coal.	Contract basis.				Contract fulfillment.				
		Tons of 2,240 pounds.	Price per ton.	British thermal units as received.	Ash in dry coal.	Tons delivered.	Average British thermal units as received.	Average ash in dry coal.	Average moisture.	Cost per ton.
					Per ct.			*Per ct.*	*Per ct.*	
Boston	Screened Schuylkill	3,000	$2.80	12,650	12.00	2,301	12,697	10.91	4.97	$2.81
Brooklyn	No. 2 Buckwheat, Pittston, Pa.	3,800	3.25	12,711	13.27	3,191	11,110	19.20	5.68	2.62
New York	Screened Lackawanna	3,500	2.48	12,998	11.68	2,053	12,105	14.58	5.33	2.21
Do	Buckwheat No. 2	2,240	3.10	12,711	13.27	2,232	11,261	19.11	5.56	2.53
Do	Lackawanna and Wyoming	500	4.15	11,662	17.49	336	11,629	18.44	4.34	4.14
Philadelphia	Pea, Lehigh	350	3.59	11,651	16.77	316	11,814	16.35	4.71	3.64
Do	Buckwheat	1,500	3.35	11,855	20.81	1,002	11,116	20.91	5.07	3.14
Do	do	5,890	2.50	.....	17.00	5,406	.....	19.87	.....	2.29

BITUMINOUS DELIVERIES.

Following is a table showing results on all of the bituminous coal contracts for the fiscal year 1907–8, the name of the city in which the coal was used, the description of the coal, contract basis or specification, and the fulfillment of same.

The figures under contract fulfillment are the averages for the year. A comparison of the items under contract fulfillment with the specifications will show better than any description the results accomplished. In making these comparisons, however, it is well to remember that the figures are averages of a large number of deliveries extending over the entire period, and that even where the averages under contract fulfillment closely compare with the specifications, there may have been wide departures from the standard on both the penalty and bonus sides, which, in the general average, balance and consequently show results obtained which closely approximate the specified standards.

Bituminous coal contracts, fiscal year 1908.

City.	Coal.	Contract basis.				Contract fulfillment.				
		Tons of 2,240 pounds.	Price per ton.	British thermal units in coal as received.	Ash in dry coal.	Tons delivered.	Average British thermal units in coal as received.	Average ash in dry coal.	Average moisture.	Cost per ton.
					Per cent.			*Per cent.*	*Per cent.*	
Baltimore	Vintondale, Pa	2,250	$3.31	14,200	8.00	1,791	14,130	7.84	2.18	$3.29
Do	do	350	3.41	14,200	8.00	292	14,521	8.01	2.01	3.49
Boston	Pocahontas, New River, or Georges Creek	1,500	5.40	14,750	6.25	1,318	14,190	6.43	3.40	5.19
Buffalo	Oak Ridge, Hillville, Pa	1,350	2.90	13,770	4.75	862	12,543	13.40	3.82	2.29
Chicago	Pawnee-Himrod, Ill	8,000	2.90	[a] 13,400	7.50	6,242	[a] 11,155	11.55	12.59	2.34
Do	do	500	2.90	[a] 13,400	7.50	413	[a] 11,310	11.30	11.89	2.41
Cincinnati	New River Sewell coal	3,000	3.00	14,700	5.00	2,658	14,574	5.67	2.02	2.97
Detroit	Kanawha Oakland, W. Va	1,400	3.30	14,000	4.36	1,189	13,440	9.07	3.66	3.10
Louisville	St. Charles and Fox Run, Ky	1,850	1.95	12,200	11.50	1,416	11,458	13.82	7.97	1.81
Milwaukee	Youghiogheny, screened, Pa	1,600	3.40	13,466	9.67	1,192	12,909	10.39	4.45	3.26
Minneapolis	Zeigler No. 1, Ill	500	4.70	12,250	8.60	550	11,927	9.90	8.56	4.58
New Orleans	Pratt City, Ala	1,050	3.75	14,000	8.50	981	13,916	9.36	1.34	3.73
New York	Acme-Hawk Run, Pa	2,500	3.46	14,474	7.80	2,067	14,022	7.93	2.58	3.35
Do	Delta, Spangler, Pa	10,000	3.45	14,315	6.80	9,300	13,982	8.39	2.64	3.37
Omaha	Fleming, run of mine, Kans	1,700	4.69	12,200	13.00	1,323	12,709	11.91	4.21	4.89
Philadelphia	Acme, Hawk Run, Pa	1,500	3.58	14,474	7.80	1,520	13,861	9.63	1.92	3.43
Do	do	4,500	3.18	14,474	7.80	2,958	13,980	9.37	3.06	3.07
Do	Irvonia, run of mine, Clearfield, Pa	1,226	2.89	14,100	8.00	7,479	13,898	9.34	2.36	2.85
Do	Run of mine, Clearfield, Pa	300	2.89	13,700	6.00	374	14,490	5.54	2.59	3.06
Do	Imperial, run of mine	624	2.89	14,500	6.00	721	13,648	9.71	4.15	2.68
St. Louis	Staunton lump, Ill	4,700	2.55	12,500	12.00	3,396	11,278	13.35	10.26	2.30
St. Paul	Zeigler No. 1, Ill	250	4.70	12,250	8.60	145	11,303	15.65	6.54	4.08
Do	do	1,200	4.70	12,250	8.60	1,201	11,425	13.34	8.11	4.31
Toledo	Milton Jackson lump	500	4.12	11,475	6.91	395	11,789	9.61	9.28	4.21
Washington	Sugar Loaf Twin Rocks, Pa	7,000	3.55	14,600	6.00	6,267	14,589	7.12	1.51	3.55
Do	do	500	3.98	14,600	6.00	1,124	14,237	6.55	3.59	3.88
Do	do	350	4.03	14,600	6.00	276	14,371	6.79	2.65	3.97
Do	Irvonia, run of mine, Clearfield, Pa	3,000	2.89	14,300	8.00	3,050	13,493	11.63	2.38	2.69
Do	Georges Creek, run of mine	15,000	3.50	14,300	7.50	21,100	14,166	7.70	2.52	3.47
Do	Orenda, run of mine, Somerset, Pa	300	3.75	14,000	10.00	540	13,851	9.69	2.58	3.71

[a] British thermal units in dry coal.

BURNING THE SMALL SIZES OF ANTHRACITE FOR HEAT AND POWER PURPOSES.

By D. T. RANDALL.

INTRODUCTION.

In the course of investigations regarding the coals most suitable for use in government buildings and the best methods of burning them, a number of plants were visited by N. H. Snyder, assistant engineer, during the winter of 1907, and data collected relating to the successful use of small sizes of anthracite. This information was tabulated and furnished to the government engineers who were nterested in the design of furnaces for burning such coal.

Anthracite is particularly well adapted to certain purposes. For domestic use its cleanliness and its slow-burning properties make it especially desirable. For power and large heating plants its principal advantage is its freedom from smoke, but with improvements in iurnaces for burning bituminous coal and a better knowledge of methods of operating them, this advantage is becoming of less importance each year.

GRADES AND VALUES OF ANTHRACITE.

Anthracite is graded as to size before shipment and the price is based on these grades. The following table indicates the relative fsizes:

Sizes of anthracite.

Size.	Through screen with mesh.	Over screen with mesh.
	Inches.	*Inches.*
Broken	.....	$2\frac{3}{4}$
Egg	$2\frac{3}{4}$	2
Pea	$\frac{3}{4}$	$\frac{1}{2}$
Buckwheat No. 1	$\frac{1}{2}$	$\frac{1}{4}$
Buckwheat No. 2	$\frac{1}{4}$	$\frac{1}{8}$

Many analyses made of coals in the government buildings show that anthracite as usually delivered contains about 4 or 5 per cent moisture, 2 or 3 per cent volatile combustible matter, 75 to 80 per

cent fixed carbon, and 8 per cent or more ash, according to the size and quality. The heating value of these coals depends very largely upon their freedom from ash.

During one season the various sizes delivered to government buildings averaged about as follows:

Ash and British thermal units in coal delivered to government buildings.

	Ash in dry coal.	British thermal units in coal as received.
	Per cent.	
Furnace and egg size	10½	12,800
Pea	15½	12,000
Buckwheat	18	11,500

A good grade of bituminous coal such as is usually delivered in Washington averages about 9 per cent ash and 14,000 British thermal units in the coal as delivered.

The smaller sizes of anthracite are of nearly the same heating value as the larger sizes and they are much cheaper. It will be seen from the above figures and a little study of hard coal prices that to burn large sizes of anthracite is expensive when compared with the possibilities attainable with small sizes of anthracite or with the better grades of soft coal. Buckwheat size may in many places be purchased for $2 less per ton than is charged for the large size coal. When this is the case a saving of considerably more than a dollar a ton may be made by burning the small size instead of the furnace or egg coal. It is, of course, more difficult for the fireman to handle the finer sizes of coal, owing to the fact that smaller quantities must be fired at a time and also to the fact that the ash accumulates more rapidly on the grate and requires more frequent cleaning of the fires, owing to the high percentage of ash in the coal. In the eastern cities, wherever the freight rates are favorable, small sizes of anthracite are burned in preference to bituminous coal.

DRAFTS.

The conditions for successfully burning small sizes of anthracite are not found in most plants unless they were designed originally or have been remodeled for the purpose. A draft much stronger than usual is required to force the air through the small pieces of coal which lay closely together. The accumulation of ash and clinker also retards the flow of air more than when burning larger sizes. The grate bars should be provided with openings as large as practicable and yet prevent loss of fuel through into the ash pit. Contrary to general opinion, it was found on examining the ashes from a num-

ber of government plants that the loss of coal into the ash pit was no greater in the plants properly equipped for burning small sizes than it was in those which burned the larger coal. The grate surface must be proportioned to burn enough coal to generate the steam required with the draft available. The coal should be fired frequently and spread in thin layers. Fires should not be disturbed until time to clean the ashes from grate; fires to be cleaned after ash has accumulated to a depth of 6 or more inches, depending on the draft available and the load requirements.

A sufficient draft may be provided by a high chimney or by a fan in connection with a shorter stack.

Experience has shown that the relation between the draft and the amount of coal burned per square foot of grate is about as shown in the table below. These figures are in general use by engineers designing plants for burning anthracite in hand-fired furnaces.

Relation between draft and amount of coal burned.

Pounds of coal burned per square foot of grate	10	15	20	25	30
Difference in pressure between ash pit and furnace in inches of water:					
Pea	0.2	0.3	0.45	0.65	0.9
Buckwheat No. 1	.25	.45	.65	1.00	1.50
Buckwheat No. 2	.40	.75	1.25	.....	.....

COMMERCIAL EXPERIENCE.

Examples of actual practice in plants burning small sizes of anthracite are given in the table below. Draft readings were made at each plant under about average conditions.

A study of this table shows that of 25 plants visited all were successfully burning cheap coal and that in order to do so a strong draft was used. Many of these plants were in the basements of office buildings, which of necessity have high stacks. Others were supplied with air under suitable pressure from a fan. A stack draft of less intensity was then sufficient to carry the gases from the furnace through the boiler and out the stack. As the load increases, the loss in draft[a] increases through all parts of the boiler and settings, and therefore the importance of short flues and breechings with as few turns as possible is obvious.

The plants studied cover a range in equipment and load conditions so wide that there can be no doubt as to the feasibility of burning the smaller and cheaper sizes for power purposes wherever it is necessary or advisable to burn anthracite.

[a] For a discussion of drafts see The significance of drafts in steam-boiler practice: Bull. U. S. Geol. Survey No. 367, 1909.

Summary of plants burning anthracite coal.

No.	Kind of business.	Load.[a]	Number of boilers in plant.	Number of boilers in service.	Boilers. Name and type.	Boilers. Size.	Horsepower of each boiler.	Total horsepower of boilers.	Kind of grates.	Square feet of grate surface.	Width of grate openings.
											In.
1	Iron and machine works.	Medium	2	2	Atlas water-tube	63 tubes 4″ x 17′ 4″	150	300	Stationary	35 31.5	$\frac{5}{16}$
2	Retail store	Heavy	8	7	Babcock & Wilcox water-tube.	294 tubes 4″ x 18′; 3 drums 3′ x 21′ 6½″.	600	4,800	Shaker	100	¼
3	Refining	do	23	20	Return tubular	72 tubes 4″ x 18′	15–120 6–150 2–180	3,060	Stationary	42.5	¼
4	do	do	5	5	Fire-tube double-deck	60 tubes 4″ x 18′	125	625	do	38.5	¼
5		Medium	4	4	Horizontal tubular	258 tubes 3″ x 20′	435	1,740	Shaker	70.0	$\frac{5}{16}$
6	Office building	Heavy	8	8	1 Heine 1 Edgemoor 6 Galloway	3,800 square feet heating surface 3,768 square feet heating surface 960 square feet heating surface	375 375 180	1,830	do do Stationary	75.25 74.50 36.25	¼
7		Medium	8	8	5 Lebanon return tubular 2 Holyoke return tubular 1 Ervine return tubular	45 tubes 5″ x 18′ 86 tubes 4″ x 17′ 58 tubes 4½″ x 18′	Av. 115	919.6	do	42.25	¼
8	Retail store	do	7	7	6 National, 1 Heine water-tube.	90 tubes 4″ x 18′; 2 drums 30″ x 20′ 248 tubes 3½″ x 14′; 1 drum 54″ x 16′	190 300	1,440	do	33.00 82.25	$\frac{3}{16}$
9	Office building	Heavy	4	4	Babcock & Wilcox water-tube.	108 tubes 4″ x 18′; 2 drums 36″ x 23′ 3⅜″.	225	900	do	49.00	⅜
10	do	Light	2	1	Keeler return tubular	60 tubes 4½″ x 20′	115	230	do	39.00	¼
11	do	do	5	3	Edgemoor water-tube	75 tubes 4″ x 18′; 1 drum 35″ x 18′	150	750	Wilkinson stoker	25.00	....
12	Dyeing establishment	Medium	4	4	Berry fire-tube	2 boilers, 1,360 tubes 2″ 2 boilers, 1,302 tubes 1½″	250 200	900	Stationary	47.20 36.00	⅜ ¼
13	Office building	Light	3	2	Babcock & Wilcox water-tube.	49 tubes 4″ x 18′; 1 drum 36″ x 23′	100	300	do	31.50	¼
14	do	Medium	2	2	Wharton-Harrison water-tube.	5 slabs of 176 units, each unit 8″ diameter.	100	200	do	30.00	¼
15	Retail store	do	5	5	Babcock & Wilcox water-tube.	168 tubes 4″ x 18′; 2 drums 42″ x 23′	308	1,540	do	59.50	....
16	Municipal building	do	4	3	do	4,162 square feet heating surface each	375	1,500	do	67.70	⅜
17	Office building	Light	3	3	Berry fire-tube	932 tubes 1¾″ x 25′	150	450	do	25.70	$\frac{5}{16}$
18	do	do	4	2	Aultman & Taylor Babcock & Wilcox type water-tube.	126 tubes 4″ x 20′; 2 drums 36″ x 20′	300	1,200	2 shaker 2 stationary	59.50	¼
19	do	do	2	2	Keeler Babcock & Wilcox type water-tube.	150 tubes 3½″ x 18′; 2 drums 48″ x 20′; 2,650 square feet heating surface.	250	500	Stationary	49.00	⅜

[a] As judged by engineer of plant.

Summary of plants burning anthracite coal—Continued.

No.	Kind of business.	Load.[a]	Number of boilers in plant.	Number of boilers in service.	Boilers.		Horsepower of each boiler.	Total horsepower of boilers.	Kind of grates.	Square feet of grate surface.	Width of grate openings.
					Name and type.	Size.					
											In.
20	Office building	Light	3	2	Babcock & Wilcox water-tube.	72 tubes 4″ x 16′; 1 drum 42″ x 18′ 6″	125	375	Stationary	30.00	¼
21	do	do	5		4 Pancoast & Moore 1 Ervine return tubular	773 square feet heating surface each 1,251 square feet heating surface each	60 90	330	do	23.7 33.50	5/16
22	do	do	2	1	Stirling water-tube	44 tubes 3½″ x 15′ 4″; 55 tubes 3¼″ x 9′ 6″; 44 tubes 3¼″ x 7′ 6″; 3 drums 3½″ x 8′ 1″; 1 drum 42″ x 8′ 1″.	75	150	do	39.50	3/16
23	Laundry	do	2	1	Return tubular	74 tubes 3½″ x 18′	100	200	do		⅜
24	Office building	do	3	2	Babcock & Wilcox water-tube.	49 tubes 4″ x 18′; 1 drum 36″ x 23′	100	300	do	31.50	¼
25	do	Medium	5		4 Stirling 1 Worthington	2,375 square feet heating surface; 2,363 square feet heating surface. 	150 250	850	do	42.00 63.00	¼

[a] As judged by engineer of plant.

Summary of plants burning anthracite coal—Continued.

No.	Stack.		Fan.			Kind of draft.	Length of flues, boiler to stack.	Number of elbows in flues.[a]	Draft (inches of water).							Coal.		Fires.	
	Height.	Diameter.	Diameter of casings.	Width of casings.	Diameter of discharge pipe.				Ash pit.	Furnace.	Back of boiler.	Stack.	Lost draft through fuel and grate.	Lost draft through boiler.	Lost draft through flues.	Size.[b]	Tons used per day.	Thickness.	Frequency of cleaning.
	Feet.	*Inches.*	*In.*	*In.*	*Inches.*		*Feet.*											*In.*	
1	64	36	48	17	24	Forced..	12	2	+0.24	−0.08	−0.10	−0.14	0.32	0.02	0.04	Rice.....	3.75	6	Twice in 10.5 hours.
2	4 stacks. 104	36	4 fans. 84	36	36 x 36	...do....	6	1	+1.18	− .16	− .35	.....	1.34	.19	.....	.....do.....	65.00	6	Twice in 24 hours.
3	Each 2 boilers. 90	42	112	72	60; each boiler 8	..do....	4	0	+ .70	− .28	− .33	− .38	.98	.05	.05	Barley.....	140.00	6	4 times in 24 hours.
4	50	.....	96	48	48; each boiler 12	..do....	35	2	+ .90	0	− .04	− .16	.90	.04	− .12	Rice.....	25.00	4	Do.
5	123	60 x 60	108	42	.....	...do....	50	4	+ .37	− .31	.....	− .70	.68	.....	.....	Buckwheat.....	58.00	6	Do.
6	175	84	.....	.....	.....	...do....	20	2	+ .80	− .20	− .50	− .88	1.00	.30	.38	....do.....	65.00	3	6 times in 24 hours.
						Steam...	30	2	+ .55	− .14	− .23		.69	.09	.55			10	
						Jet.....	100	3	.....	− .13	.....		.....	.....	.....			12	
7	123	60 x 60	96	36	.....	Balanced	35	2	+ .24	− .15	.....	− .75	.39	.....	.....	.....do.....	30.50	6	4 times in 24 hours.
8	155	72 x 72	84	48	.....	...do....	50	2	+ .96	− .17	.....	−1.14	1.13	.....	.....	Rice.....	28.00	6	Twice in 24 hours.
9	269	60	56	36	42	...do....	110	4	+ .38	− .06	− .18	.....	.44	.12	.....	Buckwheat.....	29.50	6	Do.
10	190	.....	48	18	.....	...do....	60	2	+ .42	− .20	.....	− .95	.62	.....	.....	Rice.....	5.50	5	4 times in 24 hours.
11	200	60	.....	.....	.....	...do....	27	3	+ .16	− .45	− .61	−1.02	.61	.16	.41	Buckwheat.....	13.00	3	
12	125	60 x 60	90	30	30 x 30	...do....	25	2	+ .40	0	.....	.....	.40	.....	.....	Buckwheat and rice.	19.75	6	Once in 10.5 hours.
13	140	.....	.....	.....	.....	Natural.	30	2	0	.05	− .62	− .82	.05	.57	.25	½ buckwheat, ½ rice.	3.75	6	Once in 20 hours.
14	105	36	.....	.....	.....	...do....	10	3	0	.34	− .48	.....	.34	.14	.....	Buckwheat.....	2.50	6	Once in 14 hours.
15	2 stacks 225	.....	.....	.....	.....	...do....	40 55	3	0	− .68	− .92	.....	.68	.24	.....	.....do.....	43.50	6	Twice in 24 hours.
16	160	75	.....	.....	.....	...do....	16	2	0	− .57	− .72	−1.15	.57	.15	.43	.....do.....	20.00	6	3 times in 24 hours.
17	180	48 x 53	.....	.....	.....	...do....	50	2	0	− .54	− .95	.....	.54	.41	.....	.....do.....	7.00	6	Twice in 24 hours.
18	150	.....	.....	.....	.....	...do....	45	2	0	− .28	− .32	− .38	.28	.04	.06	.....do.....	6.00	6	Do.

[a] Number of right-angle turns from boiler to stack, including one at entrance to stack, if any.
[b] Rice, barley, and buckwheat Nos. 2 and 3 are names for coal smaller than buckwheat No. 1.

Summary of plants burning anthracite coal—Continued.

No.	Stack.		Fan.			Kind of draft.	Length of flues, boiler to stack.	Number of elbows in flues.[a]	Draft (inches of water).							Coal.		Fires.	
	Height.	Diameter.	Diameter of casings.	Width of casings.	Diameter of discharge pipe.				Ash pit.	Furnace.	Back of boiler.	Stack.	Lost draft through fuel and grate.	Lost draft through boiler.	Lost draft through flues.	Size.[b]	Tons used per day.	Thickness.	Frequency of cleaning.
	Feet.	*Inches.*	*In.*	*In.*	*Inches.*		*Feet.*											*In.*	
19	142	60	.....	.....	.....	Natural.	50	1	0	−0.45	−0.64	−0.68	0.45	0.19	0.64	Buckwheat.....	4.50	4	Twice in 24 hours.
20	225	.....	.....	.....	.....	...do.....	35	3	0	− .58	− .60	.....	.58	.02	.....	No. 2 buckwheat	5.00	4	Do.
21	120	60	.....	.....	.....	...do.....	50	3	0	− .20	− .28	− .62	.20	.08	.34	Buckwheat.....	5.00	6	3 times in 24 hours.
22	190	36	.....	.....	.....	...do.....	5	1	0	− .44	.....	.....	.44	.....	.....	Rice.....	3.00	6	Twice in 20 hours.
23	88	48 x 48	60	21	22	...do.....	15	2	0	− .18	− .32	− .42	.18	.14	.10	Buckwheat.....	4.50	5	Once in 11 hours; once at night.
24	140	.....	.....	.....	.....	...do.....	30	2	0	− .50	.....	− .82	.50	.....	.....	½ buckwheat, ½ rice.	3.50	6	Once in 20 hours.
25	272	52	.....	.....	.....	...do.....	60 20	2 3	0	− .36	− .50	.....	.36	.14	.....	⅓ buckwheat, ⅔ rice.	30.00	4	3 times in 24 hours.

[a] Number of right-angle turns from boiler to stack, including one at entrance to stack, if any.
[b] Rice, barley, and buckwheat Nos. 2 and 3 are names for coal smaller than buckwheat No. 1.

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