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Contents:

(Illustrated articles are marked with an asterisk.)

LOUIS AGASSIZ.

Professor Agassiz is dead. Suddenly, unexpectedly, and apparently in the full vigor of his physical and mental power, the great master has been stricken down in the very midst of his labors, leaving to other hands the completion of his manifold enterprises, to other minds the development of the grand works to which his days have been so earnestly, so purely, devoted. Grief, sincere and deep, will everywhere greet these saddest of tidings, for the loss is not to the country but to the world; and wherever civilization extends her sway, there will his mourners be found.

It is but a melancholy duty of the journalist to pen the brief lines which constitute the last tribute to the memory of one distinguished in any walk of life, from whose lips and to whose actions the people have learned to look for counsel as from the oracles of old, or to indite the curt sentences which imprint *finis* on the work of which death has forbidden the continuance. Doubly sad is the task which now devolves upon us, in thus recording that the voice which so often, through these pages, has imparted to the world the great efforts of a master genius is for ever hushed, and that the indefatigable student and wise teacher, whose achievements have added so brilliant a luster to the works of American Science, is now but a thing of the memory, a reminiscence to be cherished, but buried in the irrevocable past.

We leave to others, who have been his immediate colaborers in the cause of education, the detailing the chronicle of his private life. To the outside world, however, we may justly say that it seemed as if he were every one's immediate friend; his personality was of that magnetic order which appeals directly to the heart, and it was the charming simplicity of his manner, coupled with the glow of enthusiasm which pervaded his every utterance, that made even the dullest units of his vast audiences feel that the subject under treatment, though never so dry, was invested with new attributes of rare and before unseen interest. It mattered little whether men were capable of grasping the thread of his consummate arguments, or whether they failed to appreciate the single hearted devotion with which he embraced the study of Science for itself and itself alone. When their intellects failed to respond to his, or, conscious of inferiority, shrank from the encounter, their sympathies were irresistibly drawn towards him; and the magic of his voice his winning smile and the sincerity of his purpose gained the trust and confidence of even those who condemned his opinions and opposed the donation of the necessary means for the furtherance of his favored projects.

There are many anecdotes of Agassiz which just now are invested with a sad but timely interest, and which, perhaps, more truly indicate the character of the man than the most carefully worded eulogy which we might produce. It was this overflowing cordiality of his nature which gained him his object even above the most stubborn of opposition, and to his qualities of heart, probably as largely as to those of brain, did he owe the completion of many of his most cherished schemes. His Cambridge Museum was built by private subscription, and his celebrated voyage up the Amazon was carried out through the munificence of a Boston millionaire. Did he need a State appropriation, he fairly charmed it out of the stingiest of legislatures; and indeed a Massachusetts law maker at one time opposed his being allowed to press his request in person, for the reason, as stated, that no opposition could stand before him. Penikese, with the princely sum accompanying, was the gift of one unskilled in Science. And the few enthusiastic *extempore* speeches made by him in San Francisco, after the Hassler voyage, brought forth the unexampled donation of Mr. James Lick, and gave Science on the Pacific coast an inestimable assistance. He gained friends by thousands simply by his smile. "We want you to come and beam upon us, that is all," said a friend who had arranged a social reception for him in Washington. "Agassiz came," said his entertainer, subsequently, "and merely shook hands. There was nothing formal, but he beamed on everybody with such a pleasant smile that it seemed as if he were diffusing happiness through the whole company." And yet, with all his success in the cause of education, it is even the more remarkable that he persistently refused to use his efforts for his private ends. "You would make any amount of money in the business," urged a wealthy capitalist who was desirous of securing Agassiz as a partner, and using his great technical knowledge for commercial enterprises. "I have no time to make money," replied the Professor. Similar to this was his answer to a publisher, who pressed him to write text books for schools. "I wrote them," said he, and his eyes sparkled with indignation, "that I was not the man to do this sort of work. And I told them, too, that the less of this work was done, the better. It is not school books that we want, but students. The book of Nature is always open. All that I can say or write shall be to make them study that book, and not pin their faith to any other." These were not the only brilliant offers, pointing to almost unlimited wealth, which he rejected, while his salary was only $1,500 a year. One more story and we pass to a brief review of his life. Agassiz detested "Science falsely so called" most cordially; and if in anything he manifested impatience or became actually incensed, it was when theories or ideas which he believed false or deceptive were submitted to his examination. In such cases, indeed, his wrath became mighty. It is related that some friends once invited him to a spiritualist exhibition to make a scientific investigation of the alleged manifestations. He turned his back upon them and motioned them to the open door in almost speechless rage, nor did he return to the subject except to express surprise at the insult which he considered had been offered him.

Louis John Rudolph Agassiz was born in Motiers, Switzerland, on May 28, 1807, his father and indeed his ancestors for six generations back being clergymen. Originally beginning the study of medicine, he entered the medical school at Zurich, thence he went to Heidelberg, and finally, at the age of twenty, began a course at the University of Munich. Here he commenced his studies in embryology, and received instructions from Wagler, Oken and Martins, and issued his first publications in the shape of brief treatises on special subjects. Subsequently becoming deeply interested in a work that he was selected to perform, namely, the classification of a variety of fishes, brought back by a Brazil exploring expedition, Agassiz gave up the practice of medicine, though not until after he had obtained his doctorate both in that art and in philosophy. His course, during the following years, was upward; for becoming a favored pupil of the great Cuvier and enjoying the association of such men as Owen, Milne-Edwards, and others of equal eminence, he laid the basis for his establishment of fossil ichthyology, and its translation to a cognate from a hitherto unknown science. Aided by Baron Von Humboldt, he was enabled to publish his great work, in which about 1,000 species are fully described and 700 more partially so, and thus to firmly establish his fame as a naturalist. Then came the enunciation of his glacial theory, the assertion of the existence of a vast sheet of ice which overspread existing continents, leaving its tracks behind. The view has been vehemently opposed, but it has triumphed, and is now an accepted scientific fact. Numerous other works were published by Agassiz in Europe, to which we need not stop to allude, except perhaps to say that they are standard volumes of reference, and invaluable to the naturalist. In 1846, he emigrated to this country, and became connected with the United States coast survey. It was not long, however, before he recognized the position of the United States in the scientific world. He saw that as a nation, we were far in the rear, and that, although in point of fertility of inventive genius, we were unsurpassed, yet Science for itself met with no fostering, and that we were content to depend upon the efforts of the learned men of the old world. Original thought was comparatively absent, and original research unknown to the masses. Seeing the need, he at once devoted his energies to its fulfilment. Accepting the chair of zöology and geology in Harvard College, he began the endeavors which have culminated in the establishment of the Cambridge museum (the most extensive of its kind in the world) and the education of scores of able and learned students of natural science. Of the more recent labors in which Professor Agassiz has been engaged, it is hardly necessary for us particularly to speak. Important expeditions have been made by him, years ago to Lake Superior, and Florida Reefs, and more lately up the Amazon and around Cape Horn.

As an opponent of the Darwinian theory, Agassiz has of late been drawn into the immediate attention of the entire world. His last writings were upon this subject; and in the *Atlantic Monthly* for January, we find an exhaustive and brilliant paper, beginning a series, in the course of which the writer designed to go over his entire ground, and clearly explain the arguments supporting his position. In his concluding lines he says: "The more I look at the great complex of the animal world, the more sure do I feel that we have not yet reached its hidden meaning, and the more do I regret that the young and ardent spirits of our day give themselves to speculation rather than to close and accurate investigation. I hope in future articles to show, first, that, however broken the geological record may be, there is a complete sequence in many parts of it, from which the character of the succession may be ascertained; secondly, that since the most exquisitely delicate structures, as well as embryonic phases of the most perishable nature, have been preserved from very early deposits, we have no right to infer the disappearance of types because their absence disproves some favorite theory; and lastly, that there is no evidence of a direct descent of later from earlier species in the geological succession of animals."

The place of a preceptor, of an instructor whose grasp of the subjects of which he taught extended to their minutest ramifications, left by Agassiz, it will indeed be difficult to fill; and the cause of scientific education has sustained a bereavement, the magnitude of which time alone will suffer us to realize. The example of the master is, however, immortal, his renown is part of the history of his adopted country; and posterity, in striving to emulate the one, will have before it a constant beacon pointing to the attainment of the proud rewards of the other.

LOOK TO YOUR STOVES.

The noxious effects of carbonic acid and carbonic oxide gas were recently illustrated, in an alarming manner, at Oakland, Pa., at a school near the Susquehanna depot. The school had been in session about two hours in the morning, when, to the astonishment of the teacher, one of her smaller pupils fell to the floor, apparently in a swoon; very soon three or four others were in a similar condition; then the number quickly increased to a dozen, all thrown down and unconscious. The teacher, greatly alarmed, dismissed the school, but only a portion of the scholars were able to move from their seats. The windows and doors were thrown open and assistance summoned. The teacher, with the aid of older scholars, dragged out the unconscious ones. A physician came; and after long effort, all were restored to consciousness and recovered, except a few who are still suffering.

It appeared, on examination, that the smoke pipe had been jammed too far into the chimney, causing a stoppage of the draft of the stove, throwing all the deadly gases of combustion into the school room. The escape of the children as well as they did is matter for congratulation.

The gases of combustion, chiefly carbonic oxide and carbonic acid, are, when taken into the lungs in comparatively small quantities, dangerous to life. One one-hundredth part of carbonic oxide gas in a given volume of air renders such air noxious.

Carbonic acid gas is not quite so bad. It may be taken into the stomach without injury. Soda water, as everybody knows, is water charged with carbonic acid gas. But when the gas is taken into the lungs, even in small quantities, its effects are injurious. One of the great causes of ill health is the accumulation and breathing of the deadly carbonic acid gas in the dwellings and apartments in which people live. Too little attention is paid to ventilation. Every one hundred volumes of air discharged from the lungs contain four volumes of carbonic acid gas. Now if air containing one two hundredth part of the gas is breathed, headache and languor are soon produced. Air that has been once breathed is therefore highly dangerous. The average amount of the gas thrown out by every person is seven cubic feet per hour. A single six foot gas light in a room gives off as much carbonic acid gas as a person in breathing.

THE REPORT OF THE CHIEF ENGINEER OF THE NAVY

Chief Engineer W. W. W. Wood, United States Navy, in charge of the Bureau of Steam Engineering, submits an annual report which contains a large amount of interesting and valuable information. Among other topics discussed, we note opinions upon compound engines, which may be taken as the result of a series of careful experiments and comparisons made by a board of prominent officers. The conclusion definitely reached is that the method of using steam of high pressure and expanding in separate cylinders (one or more in number, depending upon the power to be transmitted) is more economical and advantageous in its practical application than the former method, in simple cylindered engines, with the pressures heretofore used in such cylinders. This opinion is based upon comparisons of some forty non-compound and fifteen compound engines, though it may be considered as merely an official corroboration of facts already agreed upon by the majority of engineers.

The subject of machinery for steam vessels of war is next discussed, and the report of a board appointed to examine designs is embodied. Commenting upon the latter, the Chief of the Bureau says that no plan presented was considered as a whole superior to those emanating from the Government engineers, and hence the designs of the last men tioned officers were adopted. The following contracts for construction were awarded, work to be completed six months from their date: Atlantic Works, Boston, two engines of 800 H. P., cost $175,000 and $163,000. James Murphy, New York, one pair, 175,000. John Roach, New York, one pair, 560 H. P., for $120,000. Woodruff Iron Works, Hartford, one pair, 800 H. P., for $175,000, and Wm. Wright & Co., Newburgh, one pair, 800 H. P., for $175,000.

With reference to the internal corrosion of naval boilers, the report states that, by a careful analysis made at the Naval Laboratory in New York, this difficulty in vessels using surface condensers is found to be caused by oleate of copper, formed in the condenser, from which it passes to the boiler, where it is slowly transformed into oleate of iron, deriving the iron from the different parts of the boiler with which it comes in contact and precipitating its copper. The oleate of copper adhering to the iron under the condition of high pressures and temperatures, the deposition of copper and the absorption of iron begins. As a preventive, a method of arresting the destructive agents formed in the condenser, through a process patented by Mr. W. C. Selden of New York, is spoken of in quite favorable terms.

The most interesting part of the report relates to the question of screw propellers, and embodies the results obtained in certain changes made in the screws of vessels—from four to two blades—with a view of rendering such vessels more efficient while under sail alone. With equal propelling surfaces, it has been determined that no advantage

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whatever can be derived from using a screw of two blades, instead of four, when sailing; because, when screws are uncoupled and revolving freely, those of four blades oppose no greater resistance to the vessel than those of two. When fixed and held stationary, in a vertical position behind the stern post, the loss of speed due to the resistance of the screw, expressed in percentage of speed, has been shown by careful experiment to be 18·29 per cent; while the four or two bladed screw, revolving freely by the pressure of the water, gives a resistance of only 9·96 per cent, being nearly two to one in favor of the revolving screw. The four bladed screw also produces less vibration in a ship than one of three, and the latter less than one of two blades. The propelling efficiency of a screw is entirely independent of the number of its blades, but is wholly dependent upon the area, the pitch, the fraction of the pitch used, and the area of the circle described by the blades.

To diminish the shocks and vibration, more or less incidental to the use of the screw propeller, the largest amount of clearance admissible for the screw between the stern and rudder post should be given. It is obvious, then, says the report before us, that a post, intended for a screw, the area of which is contained in four blades having the same surface, pitch, and fraction of pitch, for that screw must be just double the length of the former in the line of its axis. Consequently, the two bladed screws, which were substituted for those of four blades, were necessarily constructed of less propelling area, as the post openings of the vessels could not be enlarged: hence the inefficiency of the screws as reported.

THE MANUFACTURE OF EARTHENWARE.

The potter's art has long furnished Great Britain and other European countries with most important branches of commerce. It was first introduced into England by two foreigners, at a place called Bradawoods, which is now Longport, situated about two miles from Burslem, Staffordshire. These two men commenced in a small way and kept themselves very secluded. The ware which they made was of quality very inferior to that of the present day; the business was only in its infancy, and the only mode of glazing the ware was by simply throwing salt into the saggars or vessels in which the crockery was baked. It was reserved for the famous and ever noted Josiah Wedgewood to be the pioneer in introducing new glazes and bodies, and to improve and bring to perfection the manufacture of earthenware. This was during the commencement of the eighteenth century. He it was who laid the foundation of the famous Staffordshire potteries, which now extend some ten or twelve miles in length and two or three miles in width. The district contains the towns of Tunstall, Burslem, Longport, Dalehall, Hanley, Stoke upon Trent, Fenton, and Longton. The potteries are right amidst the clays that are used in the manufacture. The same clays are also found in abundance in Derbyshire, which is the next county, but the most important and valuable clay is found in Cornwall. It is called china clay, and is purely white. This clay is not found anywhere else in the United Kingdom. Another valuable acquisition to the potteries is the valuable coal beds which abound in North Staffordshire, and furnish very important material in the manufature of earthenware.

The clay is generally weathered for one or two years before being used, that is, it is exposed to the effects of the atmosphere, to make it of a better color and more pliable. After which, certain quantities of each kind are weighed out, put in large vats, and worked together until they are thoroughly mixed, and become of the consistency of thick milk. Other ingredients are then mixed with these clays. They are china clay, felspar, and a few other materials to give body and consistence to the ware. After the whole has been ground and mixed up together, it is put in a large press (a new invention which has been patented); and by means of heat, the materials become more solid, are pressed into largo blocks, and are ready to be used. An earthenware manufactory is arranged in such a manner that each branch is kept separate to itself.

In making a water pitcher, for instance, the body of the pitcher is made in two equal parts, and the handle is made separately. The presser, as he is called, takes sufficient clay for the molds he is going to use; the mold is made of plaster of Paris. When both halves of the mold are filled, he puts them together, and straps them tightly; he then finishes the inside of the pitcher, by smoothing it by means of a wet sponge, to fill up the seams. He then takes off the strap, and places the mold with its contents in a small room which is kept at a high temperature. This is done to harden the clay, and evaporate the water. After being in a few hours, the clay appears white; and the mold is taken out and opened. The pitcher is then finished off and the handle is put on. This being done, it is ready for what is called the biscuit oven, where it undergoes its first baking. A similar process is gone through in making dishes, plates, cups and saucers, and other articles, except that the molds are of different shape. The ovens, or kilns as they are called, are built of brick and are of a conical shape, something like a sugar loaf.

After the ware is finished, it is placed in what are called saggars, vessels made of clay and baked before using; sand is sprinkled in these saggars and round the ware to prevent the whole from sticking together. When placed in the oven, it is exposed to a very severe heat for forty-eight hours; the fires are then allowed to go down and the ware to cool gradually. The oven and the ware are still very warm; and the men employed to take the pottery from the oven have to wear flannel over their hands and bodies to protect themselves from being scorched. They cannot remain many minutes at a time in the oven. The ware is then carried to what is called the biscuit warehouse, where it is sorted over by women and girls. In this state, it is called biscuit and is of a porous nature. The position of fireman of the biscuit oven is a very important post, and it requires a man of great experience and skill. If the ware be not fired or baked up to a certain point, it is very apt to craze, a phrase used amongst manufacturers to imply that it is liable to have those small cracks upon it which are sometimes seen upon earthenware or crockery. After being sorted over, it is prepared to go through a second firing.

The printing is done upon the biscuit ware before it receives the glaze. But figured earthenware has been largely superseded in this country by what is called white granite or white ironstone china, which is clear white. It looks much cleaner than the printed goods, and is much more easily matched. The ware, having been examined in the biscuit warehouse, is then taken to the dipping house. The dipping is a noxious process, owing to the white lead that is used in the glaze, in which the articles are dipped. The glaze is composed of borax, lead, flint, soda and other materials, which are ground together in a liquid state and put in large tubs, into which the ware is plunged and afterwards put on racks to dry. After this process, the ware is ready for the gloss oven, to give it the finishing touch. It is placed in saggars, the same as in the biscuit oven, some round and some oval, according to the size and description of the ware; but instead of sand being put in, the flat pieces, such as dishes, plates, saucers, etc., are kept separate by what are called cockspurs, small three pointed articles, made of clay and put between the wares. One may often see the marks of these cockspurs on the back of the ware. The time of firing the ware in the gloss oven is twenty-four hours, just half the time used in the biscuit oven. When the ware is drawn out of the gloss oven, it is taken to the gloss warehouse, where it is sorted over, and all the chipped, cracked, or damaged ware is put on one side. The good ware is packed in crates or casks by experienced packers, and shipped to its destination.

The importation of earthenware to the United States has been gradually increasing for many years. There were a few manufactories, established in this country, previous to the late war; and since its close many more have been started, and are doing a large business.

The duty upon earthenware is 40 per cent *ad valorem*; the freights are also high; and during the past year, the price of earthenware has been raised some 25 per cent in Staffordshire, owing to the high price of coal, labor, and materials, which have increased very much during the past two years. From these causes the importation has been much less in former years; and thus has been the means of giving more employment to the manufacturers on this side. There is no doubt but that all the materials used in the manufacture of both earthenware and china can be found in the United States; although many of our manufacturers are importing the china clay they use from Cornwall, at a great expense. This clay can be superseded by one which is found in large quantities in Alabama, and is being introduced generally. Missouri abounds with all the materials that are used in the manufacture of earthenware, and also is well supplied with extensive coal beds. There are also large earthenware manufactories at Trenton, N. J., East Liverpool and Cincinnati, Ohio, Geddes, N. Y., and St. Louis, Mo.

Considerable improvements have been made in the bodies and glazes of the ware during the past two years, and there are indications that this valuable business is firmly established in this country. Many gentlemen once connected with the manufacture of this class of ware in the Staffordshire potteries are now superintending works on this side, and there are several manufactories to be erected at different points during the coming year.

NOTE RELATIVE TO THE ESTIMATION OF THE COMMERCIAL VALUE OF COALS CONTAINING LARGE QUANTITIES OF ASH.

BY PROFESSOR R. H. THURSTON.

A question has lately been presented, involving the determination of the effects of an excessive amount of ash in modifying the commercial value of anthracite coal. The method of determination adopted will probably be of interest, since there is at present no generally accepted and standard method in use among engineers.

The value of a coal depends upon many circumstances. The proportions of uncombined carbon and hydrogen, the form in which hydrocarbons are contained in the fuel, the physical characteristics of the coal, and the chemical constitution and the percentage of the ash, all affect its market value. In individual cases, also, the form of heating or other apparatus in which the coal is burned influences the relative value of fuels equally good in other respects, one steam boiler, for example, being well adapted for anthracite, and another for bituminous coal.

Where the difference between two coals lies principally in their relative percentages of ash, the comparison is easily made.

The anthracites contain so little other combustible matter that, as shown by Professor Johnson,* their calorific value is proportional to the percentage of contained carbon, very nearly. Their commercial value is somewhat different.

The depreciation produced by presence of non-combustible matter occurs in the following ways:

First. A certain amount of carbon is required to heat the whole mass to the temperature of the furnace, of which a large part is lost. It follows, therefore, that a coal containing a certain small quantity of combustible would have no calorific value, and, consequently, would be worthless in the market.

*Report to the Navy Department on American coals.

Second. The presence of a high percentage of ash in a fuel checks combustion by its mechanical mixture with the combustible portion of the coal. A coal will, hence, have no commercial value when the proportion of refuse reaches a limit at which combustion becomes impossible in consequence of this action.

Third. The cost of transportation of ash being as great as that of transporting the combustible, the consumer paying for ash at the same rate as for the carbon, and also being compelled to go to additional expense for the removal of ash, these facts would also determine a limit beyond which an increased proportion of ash would render the fuel valueless.

Fourth. The determination of the financial losses due to increased wear and tear of furnaces and boilers, of incidental losses due to inequality or insufficiency of heat supply, and to the many other direct and indirect charges to be made against a poor fuel, will also indicate a limit which will have a different value for each case; but which will, in most cases, be difficult of even approximate determination.

The determination of the minimum proportion of combustible, under the first case, is thus made, assuming this heat to be entirely wasted.

The specific heat of ash is usually nearly 0·20. Let X represent the percentage of ash which is sufficient to render the coal valueless. Then, since each pound of carbon has a heating power of 14,500 thermal units: $14{,}500(100-X)=A$, represents the available heat of a unit in weight of the fuel.

$100\times0{\cdot}20\times3{,}000^\circ=B$: represents the heat required to raise this same amount of coal to a temperature equal to that of the furnace, which is here assumed at 3,000° above the surrounding atmosphere.

Since these quantities, A and B, are equal: $14{,}500\ (100-X)=100\times0{\cdot}2\times3{,}000^\circ$, and $X=96$ per cent.

The minimum quantity of fuel permissible is, therefore, four per cent, where the first consideration only is taken into the account.

The influence of the second is at present indeterminable in the absence of experiment.

The cost of transportation of ash to the consumer, as a part of the fuel, has no bearing in the determination of its value to him. The removal of ash is a tax upon the consumer which may be considered as the equivalent of the loss of a certain weight of combustible received. Since this cost fluctuates with the market value of coal, and since its amount is determined by the same causes, it is easy to make the statement in that form.

This cost is about ten per cent of the value of coal, weight for weight, and is therefore assumed at ten per cent of the proportion of ash found in the coal.

The losses, direct and indirect, coming under the fourth head, vary greatly and are sometimes very serious. An approximate estimate for an average example is taken, and is considered to be equal, at least, to a percentage of the total value of coal, in utilizable carbon, which equals one half the percentage of ash.

Comparing two anthracites, which we will suppose to contain, respectively, fifteen and twenty-five per cent ash, eighty-five and seventy-five per cent carbon, the first being a well known standard coal, selling in the market at six dollars per tun, we may, using this system of charging losses against equivalent values in combustible carbon, determine the proper commercial value of the second kind.

FIRST EXAMPLE.—From the 85 per cent carbon.

Deduct for heating to furnace temperature	0·040
" " transportation of refuse, 10 per cent of 15.	0·015
" " other losses, 50 per cent of 15.	0·075
Total	0·130

Leaving available and valuable carbon 85 —13 = 72 per cent.

SECOND EXAMPLE.—From the 75 per cent carbon:

Deduct for heating to furnace temperature.	0·040
" " removal of ash, 10 per cent of 25	0·025
" " sundry losses, 50 per cent of 25.	0·125
Total	0·190

Leaving valuable available carbon 75 —19 = 56 per cent.

Finally, if $6.00 is paid for 72 per cent available combustible, for 56 per cent we should pay $\frac{56\times6}{72}=\$4.66\frac{2}{3}$.

Taking a third example, in which the fuel contains the unexceptionally large proportion of 30 per cent ash, we should, by similar method, proceed as follows, deducting from the seventy per cent carbon, as before, the estimated charges against it.

THIRD EXAMPLE:

Deduct for heating	0·040
" " removal of ash, 10 per cent of 30.	0·030
" " sundry expenses, 50 per cent of 30.	0·150
Total	0·220

Leaving available carbon, 70 —22 = 48 per cent, which would be worth $\frac{48\times6}{72}=\$4.00$.

Had the first coal had a market value of seven dollars per tun, the second and third would have been worth, respectively, $5.44½ and $4.66⅔.

This method is evidently largely empirical, and its results are but approximate. It is, however, simple and easily applied, and will often be found of use in the absence of more precise means of determination. Those whose experience may differ from that of the writer can readily modify the values for themselves.

Stevens' Institute of Technology, Hoboken, N. J.
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