

AN ENQUIRY
INTO THE
CHYMICAL CHARACTER AND PROPERTIES
OF THAT SPECIES OF
COAL,
LATELY DISCOVERED AT
RHODE ISLAND :
TOGETHER WITH
OBSERVATIONS ON THE USEFUL APPLICATION OF
IT TO THE ARTS AND MANUFACTURES
OF THE EASTERN STATES.

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AN ENQUIRY, &c.

THE subject of the following pages is so interesting to the inhabitants of this country, that little apology is requisite for intruding it on the publick. Providence has so bountifully distributed its favours over the continent of America, that few articles are required from other countries, which could not be obtained here by proper industry and research.

While the population of America was but limited, and while the forests afforded a sufficient supply of so useful and necessary an article as fuel for the purposes of common life, no exertion was made to discover other substitutes, but as the soil becomes cultivated, and as arts and manufactures increase, a necessity arises for seeking a supply of fuel from other sources than the woods of the country.

It is unnecessary to dwell on the advantages which must result to a country so eminently flourishing as America, from the dis-

covery of Coal Mines : few who are acquainted with the rapid increase of the arts and manufactures in England, but must attribute much of their success to the benefit which they derive from their Collieries. In this respect, I hope to make it appear, that England has no great superiority over this country ; and those who wish well to the manufactures of America, can in no higher degree promote its best interests, than by encouraging researches which so obviously tend to their prosperity.

The inhabitants of the eastern States, and of Boston in particular, are much indebted to the genius and perseverance of one of their own countrymen, for the discovery of a Coal Mine at Rhode Island, so eligibly situated in every respect, that a constant and regular supply can be obtained at all times, without difficulty. My object at present is, to describe its geological situation, to give an accurate analysis of the Coal which has been discovered, and to explain some of its most obvious qualities ; and I am more particularly induced to this attempt, from observing that much ignorance prevails on the subject, and that many of its properties are either unknown, or misrepresented.

In this description, I shall confine myself entirely to that part of the Island where the Coal Mine is at present situated, and where the indications of Coal were so strongly marked, that it is rather surprising it should have so long escaped general observation.

The fossils which appear on the surface, in the neighbourhood of the Coal Mine, are argillaceous sand stone, abundance of schistus, or shale, and white quartz in large detached masses. When the ground is penetrated a few feet, the appearances are such as to leave no doubt that the strata consist of what is called the true independant Coal formation. Shale and argillaceous sand stone, abounding with vegetable impressions, present themselves first, and immediately under the sand stone, Coal is discovered ; in some places, even within six feet of the surface.

The position of the bed is here, as is generally the case in the independant Coal formation, not horizontal or vertical, but forming an angle of about 75, and the veins of coal appear to be separated from each other by various coloured sand stones, which interpose between the seams. Though all these substances belong to what is called

the transition rocks, yet fine specimens of indurated talc and green Asbestos in capillary crystals, are also discovered, interspersed through the shale, and immediately covering the Coal. Substances, which it is difficult to account for, as they have been generally supposed peculiar to primitive rocks.

The veins of coal run nearly in the direction of east and west, and the stratum which is worked at present, appears to be about 14 feet wide ; so little change has as yet taken place in the course of the vein, that there is every appearance of its improving, as they proceed farther from the surface : with only fifteen workmen, they can raise at present, from ten to twelve chaldron of coal per day, besides keeping the mine free from water, from which they suffer little inconvenience.

The character of Rhode Island Coal, is as follows :

Its colour is black, or greyish black, with a metallick lustre, it soils the fingers ; its fracture is slaty, but its cross fracture is conchoidal, and the sides of its natural divisions are sometimes covered with a ferruginous earth. It burns slowly, producing an intense heat, without smoke, and with a very light lambent flame ; but emits no sulphureous or bituminous vapour, and, when

perfectly burnt, leaves a very small quantity of grey ashes. The unconsumed particles of it, retain their original colour and lustre.

Specifick gravity from 1,450 to 1,750

From the above description, little doubt can remain of the true character of this Coal ; but in order to ascertain with precision the quantity of ingredients which it contained, I examined it according to the rules so ably laid down by Kirwan, and as my object was principally to determine the proportion of carbon which it contained, as the substance upon which all its good qualities depend, I repeatedly deflagrated it with certain proportions of nitre, and uniformly found, when the experiment was made with proper attention, that 100 parts of coal, contained from 90 to 94 of carbon ; and in order to compare it in this respect, with the charcoal in common use here, I found that it required more charcoal to saturate a given proportion of nitre, than it did of Rhode Island Coal. These experiments were also confirmed by submitting 100 grains of the Coal to an intense heat in a crucible, which, after five hours, were reduced to six grains of ashes ; those ashes, which consisted, perhaps, of an oxyd of iron and an earth I had not leisure to examine ; nor was it of much consequence in the main object which I had in view, which was, to

ascertain the qualities of the coal, as an article of fuel.

The following table of the relative proportion of carbon, which it bears to some other mineral coals, may not be unacceptable.

100 parts of	Carbon.	Bitumen.	Ashes.	Sp. Grav.
Swansea,	74	22	4	1, 357
Whitehaven,	57	41	2	1, 257
Newcastle,	58	40	2	1, 71
Rhode Island,	94	—	6	1, 750
Kilkenny	97	—	3	1, 526
Anthracite } of Haüy	64	—	36	1, 300

Thus it appears that this coal is nearly a pure natural carbon or charcoal, resembling, in many of its properties, the Anthracite of Haüy, and approaching as nearly as possible to the description of Kilkenny Coal, but superior to the former, as containing vastly more carbon, and much to be preferred to the latter, as it contains neither pyrites or sulphur, substances which render that coal peculiarly disagreeable for domestick purposes.

Though coal is so profusely distributed in different parts of the earth, yet there is no substance which differs more in its nature and qualities, a knowledge therefore of the ingredients which each species contains, is

necessary, in order to apply it to the purposes for which it is best adapted. In such a country as this, where the inhabitants are so long accustomed to the use of wood for fuel, it is not surprising that much ignorance should prevail on this subject, and that prejudice in favour of what they have been accustomed to, should operate strongly against the introduction of a more economical, and, in many respects, a more convenient substitute. To point out therefore, in this place, the distinctions between the different species of coals, the various uses for which each of them are designed, and the particular purposes to which Rhode Island Coal may be applied with advantage, will not, I hope, be generally unacceptable.

The two points which are principally to be considered with respect to Pit Coal, are, first the intensity of the heat which it emits, and secondly, the duration of its combustion. Coals which abound in bitumen, maltha, or petroleum, such as Whitehaven, Newcastle, and some of the Virginia Coal, burn quickly and briskly with considerable flame and smoke. They may generally be distinguished by their low specifick gravity, and when bitumen or maltha prevails, a sort of semifusion occurs, which causes them to cake and swell, producing a cohesion on

their surface ; this interrupts a free circulation of the air, and renders it necessary that the substance should be broken in order to keep up the combustion.

Common bituminous Coal is certainly what is generally used in England. It usually contains from 30 to 40 per cent. of naphtha or bitumen ; but though the presence of these volatile substances does not injure the qualities of the coal for domestick life, yet they render it unfit for use, when in its natural state, for many purposes where sulphureous or bituminous vapour would be injurious, and where its tendency to caking or cohering, would interrupt the current of air, and create great irregularity in the temperature of the fire.

In order, therefore, to deprive it of these volatile ingredients, it is first charred, and by this means converted into Coak, a substance resembling charcoal in many of its properties and in every respect nearly similar to Rhode Island Coal. In this state, Coak gives a very intense and durable heat without flame, and is in general use for blast or wind furnaces ; but it is much less pure than charcoal ; it requires a greater draft of air, and is more apt to vitrify ; though in one respect, this, as well as Rhode Island Coal is to be

preferred ; as it bears the blast better, and, when urged by a strong blast, is not so easily blown away, nor does it consume so rapidly.

I have thus given a short view of the different species of Coals. It is the business of the artist or the manufacturer to inform himself of their qualities, before he can adapt them to their different uses. For all general useful purposes, it will appear, that Coals which contain the most carbon, and the least sulphur or bitumen, which burn slowly, and produce an intense heat, leaving but a small residuum, are the most valuable and economical. From the above description and analysis of Rhode Island Coal, it will be seen, that it comes nearer to the properties of pure carbon or charcoal, than most others, and of course that, for most purposes in which charcoal is used, it is equally applicable, and, for many, it is greatly superiour. I shall now endeavour to point out concisely, and without prejudice or partiality, the various purposes to which Rhode Island Coal may be applied, as well as those to which it appears to be inapplicable, concluding with some observations on the most eligible method of using it.

The manufacture of iron has become so general and extensive over the continent of America, that it has, perhaps, more than any other circumstance, contributed to raise the price of fuel; and, should it continue to increase, the woods of the country cannot long afford a sufficient supply, in situations where such works can be carried on with the greatest advantage. Many of the most valuable mines must therefore be neglected; in the neighbourhood of Rhode Island in particular, this has already been the case; and, though abounding in iron ore, the scarcity of fuel on the spot has discouraged the manufacture of it.

It therefore requires but little argument to shew the advantage that may be taken of this discovery. The Rhode Island Coal is peculiarly calculated for the smelting of iron ore; it bears the blast remarkably well, and, having no tendency to vitrify in the furnace, besides producing an intense heat, it may be applied with more economical views to this purpose, than charcoal. And as the arts progress in this country, and iron from its crude state is manufactured into steel, this coal may be used to advantage, as it seems to possess the peculiar qualities necessary for the manufacture of this article.

Steel being nothing more than bar iron, impregnated with a large proportion of carbon, either by fusion or cementation, it naturally follows that this coal, which consists principally of carbon, is as well calculated as possible, for the conversion of crude iron into so useful an article.

For the burning of lime, Rhode Island Coal will also be found an useful substitute for wood. The steady and uniform heat which it gives, renders it superiour to wood for this purpose, as when properly applied, all parts of the kiln will receive equal degrees of heat, and the lime will, of course, be burnt equally, without subjecting some parts of it to vitrification, while others are not affected by the heat, which is often the case in the general method of using wood for the purpose.

In all those processes which require a slow and uniform degree of temperature, such as evaporation, this species of coal is to be preferred, and I cannot, at present, point out one to which it is more applicable, than the manufacture of salt, an article of the first necessity, and to which, America will, at some future period, find it necessary to pay more attention.

For the supply of the steam engine, and in general, for every species of furnace but the reveratory, this Coal is well qualified, provided the grates are so constructed as to give a sufficient draft of air, without which it cannot be properly ignited. This, however, with the knowledge which we possess here, of the principles of combustion, is a matter of little difficulty; and the circumstance of its never caking, or adhering in cohesive masses, as well as its affording so little ashes to choak the grates, renders it extremely convenient and economical, when once it is perfectly ignited, the fire is more durable than any other coal, and it requires less attention.

With these qualities, it is obvious that it is well calculated for breweries and distilleries; for the purpose of drying and preparing malt, no other species of coal will answer so well, as almost all others contain so much sulphur, or other volatile substances, that they cannot be used without destroying its flavour. This fact is so well understood, that the malsters, even of America, have hitherto found it necessary to import Kilkenny Coal, at a prodigious expense, for no other purpose but the use of the malt kiln.

The smith will find considerable saving when he becomes accustomed to the use of Rhode Island Coal. I am perfectly aware that it is not calculated for every purpose of the forge, and that, as it cannot be brought to cake or adhere, it will not answer on those occasions, where what is called by the smith a hollow fire, is required; but still, for small work, and all the common purposes of the forge, it will be found sufficiently well adapted, and it has already been used with success by many of the smiths in the neighbourhood. I cannot at the same time omit stating, that the brazier, the bell founder, and those who are engaged in the casting of metals, will perceive the great superiority which this Coal has over others. The intense and durable heat which it affords, renders it an article peculiarly valuable to artists of this description.

For the burning of bricks, and the manufacture of earthen ware and all sorts of pottery, such Coal as this is particularly convenient. The total absence of all smoke or vapour, renders it an article of consequence, in particular for the finer kind of ware.

But the same circumstances that make it most eligible for such manufactures, ren-

der it unfit for the reverberatory furnace, which is used in refining a variety of metals, as well as for other purposes. No fuel being adapted for such furnaces, but those which produce considerable flame and smoke, such as the Virginia Coal, or wood, as the principles upon which these furnaces are erected, requires that the flame only should traverse the surface of the metal, without any part of the fuel being in contact with it.

Having no doubt myself of the benefit which this country may derive from the more general use of an article so well adapted to the purposes which I have hinted at, I can, without hesitation, recommend it to the serious attention of artists and manufacturers, particularly to those who are situated in the neighbourhood of large cities, where wood is gradually becoming an article of considerable expense, and I cannot conclude this part of the subject, without expressing my most decided conviction, that those who will give this Coal a fair trial for culinary purposes and domestick use, will be forced to acknowledge that it has many advantages.

I am perfectly aware, that such a proposal will meet with many objections. The

prejudice arising from long and early habits, it takes some time to remove. So deeply rooted even are these, that I have heard it doubted by many, whether it was possible to make such a fire with Coal, as would answer the purpose of cooking. Such prejudices are not confined to any country; the Englishman has the same doubts with respect to the qualities of wood. But as these doubts arise from perfect ignorance of the true mode of using either of these articles, so are they removed, when each party obtains a more correct knowledge of what the other has discovered by experience.

Those, who are at length persuaded that this, or any Coal, can be made to burn in common grates, will next inquire, what are its advantages over wood, before they resign an article to which they are accustomed, and with which they are perfectly satisfied; to this I shall concisely reply, as follows: and upon this answer I rest its merits.

First: Such Coal as this, when properly ignited, gives a more steady, intense and durable heat.

Secondly: It is more æconomical, produces no disagreeable effluvia, and requires none of that attention to the frequent re-

newal of the fire, which is so necessary in the use of wood ; and,

Thirdly, from its emitting no sparks, and from the manner in which it burns, producing neither flame or smoke, many of those accidents arising from fire, to which chimnies, stores, and dwelling houses are liable from the general use of wood in large cities, would by this means be avoided.

I shall add but one circumstance more, which should, perhaps, have some weight in this country, though the fact may be received with hesitation by the generality of readers, yet it has been asserted by medical men and philosophers, that the use of this article for fuel in England, has contributed to check that tendency to contagious diseases, which was at one time so prevalent in their large cities ; and Dr. Mitchell, a celebrated philosopher and senator of America, has endeavoured to explain it, on principles connected with established theories in chymistry.

It now only remains for me to make a few observations on the best method of using this Coal ; and I must confess, that I have heard so many difficulties started on this subject which have no grounds whatever,

er, that it is with some hesitation I attempt to remove them.

Well informed and enlightened men will easily understand, that such coal as this, when properly ignited, must possess all the qualities of carbon. To such persons I cannot always appeal, and as the difficulty of igniting this substance is much greater than that of charcoal, many are disposed to doubt that it has any advantage ; all, however, that is required, is, that the furnace or grate should have a strong draft, and that a little more patience is bestowed in kindling the fire, than is usually afforded by those, who are accustomed to the burning of wood. The coal should be broke into small pieces, and a proportion of charcoal placed under it ; when this is set fire to, the draft of the flue should be increased by proper management of the door or register of the furnace, or by blowers applied to the chimney. In a short time the whole is ignited ; it never requires stirring, and no further trouble is necessary but to keep the lower bars of the grate free from ashes, or any substance that would interrupt the free circulation of air. A fire made in this manner, will continue to produce considerable heat for six or eight hours without a renew-

al of fuel, and with only an occasional attention to keep up the draft of the flue.

I have thus been lead into a more detailed view of the subject of this Essay, than I originally intended. Conscious that it affords a field for a much abler pen, I should, perhaps stop here, but my excuse must be found in an anxiety to direct the attention to the encouragement of those manufactures, for which the present state of this country is peculiarly calculated. I should pay but an ill compliment, indeed, to the American character, were I not freely to acknowledge, that for talents and genius there can be none superiour. The same spirit of enterprise which has led them to the successful pursuit of commerce, will naturally induce them, at a proper season, to turn their attention to those arts and manufactures, which are best suited to the skill of the inhabitants, and are most intimately connected with the necessities of the country.

It will readily be allowed, that the different branches of manufacture which are pointed out in these pages, are objects of the first consequence. The materials are obtained in abundance, and no greater proportion of labour is required, than in the

present state of population can be spared * from other pursuits ; they have also this advantage, that they have already been tried and succeeded.

Premature attempts to divert the channels of commerce, as well as to excite a rivalry in manufactures, however plausible they may appear in the reasoning of a philosopher, experience has shown them to be erroneous in theory, and dangerous in practice.

That species of industry, which has already succeeded, which has contributed to the wealth and prosperity of the country, which encourages a spirit of literature, and promotes the diffusion of knowledge, should not be rashly abandoned, for speculations, founded on false views of the real interests of the nation.