

Mr. C. W. SIEMENS said he had lately paid considerable attention to the subject of coke-making; and he believed that the coke ovens generally used, especially in the north of England, were very primitive. The admission of air into them caused a portion of the coke to burn, and the gases from the remaining coal, being driven out, went to waste. He thought it hardly possible to conceive anything more rude than that system, because those gases, possessing heating powers of nearly equal value to the remaining coke, were allowed to escape freely into the atmosphere, involving not only a great loss of fuel in its most valuable form, but also a serious nuisance in populous districts. As regarded the quality of the coke produced in the ordinary oven, it had been satisfactorily proved to be inferior to that produced in the close oven when properly arranged, although it was, perhaps more lustrous in appearance. The reason of its real inferiority was, that the coke first acted upon by atmospheric air was partially burned; but the carbonic acid formed by this combustion passed through the remaining mass in the oven, and robbed it of such an amount of carbon as was necessary to reduce the carbonic acid to carbonic oxide. Hence the earthy constituent of the coke was relatively increased, and, as was stated in the Paper, the coke produced in close ovens contained, for the same amount of earthy matter present, 15 per cent. more pure carbon. This, with a poor description of coal, was a most important feature, irrespective of the value of the additional yield, both of coke and of the secondary products.

As regarded the conversion of the ordinary coke oven into a close oven—which he understood to be the subject of this Paper—he considered that it was practicable, and that the kind of oven now brought before the notice of the Institution had many excellent qualities, but, that it was not the only one possessing important improvements. The plan had been tried, indeed, at Lambeth, with this difference, that coal was burnt to effect the carbonization, the gases being used for illuminating purposes. Those ovens were being pulled down, because the gas produced in them was found to be deficient in brilliancy. Those most in use on the Continent were of two different descriptions. The first was a semi-cylindrical horizontal oven, closed at the ends with movable doors, and provided with a covering arch forming an annular chamber, through which the gases generated in the oven circulated, and were consumed there by the admission of atmospheric air, in order to continue the distillation of the coal inside. That was an improvement, inasmuch as the gases did not go to waste; and he believed ovens of that description were used at the Ebbw Vale works, with great effect. In South Wales excellent coke was

formed by mixing anthracite with bituminous substances, and by exposing the mixture to great heat in close ovens.

Another description of coke oven which he had seen in France, and which seemed to be a favourite in many establishments, was in the form of a number of upright retorts, and was known as the 'Four Appold.' Each retort was slightly conical, and was filled by shooting the coal from carts at the top. The gases evolved, passed through the sides of the retort, and were burnt there by the admission of atmospheric air. After a distillation of 24 hours or 40 hours, a trap-door at the bottom was opened, and the whole of the coke, amounting to several tons, was dropped into railway trucks, or carts, and carried away. That was another instance where the full value of the carbonaceous material was obtained. He might mention also an oven he had lately tried, which was based upon the same principle, as regarded the general arrangement. It was an upright retort, but, instead of being simply heated by the gas issuing from the coal, a poorer kind of gas was used, which had been previously heated by passing through a regenerator; the air necessary to combustion being also passed through a regenerator placed at the side of the retorts, so that only a portion of the gases evolved was required to heat the coal, the rest being applied to other uses, either for illuminating purposes or for the heating of working furnaces, &c. He had noticed the remarkable fact, that when the gas was drawn from the bottom of the retort, instead of from the top, a much higher illuminating power was obtained. Operating on Staffordshire coal, which, in the ordinary way, yielded gas of about 10-candle power, he had obtained, by this method, an illuminating power of eighteen candles, or twenty candles. Very little tar, or other secondary products were formed, because, in passing over the heated surfaces, they were decomposed and turned into gas, or combined with the coke, which latter was thereby increased in hardness. It might be considered a drawback that there were no secondary products, but it was in reality not so; for in most places the tar and ammoniacal liquor were difficult to dispose of, and if used to improve the coke they were applied to the best advantage.

He thought the question of coke-making had been treated too lightly. The present tendency of engineers was to burn coal in locomotive engines, because coking, as generally performed, was a wasteful process, in which the most valuable part of the fuel was lost. But by improving the coke ovens, and by making judicious use of the gases, both for illuminating and heating purposes, coke might be produced at a reduced rate, to be used for locomotive engines and blast furnaces, and a larger aggregate saving of coal might be effected.

Mr. E. A. COWPER said, that a set of twelve ovens, on the plan of Mr. Henry Eaton, of Bordeaux, were in use at the iron-works of Messrs. Cochrane and Co., Woodside, Dudley,¹ where good solid coke was being made, partly from bituminous coal and partly from Staffordshire coal, and, in some cases, from dry coal, or slack, with an admixture of tar or pitch. The yield had been increased 9 per cent., and, at the same time, the quality of the coke had been improved. These ovens, which deserved to be better known, were arranged in the form of a circle, with rather thin divisional walls between them. While ovens Nos. 1 and 3 were being heated, No. 2 was charged with coal, so that the heat in Nos. 1 and 3 assisted in giving heat to No. 2; and while Nos. 2 and 4 were working, No. 3 was charged, so that the heat of the alternate ovens was of great benefit in working the contiguous, or intermediate charges. The quantity of air admitted through the door was exceedingly small, and, by means of the central chimney, the amount of draught in each oven was equal, and was more exactly regulated than when the ovens were built in a long row. From 50 per cent. to 53 per cent. of coke was produced when common Staffordshire slack was used, in the proportion of 75 per cent. of slack to 25 per cent. of pitch. Of course, there was a certain amount of coke burnt; and in this case, as in ordinary coke ovens, the gases were allowed to go to waste. When 45 per cent. of slack and 55 per cent. of bituminous Welsh slack were used, the yield was from 55 per cent. to 60 per cent. of coke.

He thought, that the old plan of coking in ovens was a crude and wasteful system, and, that it had its origin in the fact, that there was then a demand for the coke, and not for the gas. The coke was therefore made, in the first instance, in heaps in the open air, and afterwards, in order to save it, in close ovens; but still the gas was allowed to pass away, almost entirely to waste. There was no doubt, that gas of illuminating quality could be obtained from coke ovens. Some peculiarly constructed ovens had been tried at the London Gas Company's works at Lambeth; but, after they had been worked about three years, it was found that the gas had not sufficient illuminating power. But if close ovens were made, and if the gas were taken from the lower part, he thought the Company might use it with great advantage. He had had an opportunity of experimenting practically with one of Mr. Siemens's coke ovens constructed on this plan, and had obtained gas of 17-candle power from Staffordshire coal, which would not make gas of more than 8-candle power, or 9-candle power in an ordinary retort.

Dr. CRACE CALVERT said he had, for several years, paid great

¹ Vide "Institution of Mechanical Engineers. Proceedings." 1861. Page 72.

attention to this subject, with some idea of engaging in the manufacture of coke, and with this view, he had visited the Continent, for the purpose of studying the best processes in use there. The result of his inquiries had satisfied him, that the principle of saving the ammoniacal liquors and their products, had been understood and carried out for a considerable period, in Belgium as well as in England. Circular ovens, on Mr. Powell's system, and similar to those described in the Paper, had likewise been long in use, and might be seen at work on a large scale in Durham, in Cumberland, and at Vauxhall, where they had been employed for about fourteen years. In Mr. Powell's ovens the gases could either be reserved for illuminating purposes, as was done in Paris, or be burnt in distilling the coal, as it was in other parts of France and in Belgium, where the same system was pursued. There was not any novelty in the principle of distilling coal in one circular oven, by burning the gas generated in another. The question was, consequently, limited to the relative advantages of circular ovens and long ovens; and, from his experience of what he had seen at Lyons, he might state, that the coke made in circular ovens was rather better than that made in long ovens, because the heat was radiated equally, from the centre to every part, and gave uniformity of quality to the mass, and as the coking was better, the yield was increased by a slight percentage; but there was no increase of gas, or tar, or ammoniacal liquors.

Mr. LAMBERT remarked, that there was not much novelty in the system described in the Paper. Ovens, similar to those recommended, were in use, at the Vauxhall Gasworks, about twelve years since. The coke made in them was exceedingly good, as regarded strength, and no difficulty was found in selling the whole of it, during the three years that method was pursued. Iron founders were anxious to purchase the coke, owing to its freedom from sulphur. He believed that the Brighton Railway Company were supplied with it for six months, and that they discontinued its use chiefly on account of its splitting into small pieces, and falling through the fire bars: that was its only fault.

Mr. JABEZ CHURCH observed, that the most important question was, the method of making the best coke, and whether, by making it in close ovens, it would be of such a quality as was necessary for locomotive purposes. He thought, from his own experience, that it would not; as when made in that way it was inferior in colour, density, and soundness to the coke which was made in open ovens. With reference to the produce, coke made under the best circumstances would yield 70 per cent. upon the quantity of coal used; but its quality could only be tested by ascertaining its heating powers and its freedom from sulphur. He believed, that when made by this process it was more friable, contained a larger amount of sul-

phur, and the heating powers were below that made in ordinary coke ovens. The heating power of pure carbon was represented by the number 340, as 10 grains of pure carbon produced 340 grains of lead by burning it with oxygen from litharge. The maximum heating power of the best charcoal made in this country was about 304, and the heating power of the best description of Newcastle coking coal was 309. The coke made in the gas-making ovens at Vauxhall, though of inferior quality as oven coke, was better than ordinary retort coke; but with the best coals used under these circumstances, he believed it was impossible to make coke of the same heating power as by the ordinary process of combustion. The great feature in coke making was to obtain complete carbonization of the coal, and to prevent a second combustion after it was so carbonized. The atmosphere had a great effect upon it. By cooling the coke down, before it was drawn from the oven, a large quantity of sulphur was passed off, and the quality was greatly improved. If the second combustion were prevented, there was no difficulty whatever in obtaining, in properly constructed ovens, 70 per cent. of coke of superior quality, from the quantity of coal used.

Mr. PENNY said he had had an experience of twenty years in coke making, and though he had not achieved the result just stated, of 70 per cent., yet he had got considerably beyond 55 per cent. or 60 per cent.; but he thought this question should be looked at in another point of view. Coke making was a separate occupation from tar and sulphate making, and, in most cases, it was inexpedient to combine the two. The premises would require to be enlarged, in order to receive the large and numerous condensers necessitated by the increased number of ovens, and if gas-making were embarked in, holders must be added. His experience of coke making was, that the utilizing of the products injuriously affected the quality of the coke. It became of a friable character, for which there was no demand. There was a demand for coke for certain purposes, and it must be produced of the quality required. Where there was plenty of space and blast furnaces to be acted upon, it was quite possible to utilize the products in the way described, as the coke might be used in the furnaces; but generally, in the large manufactories, such as those in the north of England, where the refuse coal was worked up, it would not answer to do so; and, although the mode of making coke in those places, was in itself bad, yet, for the purpose for which it was intended, it was suitable. He might add that, as a practical maker of gas, as well as of coke, he had been surprised to hear, that 11,500 cubic feet of gas could be obtained from a ton of coal under the process described. But the gas so obtained could not have been of the standard quality of commerce, as, under the most favourable

circumstances, and with the best coals for coking, only about 9,500 cubic feet, or 10,000 cubic feet of gas could be extracted from a ton of coal.

Mr. H. P. STEPHENSON agreed with Mr. Church, that coke could not be produced of as good a quality in close ovens as in those which were partially open. As a gas maker, he had carbonized coal in close ovens, and he had found, that the coke was neither so good, nor (which was an important point when it was required for locomotive purposes) was it so large, as that generally used for engines. But if the coke were really improved by the process under discussion, the gas must be proportionately inferior in illuminating power, especially towards the end of the charge, at which period, it would be laden with other matters, involving extra purification. As regarded the cost of labour under the new system, he would remark that, with longer charges, the expense would be greatly increased. In the London works, the most satisfactory results, both as to labour and purification, were obtained from charges of four hours, or six hours.

M. Pernolet said, the main points which he should notice were, that Mr. Crace Calvert and Mr. Lambert appeared to contest the novelty of the system, whilst Mr. Jabez Church, Mr. Penny, and Mr. H. P. Stephenson expressed doubts as to the advantages it presented, in consequence, as they stated from personal knowledge, of the coke manufactured in close ovens being always friable and sulphurous.

Now M. Pernolet contended that these opinions were refuted by facts which were generally accepted, and were especially well known at St. Etienne (France), and at Elonges (Belgium). These facts were:—1st., that the ovens built on the Powell system at Durham, and at the Vauxhall Gasworks (London), had been so much modified and simplified, that the cost of building had been reduced to one-third or one-fourth of the original expense, which was with justice considered a *sine qua non* for the introduction of the system for metallurgical purposes; and not only was there now this economy of construction, but care had been taken to design the plans with a view to altering existing coke-ovens at a comparatively small expense: this had been tested and proved by the recent alteration of one hundred circular ovens at St. Etienne, from which very successful results had been obtained; and, 2ndly, that by this system, it had been found possible to produce coke as large and of as good quality as in the ovens specially adapted for that manufacture only, and still to obtain and use all the gas, the tar, and the ammoniacal liquor. The price at which this coke was purchased for the railways and the blast furnaces proved that the quality was considered as good as ordinary coke.

He must, therefore, contend that the novelty of arrangement,

and the advantages of the system, were fully proved; and, moreover, he felt assured that if the system was generally adopted, there would result an entire absence of the injurious effects upon the trees and upon the vegetation generally which he had observed in the neighbourhood of existing coke ovens in England. He begged to express his thanks to the members for the attention they had given to the question, which he trusted would be practically tested on a large scale in this country.

In pursuance of the notice on the card of the Meetings, it was proposed and resolved unanimously :—

“That in order to insure a fuller attendance of Members than could be obtained on Whit-Tuesday, the Meeting be adjourned until Tuesday evening, the 24th of May.”
