INSTITUTE OF MARINE ENGINEERS
INCORPORATED.

SESSION 1902-1903.

President—D. J. Dunlop, Esq.

Local President B.C. Centre—Sir Thos. Morel.

OPENING MEETING OF THE AUTUMN SESSION.

Volume XIV.

ONE HUNDRED AND THIRD PAPER

(OF TRANSACTIONS).

OUR FUEL SUPPLY.

BY

Mr. JAS. ADAMSON (Hon. Secretary).

READ AT THE

INSTITUTE PREMISES, 58 ROMFORD ROAD, STRATFORD,

On MONDAY, OCTOBER 6th, 1902,

(ADJOURNED DISCUSSION, MONDAY, OCTOBER 20th, 1902)

AND

PARK PLACE, CARDIFF,

On WEDNESDAY, DECEMBER 17th, 1902.

PREFACE.

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58 Romford Road,

Stratford,

October 6th, 1902.

The opening meeting of the Winter Session 1902-3 was held here this evening, presided over by Mr. W. McLaren (Convener Experimental Committee). A few remarks on the general work of the Institute preceded a paper on the subject of "Our Fuel Supply," which was in part discussed. The report of the evening's proceedings is published in the following pages.

Jas. Adamson,

Hon. Secretary.

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CHAIRMAN:

MR. W. McLAREN (CONVENER, EXPERIMENTAL COMMITTEE).

THE CHAIRMAN: As you are aware, we re-open the work of the Session to-night, and I will call upon Mr. Jas. Adamson, our Hon. Secretary, to begin the proceedings.

The HON. SECRETARY : At the re-opening of the session it may be well to give a few words of general interest in connection with the work and the prospects of the year upon which we entered under the presidency of Mr. Dunlop. The Institute is increasing in membership ; its growth of recent years has been like that of most substantial things—slow and gradual—but may stand to be increased ; the quality of those proposed being duly considered, however, along with the desire for an increase in numbers.

The advantages offered to juniors and those who are serving their apprenticeship do not appear to be so well appreciated as they might and ought to be ; these advantages should be brought forward more prominently before young men entering upon the business of marine engineering.

The financial position of the Institute is good, and its finances sound. In order to increase its usefulness there are many directions in which money could be well invested if we had it to spare, as, say, in providing accommodation for the residence of members on the premises, and introducing more of the club element—such being anticipated in the original byelaws ; equipping a laboratory and experimental department ; starting a fund which might form a nucleus to be developed (when the season is ripe) into a fund to cover the cost of a building fit and suitable for the Institute of Marine Engineers. It has been suggested to me that the new Education Bill may contain a clause to embrace the work of the Institute, or under which its aims may be grouped. An obvious and simple solution of the difficulties in connection with the contested clauses suggests itself in that, where litigants cannot agree, the funds in dispute should be handed over to the Institute to be incorporated and administered, a solution which would doubtless prove effective. Should there be such a clause as indicated the hearts of our conveners and treasurer would rejoice.

The papers and lectures to which we have listened with pleasurable profit already this session have been in the direction of higher education and a more intelligent knowledge of the materials which fall to be dealt with in the daily life of the engineer. It was pleasing to have with us as guests at the annual dinner those who kindly ministered to us from their stores of technical research, and it is hoped that ere the year ends they may not only be for us, but of us.

The social side of the Institute has, happily, not been overlooked during the recess, and the tennis club has flourished under the direction of its enthusiastic committee. The appropriate and extremely pleasant gathering held at the close of their session on Saturday, September 27th, proved that the enthusiasm was maintained, and would probably be riveted by the closing function ready for another year's service when the time comes round.

The experimental department is commended to the attention of members and friends. Help—mental, physical, and financial—is wanted to carry on the work of the committee: there is ample opportunity for those who are willing to assist, and volunteers are invited. Many fugitive thoughts occur to one day by day, and are undeveloped; chained to a notebook by pen or pencil and brought before the committee, such might be developed usefully and profitably considered for the general good, and at the same time serve as a whetstone to brain and intellect. The excellent example set by several members who have prepared a workshop and supplied it with tools, or presented models for the benefit of those who visit the premises to improve their ideas, might be fittingly followed and become contagious; there are not wanting the opportunities, granting the spirit to meet them.

There are papers in preparation for the forthcoming meetings; yet room for more. Several subjects occur to one when thinking over the possible papers which may be brought before us that we might profitably consider and discuss from the various points of view induced by many minds dwelling upon the same object. A few of these I would now simply refer to, in the hope that it may be a scattering of seed to fructify later on into many leaves of manuscript. The subjects are:—Cold: refrigeration and insulation; the many systems and modifications in operation in connection with the former; the many styles and material in use for the latter. Heat: its value, its preservation and conservation; systems of insulation. Fuel: its many forms, modes of treatment, with special reference to the Royal Commission now searching into the question of fuels, investigating our coal supplies, their possible exhaustion, and the best system to adopt in order to conserve them. Steam: how to use it to the best advantage from the boiler back again to the check valves, to maintain the best value in the steam pipes, to obtain the best value in the cylinders and condenser, minimising the losses from leakage. Economy: how to minimise in every possible direction the running cost of machinery without detriment to the machinery itself, to maintain the details so as to reduce the insurance risk and preserve the highest efficiency, to educate the coming generation of engineers so that overhauling and repairing of machinery and its efficient running and upkeep may be dealt with to the best advantage, the difference between economy and extravagant cheapness.

With these opening words, let us now proceed to take up the work of the session with energy and hope to accomplish much that meantime lies beyond.

OUR FUEL SUPPLY.

The increased and increasing demands all over the world for coal are tending to enhance its value, and, at the same time, induce thoughts of its exhaustion; how to conserve our supplies and how to supplement them; or, how to substitute another fuel to eke them out. When we consider that almost daily, new works, factories, locomotives, steamships, etc., are being started as users of coal, and that in some cases steamships use fully one ton per mile run, it appears that none too soon has a Royal Commission been appointed to investigate the subject from all its bearings. There are controversial elements in connection with the coal industry, which upholders of the one view or the other will probably always maintain, but there are other elements which appeal to the whole community so forcibly that these should be discussed from a broad yet withal patriotic standpoint.

Some of the elements which form the groundwork for discussion are: (1) The increasing demands for coal at home and abroad. (2) The enhanced value of coal, and the increasing value of the superior qualities. (3) The necessity of conserving that which cannot be replaced. (4) The desirability of preserving for national purposes a necessary commodity of which there is a limited supply. (5) The desirability of finding a substitute or substitutes for coal, in order to conserve it, and, at the same time, avoid the distress which arises from a fictitious value being placed upon a commodity under protection, and especially upon one of the necessaries of life. (6) The extent of the coal fields in Great Britain and in the Empire. (7) The rate of consumption and the probable time of exhaustion. (8) The duty which one generation owes to succeeding generations. (9) The duty which one nation owes to another. (10) The duty which the individual owes to the State. (11) The duty which the State owes to the individual. (12) The duty which lies at the door of everyone of utilising fuel in the most economical way for every purpose.

The amount of coal brought forth in the United Kingdom during the past fourteen years to 1901 is given as follows in the official blue book: I have noted the increase each four years and the last two years.

1886—157,518,482 tons
1890—181,614,388 ,,
Increase 24,095,906 = about 16 % in 4 years.
1894—188,277,525 tons
1898—202,054,516 ,,
Increase 13,776,991 = about 7 % in 4 years.
1900—225,181,300 tons
Increase 23,026,784 = about 9 % in 2 years.
In 14 years total increase 67,662,818 = about 42 % in 14 years.

The value of the coal at the place of output is given as follows:

1886— £38,145,930	
1890— £74,953,997	
	Increase £36,808,067 = about 96 % in 4 years.
1894— £62,730,179	
1898— £64,169,382	
	Increase £2,439,203 = about 3·3 % in 4 years.
1900—£121,652,596	
	Increase £57,483,214 = about 89 % in 2 years.

In 14 years increase £83,506,666 = 218 % in 14 years.

The mean average value based on these figures is as follows:

1886—4·1 tons of coal per £1 =	4/10½ per ton	
1890—2·4 ,, ,, £1 =	8/4 ,,	
		Increase 3/6½ per ton.
1894—3·0 ,, ,, £1 =	6/8 ,,	
1898—3·14 ,, ,, £1 =	6/4½ ,,	
		Decrease -/3½ per ton.
1900—1·8 ,, ,, £1 =	11/1¼ ,,	
		Increase 4/8¾ per ton.

In 14 years the increase is 6/2¾ per ton or 127 %.

The causes at work during the years 1894-98—which show a reduction in price—including the disastrous labour troubles, would prove a good subject for a paper; at the same time it is a tempting one, but would take too long to introduce now. Let us rather compare the exports and values of fuel covering the same periods, comprising coal and patent fuel:

1886—23,283,389 tons	
1890—30,142,839 ,,	
	Increase 6,859,450 = about 23 % in 4 years.
1894—33,073,698 tons	
1898—36,562,796 ,,	
	Increase 3,489,098 = 10 % in 4 years.
1900—46,098,228 tons	
	Increase 9,535,432 = 24 % in 2 years.

In 14 years increase 22,814,839 = 98 %.

The average price of the exported coal and manufactured fuel is given as under:

1886— 8·32/- per ton	
1890—12·39/- ,,	
	Increase 4·07/- in 4 years = 50 %.
1894—10·41/- per ton	
1898— 9·79/- ,,	
	Decrease ·62/ in 4 years = 6 %.
1900—16·52/- ,,	
	Increase 6·73/- in 2 years = 68 %.

Increase 8-2/- in 14 years = 100 %.

We presume that most nations are increasing their consumption, some of them in greater ratio than our own, and that they also have something to look forward to, as coal is found in almost every land, and in varying qualities. Welsh coal is a standard approximated to more or less by the best of other nations, but, owing to its special qualities for steaming purposes, its value is always in advance, the market price being ruled by the circumstances of commerce and freights. At several ports where formerly Welsh coal was used it has been superseded by a native coal, owing to the Welsh reaching a price which was beyond the equivalent value in the native article—added to commercial reasons. This is specially the case in Australia, China, Japan, India, America, and South Africa. The price at Cardiff in the different years quoted is, perhaps, the best guide to take for the true value of Welsh coal, as the other elements of commerce and freights to the various ports are eliminated, but the figures given as the prices at the pithead, taken from the Blue Book, give the average cost for the year of all coal. It may be of interest to note that recently in South Africa, Natal coal was selling at 26s. and Welsh at 36s. per ton.

According to the mean of various approximated computations, our stock of known fields of coal would last for about 400 years. Since these computations were made the consumption and output have materially increased, and if it continues to increase the end is approaching all the more rapidly, and the nearer the end the scarcer and necessarily the dearer the coal—it being a non-replacable material, which we hold as a legacy from the past and ought to use to the best advantage, transmitting to those who follow the residue as nearly unimpaired as possible, consistent with proper use and fair tear and wear. Our coal fields form a national entailed estate, the heirs being successive generations, who seek to get as much out of their patrimony as it can well stand, necessity compelling to a certain extent, self-interest urging the rest beyond. The necessity for conserving the product of our coal fields is, perhaps, not very obvious to us in this generation, but it is well to apply the brake before the steepest part of the hill is reached, while the increasing cost of coal is an indication of what is coming, the pinch of poverty accentuating among masses of the people the necessity of saving so far as the individual consumer is concerned.

The appointment of a Royal Commission to investigate and consider the whole question of our fuel supply, and methods of using it, with a view to economise the consumption, discover what classes of fuel may be substituted for coal, etc., shows that it is considered advisable by our legislators to take some steps in the matter. There is an obvious hardship in arbitrarily restricting the output of a material which is brought into the market by the efforts of men who are largely dependent on the output for their livelihood; although the other side of the question has occasionally been illustrated, one case recently was very properly dealt with by the judge, when he found that, with a view to the enhancement of cost for individual gain, miners have not the right to combine to stop work in order to raise prices against the consumer, and thereby also hamper the contracts of their employer, increasing, at the same time, the hardship of the many. The wholesomeness of this principle might well be enforced with rigour in other places than coal mines. The iniquity of some rings and combines does not fall far short of that attached to bogus company promoting or to devilling stock.

There are several methods of restricting the consumption of coal without violating any principle of right or of political economy. Of these the following may be named :—(1) Economising in the burning of the coal. (2) Adopting the best methods of utilising the products of combustion. (3) Utilising to the best advantage the elements, whether steam, water, or electricity, brought into service from the fuel. (4) Maintaining in the highest efficiency the machinery whose motion is directly due to the fuel expended. (5) Testing and adopting other fuels as substitutes for coal. (6) Testing and utilising the refuse heaps from mines, where such exist, for certain purposes where a high evaporative power is not of such moment as in a steamship. (7) Experimenting with and testing the refuse from sewage works, with a view to making use of the combustible portions.

The pressing demand made upon us of recent years to economise, impelled by competition and increased taxation, has resulted in closer attention to the details of expenditure, and the adoption of improved methods of manufacture. The more economic use of coal has also had a special share of attention in many works where the coal bill does not bulk very large, while in most large works and factories changes have been introduced to obtain the highest efficiency for the fuel expended, keeping boilers clean, preventing the formation of non-conducting scale on the heating surfaces, both on the fire side and the water side of the plates, and generally giving attention to apparently small matters formerly passed over as of little moment.

It would lengthen our present considerations too much this evening to deal with the estimated coal fields of other nations, some of which exceed our own, but it is well to note we are not alone in taking up the question of the possible exhaustion of supplies, as others are also giving attention to the subject. For instance, Germany estimates her available supply at 109,000 millions, being thus about 20,000 millions of tons greater than the coal fields of the United Kingdom, based upon the figures given in the blue-book. These are exclusive of our great coal-producing dependencies—India, Australia, and South Africa.

Schemes have been brought forward from time to time to utilise our water power, both river and tidal, to a greater extent, and it might reconcile us to some extent when overtaken by showery weather to know that the rain drops falling around us were being stored and utilised to protect future generations from a coal famine. There is no doubt that where-ever possible water power should be applied, and might be used advantageously where the supply is fairly constant and not readily cut off on account of drought during a summer of sunshine. Heads of water are now made use of for generating electric plant in some parts of the country, and more should be encouraged, for economic reasons. I have no doubt that within the knowledge of each member are waterfalls, which could be made useful after passing the romantic glens they beautify and adorn, without causing a shudder to a Ruskin—nay, further, perhaps causing a pæan of praise to arise from lovers of pristine beauty and opponents of the utilitarian who is regardless of besmearing the land with coal dust and of polluting the atmosphere with smoke; for, with Nature to develop the power, here we have a factory free from these objectionable features, making use at the same time of one of the products of Nature courting our service, and revivifying after each passage, ready for further labour.

Some years ago experiments were made with a view to produce peat charcoal for commercial purposes, having special regard to its fitness for smelting works. The results were such that, in the light of present-day requirements, we might well reconsider them, and endeavour to trace the causes which contributed to laying on the shelf the hopes of those who were then prosecuting researches in order to create an industry alike profitable to themselves and the community. As far as can be ascertained, the circumstances which prevented the manufacture of peat charcoal and fuel as a commercial success were the cost of production and the want of sufficient capital and enterprise in combination to carry the venture to a successful issue. That the tests made appear to have given satisfactory results can be gathered from the notes made at the time, and these are now brought forward in consequence of the subject having been discussed and a few tests made by the Experimental Committee at our meetings on Monday evenings, and a consideration of the specification of the Royal Commission appointed to deal with the question, which showed the desirability of looking around for a fuel to eke out our coal supplies. The conditions are now somewhat modified since the tests referred to as having been made some years ago, inasmuch as the price of coal and coke has been increased; and possibly with fresh light thrown on the best and most economical process for the manufacture and treatment of the peat, where failure was, success might now attend. The analysis of the test sample of peat charcoal—which was specially made—was given as follows: Carbon, 79·54 per cent.; ash, 3·51 per cent.; sulphur, 0·46 per cent.; volatile matters at red heat, 6·84 per cent.; moisture, 9·71 per cent.; total, 100. This test sample was simply prepared in the laboratory to find out what process would be necessary to deal with the peat for the market, the most suitable plant for preparing it, and the probable cost. Other considerations arising out of the experiments as side issues, but bearing upon the nett cost of production and possible modifications in the treatment, naturally were: what by-products of commercial value could be obtained? On further drying the test sample, the carbon was increased to 88·63, and the sulphur reduced to ·44. For smelting and forging purposes, a fuel with so small a percentage of sulphur was very desirable, and hopes were entertained that the peat thus treated would find a ready market. In order to show a comparison with coal and coke, the following analyses are taken from a standard table in the discussion on a paper we had published in Vol. II., No. 13:

Water	Volatile Matter	Carbon	Ash	Sulphur	Coke	
1·29	5·23	90·71	1·95	0·82	92·66	Anthracite—Glamorgan
1·25	3·69	92·10	1·20	1·06	94·00	Anthracite—Carmarthen
·89	8·97	87·61	1·75	0·78	89·36	Bituminous—Glamorgan
1·08	8·75	84·51	4·75	0·91	89·26	Bituminous—Blaen Rhondda
3·23	30·37	60·50	5·00	0·90	68·5	Bituminous—Lancashire

It will thus be seen that peat charcoal stands in a good position relatively in so far as the analyses go, save the large percentage of moisture, the extraction of which is one of the difficulties in preparing peat fuel for the market. The cost of production is the next necessary consideration, and if we take the price of coal at the time the experiments were made, and the price at the present day, we shall see the difference in the relative commercial values, and be able to gauge to some extent the prospect of the peat being now introduced with success:—Estimated cost of peat charcoal: 80s. per ton: ·44 per cent. of sulphur. Cost of coke, 1887: 14s. per ton: ·9 per cent. of sulphur. Cost of coal, 1887: 7s. per ton: ·5 to ·6 per cent. of sulphur. Cost of coal, 1900: 17s. 6d. screened; 15s. 6d. unscreened. Cost of coal, 1902: 10s. 6d. screened, and 8s. 6d. unscreened, with a small percentage of sulphur, suitable for forging purposes. These figures show that as time goes on, and improved methods of dealing with peat are discovered, and the price of coal increases, the relative prices of peat-charcoal, coal, and coke approximate to one another more closely. To this aspect of the question we may revert later on. Meantime, it may be of interest to see the analysis showing the by-products which may be obtained from the peat. This showed that one ton of peat produced the following: 13,000 cubic feet of gas free from sulphur; 16 lbs. acetic acid; 46 lbs. wood naptha; 20 lbs. of sulphate of ammonia; 12 lbs. paraffin wax; a quantity of tar. Peat as dug from the field contains much moisture, even when sun-dried, and one of the difficulties in connection with its use as a fuel, which renders its preparation for the market expensive, is that time and machinery are required to compress the fibres and extract the moisture. By a process which has been recently patented, the time and machinery necessary have been greatly reduced, and hopes are entertained that in the near future a preparation of peat will be available for steam purposes at little more than half the price of coal, with a storage capacity of little more than coal, but of less calorific value. Some of the samples resulting from this process have been tested here and yielded good results. Samples of crude peat from different parts of the kingdom have also been tested, and it is proposed to continue these tests and mixings with a view to discover what can be done to make use of peat in a manufactured state for domestic and other purposes. With these few rambling notes on the subject, it is hoped that our interest may be increased, and our thoughts directed into channels whence may spring improved methods of dealing in the utilisation of fuel and of mechanical power.

The CHAIRMAN, in opening the discussion, said they were very thankful to the Hon. Secretary for coming forward and giving them so much valuable information. It was also gratifying to know that the Royal Commission now investigating the question of fuels had asked them to assist in their researches, and he thought they ought to take the opportunity of sending some of Mr. Adamson's remarks forward to the Commission. He had no doubt that they, as marine engineers, would be able to add something in the way of information. He would have liked to have heard a little more in regard to liquid fuel as a producer of steam, as it was being pushed forward at present. He was of opinion that at the present price of Welsh coal it would take liquid fuel all its time to compete. The only advantages to be derived from the use of liquid fuel were, absence of refuse, cleanliness, and a certain reduction in labour. This latter, however, would only apply with a certain battery of boilers. Where only two or three boilers were in use the labour question would be less apparent, and would only show a very low profit. They were all very sorry to lose the services of Mr. Newall as convener of the experimental committees. He had not been able to give the attention that he had done at the beginning of last session, but it would please them to know he would still give them all the help and time he could spare. If there were any other gentlemen who would like to assist in the work of the experimental department, the Committee would be happy to avail themselves of their assistance.

Mr. T. F. AUKLAND (Companion) said the number of questions arising out of Mr. Adamson's intensely interesting paper required very much consideration before one could say much upon the subject, except in very general terms, until the paper could be printed, and time allowed to consider it. So far as the coal itself was concerned, he had for many years had very serious fears that we were sending abroad what might be termed our very vitals, which we ought to have ourselves to depend upon in future for our use in time of war especially. We do not yet know of any other description of fuel or other means of propulsion than that of steam generated by water heated by the burning of coal, and all our power in numbers of naval and commercial ships would be worth nothing but for the coal that we are able to get from the mines in Great Britain. We may have the fastest ocean greyhounds and the fastest cruisers, and the most powerfully armed battleships that the mind of man can produce; but what are they worth without material by which steam alone can be raised to enable them to do their duty. Then why should the nation who are so utterly and entirely dependent upon this commodity, allow of certain persons who happen to own the collieries, merely for their own enrichment, to sell this vital asset of the nation by which alone her supremacy of the ocean is maintained, and the whole country thus saved from absolute extinction. The Government ought to buy the coal for the nation's weal, and not allow foreigners to buy it of us *ad lib.*, to further their own advancement as against our own. To talk about coal being exported coming under the category of trade and being rejoiced in whenever orders from foreigners come to us, as they did very lately in the American scare, and also when our continental neighbours order and contract largely, why, it is something like a man selling his home because someone else would give him so much money for it, and calling it a good stroke of business; when in order to get another home he would have to pay more money than he received for the old one to reinstate himself as he was formerly. We cannot yet do without coal, and until some other system of propulsion has been fully developed so that we *can* do without it, we must depend absolutely upon coal for our very existence, and we should make this a certainty by not allowing any coal to be sold or used except by steamers belonging to the purely English mercantile fleet, and the Royal Navy of England. We should not depend upon this or that expert telling us that our coal will last indefinitely, and that when one mine is used up another can be found to take its place—that may or may not be true. The latter appears to be far more likely than the former. Our English coal is our very salvation from utter ruin, and unless we set to work immediately to conserve all we have for our own absolute use, and stop any from going out of the country to supply others with the sinews of war, both commercially and nationally, we shall one day find ourselves in appalling extremity, and our very existence threatened as a nation.

Such excellent papers as these do infinite good in arousing the people from a state of apathy, because they do not think of the amazing importance of safeguarding our own interests. While it is in our power to do so it is a duty we owe not only to the generation in which we live but to those who shall come after us. I congratulate the writer of this paper and the Institute of Marine Engineers upon the very valuable information brought before us to-night.

Mr. G. W. NEWALL (Member) said this paper was so full of information that it might form the subject of discussion for many evenings. It appeared to him that the coal question was one of the most serious that engineers had to deal with, considering, as Mr. Adamson tersely put it, that, in many cases, for every mile a steamer ran she consumed, for all purposes, over a ton of coal. He did not think they got out the figures correctly enough to state when their coal would be at such a depth that it could not be got at. He did not quite know the methods employed by experts for telling the extent of the coal fields in this or other countries, but it was, he thought, open to doubt how long our coal would last. We knew, however, from past experience, that to-day more was paid for a ton of coal than ever before. Marine engineers certainly used more coal than any other class of consumers of that particular fuel. Since coal was becoming so scarce great efforts were being made to use peat, and one particular process was to dry the peat and impregnate it with hydro-carbon oils. Of course, the value of that preparation remained to be proved. He was afraid many engineers would fight shy of filling their bunkers with a fuel that gave off hydro-carbon gases. They had heard a lot about oil fuels, and perhaps a little too much of troubles in the way of disasters on steamers using this fuel. The oil question, however, was one that deserved more consideration than it got to-day. There were certain dangers attending its use, but these could be got over in the near future. Then arose the question whether a ship of a few thousand tons might not be propelled across oceans by stores of electricity. Instead of storing two or three thousand tons of coal on a ship there was the possibility of putting on board two thousand tons weight of storage batteries. If they could use Nature's streams to charge their ships' batteries with this power, they could then use it for the journey across the Atlantic. Of course, the dream side of these questions was very well in its way. The dream, or, rather, the ideal, of the electrician was to use a generator ashore, and, if it might be so expressed, a sympathiser on the ship, and without the use of wires, to transmit through ether, electric force under the control of the men on board the vessel, so that the engines should be worked without coal at all. It had recently been proved at Portsmouth what could be done. Mr. Marconi had conducted experiments with a torpedo, weighing between six and eight hundredweights. He sent it out to sea, brought it back again, and manœuvred it about at his will, controlling it all the time from the shore without the use of wires. That was the electrician's dream, and at the outset it looked very strange. But, if Marconi could manipulate a torpedo weighing six hundredweights, who knew but that at the end of the present century they might be dealing with thousands of horse-power through the same means, controlled in every way similarly to that demonstrated. In America there was an unlimited supply of power for generating electricity, and the thought of the immediate future, as coal became too scarce for ship-work, would be, How could they use up the forces ashore for their ships at sea? Would it not be possible for the Government to take charge of the coal mines, so that the foreigner would be kept out? In the event of war, how could they at the moment store up those hundred thousands of tons of coal that would be required, and put them in places to be protected? It was a very serious question, and they ought to do all they could to use the coal properly, to understand it better, and to take care of what they had. Last year several tests had been conducted in the Experimental Department with the idea of ascertaing the calorific effect of various fuels. Since that time he had heard it mentioned by some of their members that they were not satisfied with the experiments made. He did not mean to say that the tests were wrongly made, but some of their members considered that the experiments were not a true criterion of the coal they had to deal with. The instrument they had used was Thomson's calorimeter, which was considered a very good instrument for ordinary purposes. The gentlemen who objected to the results obtained had based their arguments thus: "How," they said, "was it possible in 2,000 tons of coal on board a vessel to take two grammes, and so find the calorific value of the whole amount?" It was then suggested that they should have a plant whereby instead of using so small a quantity for testing purposes, they might experiment upon two or three hundredweight. He would suggest that those members who were not satisfied with the two grammes test should come forward and do their level best to get such a plant that they might make their experiments on the larger scale proposed. He had recently been to some trouble to find out what there was in the scientific world in the shape of calorimeters, and in a book that had been lent to him he found descriptions of about thirty different calorimeters for measuring the effect of burning fuel, and it was impossible to pick out one that would suit them. The majority of these calorimeters tested with one gramme, some with half a gramme, and very few with two grammes. To burn one pound of coal in a scientific way (that is to say, to get all the heat out of it) they would require something like fifteen pounds of oxygen mixture, and half a ton of water, while the cost of each experiment would be about twelve shillings. So, to test coal by the hundredweight would be prohibitive, owing to the price of the oxygen mixture, or pure oxygen required. The only way to ascertain the fighting value of coal by the hundredweight would be to do as was often done on board ship, or on shore, to burn a given quantity of coal and measure the water evaporated in a given time, that would appeal to engineers in this way, in the scientific way they used up all the atmosphere; in practice they could not do so, because there were so many enemies to heat; there was the combustion of the fuel, waste of gases up the funnel, radiation and leaks. The boiler threw off heat which, to make a proper test, they would have to catch and register. The question arose whether they could not get the plant to enable them to test coal by poundage. If they could formulate something to submit to the Council no doubt they would help.

Mr. J. R. RUTHVEN (Convener Papers Committee) said he agreed with Mr. Newall that it was cutting things very fine to deal with grammes, and they certainly ought to make an effort to deal with larger quantities, and so obtain a better average. If they did not succeed in getting all the heat out of the coal they would still be able to estimate how much was lost. He had recently examined some coal through a microscope, and he thought such an instrument would be useful to the Institute. Another useful instrument would be the Röntgen Ray apparatus. He thought if the majority of the members were more familiar with the uses of these instruments it would be to their advantage, and to the community at large, especially in view of the fact that coal was getting more valuable and scarcer. Until they could devise a method for doing without coal it would be necessary to use it with economy.

Mr. G. SHEARER (Member) was of opinion that it would be to the advantage of the Institute to conduct the coal testing experiments in a more practical light, and leave the scientific tests to the higher laboratories. He did not see that there need be any difficulty in using an ordinary boiler for the purpose—burning the coal in quantities. Regarding the escape of gases and the loss of heat in one way or another it would be equal for one coal, or one fuel, or whatever material so used. The ratio would be the same. He failed to see that they were correct in their experiments. There was not a proper base to work from in regard to the oxygen mixture; they did not know what quantity of oxygen mixture each fuel required, and, in his opinion, there was a good deal of guess work about it. He had recently heard of a more modern instrument where they had the free gas to work from instead of the oxygen mixture, and he considered that when they could see the quantity consumed they would know exactly what they were doing. In their tests he had never been able to understand what portion of the temperature was coming from the fuel, and also how much was coming from the oxygen mixture. That was the puzzling point. He would advocate for the use of the steam generator, using either a tubular or cylindrical boiler. This, he considered, would afford the best kind of test for all varieties of fuel.

Mr. FARENDEN (Member) said he could not see where there need be any difficulty in conducting their experiments with a boiler. The temperatures could be taken of the surrounding atmosphere and of the generator, together with the amount of water evaporated and the quantity of fuel consumed could be measured. He believed that by this means they would get much more practical results.

Mr. NEWALL then explained that the oxygen mixture used gave no heat. It was not possible to burn oxygen mixture. So they could not add one degree of temperature to the water by using either pure oxygen or oxygen mixture. The oxygen mixture simply supported combustion and nothing else.

Mr. SHEARER remarked that he quite agreed with Mr. Newall theoretically; he did not mean to say that oxygen could be burnt by itself, but practically he was of opinion there was something to be got at times that they could not always grasp. He had sometimes found the test of the worst possible coal come out nearly as good as middle-class Welsh coal.

The CHAIRMAN said there were some wrong ideas as regards the utility of the tests. They had taken the samples as they were brought forward, and put them through the tests, which were tests for either the quality or quantity of the coal used. If they added to the oxygen mixture it was the same as if they gave a greater area, and the time would be much longer. With reference to the suggestion that they should make a practical test of the coal in a furnace and boiler, there were many points that required consideration. There was the addition of the boiler surface—they might have a short or long boiler, and the length of the boiler would always have an effect upon the results. Then there were the chimney heat, and the weight of the air or gas. This had to be contended with in such tests.

Mr. JOHN MACLAREN (Member) said he had taken part in some practical tests with a series of small boilers, and afterwards with larger boilers, but had found they could never get the conditions the same, so they were obliged to go right back to a scientific test again and make the best of that. So far as testing with boilers was concerned it was a failure.

Mr. ADAMSON, in replying, said he knew Mr. Aukland took the very practical view that we ought to protect our coal and coal industries with an eye to future eventualities. A large proportion of the coal exported from this country was used to supply our out-going steamers at Port Said, Malta, Marseilles, etc. The blue books published would probably contain the figures relating to the amount of coal imported by the different foreign nations, but at present he could not give the statistics. Recently America had been importing to a large extent Welsh coal on account of the labour troubles in the States. Welsh coal, he apprehended, was the best that the world produced, and was especially suitable for the Navy. Such being the case, they ought to conserve that which was invaluable to them in a sea-girt isle. Referring to the chairman's remarks about oil fuel, he had not sat down with the idea of preparing a paper on the whole subject of fuels. The paper was really the result of a few random thoughts at the seaside, which, but for the note book, would probably have been lost. There were many points connected with these notes that might form the subjects of papers in the future. Mr. Newall had referred to peat and petroleum. There was a paragraph in a paper a short time ago, in which it was stated that another process had been discovered for the preparation of peat for the market. The peat was treated in some special way with petroleum, and it was claimed that very good results would follow. Regarding the utilising of waste products, he had that evening received a sample that looked like some of the peat charcoal which they had tested, but the product in question had, he understood, been prepared from sewage. The calorific value of this product was not very high, but, at the same time, it was a product which they, as a nation, had been throwing away and making no use of, except, perhaps, on sewage farms. The sample in question had been prepared from the solid portion of the sewage. He understood that it had been used on some of the electric light works, and found to give satisfaction. Perhaps their much-abused scientific instrument would have an opportunity of trying its value upon the sample in the course of one or two evenings. They also proposed to test some samples of prepared peat, with a view to discovering what use could be made of it. An idea had been thrown out that evening that the Government should take possession of their coal fields. He was afraid that would be rather a big handful, rather worse than the Education Bill now in hand. Mr. Ruthven's suggestion respecting the acquisition of a microscope for the use of members was a very good one: it would be a very useful instrument for them to possess. With reference to the depth of coal mines, he believed that the Royal Commission which sat upon the subject some years ago decided that 4,000 ft. was about the limit to which it was possible to go—first of all, for economic reasons on account of the mechanical appliances, and secondly, on account of physical reasons, because of the heat, which became great as the depth was increased. In several parts of the country it was estimated that coal went much deeper than 4,000 feet, as, for instance, in Yorkshire, Cheshire, and some parts of South Wales. In regard to the tests they had made, they were only able to use the means they had at command. No doubt if some of their millionaire friends knew they were in want of a big boiler and a few tons of coal to keep it going, they might possibly be able to enlarge their premises. At the same time, he thought their testing apparatus was fairly accurate. He knew the different kinds of coal that had been tested, and in the experiments the values compared exceedingly well. The results were just what he had expected them to be. On one occasion he had brought a sample of Indian coal, of which he did not know the value, and he had purposely refrained from asking what the results had been during the voyage. On that night they had with them the chief engineer of the steamer from which the sample had been taken, and the results of the test came out just about what the chief engineer had estimated from Welsh. The result was taken from a series of four or five tests, and in that particular instance he knew that the instrument gave a very fair indication of the value of the coal relatively to the standard.

The CHAIRMAN then announced that the experimental work would be carried on every first and third Monday evening of each month during the Session, commencing October 20th.

Mr. T. F. AUKLAND proposed a vote of thanks to the author of the paper, and a similar vote to the Chairman closed the proceedings.

DISCUSSION CONTINUED.

MONDAY, OCTOBER 20th, 1902.

58 ROMFORD ROAD, STRATFORD, E.

CHAIRMAN:

MR. W. McLAREN (CONVENER, EXPERIMENTAL COMMITTEE).

THE CHAIRMAN: We propose to-night to continue the subject of our fuel supply, to test some samples of peat, and examine a sample of fuel manufactured from sewage. The Hon. Secretary will describe the sewage fuel manufacture while the tests are being prepared.

The HON. SECRETARY said that at the last meeting the points considered were the increasing demand for coal and its enhanced value, the necessity of conserving that which could not be replaced, and the desirability of preserving a special quality of coal for naval purposes, of which there was a limited supply. He had looked through the blue books in response to the enquiry made by Mr. Aukland as to how much of the coal and fuel exported from this country was imported by foreign nations; unfortunately he had not found the blue book that gave the information required, but it was currently reported that other nations had been importing a good deal of coal from this country. In the case of a European war this would tell against us, and it tended to diminish our supply of good Welsh coal. It would take a good many years, however, before this diminution was felt, but they ought to look after their own interest, and consider the view that was put forward by Mr. Aukland at the previous meeting, and conserve their best steam coal for their own purposes, so that in the event of a naval war they would have a good command of Welsh coal. It was suggested by Mr. Newall that the Government ought to have in their own hands the coal industry; on referring to the blue book, he found that in Persia the Government owned the mines, and leased them out to private individuals. So, from the point of view of those who considered that the mines should form a national investment, Persia was well in advance. Such would be an arrangement extremely difficult to bring about in this country now. He stated that during the year 1900 the total output of coal in Great Britain was 228,794,917 metric tons; Canada, 4,837,291 tons; Queensland, 505,110 tons; British Borneo, 51,251 tons; Tasmania, 43,700 tons; Cape Colony, 201,636 tons; India, 6,216,882 tons; New South Wales, 5,595,879 tons; Natal and Zululand, 245,203 tons; New Zealand, 1,111,546 tons; Victoria, 214,922 tons; and Western Australia 120,310 tons.

A paper descriptive of the method employed by Mr. Springborn in producing fuel from the sewage sludge had been received, along with a sample of the fuel, which was before them for examination and test.

The paper was as follows:

SEWAGE.

The oldest system in use for the collection of the sludge is the house to house collection, which method is still in operation in many countries.

In former times each household had its own collection tank. These tanks were interchangeable and were regularly collected on carts to be taken to outlying fields, where the contents were emptied on to the latter as manure. In other instances larger tanks were provided, which from time to time were emptied by means of buckets and filled into barrel carts, and thus removed to the fields, but in most cases the sludge is now taken from the tanks by suction carts. The sanitary drawbacks of this system are obvious. It not only causes inconvenience to the households, but experience has also taught that the continual oversaturation of the fields thereby caused accumulation of solid matter detrimental to the land.

In modern times the house to house collection has largely been superseded by the drainage system.

In this case, the sludge is collected from the houses by means of drains or sewers, in which the sewage is conducted to some outlying place, from where its disposal can be conveniently operated. It is needless to say that the drainage system, so far as collection of the sludge is concerned, has wrought great improvement. The question of actual disposal of the sewage, however, remains the same as before. It is true, the introduction of the drainage collection has been productive of various new devices to solve the problem of getting rid of the sludge so collected, but, as will be shown, these devices simply open channels for the removal of offensive matter but not for its actual disposal, its destruction or consumption.

The various methods in use for treating the sludge collected by means of the sewer system may be summed up as follows, viz.:

(*a*) Collecting the sewage in settling tanks: The sewage is allowed to accumulate and to remain often for years until a compact mass is obtained which is frequently used to fill up waste land, which is the case at Barking, where there is a deposit of 20,000 tons. The stocking of sludge as operated in this case endangers common health. Again, pollution is carried over wide areas by the effluent water from the tanks.

(*b*) Antiseptic chambers: Here the sewage is driven through a series of chambers, where, it is claimed, new bacteria are formed, feeding on the dangerous microbes contained in the sludge, the solid matter, when removed from tanks, is there either stocked or thrown on waste land. The water is allowed to pass off through coke beds or gravel. The water is claimed to be free from taste, smell, and bacteria, a claim over which opinions greatly differ. Moreover, this system is only practicable in small places.

(*c*) Precipitation: The method of precipitation of sewage is used to separate the solid matter of the sludge from the water. The precipitant commonly used is lime, superfluous moisture remaining in the mixture thereby obtained being further removed by driving the latter through filter presses, leaving the solid matter in the form of cakes or slabs. These are either thrown on the land, or taken out to sea, as in London, for instance, which in the year 1900 sent 2,372,000 tons of this sludge into the sea, at a cost of 4·86d. per ton. The expenses were £175,351 2s. 6d.

The solid sewage London had to deal with in that year was, after deducting 10 per cent. of lime (as the lowest quantity necessary) 237,200 actually solid tons. The same amount would give following result if worked through my process :

	£	s.	d.
Wages, 2s. 6d. per ton	37,062	10	0
Chemicals 1s. 6d. per ton, outside	22,237	10	0
Other expenses, such as salary, rent, and use of machinery, etc.	15,000	0	0
	74,300	0	0

For this amount I would obtain 296,500 tons of fuel of a calorific power from 6·0 up to 9·0 at the present market value of 15s. per ton.

Attempts at utilising sewage commercially have proved inadequate, and the disposal of sewage consequently represents an operation involving an enormous outlay without returns. Nor is this all, for in spite of the great sacrifice made year by year by municipalities and corporations, the methods hitherto adopted for disposing of these offensive matters represents, in most cases, nothing more than the transfer of pollution from one place to another.

Under these circumstances, and in view of the large and ever-increasing quantities of offensive matter to be dealt with, the question of its effectual disposal has developed into one of the most pressing and far-reaching problems of the day.

I have for years studied the question of finding the best method for the disposal and use of sewage, and to enable me to demonstrate my process on a larger scale, I obtained a concession of the Romford Urban Council in 1899 to 1900 to work my process at their sewage farm. On the 15th of January, 1900, the manager of the sewage farm at Romford handed the following report of my trials to the Urban Council:—

"That Mr. Springborn, an analytical chemist, had, with the farm manager's consent, been making experiments with the sludge, with the view of utilising it as fuel, and that the experiments so far had been successful, showing that 9·1 lb. of water could be evaporated with 1 lb. of the fuel derived from the sludge obtained from the farm tanks."

With the fuel I manufactured out of this sewage the following trials were made, viz.:—

A trial at the electric lighting station, Barking.

A trial at the sewage works at Redhill, Surrey.

A trial at the electric lighting station, South Ealing.

A trial at the Ramie Fibre Spinning Syndicate Mill Works, Staines.

A trial at the Ind Coope & Co. Brewery, Romford.

A trial at the Wharf of Messrs. Chambers & Fergus, Hull; and others.

A trial at the laboratory of Mr. George T. Holloway, Consulting Chemist, Metallurgist, and Assayer, 57-58 Chancery Lane, London.

All these trials, of which the copies of the reports are enclosed, were satisfactory, and proved the value of the fuel, but there were still some alterations to be made.—I may add (according to all experts' opinions) sewage untreated has not more calorific value than 1 to 1·5 lb. of water per lb. of sewage.

This fuel was too porous, consequently the furnace had to be filled oftener, which threw more work upon the fireman, and required a skilled fireman, to bring the proper evaporating power out of it. The process was too costly; the precipitant I used acted too slowly, and I could not get rid of the gases.

I found that for the success of my undertaking certain problems had to be solved. The product made from sewage should be free from smell, and sterilised at a low cost. The whole process should not be more expensive than the present precipitation with lime, the same machinery being utilised in both cases. The water which passes off should be free from microbes, and absolutely clear.

After two years' trial I succeeded in precipitating sewage with prepared sewage, and found, by leading the effluent through a filter-bed of the same material, this water was quite clear, and free from any microbes.

This precipitant can be used in precisely the same way as lime; but in the one case, where lime is used, the product is useless, and in the other case I obtain a fuel with the required density and a high calorific power, or a manure of great value for farming purposes.

Where the precipitation by lime is not in use I erect, not less than 100 ft. from the outlet of the sewer, an apparatus in the form of a sand glass, to allow only the necessary chemicals to run in the sewer. The chemicals arriving in the sewer mix with the fluid immediately after they come in contact with the sewage, they concentrate the solid matter in the fluid, whereby the gases undergo oxidation, through which process all smell is removed. Close to the outlet of the sewer I erect two iron gratings, one over the other, both sloping, the first 4 in. and the other 12 in., to the yard; under all is the channel for allowing the fluid to pass off. The bottom of the canal slopes about 2 in. to the yard, the iron bars of the first grating are $\frac{1}{4}$ in. apart, of the second $\frac{1}{32}$ of an inch apart, underneath the second grating I fix canvas. All gratings and canals must be fixed in such a way as to be easily cleaned if required.

The fluid arrives out of the sewer on to the first grating, the passage between the bars allowing the water in the sewage to flow on to the second grating. Only solid material, such as stone, iron, etc., will be retained and deposited at the bottom of the slope, and may be used according to its value.

The second grating and canvas allow the fluid to pass through, but retain the solid. The solids glide to the bottom of this grating, and can be taken to the machinery and formed into blocks, etc., and stacked for drying. The canal which is running under the canvas is lined with specially-prepared wooden blocks. On the end of the channel I have a specially-prepared mass of sewage, through which the water has to pass, then through gravel, and lastly through broken bricks. The water which passes from these bricks is free from bacillus, clear, and even drinkable.

Estimate of the cost of machinery and plant where the precipitation with lime is not in use, but the drainage system is (for the production of thirty tons per day). The plant necessary to carry out the above is as follows :

	£	s.	d.
Apparatus similar to a sand glass	5	0	0
Two iron gratings	15	0	0
Canvas	1	0	0
Canals	5	0	0
Sewage bed	5	0	0
Gravel and brick filter beds	10	0	0
One briquette machine, 30 tons capacity per day	75	0	0
Sundry implements, endless bands, and ropes, belting, etc.	150	0	0
Two retorts for sterilisation of sewage and other highly offensive matter..	100	0	0
Two drying sheds holding 190 tons each ..	100	0	0
	£466	0	0

It is impossible to make a clear distinction between thirty tons and double that quantity, or perhaps more.

The larger output would not seriously enlarge the present estimate, the principal additions required for such an emergency being merely increased space or larger drying sheds.

The chemicals I use I chiefly prepare out of sewage, and use therefrom 1 oz. to 1 gall. of sewage fluid containing no more than 5·7 solids to be treated.

The cost of one ton of fuel made under this process does not exceed 5s. per ton, including chemicals and labour.

Samples of Norwegian peat fuel were then submitted to test. This fuel, which had been fully carbonised by the Angel carbonising process, when analysed was found to consist of volatile matter, 58·41 parts; fixed carbon, 40·70 parts; ash, 6·89 parts, and moisture 5·96 parts. It was claimed for it that one pound would evaporate 14·85 lb. of water at a temperature of 212 degrees, and that one ton would produce 310 cubic feet of 19-candle power gas. Six separate quantities of this fuel were tested, with the addition of varying quantities of oxygen mixture. The results of the six tests are shown in Table 1.

It was announced that these tests would be continued at a subsequent meeting with larger proportions of oxygen mixture, when the results would probably show higher evaporative power.

Time did not permit of more than three tests with the sample of fuel prepared from sewage. The first of these was an open test, two grammes of fuel being ignited with six grammes of oxygen mixture, the combustion being completed in five seconds. The results of the other two experiments with this sewage product are given in Table 2.

The extremely interesting report on the oil fuel tests conducted under the auspices of the Navy Department of Washington will be read with satisfaction by members who desire to know the advantages of oil fuel. It is stated that greater heat is generated more quickly by oil, fewer firemen are needed, less smoke and less residue.

TABLE 1.

SAMPLES TAKEN FROM PEAT FUEL.

TESTED BY THOMPSON'S CALORIMETER.

No. of Tests	Fuel in Grammes	Oxygen Mixture Grammes	Temperature of Room	Temperature of Water before Test	Temperature of Water after Test	Difference in Temperature Fahr.	Difference of Water + 10 %	Time in Seconds Combustion	British heat Units per lb. of Fuel	Evaporative power of Fuel in lbs. Water
1	2	4	63	60	65·5	5·5	6·05	30	5850·3	6·05
2	2	4	63	61	65	4	4·4	40	4254·8	4·4
3	2	6	63	61·4	67·4	6	6·6	36	6382·2	6·6
4	2	6	64	60·7	67	6·3	6·93	38	6701·3	6·93
5	2	8	64	58·4	65	6·6	7·26	55	7020·4	7·26
6	2	10	64	59·4	69	9·6	10·56	50	10211·5	10·56

TABLE 2.

SAMPLES TAKEN FROM FUEL MANUFACTURED FROM SLUDGE, OR THE SOLID PART OF SEWAGE.

TESTED BY THOMPSON'S CALORIMETER.

No. of Tests	Fuel in Grammes	Oxygen Mixture Grammes	Temperature of Room	Temperature of Water before Test	Temperature of Water after Test	Difference in Temperature Fahr.	Difference of Water + 10 %	Time in Seconds Combustion	British heat Units per lb. of Fuel	Evaporative power of Fuel in lbs. Water
1	2	8	64·25	60·3	67·75	7·45	8·195	24	7924·5	8·195
2	2	10	65	62	70	8	8·8	40	8509·6	8·8

DISCUSSION CONTINUED

ON

OUR FUEL SUPPLY,

AT

58 ROMFORD ROAD, STRATFORD.

MONDAY, NOVEMBER 17*th*, 1902.

CHAIRMAN:

MR. W. McLAREN (CONVENER, EXPERIMENTAL COMMITTEE).

MR. JAMES ADAMSON (Hon. Secretary), in continuation of the subject of fuels, read an extract from the *Board of Trade Journal* of October 9th, and commented on the efforts being made in several parts of the world to produce fuel, other than coal, for purposes of raising steam and heat. In Canada the experiments made to utilise peat had been successful, and owing to the recent coal strike in the United States the value of such experiments was brought home to the Canadians by reason of the threatened coal famine. The process by which the crude peat was brought into a state for the market, with the moisture extracted, had been gradually improved, and by means of machinery of ingenious design it had been found possible to manufacture peat coal and charcoal from the crude peat quickly, and at a cost which enabled the manufacturer to sell it profitably in Toronto at 17s. 8d. per ton retail or at the works at 13s. 6d. It was stated that there was a ready sale for the manufactured peat at these prices. About 3,000,000 tons of anthracite coal was said to be the yearly consumption of Canada, mostly imported from Pennsylvania; the scarcity of the usual fuel had thus given a decided impetus to the manufacture of peat —another illustration to show the folly of a section of men trying to raise the price of a commodity against the public, forgetting that there were other avenues of supply besides their own, at the same time stimulating research and experiment, to bring forth inventions to meet the demands of necessity. Canada had been spending money and labour in endeavouring to find the best method of preparing peat for the market and home consumption. Private efforts, at the same time, had not been wanting in Britain and other countries. The process which was being introduced, and by which the samples supplied to the Institute for testing purposes were made, was claimed by the promoters to be the best from an economical standpoint. About 100 tons of wet peat were equal to 20 tons of dry, which would cost 2s. to 2s. 6d. per ton if disposed of in large quantity, or 3s. per ton at the outside, at the place of production. The present selling price in Dublin is given as 15s. per ton, carriage paid. Ten tons of peat coal, again, could be produced from 100 tons of wet peat at a cost of 6s. to 8s. 10d. per ton; seven tons of peat charcoal could be produced from the 100 tons of wet peat, and, allowing for the sale of the by-products, at a cost of about 12s. 8d. per ton, free from sulphur. Reference had been made to the coal exported from Britain to American ports during the strike; this amounted to about 190,000 tons, a considerable quantity in the time involved. It was also pointed out that a fuel was being produced in France from petroleum, made into briquettes, which was found to give very good results, possessing the advantages of both coal and oil without the disadvantages of either, clean to handle, and with very little residue. Samples of peat coal were then tested, and gave results showing the calorific value to be 11·25 lb. water per pound of fuel. These tests were made by means of a new calorimeter (Darling's), in which oxygen gas was used. This was found to be a great improvement, involving less work in preparing the samples for test, and not liable to failure by reason of a damp atmosphere. The new instrument, it was announced, had been kindly presented by Mr. G. W. Kidd (Hon. Treasurer), to whom a vote of thanks was accorded for the gift. With reference to the cost of peat charcoal, the very great difference in the estimated cost given as the result of the laboratory experiments carried out some years ago, and the proposed selling price based upon the most recent trials, it was pointed out that probably in the former case no allowance had been made for the sale of the by-products, which would yield a good return, and thus admit of the peat fuel being sold at the figure quoted.

Specimens of locomotive stays, manufactured of a specially-prepared mixture of bronze to suit the purpose, were exhibited from Messrs. Stone & Co., Deptford, also a test piece showing a breaking strain of 19 tons.

A positive lock nut and gauge were exhibited and explained by means of models in the course of the evening by Mr. Lowman, the inventor, who claimed that his device was not only a great improvement over all other arrangements at present in use for locking nuts, but, in addition, that it provided an accurate means of adjustment and measure of tightening up. Expressions of approval were given by several of the members, and it was considered that, for many purposes, the device was an undoubted improvement over the usual double nut.

The HON. SECRETARY: It may be interesting before closing the subject at present, to refer to the published figures giving an approximate estimate, based upon trials of the values of some of the South African coals compared with a Welsh standard. These are as follows:

Welsh Coal (Ocean Merthyr)	.. 1,000 tons
Viljoen's Drift (Vereeniging)	.. 1,562 ,,
Indwe	.. 1,634 ,,
Cyphergat	.. 1,729 ,,
Wallsend (Cape Colony	.. 1,502 ,,
Molteno	.. 1,706 ,,
Natal Coal (Best quality)	.. 1,102 ,,

The following figures are taken from the *Shipping Gazette* of November 12th, 1902, giving the approximate quotations for coal, f.o.b., less 2½ per cent., exclusive of tax:

Very best Cardiff steam coal	15/3 to 15/9
Good ordinaries	14/6 ,, 15/3
Other sorts from	14/- ,, —
Drys	15/- ,, 16/-
Best Monmouthshire..	13/3 ,, 13/6
Seconds (Cardiff Shipment)..	13/- ,, 13/6
Best House Coals	16/- ,, 17/-
Seconds	14/9 ,, 15/9
No. 3 Rhondda large..	15/- ,, 16/-
Through and through	12/3 ,, 12/9
Smalls..	10/- ,, 10/3
No. 2 Rhondda large..	11/9 ,, 12/3
Through and through	10/- ,, 11/-
Smalls..	7/- ,, 8/-
Best Small Steamer	8/6 ,, 9/-
Good Ordinaries	8/- ,, 8/3
Other Sorts	6/9 ,, 7/-
Patent Fuel (according to brand)	15/6 ,, 17/-
Coke (according to requirements)	15/6 ,, 24/-

Further tests have been made of the samples of fuel manufactured from sludge, with the object of obtaining the average from a series of tests, with the results given in Table 3.

The article recently published on "The World's Fuels" gives many interesting details in connection with the subject. Dr. Fischer estimates the coal supply of Germany at 160,000,000 tons, of Great Britain 81,500,000 tons, North and South America 684,000,000 tons, while China is estimated to have 630,000,000 tons each of anthracite and bituminous coal. With all the mineral wealth of China to develop, one is led to ponder over the thought that, when China does wake up, will the seat of civilisation be shifted East?

One is reminded, in connection with the policy of exporting coal eagerly to whoever will buy, and *apropos* of Mr. Aukland's remarks, of Æsop's fable of the cockles being roasted, "O, foolish Cockles, singing while your houses are burning!"

3.

FURTHER TESTS OF SA[illegible] PARED FROM SLUDGE (SEWAGE) MIXED [illegible] ICALS.

No. of Tests	Coal in Grammes	Oxygen Mixture Grammes	Temperature of Room	[illegible]	Difference in Temperature Fahr.	Difference of Water + 10 %	Time in Seconds Combustion	British heat Units per lb. of Coal	Evaporative power of Fuel in lbs. Water
1	2	6	60	[illegible]	6	6·6	55	6382·	6·6
2	2	10	60	[illegible]	8	8·8	40	8509·6	8·8
3	2	12	60·25	[illegible]	8·25	9·075	70	8775·5	9·075
4	1	Gas	58	[illegible]	4	(Darling'sC	alorimeter)	5890	6·09
5	1	,,	60	[illegible]	4·2	,,	,,	6372·6	6·59
6	1	,,	60·25	[illegible]	4·6	,,	,,	7081·4	7·32
7	1	,,	54·75	[illegible]	4·25	,,	,,	6270·5	6·4
8	1	,,	58·	[illegible]	4	,,	,,	5890	6·08

The figures referring to "The World's Fuels" have not been printed correctly, and should read as under:

Germany	169,000	million tons.
Great Britain	81,500	,, ,,
N. & S. America	684,000	,, ,,
China	630,000	,, ,,

PREFACE.

3, PARK PLACE,

CARDIFF.

December 17*th*, 1902.

A MEETING of the Bristol Channel Centre of the Institute of Marine Engineers was held here this evening, presided over by Mr. T. A. Reed (Member of Committee).

Mr. T. ALLAN JOHNSON, at the opening of the proceedings, said it was his melancholy duty to have to state that that morning he received a telegram announcing the death in London of Sir Edward Hill, who had done them the honour, only a few days ago, of accepting the presidency of the Centre.

Mr. W. SIMPSON, in sympathetic terms, proposed that a vote of heartfelt condolence be sent in the name of the Bristol Channel Centre to Lady Hill and the family.

The CHAIRMAN seconded, observing that they had looked forward to the presidency of Sir Edward Hill with keen anticipation. The deceased gentleman had been closely identified with the foundation and development of a great industry, in the prosperity of which the port of Cardiff was deeply concerned.

The vote of condolence was passed, all the members standing.

A paper by Mr. JAS. ADAMSON (Hon. Sec. of the Institute) was then read by Mr. E. Nicholl, Mr. Adamson being unable to attend.

GEO. SLOGGETT,

Local Hon. Secretary.

DISCUSSION

AT

3 PARK PLACE, CARDIFF,

ON

WEDNESDAY, DECEMBER 17th, 1902.

CHAIRMAN:

MR. T. A. REED (MEMBER OF COMMITTEE).

Mr. W. SIMPSON said the question of economical consumption of fuel was as important as it was a fascinating study, and much had been done in the past to devise methods of attaining this object.

Mr. R. O. SANDERSON, looking at the question from the political economy point of view, said he was in favour of as much coal being worked as possible, and he was glad to see from the local Chamber of Commerce statistics that this year's output from the port of Cardiff was going to be a record one—about twenty-one million tons. There were great virgin coalfields lying to the west of the Rhondda Valleys, specially of anthracite, and he agreed with Mr. Adamson that the coalfields of this country were good enough for another 400 years. At the same time they could not afford to overlook the great developments going on in the coalfields of other countries, and in view of probable substitutes for coal as fuel for rapid steam-raising, it behoved us to get on with our output as quickly as possible. Then the question had a most important bearing upon our import trade. If the ships had not an outgoing cargo of coal to take, what would they do? They could not all go away in ballast. The fact was, the export of coal had a considerable influence on the supply of foreign commodities so necessary to the welfare of this country. For this and the other reason he had stated, he did not agree with the author of the paper that we should conserve our coal supplies for future generations of Englishmen, who probably would not need them. He was somewhat amused with a statement made by Mr. T. F. Aukland in the discussion in London on Mr. Adamson's paper—that we should not allow any coal to be sold or used except by steamers belonging to the purely English mercantile fleet and the Royal Navy. Where would we be if other nations adopted a similar policy? How would our ships get home? Mr. Adamson had referred to water power, but it was well known that our forests had been so denuded that our streams were drying up. Mr. Adamson had overlooked the "coming to stay" of electricity, oil, and other fuels. With a general adoption of electricity as an illuminant, the use of gas, in the production of which so large a quantity of coal was necessary, would be a thing of the past. With regard to the safeguarding of our Navy, he was in favour of the Government securing its own coal area, to ensure a good supply of the best steam coal.

Mr. T. ALLAN JOHNSON thought Mr. Adamson had wandered from the engineering question to that of political economy. For his own part, he was not so much concerned with the quantity of coal we exported from our shores as for the kind of return we had for it. He knew Welsh steam coal commanded gold, but was that all we should look for? He had been impressed with a short article which had come into his hands, and which ought certainly to see publication, embodying the ideas of Mr. Cecil B. Phipson, of Moy, in County Tyrone, who had written two very interesting books on political economy, one being called *The Redemption of Labour and the Science of Civilisation*. The article in question was in advocacy of Great Britain de-monetising gold, the argument being that it is the exchange of labour products that alone benefits nations, and such exchanges are prevented to some extent as international payments as receipts of money take their place. So long as commerce between any two nations is confined to exchanges of labour products, and the money tokens of each are valueless to the other, there cannot be any competition between them, for the only competition possible is that between the merchants of each nation and amongst themselves as to which shall secure the largest imports of foreign commodities for sale to home customers against any given quantity of exports purchased from home wage-earners. Under existing conditions that country in which little money circulates and prices are low is enabled to everywhere undersell that in which much money circulates and prices are high. Wherever, then, this common international factor is introduced into the currencies of any two or more nations an enormous commercial advantage is at once created in favour of the poorest and least advanced country in respect to whatever commodities are common products of both, and such country is enabled to immensely increase its commodity-exports without being any longer under an obligation to accept commodity-imports in return. Trade under these conditions ceases to consist of exchanges of labour-products, and ceases to be either fair or free. During the twenty-five years since all round Free Trade had ceased (1874-99), despite the universal activity, the enormous increase of population, and the fact that the British Empire had extended by 4,000,000 square miles, not a single pound has been added to the totals of purely British exports, while their value per head of the population has steadily declined, so that huge as has been the increased demand for manufactures accompanying this ubiquitous development, the whole has been supplied by foreign exporters, and not one penny's worth by British. Had the conditions remained the same during 1874-99 as had prevailed in the previous thirty years, the total purely British exports would have reached the astounding sum of £1,000,000,000 a year. Such, in brief, was the thesis of Mr. Phipson, whose article he had quoted from, and which, as he had said, deserved to be printed and widely circulated.

The discussion was continued by Mr. NICHOL, Mr. W. JONES, Mr. W. THOMAS, and the CHAIRMAN, and closed with a cordial vote of thanks to Mr. Adamson and to Mr. Nichol for reading the paper.

The CHAIRMAN remarked that they were all delighted to learn that Mr. D. B. Morison had been awarded the gold medal of the North-East Coast Institute of Engineers for his admirable paper on the Status of the Naval Engineer, a paper which produced such a capital discussion at the Bristol Channel Centre, as it did elsewhere. It was gratifying to know that Mr. Morison's paper would probably result in much practical benefit to the Royal Engineer.

A vote of thanks to the Chairman concluded the proceedings.

The HON. SECRETARY: Before referring to the points raised in the discussion held by our members at Cardiff, the sad event which laid a hush upon the meeting, coming so soon after the announcement of Sir Edward Hill as the President-Elect of the Bristol Channel Centre, evokes the general sympathy of the whole membership of the Institute, and we join in the expressions conveyed to Lady Hill and the family of the deceased gentleman. The grief of our members resident on the Bristol Channel is shared by all—all being members of the same body.

The commercial supremacy of one nation over another, and the various causes tending to such a condition, is a subject which admits of much argument, and may be viewed from many standpoints. There are around us at the present moment features pointing apparently to the coming supremacy of a nation because of the superior speed of its best steamers. Controversy has been waged on the question of what is the gain to the nation at large, and what to the Company owning the steamers. Does the superior speed pay for the extra coal consumed? It is an advertisement, no doubt, and as such is of value to both the nation and the company. It may be worth while to pinch the needs of the rest of the children to feed fat the eldest. Whether steamers at the high rate of speed pay in themselves, or only as advertisement aids to the company running them, we cannot but regard with satisfaction that the spirit of emulation has been actively exercised, and we may soon see the results afloat, the enormous coal consumption notwithstanding in the proposed new Cunarders.

It is quite possible, as has been suggested by Mr. Sanderson, that future generations of the inhabitants of this country—I should not like to endorse the view that they will be Englishmen, probably a few Scotchmen may still be left—might be independent of coal as fuel, and make use of it only in the laboratory for the manufacture of diamonds, etc., or in the museum as the light of the past. We have almost a parallel case in the oaks and other trees which benevolent patriots planted as seeds in the years that have gone, in order that their successors might reap the benefit—especially for the building and upkeep of the navy, a purpose for which the necessity has gone by.

The reference to water power had direct connection with the generating of electric force with a view to dispense with steam or other medium which involves the use of fuel. There are many villages situated on river banks, where very poor coal gas is used to reveal the darkness, which could be brilliantly lighted by water power, and their factories run by means of motors. It is hard to say what the fuel of the future will be, but the claims of electricity were not overlooked, and its possible generation without the medium of a driving power, nor were oils—not less inexhaustible than coal if brought into general use—and other fuels, results of experience with which on the part of members would be welcome. Mr. Sanderson agrees so far with Mr. Aukland that a portion of the best coal area for the purpose should be set aside for the use of the national Royal Navy.

The questions dealing with the political economy side of our fuel supply were lightly touched upon with intention, as it is well that the thoughts of engineers should not be confined to the narrow groove of temporary utility; the references made by Mr. Allan Johnson are sufficiently illustrative and interesting to justify the intention. The value of our imports is so greatly in excess of that of our exports that the process of barter would be exceedingly difficult to adjust, our imports per head of population being nearly double our exports, that is to say, in monetary value, or, in other words, the comparative value of the exports and imports reduced to a common standard—gold. Interest in the pamphlets quoted by Mr. Johnson is excited by the references he has made, and the writer hopes to study them, although the views expressed are somewhat akin to those of others of the same school of thought. The exportation of coal in order to lessen the cost of importation of other necessaries does not quite appeal to the aspect of the subject on which stress was laid. The law of supply and demand regulates freights, both as to tonnage and goods, and no doubt it is more expedient to carry coal at a more or less remunerative rate than ballast at a loss, with the prospect of a homeward freight not covering expenses. The writer is indebted to those members who have taken part in the discussion, and for the suggestions made. The subject has been dealt with in several papers and articles lately, and recent events have given illustration to one or two points incidentally commented upon, including the tyranny of combines, where such are made to the exclusion of the courtesy and grace of life, and one feels inclined to echo the question propounded by Mr. Allan Johnson: Is gold all that we should look for?