PREFACE.

58 ROMFORD ROAD,

STRATFORD,

March 14th, 1904.

A MEETING of the Institute of Marine Engineers was held here this evening, presided over by Mr. T. F. AUKLAND (Companion), when a Paper by Mr. J. T. SHELTON (Member), on "Coal, from Seam to Shipment," was read by the Hon. Secretary.

It was the intention of the author to be present to read his paper and reply to the discussion, but he was prevented by intervening business, which detained him at Cardiff, to his great disappointment and that of the members assembled this evening.

JAS. ADAMSON,

Hon. Secretary.

INSTITUTE OF MARINE ENGINEERS

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President—Hon. C. A. Parsons, M.A.

Local President (B.C. Centre)—Lord Tredegar.

Volume XVI.

ONE HUNDRED AND FIFTEENTH PAPER

(OF TRANSACTIONS).

COAL, FROM SEAM TO SHIPMENT.

BY

Mr. J. T. SHELTON (Member).

READ AT 3 PARK PLACE, CARDIFF,

ON WEDNESDAY, FEBRUARY 10th, 1904.

Chairman:

Mr. GEO. SLOGGETT (Member of Committee, B.C. Centre).

AND AT 58 ROMFORD ROAD, STRATFORD,

ON MONDAY, MARCH 14th, 1904.

Chairman:

Mr. T. F. AUKLAND (Companion).

This paper refers more particularly to the South Wales large steam coals sent away as cargoes for the various depôts in different parts of the world.

The South Wales coalfield is about the second largest in Great Britain, and extends from Pontypool in the east to St. Bride's Bay in the west, and covers an area of about 900 square miles. The qualities are varied; in the east it is bituminous, in the centre semi-bituminous (and called steam coal), and further to the west it gradually passes into anthracite.

The general opinion of the value of this large steam coal is well known, and being practically smokeless is largely in demand by all the principal navies of the world and important passenger steamers.

There is less difficulty found now in burning it than on its introduction into steam vessels years ago, when experts were sent to instruct how this operation was to be carried out to obtain the best results; and the same conditions should be observed at the present time.

The examination and general inspection of coal commences at the seam and is continued until it is loaded.

At times complaints are made that it has turned out dirty, which is a term often used to indicate dust rather than impurities; but this is not meant to imply that impurities do not exist, as although the payment for getting it is for large, clean coal, by carelessness or otherwise impurities are found and have to be dealt with.

It is advisable to know which pit and seam the coal is wrought from, with the object of identifying and locating it; to occasionally visit the colliery and go below, also to examine the system of cleaning and screening.

In reference to the cleaning, impurities consist of "shaly" matter and iron "pyrites," the latter commonly called "brasses," doubtless from the yellowish appearance in some instances. This has no steaming value, and, unless by mischance, should never be sent to the surface; on handling it can always be detected by the weight, being so much heavier than coal. Some streaks of foreign matter running through the coal is referred to as "mother" coal, and is an

indication of good quality, but there are impurities similar in appearance which produce refuse. The shaly matter will burn to a certain extent and produce a high percentage of refuse, but is not so detrimental as the iron pyrites, found occasionally in large pieces.

The coal is taken from the seam and sent to the surface in colliers' trams, the large being supported by small in the centre, and it is surprising to find so much small sent up when the payment is made on the large only; it is due to this fact that shaly matter is sent up and often allowed to pass into the wagon. Each tram holds about 30 cwt. (20 per cent. of which is small and falls through the screen), and is examined so far as possible in the tram, and again as it passes over the screen on its way to the wagon, but if the coal is not properly cleaned at the seam there is not much chance of doing so effectually afterwards. Under the usual method of screening, the only cleaning that can be done is to that seen from the tops of the wagons.

At many of the collieries, travelling tables or picking bands of considerable length are fitted to convey the coal from screen to wagon, and during its passage enables men on either side a good opportunity of cleaning or removing impurities. It is a greatly improved appliance, and should be generally adopted. On arrival at the dock it is further examined in wagon and also in the hatchway of the vessel, and thus a good idea of its condition is obtained.

Formerly complaints were frequent of the weight of the cargo turning out a shortage, but wherever the discrepancy took place there are now fitted to each coal tip at the Cardiff loading ports two weighing machines, thus affording anyone an opportunity of checking the weight of both the full and empty wagon.

Prior to the more general system of re-taring the empty wagons, shipowners had to pay for the shortage of cargo at the port of discharge, but that

has been abolished, and even had it not been so, the re-taring of the empty wagons at shipment would have been a considerable advantage to him. Further than this, the coal shipped after exposure to rain increases the loss to the buyer, but that is a point that cannot be avoided, as all coal is shipped from uncovered wagons. The re-taring is an important point, and tends to keep more regularity, voyage by voyage. The weight of a wagon from a wet to a dry condition is very considerable—of course, less where iron frames and bottoms are fitted, varying several hundredweights between the painted and actual tare, however carefully attended to in the "tare" painted on the wagon.

Small coal adheres to the bottom in wet and frosty weather, and owing to the large quantities of smalls now shipped, both as cargo and bunkers, this point assumes greater importance. The severe winter weather a few years ago caused the coal to freeze so hard and compact that the use of a pickaxe was made to remove it.

In loading large coal, the angle of shoot, use of anti-breakage box, keeping shoot at lowest point, leaving some coal in shoot to act as cushion to that from the succeeding wagon, hatchway beams being removed, distance it has to be trimmed in the holds, and suitable holes which act as escapes for both men and gas and to facilitate the loading, are all important points tending to preserve coal from breakage after the particular treatment it has had at the colliery; and whatever is done, or however roughly discharged at destination, it should be the desire to preserve it as large as possible on leaving the loading port. Also, from whatever cause in the ship there is unnecessary breakage in loading and stowing, the defect applies in the same degree on discharging. The larger pieces weigh several hundredweights, and often reported to be very roughly treated on discharge, causing much breakage and small, which would be considerably lessened were a tool similar to the miner's pick used to split the large pieces, in place

of a flat-faced hammer, as generally used—for coal has a grain, and there is a right way to split it.

In loading at the ordinary tip it is at first necessary to use an anti-breakage box, which varies in size and construction, the older description being small and square, formed by iron plates, which was suitable for the earlier constructed tips and smaller hatchways of vessels, one side forming the door, opened by withdrawing a pin worked from the deck; this would hold less than one ton. The more modern kinds are larger, on the same principle, and hold about two tons; another kind, which works on the same principle as a mud grab, holds three tons, closes automatically; another, where a hinged plate fitted on the inside separately from the box, which alternately formed top, side, and bottom, holds three tons; or again, where the bottom is in halves and opens outward, holds three tons; another of larger kind, and a speciality, where the whole contents of the wagon are tipped into it, then lowered to the bottom of the hold or near to the coal and released from a conical bottom. There was yet another kind, consisting of a spiral shoot, but was found too cumbersome, and not adopted, and other appliances for assisting trimming, but these were also found impracticable.

The advantages of using the anti-breakage box at commencement of shipment and until the coal has piled up to a good height in the hatchway will be apparent when we consider the modern large vessels, some of which carry 10,000 tons, and consequently have large holds. It will be readily assumed that if from 8 to 10 per cent. of small is made on first handling, and from colliery to dock, much more would be made were these points disregarded.

The anti-breakage box, as usually fitted, and door opened by withdrawing a pin manipulated from the coaming, was more suitable for narrow hatchways, and in such it was possible to load the coal by this box until it reached a point some six to eight feet from the coaming; but with the larger ships and wider hatchways it is not nearly so efficient, and the

only way to overcome this is by carrying the releasing rope or chain round a separate pulley in the jib of crane which carries the anti-breakage box. By such an arrangement it is possible to continue boxing the coal to any height, and with a larger box loading can proceed without this causing delay. The boxing is a great saving from breakage of the coal, and should always be used on commencement of loading.

Large coal is loaded under three denominations. Firstly: colliery screened, which contains a proportion of small due to the fall into wagon at colliery and carriage to dock. Referring to fall into wagon at some of the collieries, the coal can be lowered from the shoot to the bottom of the wagon, thus saving that fall and breakage, the shoot being arranged to work lengthwise, and not over the side. Secondly: single screened, in which one screen in the coal shoot is open to allow the small to pass out. Thirdly: double screened, in which both screens are open and at times referred to as thrice screened, the colliery screening being reckoned as one.

It is sometimes stated that owing to the absence of small in screened coal, the lumps grind together and make small during the voyage, but the more coal is screened the cleaner and better it must turn out. The screen bars are spaced $\frac{1}{2}$ to $\frac{5}{8}$ of an inch.

During the operation of stowing the coal in the holds of a vessel, candles are mostly used, as much as 120 lb. being of common occurrence, which would represent five to six hundred. But accidents are very few, and gas explosions are happily not of frequent occurrence, and when such do happen it is generally due to the gas coming into contact with a fire or flame, with the necessary air admixture; indeed, we may assume that the elements for an explosion are always present at loading, as a large quantity of gas is liberated by breakage, and should not be allowed to accumulate.

Steamers are generally fitted with efficient ventilators, but cases of neglect occur in not keeping them clear, in that sacking, canvas, or other covers that have been used for the homeward cargo have not been removed before loading. This happens as well in holds where bunker coals are carried.

The central holds, being generally filled, are not so liable to explosion as the ends, where there is often a space on completion of loading for 200 to 300 tons, and may become filled with gas, more so in sailing vessels, where stowage is made midway and tapered off toward the ends, representing one large hold with ventilation imperfect, and probably a fire in use above with leakage thereto. It may be remarked that gas explosions do not generally cause damage to the coal.

Spontaneous ignition takes place at times during the voyage, but the South Wales best steams are considered not liable to such, and if fire does happen, it may be due to other causes ; although cargoes become sufficiently heated to cause alarm, a prolonged voyage in the tropics causing any increase in temperature would set up a squeezing which may go on increasing to a certain point. Loading during our hottest summer weather is quite disregarded as influencing a quicker rise in temperature, and the same would apply in loading in cold weather, that is, whichever season it may be, these coals are not so easily affected as others.

Some few months ago a sailing vessel had a prolonged voyage, leaving this side in the middle of July, 1902; she was some seven-and-a-half months on the voyage (223 days) and no trouble with her cargo of South Wales steam coal was experienced.

The rough shipment of coal causes a large mass of small to accumulate in the hatchway, and it is mostly at this point where heating has been found to commence. As referred to previously, means have been fitted to lessen the breakage, and should always be carefully carried out, as disregard is in all ways detrimental to the coal. The question of spontaneous

ignition has been so fully inquired into from time to time, one may almost assume that when loaded in a certain manner and condition such would produce a known result; but so far as I have been able to trace this is not so, and varies considerably, the greater depth of coal being an important point, however.

It is quite a common practice, particularly in sailing vessels, to fit an iron tube in each hatchway, thus providing a means for ascertaining the temperaature, at a point where heating would take place, and although a good plan, has often given cause for anxiety where none may have existed. Pieces of wipings saturated with oil accidentally fall into the coal wagons and may pass into the hold, as well as other foreign substances liable to ignition; pieces of sacking and other insulating material left over from grain and other cargoes should always be removed. Ships having carried petroleum might on the succeeding voyage carry coal—that also is a danger, more particularly in wooden sailing ships; and also a practice which should not be allowed is that of stowing casks of paraffin and oil on the coal in the hatchways. Coal for ship's use when not the same in kind as the cargo should be kept separated therefrom in sailing vessels.

Coal is shipped at times, owing to the weather, in a wet condition, and is not so liable to spontaneous ignition as when the moisture is introduced after loading. The moisture will not readily evaporate, but the effect is to set up a softening action, and in time a depreciation, often heating, and, therefore, the drier coal is the better its condition, and more reliable. Storing coal below water in tanks would be expensive; it will be preserved in better condition than if exposed to the sun and rain, but can be kept in excellent condition if properly covered in dark sheds. Depreciation will always take place by breakage into small, the lumps under most ordinary conditions and not exposed as stated will retain the calorific value a longer time.

Wet coal has a detrimental effect on ironwork, more so on that exposed to heat; although coal storage is a necessary precaution at depôts, we can with such vast carrying power convey coal more quickly now than formerly, and there is not so much necessity for large storages.

It need not be accepted that large coal loaded where there are excellent appliances should always turn out well; each cargo must stand on its own merits, greatly depending on the proper use of the appliances for loading.

One of the varying features in the burning of coal is that in different vessels different results are obtained, and may in a measure be accounted for by the degree of skill in firing it. With mechanical firing and self-cleaning bars the best results would be obtained; the burning of coal, particularly on board ship, is of great importance, and if carefully studied will result in considerable saving to owners.

The percentage of ash found by analysis is of little use in anticipating that by actual consumption, the generally increased speeds now demanded increase the refuse mainly as partially unconsumed coal, particularly the smalls. In the general arrangement of steamers most parts are taken into consideration excepting the facilities for bunkering, although perhaps not so in the most modern kind: ventilators, stanchions and other fittings, as well as beams crossing the hatches and trimming holes, causing much obstruction and detention. Too much facility cannot be given to arranging for quick bunkering, and the same also applies to stowing the holds.

At many of the Scotch and English coal loading ports weighing machines are not fitted at the tips, so colliery weights are usually taken; neither anti-breakage boxes nor other means for lessening the breakage at shipment, and although not so necessary as with Welsh coal, the use of such appliances would preserve the coal in its large size with less small;

the same kind of fittings that were used in the earlier days for smaller vessels are not suitable for the large vessels of the present.

As to the causes of so many cargoes heating in sailing vessels loaded with coal from N.S. Wales, it was found to commence in the hatchway, attributable to the mass and depth of the small caused by the rough method of loading, the hatchways of sailing vessels, excepting the main, being generally too small to allow a wagon to pass through or the use of anti-breakage appliances without retarding the loading. Coal heaps become unduly heated and occasionally fire when stored in large quantities, more particularly so when composed of small, and under certain conditions show quicker action towards heating, greatly accelerated by moisture.

DISCUSSION

AT

3 PARK PLACE, CARDIFF,

ON

WEDNESDAY, FEBRUARY 10th, 1904.

CHAIRMAN:

MR. GEORGE SLOGGETT (MEMBER OF COMMITTEE, B.C. CENTRE).

Mr. EDWARD NICHOLL would like to ask Mr. Shelton whether he had found that the Lewis Hunter crane was the best adapted crane for shipping the coal.

Mr. WILLIAM SIMPSON regretted he had come a little late, but felt from his hasty perusal of the paper that it deserved a very full discussion, as it was a subject on which every marine engineer could cite some experience. He felt that they had not only to

contend against the loading of the coal, but also the quality of coal that was being loaded.

Mr. BOWDEN (Companion) would like to know whether it was not the case that coal in stock at collieries and stations did not take fire.

Mr. COOKE (Elder, Dempster & Co.) asked whether consideration had been given to the amount of coal wasted in the dust that blew away when tipping, and the quantities that always fell into the dock.

Mr. J. G. WALLIKER asked whether it was not a fact that some means had been found to cope with the combustion which very often occasioned disastrous explosions on ships making long voyages. He had heard that there was some means by which insurance rates were reduced 50 per cent.

Mr. J. FERGUSON (Visitor) had also heard of this being an English patent, and would endeavour to provide particulars were the discussion adjourned.

The CHAIRMAN felt that careful consideration ought to be given to the taring of wagons. In regard to the heating energy of coal, he mentioned that it was common information that, supposing every 1 lb. of coal gave out 15,000 units of heat, of these not even 1,000 were utilised, the rest going up the funnel or being otherwise lost. He felt that with our modern appliances we ought to get a greater proportion returned. What we required was an internal combustion engine, as the best means of deriving all the heat benefit we could from the coal.

Mr. SHELTON, in reply to the several queries, remarked that he would prefer not to give a public opinion of the loading arrangements of any particular dock, but the cranes referred to were very suitable, particularly for large vessels.

Heating, he observed, very often took place in coal in stack, but the atmospheric conditions had a

great deal to do with it. Rain very often proved detrimental to heating, but at other times assisted, particularly in respect to the coal when oxidising. Heating would take place at a much lower temperature where "pyrites" was much in evidence, Locally, steam coal was recognised as that raised in Mid Wales. In cargoes it often happened that a piece of oily waste was inadvertantly shipped. This was a ready incentive to combustion, as it would fire at a temperature of 140°-161° F., which would easily be attained in the tropics, and more especially in large coal cargoes.

Respecting burning of coal in the boilers, this required very great attention. Fires should be kept at an incandescent heat, not red, and the best results would be obtained. He had heard of two or three different methods of fire prevention; one by placing chemicals amongst the coal, and when heating took place this fluid gave off a gas, which retarded any firing.

Mr. Shelton displayed a large number of samples of coal taken from various parts of the South Wales coal field, and pointed out the difference in these.

Mr. EDWARD NICHOLL moved, and Mr. W. SIMPSON seconded, that the discussion be adjourned till Wednesday, 17th.

DISCUSSION CONTINUED

AT

3 PARK PLACE, CARDIFF,

ON

WEDNESDAY, FEBRUARY 17th, 1904.

CHAIRMAN:

MR. T. W. WAILES (VICE-PRESIDENT, BRISTOL CHANNEL CENTRE).

Mr. E. NICHOLL: The author mentions that modern ships are efficiently ventilated, and implies that where that is the case the danger of explosion is small. Yes, we are compelled to fit plenty of

ventilators according to Board of Trade regulations, but I am by no means sure that this is the most certain method of guarding against this danger.

Could we always make sure that a current of air was kept circulating through every part of the hold, and so prevent the accumulation of gas in pockets, no doubt ventilation would be effective, but it is just the thing we cannot do. Now, what do we find in practice? In the majority of cases you will find two ventilators to each compartment, placed at the corners. To make them effective you want a clear space between the coal and the deck all through the compartment, which, as far as my experience goes, you do not find.

Now, again, it is certain that if we could cut off the supply of air to the coal there would be no combustion, and therefore no explosion. I would say, Shut up your ventilators, batten down the hatches, and all fear of explosion is gone. Rather drastic, you say. Yes, because it is opposed to present methods, but it is common sense. The only source of danger to my mind is the shaft tunnel, and this arises from the fact that tunnels are not even watertight, let alone gastight. Under the circumstances, ventilation is perhaps necessary in it.

With regard to spontaneous combustion, if the plan of shutting places where air could possibly get into the holds were adopted, the danger from this would be considerably reduced, as combustion could not continue without fresh supplies of oxygen, and I do not think the coal, whatever its condition may be when loaded, can contain sufficient to maintain combustion for long. Then suppose it did begin to burn, the carbonic acid gas given off would soon stifle it. Emphatically I say, "Hermetically seal the holds."

Now the author states that the best results from the coal would be obtained by mechanical firing and self-cleaning bars, and with this conclusion I quite agree, but I venture to say that the problem, although not difficult perhaps on shore, is a very different one

at sea. Mechanical stoking, to be successful, requires plenty of boiler power. In the majority of cases the consumption does not exceed 12 to 15 lb. of coal per sq. ft. of grate per hour, and I have often observed that when pushed for steam the fireman plies the shovel by way of assistance.

Now in marine practice I should say there are few modern steamers burning less than 20 lb. per sq. ft. of grate, and very often more, with natural draught. With forced draught the consumption is more like 30 lb. and over. Then, to use mechanical stokers would require double the boiler power that we have at present, which in itself puts the appliance out of court.

Now since this question has been raised—although perhaps I am digressing from the scope of Mr. Shelton's paper—may we not ask ourselves the question: Do we employ the best methods for utilising the heat in coal? Of course the answer anyone here this evening would give is, "No, we do not." It is a well known fact that gas engines are working at a very much less consumption of coal per horse per hour, using gas from producers such as we see in steel works for heating furnaces. That is to say, using half, if not less, the coal that we do in the best marine practice. I don't wish you to understand that I advocate gas engines for marine purposes, for the gas engine of to-day is in my opinion not suitable for the purpose; nevertheless, I think it has great possibilities, and may yet come to the front for this purpose. I believe there are several engines of 1,500 H.P. working and under construction in this country at the present moment, but as yet more seems to have been done in Germany than here.

What I would ask is: Is it possible with economy to use producer gas in the furnaces of boilers. Of course I am aware that this is a problem that would require to be very carefully gone into, and at present I have not the information to go into the matter, but I may make it the subject of a paper when I can find time. One great saving seems to me to

result, viz.: Any refuse coal may be used for producing gas, and such as could not possibly be used for steam raising in the ordinary way.

I should also like to ask you here: do you consider the large coal sent down would be entirely free from small and impurities when passed over the picking bands at the collieries, and is the system being generally adopted? I should explain that the picking band at the collieries is a revolving band like a travelling table, the screenings falling before the large coal falls on the band itself; the coal being taken over it and passing into the truck is then called picked coal.

Weights in summer and winter: does the weight vary so much in the tare? My own experience is that we carry very much more cargo under winter loading conditions, and taking an average of ten ships over a long period—boats up to a carrying capacity of 4,000 to 5,000 tons do not come up to their summer cargoes, when we take the rise between winter and summer, by an average of 40 to 50 tons, and I attribute the nearer deadweights carried in recent years, to the improved conditions of loading and re-taring. Formerly, say ten years ago, there was a very much greater difference in their cargo than now. Re-taring is only occasionally done, and when specially requested.

Is it possible to keep the weight of wagons correct? With all the appliances for lessening breakage, is there still room for improvement?

It is stated that cargo is not now weighed out. The merchant abroad has still the option of weighing out his cargo, or accepting it less 2 per cent., if receivers elect to weigh the cargo at port of destination. The weighing must be done by an official weigher at receiver's expense; the owner has the option of providing a check-weigher at his own expense, but even then, the weighing out is often against the shipowner. He formerly had to lose both freight and cargo shortage, but now he only has to lose the freight on the shortage when weighed out.

Another interesting point to anyone looking after the loading of ships would be, to know how the colliery weights of coal sent down for shipment compared with the weights given over the tip; the coal is certainly weighed at the colliery.

In conclusion, I should like to add my thanks for the very valuable information contained in the paper, and sincerely hope further interest will be given the paper by those about to follow, both with question and answer.

Mr. S. W. ALLEN, referring to the best means for shipping coal, contended that the box method was singularly the most successful, and although perhaps somewhat slow, he still felt that even the most modern appliance was a retrograde step on the box method. This means of shipment was formerly in use at Sunderland and Cardiff, where the boxes were loaded at the colliery in usual fashion, run down to the vessel's side, slung into the hold, and quietly tipped, ensuring thereby a minimum of breakage. The boxes might be worked in threes or fours, and carried on large flat trucks. Mr. Allen instanced the deleterious effect of certain coal on copper, in that it corroded through a fire box in two years; this coal had been proved by analysis to contain an excess of volatile sulphur. The anthracite coal being a slow combustion coal, and with no flame, required trained stokers to obtain the best results. The collier's "salmon," or, otherwise, brasses, Mr. Allen explained, belonged to the fossil period as formed from the trunk of a certain tree now extinct in this country, but still growing in New Zealand.

Mr. WILLIAM SIMPSON pointed out that at Liverpool recently Professor Boyd Dawkins had stated that coal ought to be left underground. He thought, however, that if they were to mine it that Britain should get the first pull, and that the Navy get preference to the mercantile marine. Unless buyers could depend to a great extent on the faithfulness of the owners of the collieries they would very often

have a coal from a totally different pit sent to them. In respect to taring of wagons, he pointed out that weighing machines were now overhauled by Government inspectors. The box method, he thought, was not faithfully treated, and much breakage could be saved if these boxes were properly handled by the tippers. Even if the cranes at present in use on the Roath Dock were properly worked a great deal of breakage would be saved. He had thought that a continuous shute might be adopted. (A member: This is in use at Glasgow.) With regard to storing coal under water, this, he thought, was much too expensive to prove its utility. Whitewash, if well applied, would serve the same purpose, i.e., excluding the air.

Mr. LE LUBEZ felt that there was still a large field open for improvement in respect to utilising in greater part the heat energy derived from coal, and this was distinctly a phase to which marine engineers ought to turn their attention.

Mr. GEORGE SLOGGETT instanced, in respect to impurities in the small coal, that the Conciliation Board had but recently stipulated that colliers would only be paid for the large coal sent to the top, hence it was apparent that colliers could not afford to take the trouble to clean the small coal.

Mr. A. E. SMITHSON spoke in regard to the large quantities of coal lost in transit from colliery to dock.

Mr. KEY described the cone arrangement which was in use in Glasgow, and which was found very saving in breakage.

Mr. SHELTON, in reply to Mr. Nicholl, said he could not agree with him that excluding air would save the situation in respect to explosion. He felt that the ventilators were the better arrangement, and to induce, if possible, a free current of air over the top of the coal in the hold. Even if air were

excluded, a certain amount of heating would take place. A method of ventilation had been suggested by placing a shaft down the centre of the hold, and from that running a platform for conducting the air, but this he did not think at all practicable, and was unsuitable. In regard to mechanical stoking, he had not gone into this point very far in regard to expense. Tare marks on wagons he thought impossible to keep correct in consideration of the climatic changes. He did not think that colliery companies would give such information as the colliery and tipping weights. He had no experience such as Mr. Allen had stated, but no doubt such might be the case. He had still a liking for the old method of shipping by the boxes, as he was sure they occasioned very much less breakage. The great demand for quick loading would not permit of this method now.

With regard to storing coal under water, he thought that if it were protected by shed or other structure from the elements an equal benefit would be derived at less cost. If coal were stacked to greater heights than 14 ft., then heating would take place more rapidly. In regard to taring wagons in this district, weights were very variable, as the small coal stuck too freely to the wagon, and was not always cleared out, showing the necessity of re-weighing the empty wagon.

In some Yorkshire collieries the impurities in coal were got rid of by washing. The cone arrangement of shipping had been tried in New South Wales. If assurance companies could be satisfied that small coal had not been shipped in any quantity with a cargo of large they would give reductions in the insurance rate—i.e., if by some arrangement there was more distribution and not such a mass of small in one particular place, as, say, in the main hatchway.

DISCUSSION

AT

58 ROMFORD ROAD, STRATFORD, E.,

ON

MONDAY, MARCH 14th, 1904.

CHAIRMAN:

MR. T. F. AUKLAND (COMPANION).

Mr. JAMES ADAMSON (Hon. Secretary): I regret, as he himself does, the unavoidable absence of the author, who had arranged to be present, with various samples of coal, but the intervention of business has prevented his intention being carried out.

The CHAIRMAN: We have now heard a very interesting paper, in which there are a great number of points which I feel sure those present can say something upon. The paper has explained some of the difficulties which arise both in getting coal from the pit and also during the shipment, and also during its voyage and discharge at destination. I am quite sure a great many of the members can give us some very valuable information on the subject.

Mr. W. LAWRIE (Member of Council) said he regretted very much that the author of the paper was not present that evening, because the members in the London district could not discuss the subject so well as those members who resided in the vicinity of Cardiff. Had Mr. Shelton been present, there were some few questions that he would have liked to put to him, as the paper lent itself for discussion more in a district such as Cardiff than in London. In the early part of the paper the author said: "It is advisable to know which pit and seam the coal is wrought from, with the object of identifying and locating it, and to occasionally visit the

colliery and go below, and also to examine the system of cleaning and screening." That was rather more than they in London were in a position to do, and on that account he was afraid that anything he had to say would scarcely be to the point. The author said that "there was less difficulty in burning it now than on its introduction into steam vessels years ago, when experts were sent to instruct how this operation was to be carried out to obtain the best results, and the same conditions should be observed at the present time." He did not suppose they were working under the same conditions now, and he took it that the author meant that the best results ought to be obtained from firing. How long was it since they sent those experts out with Welsh coal? He had had a pretty long experience with Welsh coal at the beginning of the seventies, and at that time they knew pretty well how to burn Welsh coal, but no doubt Mr. Shelton meant further back than that. Again, the author referred to the impurities that were found in the coal. He said: "Some streaks of foreign matter running through the coal is referred to as 'mother' coal, and is an indication of good quality, but there are impurities similar in appearance which produce refuse." He supposed it would take an expert to tell the difference between the impurities of "mother" coal and the impurities of the other kind of coal, which were pretty much alike. He would like to know whether, to the ordinary engineer, the difference would be distinguishable, because when the "mother" coal was present it was generally taken as evidence that there was a good quality of coal there. If they were able to distinguish that "mother" quality they would have some good idea as to whether they were getting their coal from a good seam, or part of a good seam, or not. It seemed to him that there was a certain amount of negligence in getting the coal from the pit to the surface, because in one paragraph the author told them that the miner was only paid for

the large coal, and in another paragraph he said, "It is surprising to find so much small sent up." That, he had said, was often due to shaly matter which was sent up and allowed to pass into the wagons. It seemed as if there were something wrong there. If the miner were only paid for the large coal and the small was also sent up he took it that it was the mine-owner that profited, and he, no doubt, had no very serious objection to the small coal coming to the surface. It was rather difficult to understand the position of the mine-owner. At any rate, it was quite evident that the small coal was brought up at the mine-owner's expense, and no doubt he was able to dispose of it in a legitimate way as small coal. Of course, they bought various grades of coal. He did not see any harm in the small coal coming to the surface, but the author had said "it is surprising so much of this small coal is sent up." If it were left at the bottom of the mine it would accumulate and get in the way. The author also said: "Each tram holds about 30 cwt. (20 per cent. of which is small and falls through the screen), and is examined so far as possible in the tram, and again as it passes over the screen on its way to the wagon, but if the coal is not properly cleaned at the seam there is not much chance of doing it effectually afterwards." He did not say what system was employed for cleaning it out of the seam. He rather seemed to say that if it were not done there there was not much chance of doing it afterwards. And the next few lines in his paper read: "Under the usual method of screening, the only cleaning that can be done is to that seen from the tops of the wagons." In the next paragraph the author explained that "travelling tables or picking bands of considerable length were fitted in some collieries, so that they could pick out the impurities from the coal whilst it was on its way to the wagon." It might be that that was done in some few cases, but in the majority of cases he was afraid it was not done. It had occurred

to him that there was a want of supervision. The coal got to the pit mouth and seemed to find its way to the wagon, and they knew the result—they got bad coal sometimes. Then with regard to the weights and the wagons. Of course, nearly every shipowner now-a-days guarded himself against shortage. He took care that the coal put on board was actually the amount of coal represented, and not what had stuck to the wagon. Later on in the paper the author referred to the large coal, and he told them the different processes that it went through, and in one paragraph he said: "It is sometimes stated that owing to the absence of small in screened coal the lumps grind together and make small during the voyage, but the more coal is screened the cleaner and better it must turn out." He would like Mr. Shelton to amplify that somewhat, because there were some of the Welsh coals that were so friable, and broke up so badly, that he should have thought that excessive screening would not be necessary. In fact, the quality of the coal did not go by the size of it. He had seen Welsh coal that to look at it one would imagine it would not have been of much use; in fact shipowners had complained of it being too small. The author had explained that what was meant by indifferent coal was not small coal, but impure coal. They had always called small coal or dirty coal "slack." Dirty coal was really that which contained a great amount of impurities and ash, that was what he had heard described as "dirty" coal. Then, again, he would like to know the causes of spontaneous combustion to which the author had referred. In the paragraph dealing with spontaneous combustion, the author referred to "squeezing." That, no doubt, was a technical term, and although he thought they might understand what was meant, he considered that the meaning might have been made clearer. He would like to know what were the results of "squeezing." Possibly some of the other members could help him in regard to that point. The author had cited the case of a

sailing ship, loaded with Welsh coal, which was seven-and-a-half months on passage, everything passing off satisfactorily. He supposed that was because the vessel in question was adapted for the trade in which she was running. The author, however, had not given them any idea as to how it came about, or whether there was any particular cause for it. Again, a little later on in his paper, referring to spontaneous ignition, the author said the question had been so fully considered that the results should be the same under the same conditions. One would think so, but yet he went on to say "this is not so." He would say the conditions were rather different where they had a light or deep body of coal. Those were points that did not seem quite clear to him, and he hoped that Mr. Shelton would be able to explain them. The author further said, "It need not be accepted that large coal loaded where there are excellent appliances should always turn out well; each cargo must stand on its own merits, greatly depending on the proper use of the appliances for loading." Well, it need not, but it certainly ought to be accepted, that large coal loaded under favourable conditions should turn out well. If it did not do so, and the carelessness of loading went to such an extent that they damaged the coal, it did not speak very highly for the loading port. Sufficient care, he thought, ought to be taken to see that it was properly loaded. The author also referred to the various features of burning the coal, and said that "in different vessels different results are obtained, and may in a measure be accounted for in the degree of skill in firing it." Most seams of coal had to-day a pretty well established reputation. He thought that as a rule they could make pretty certain when they stipulated for a particular quality of coal, and got it, what the result would be. He was of opinion that at the present day their engineering had been so advanced, that a chief engineer as a rule knew whether the coal was being properly fired or not, and also took care that it *was* properly fired. One would

almost think that the coal was put on board the ship and the firemen did exactly what they liked with it. That might be the custom in some ships, but it would not do in others. The coal question was rather a difficult business to tackle at any time, and in a port like London they had many difficulties to contend with. Coal merchants, apart from their business, were very nice gentlemen, but somehow or other, in the matter of dealing with coal, they had very little compunction of giving them a bad barge or two now and again, when they could get away with it. In the leading lines the matter rested very much with the chief engineer, and the chief engineer of to-day had a fairly good idea of coal, although they were not all coal experts. The chief engineers had not much control as to whether they would have one quality or another: that was decided for them, but he thought it was carefully worked out as to results. Had Mr. Shelton been with them that evening he could have made clear several points in his paper, and his guidance would have been appreciated very much by all, both superintendents and engineers on board steamers.

Mr. W. McLAREN (Convener Experimental Committee) said it was a pity the author had been prevented from being with them that evening. He would have liked to ask him what he considered as "large" steam coal, using the term as applied to bunkers. The question of the size of coal was an important one. It was rather a moot point, and they often found that 75 per cent. of their bunkers was on the "small" side. So far as his experience was concerned, he did not think there was a sea-going engineer who did not consider himself an expert in burning Welsh coal; indeed, he often thought he could teach the firemen. As sea-going engineers, it was to be regretted that they did not get what they ought to get, viz., the depth of seam from which the coal was mined, for the deeper the seam the better the class of coal. They knew that from certain

districts they got certain classes of coal, but they were never informed the depth of the seam. The Institute had been presented with a good quantity of Welsh coal for testing purposes, and he must say with pleasure that they had got the depth from which most of those samples had been mined. They had nearly forty samples of coal, and one piece weighed nearly a ton, although he was not present when that lump was brought in. Those pieces, of course, were samples: he did not say they were the ordinary class of coal that was put on board ship. With regard to quality; the author had told them of the trouble and pains that were taken with the coal from the time it came from the miners' hands, on its way to the surface, right down to the time it was put into the wagons. It was a wonder to him how they got so much sand into the coal; the impurities seemed to be increasing. It was hard to get at the cause of that. If they complained to the coal-owners and agents those gentlemen shifted the blame on to somebody else. The coal had to be turned out at great speed, and the question arose as to whether it justified the great inspection that had been referred to. They heard a great deal of the demand for coal and of their supplies running short. The demand for such an inspection would not be made, except when it was a question of price, and they certainly charged enough for it. Mr. Lawrie seemed to have covered all the points in the paper. If the miner were only paid for the large coal, then the owner or agent must get the benefit, which included the profit on all and sundry that went to the top as material coal. He would like to ask the author, By whom was the coal inspected as it went alongside the wagon-ways at the dock before it was tipped into the vessel? Then there was the question of weighing; the author had said that there were two machines. He presumed one was for weighing the loaded wagon as it was tipped into the shoot, or box, for preventing the breaking up of the coal, and the other machine was intended to revise

the tare of the wagon. The author did not say so, but presumably they could have that done. It seemed to him a very good plan, and should satisfy all parties concerned. But apart from the weighing at the tips, it had always appealed to him that it would be to the owners' interest if, instead of sending a ship out of port in a hurry, they would give the engineer time to see that he had got his proper weight of bunkers. They could always get 2,240 lb. of coal to the ton in sacks, but when purchasing in bulk they often only got 2,000 lb., and the engineer, when weighing up his coal afterwards, had that against him. The only port he knew of that had a good reputation for giving full weight was Port Said. He should think it would be a great boon to the consumers when a great deal of the small coal became frozen to the wagons, and they were taking the tare of the wagons directly it was tipped. The author had said that some of the larger pieces of coal weighed several hundredweights. He could quite believe that from the sample they had had sent to them for testing purposes. With regard to the use of candles in the hold of a ship when loading, he had been in Cardiff a few times, and also at Newport and other coal ports in the Bristol Channel, but he had never seen Welsh coal loaded, either as cargo or bunkers, without a Davy lamp being used. He had never seen or been acquainted with the use of candles. He thought there was such a scare of the gas accumulating that the emergency was provided for, although whether it was a question for the authorities to decide he could not say. Then, with reference to the statement that the centre of hold was not so liable as the ends to the accumulation of dangerous gas, that was all a question of trimming. He thought that the majority of ships being so flat-bottomed would be able to hold a good body of coal, and would not require any pyramid trimming or pyramid loading. They would be able to stow their cargo well up. He knew of a certain vessel of 1,200 tons carrying

capacity, which went into dry dock for a general overhaul. The captain of that vessel was very particular in seeing that everything was kept up to the mark, and he got rated for not carrying 30 tons more cargo; that was the result of bad trimming on previous voyages. The author had referred to liabilities to spontaneous combustion, and he had finished up by remarking that in the case of the sailing ship the cargo had been carried without any trouble arising, although the vessel was seven and a half months on the passage. With regard to the carriage of coal in sailing ships that had carried petroleum on the previous voyage, he took it that the petroleum had been carried in casks, and he did not suppose that petroleum would be a great source of danger. The question of the submerged storage of coal had also been touched upon. That was a great point at the present time. They did not seem to get a great deal of information as to what the Admiralty were doing in the matter now, but so far as he could understand they were experimenting with submerged stowage. It might be a good plan, but he was of opinion that the tipping and recovery of the coal would be very expensive. He was of opinion that small coal was the coal for mechanical stokers; large coal could not be dealt with by mechanical stokers, and they could not get a good result from it. The movement of mechanical grates kept small coal sufficiently open to allow of a plentiful supply of air, whilst large coal would get too open. There would be too much air, and they would not get the same amount of flame. Then the author said: "The percentage of ash found by analysis is of little use in anticipating that by actual consumption, the greatly increased speeds now demanded increase the refuse mainly as partially unconsumed coal, particularly the smalls." There were two results there, and it was what members had many times asked for information on at the meetings. The percentage of ash they were able to get with the calorimeter, but they had not been able to get the

analysis. It was a comparison they obtained by the calorimeter test, and the comparison would be the same in the actual consumption of the coal; because they had it from the author that experiments had been conducted on board a steamer to show the consumer how to use the coal. That would also be a comparative test, as one might be able to get a better result by shortening the grate area, by narrowing the air spaces, etc. It was open to question which was really the best test. For a practical man the coal consumption was the best, but from a scientific point of view the calorimeter test was the best that could be got for a comparison. The author had said that the greatly increased speeds now demanded increased the refuse. He did not see why it should do so unless the grate were very small and the fire was forced, or there was forced draught and the fire was not trimmed for forced draught. Large coal was not suitable for mechanical stokers. It ought to be of the nut size. It might be less in size, but should not be larger, and then, he thought, they would get the best results from any class of coal, free from sand and impurities.

Mr. J. THOM (Member) said that coal should be carefully handled from the time it was mined right up to the time it was used. It should also be burned as large as possible, and that, he thought, could be done best by hand stoking, not so well with mechanical stokers. Small coal gave the best results with mechanical stokers, the pieces being not more than approximately an inch square. The author, he thought, had all through his paper spoken a great deal about the care that should be given to the handling of the coal, and there was no doubt that since boxes had been used at the bottom of the shoot to lower the coal, whether as cargo or bunkers, into the vessel, if they landed it down at the top of the heap there would be less breakage than otherwise. He had seen coal dropped thirty or forty feet—dreadful destruction. After the first fifty

tons were loaded there was a heap to land the coal on, which considerably reduced breakage. There were some places where they had not got those boxes at the bottom of the shoots, and there were also places where they had wagons that could be lowered down into the holds of vessels. In many cases the coal was certain to be broken up. He was of opinion that there were very few steamers coaling in London in which a great deal of breakage of the coal did not take place. The coal might be brought to London in good condition. Then it was taken out of the collier and put into a barge. Certainly they did not drop it very far when putting it into the barge. Afterwards it had to be taken out of the barge and filled into baskets, or some other arrangement, and got down into the bunkers of the steamers, and he was sure it was dropped thirty or forty feet there when first starting. He thought quite as much damage was done in the vessel that used the coal as in the vessel that had carried it from the coal port. The Welsh coal was, he thought, the coal that was most affected by rough handling. It was the most tender coal that they had to deal with as regards handling, and it naturally required all the manipulations that the author spoke of in his paper. He had no doubt there were places where they did not handle it so well as at other ports. The author was very anxious to let them know that it was necessary that the coal should not be broken up any more than possible. In getting the coal out of a small seam there was more liability for foreign substances to get left amongst the coal than from a big seam, because, in comparison, there would be very much less coal to be taken out of that seam. Miners working in narrow seams were anxious to send up as much as possible, and he was sure they would always try to put as much in with the good coal as they could, whether it was good coal or not. They were paid by the number of skips they produced per day, and if the skips were filled up with small it was so much more for the miner if he "got away with it." The author had also spoken of loading in New South

Wales. In that place they had no boxes for lowering the coal down to the bottom of the hold, but in the case of large vessels having 15 or 18 ft. hatchways, the wagons were lifted bodily off the frames and were lowered down into the hold, and when near the pile at the bottom a pin was knocked out and the bottom of the wagon fell out, thus releasing the coal. Those wagons, when loaded, weighed 12 tons. Of course, in the case of a small vessel, or where they were taking in bunkers, there was no possibility of doing that—the coal fell down into the hold at once, and was more broken up than if it were lowered down into the hold in boxes, and then at the same time that that drop was taking place there was a ramming of the coal tightly together, which was no doubt the cause of combustion taking place immediately below the hatchway. The coal was trimmed away to the ends of the vessel, and with no small, there was not so much likelihood of a fire. The greater the weight of coal, the more likelihood there was of combustion taking place under the hatchways. In examining the coal when passing over the screens there were, of course, certain men, and in some places women, employed. When the coal was passing along they were supposed to pick out all shale, pyrites, slate and other foreign stuff. But they did not always see the side upwards which had this foreign stuff sticking to it, for some pieces might be good on top and bad underneath. Unless the coal was turned over it might not be seen, but if turned over they would find all the foreign commodities as it was travelling along. Speaking of coal stored in buildings, it was very necessary that those buildings should be kept dark. Sunlight would be found to deteriorate coal as much as anything. If stored out of doors it should be protected from the wet weather and variations of the atmosphere. He did not think that the big Welsh coal was as satisfactory to use with movable grates; he thought they would always get better results from hand-firing with big coal.

Mr. FRANK COOPER (Member) said he had two reasons for thinking that Mr. Shelton had not

written his paper for sea-going engineers. In the first place the sea-going engineer had little or nothing to do with the coal before shipment; and, secondly, he had little or nothing at all to do with it after shipment, except in the bunkers. He thought the author had chosen a title for his paper which they had overlooked. They would see that it was "Coal, from Seam to Shipment," that was to say, it was on the handling of the coal from the mine to the shipboard, and not after. They had been criticising the paper more on the using of coal than between the seam and shipment. In the early part of his paper the author had said that it was advisable to know which seam the coal was wrought from. That could not have been written for sea-going engineers. Then, later in his paper, he spoke more than once of spontaneous ignition, or spontaneous combustion. He thought that many years ago Professor Tyndall had declared that there was no such thing as spontaneous combustion or ignition. Nothing would catch fire unless there was a cause, and nothing would generate spontaneously. The author spoke of the storage of coal, and he had told them of a case where coal was stowed in a ship's hold for seven-and-a-half months, and had no trouble with her cargo of South Wales steam coal. That, he thought, must have been due to the fact that the air was allowed to circulate through that coal, and the coal did not ignite. He had seen in China and Japan blue flames rising from the coal in the barges before it came on board, and with such a cargo they would have to look out for actual combustion in the bunkers. He thought really that the cause of the ignition of coal in a vessel's hold was simply want of air. Every engineer knew that the first thing to do was to get the bunker lids off and get a current of air from the bunker door, and keep the coal from accumulating gas. There was one paragraph in the author's paper which had not been referred to. He stated: "Ships having carried petroleum would on succeeding voyages carry coal, that also was a danger, more particularly in wooden sail-

ing ships." He did not know why it would be a greater danger in wooden sailing ships than in any other ships. In the first part of his paper Mr. Shelton had referred to South Wales coal as being so much run after for war vessels and important passenger steamers. Some of their friends had, he thought, advocated that we should not sell our coal abroad: we ought to keep it for our own purposes. There were, however, some places where the coal was just as good as Welsh coal. He had had coal from Borneo which was equal to the very best Welsh coal. They had it once, and possibly they gave too good a report of it, for they never got it again! Also, the Japanese Navy was able to get just as high speed with Japanese as with Welsh coal. As a matter of fact, he believed the Japanese had been able to get as much as two knots more out of their torpedo-boat destroyers in Japanese waters with their own men and coal, than either Yarrow or Thornycroft were able to get out of them here. The great advantage of Welsh coal for warships was, of course, its smokeless quality.

Mr. W. BRANDER (Member), referring to the statement of the author that "the miner is only paid for the large coal," said he thought it would be a great loss to the mine-owner if all the small coal were left in the mine. He (Mr. Brander) had visited a mine in New South Wales. At that mine they tried to keep the coal as large as possible in mining it, but large and small were both sent up, and at the mouth of the pit there were two men representing the miners and the mine-owners, and those men superintended the weighing of all the coal, and the miner was paid accordingly. It was then passed on and screened. Shipowners paying for large steam coal got it, whilst others who went in for economy took the small coal, which gave very good results if they had plenty of boiler power. The coal came up very large from the mine, and anyone seeing it mined and then seeing it

put on board the ship, would not believe it was the same coal—it was so broken up by putting it on board the collier. The coal was put into wagons containing about eight to twelve tons, run down to the quay, when the coal was tipped out of the wagon and run down a shoot, falling from 20 to 30 ft. to the bottom of the hold, breaking up very badly; indeed, they would hardly believe how small it broke up. There was another point in the last part of the author's paper about burning coal with self-cleaning bars. Large coal would not do with mechanical stokers. With some kinds of coal, such as South African coal, they would get very good results with movable bars; but with Welsh coal he was of opinion that they would not get good results with movable bars unless the coal were very small.

Mr. A. H. MATHER (Hon. Financial Secretary) spoke to the question of spontaneous ignition, referring to the expression in the author's paper that "the greater depth of coal being an important point." He took it that by that expression Mr. Shelton referred to the depth of coal supposing it were stored in the open air, simply as a large heap waiting for use or shipment. He knew of one case where there was a large amount of coal stored in the open, and it was built into a heap rising to the height of 20 to 30 ft. or more. Those heaps frequently caused trouble through catching fire. Let them compare such a heap with the usual practice of railway companies. Those companies seldom stored their coal in heaps more than 7 or 8 ft. high, but they spread them out, covering a large extent of ground, and they rarely heard of a stack of railway coal catching fire spontaneously. He thought that comparison proved what the author had said on that point. The most important feature in Mr. Shelton's paper had been referred to at some length by Mr. Thom, viz., the handling of the coal, and the necessity of keeping it as large as possible. They had

heard a good deal about the appliances at Cardiff and the other Bristol Channel ports for keeping the coal as large as possible, but there still seemed to be a considerable amount of carelessness, perhaps in the previous stages before it got to the ship, as, with all those appliances, anti-breakage boxes, correct angle of shoot, etc., there was still a considerable amount of breakage. That, however, did not account for the condition of the coal they saw here in London. Mr. Thom had referred to the handling of the coal when it was being taken out of the colliers and put into barges. They might see examples of that handling every day on the Thames or in the Regent's Canal dock. The coal was taken out of the collier and dropped into barges alongside, a distance of probably 20 to 30 ft., and in that fall the coal got very badly broken. That seemed to be a feature of coaling in London, and was one reason why coal for bunkers was more knocked about in London than in any other port in the country.

Mr. K. C. BALES (Member) said he remembered reading a book some years ago on trigonometry. That book was written by one of the well-known professors for use in a certain technical college. He commenced his book by assuming that the student had a knowledge of the meaning of the various terms used in trigonometry, was acquainted with the use of logarithms, and could work out calculations by them. Mr. Shelton, in writing his paper, reminded him very much of that professor. He (Mr. Bales) had no doubt that Mr. Shelton was an expert on the subject of coal from seam to shipment, but he assumed that everybody else knew as much about the subject as he did himself. He (Mr. Bales) might be exposing his ignorance, but he did not mind doing that if he could learn anything, and he thought it was a great pity that Mr. Shelton was not with them that evening to answer the questions that they would all like to put to him, and to explain some of the points in his paper. He did not under-

stand some of the technical phrases that the author had made use of. Mr. Thom seemed to have a great deal of information on the subject. He quite agreed with Mr. Cooper that the paper, as written, was coal "from seam to shipment," and not on coal as used after it had been on board ship. So far as he understood the paper, it had been written to explain how coal was mined, how it was brought to the surface, and then loaded into ships to be brought round to various ports for use, points which they need not enter into. It would have been very useful if they could have been furnished with details as to how the coal was got out of the mines, as regards the cutting tools, how the screening operations were carried out, and so forth. They would have then have got some very useful—or at any rate interesting—information on the subject.

The CHAIRMAN: Is it your wish, in the first instance, that we have an adjourned discussion upon this subject, with the possibility of being able to get the author here, so that he may answer any question which those present may like to put to him? If that is the wish of the meeting we might endeavour to make an arrangement for March 28th, or a subsequent date.

It was decided by a show of hands that the discussion should not be adjourned, but the desire was expressed that Mr. Shelton might reply fully to the various queries.

The CHAIRMAN said that if Mr. Shelton were present on March 28th to reply, his reply might precede the paper that was to be read that evening. Whether they had an adjourned discussion or not, they would all like to hear his reply. Referring to the subject of Mr. Shelton's paper, there could be no doubt, he said, that coal for shipment ought to be well screened and as large as possible. The great danger, they had always found, was under the main hatch. He could not understand how some people

seemed to think that the danger was in the forward or after holds, where gas might accumulate in any spaces not filled with coal, by the same not being perfectly distributed by careful trimming during the process of loading. The transport of the coal to the ship should be conducted in as dry weather as possible; they should avoid the wet, and the more gently it could be put into the hold the better. Years ago they used to have an immense number of shipments of coal for the Indian railways, and those cargoes were all sent out without a single fire occurring. It was most extraordinary; the coal was shipped in all sorts of vessels and they never had a fire. The coal sent out was Birkenhead coal. A story was told to the effect that the old gentleman who had to supervise the shipment of that coal used to wipe every piece with his pocket handkerchief before it went into the hold of the ship. The fact that no fires ever broke out was, no doubt, due to the care with which it was put into the vessels' holds. He remembered a very old shipowner, named Seymour, who always asserted that coal was the best cargo that a ship could carry, because its weight was equal throughout, and it was distributed evenly through the ship. They must see, however, that it was properly trimmed, and there must be no large spaces left by means of which the coal could shift when the vessel got to sea, or otherwise she would probably get a list, or even be thrown on her beam-ends. In New South Wales they were paying special attention to the trimming of coal cargoes. They paid expert men good money to have the coals trimmed right throughout the ship, and when that was done they might depend upon it that coal was one of the best cargoes a ship could carry. He was of opinion that the less ventilation they had with coal cargoes the better. Once the coal was on board, the best plan was to batten it down. If there were opportunities during fine weather, let them take off the hatches so as to let off any surplus gas by a little surface ventilation, but directly after put on the

hatches again and keep them sealed. The chances were that if they paid a little attention to those details they would go from the port of loading to destination without anything happening of any note in the way of combustion in the cargo. Speaking further on the subject of ventilation, he said he remembered two ships loading coal in the north-east of Scotland. One of those vessels belonged to a very celebrated shipowner, and the other to a gentleman who thought he knew a great deal about the carriage of coal. The former of those gentlemen had at one time been a practical man at sea, and he had become one of the most practical men in shipowning in London. That gentleman went to the other shipowner and said, "What are you doing with this coal?" His friend replied, "I am putting in this special system of ventilation." "Well," said the first gentleman, "I am afraid you are going to burn your ship." To that the other replied, "No, no, ventilation is the great thing." Well, those two ships went to sea. The ship without any special system of ventilation arrived out, and the other, fitted with the special system of ventilation, did not. There could be no doubt that the unventilated ship arrived out safely because that old practical sailor knew a great deal more of the subject than the other shipowner did. He shut down his coal once it was on board, and may have taken the precaution of taking the hatches off in fine weather, as above suggested, and his ship arrived out without any difficulty.

The CHAIRMAN then announced that on Monday evening, March 21st, there would be a continuation of the coal testing experiments, and on the following Monday evening, if Mr. Shelton could arrange to be present, he was sure they would like to question him upon some of the points in his paper, which they had listened to with so much interest that night. On that same evening, March 28th, a paper on "The Application of Electrical Power on Cargo Steamers" would probably be read.

Mr. J. R. RUTHVEN (Member of Council) proposed a vote of thanks to Mr. Shelton for his paper. He had, he said, no doubt that the author would supplement the information he had afforded them, and answer the questions they had asked.

Mr. W. E. FARENDEN (Associate Member) seconded the proposition, which was carried unanimously.

Mr. W. MCLAREN moved, and Mr. A. H. MATHER seconded, that a hearty vote of thanks be accorded Mr. Aukland for occupying the chair that evening. It was, he said, a pleasure to see him in the chair. Had the night been somewhat younger he thought they might have pressed him for some further information on coal carrying, and if he could only arrange to be with them that day fortnight, when they expected Mr. Shelton to be present, he ventured to hope that they might be favoured with some further remarks from him.

The CHAIRMAN: I am very much obliged to you for your kindness in passing this vote of thanks. I am always pleased to do anything I possibly can, and I feel it is a privilege to be allowed to be here, for I come as a non-expert among experts. I take a great deal of interest in all these questions, and find the greatest gratification in being present to listen, so that anything I can do for the Institute I am always pleased to do.

This concluded the business of the meeting.

Mr. SHELTON'S reply: In the first place I beg to say how much disappointed I was at not being present to read this paper on March 14th, having looked forward to that occasion with the very greatest of pleasure, but in my unavoidable absence was glad to know that the paper was read by the hon. secretary and that there were various points

discussed, which Mr. Adamson has kindly forwarded to me for reply. As Mr. W. Lawrie mentioned, the members in London could not discuss the subject so well as those at Cardiff; at the same time marine engineers take great interest in the coal question, and when Welsh coal is referred to, expect it to be of good quality. I agree that it is not so practicable for buyers or those using coal far away from the collieries to visit them and find out which seams are being wrought, this object is more easily obtained by those on the spot. The "mother" in coal referred to consists of fine veins and soft, while the impurities similar in appearance are hard, and produce refuse, and could be seen on close examination.

The miner is paid for the large coal, but actually sends up a proportion of small with it, on which he is not paid. This falls through the bars during the operation of screening. The small is largely sold for bunkering, many of the cargo vessels using small entirely. Good supervision is required, as stated, from pit to wagon, to see that any impurities that have been sent up may be removed, and that all the small is screened away.

With regard to the weight of a coal cargo, shipowners can protect themselves by having a checkweigher at loading the vessel to see that all the wagons, both full and empty, are stopped on the weighing machines and the weight accurately recorded.

The causes of spontaneous combustion are varied. Coal loaded or stored to a depth of 20 ft. in a certain moist condition would become heated; such heating would continue up to firing point, and the writer's opinion is that ignition is due to small coal under pressure, also pieces of oily waste or such accidentally falling in with the coal on loading or storing.

In reply to Mr. W. McLaren, the large coal referred to is the condition in which the South Wales coals are sent off from the Bristol Channel ports, having been well screened at the colliery, conveyed to the docks in wagons, and shipped in

a careful manner. There is, doubtless, with some classes of coal a very large percentage of small by the time it is loaded into bunkers and the stokehole of the steamer at depôt, and, doubtless, our marine engineers of to-day being more used to this coal than formerly know better how to burn it. I did not touch on the different depths at which the coal is wrought, but would mention that about the greatest in the South Wales coal area is 700 yards. Although the coals at these depths may show good results by analysis, they could not always be used to satisfaction, and may be found less suitable in some cases.

Referring to the use of candles when loading a coal cargo, I may say it is general, and in only an exceptional case or two do I know of the Davy or such lamp being necessary. I recently had reported that, in loading with the lamps, gas was noticed, and care had to be taken to see that it was allowed to clear away. In this case safety lamps were in use.

Mr. Frank Cooper mentions doubtless spontaneous ignition does take place, and, as previously mentioned, may be due to other causes than the coal. A good supply of air by a system of casings and ventilators has been tried, but only proved more effectual in promoting combustion. Regarding the value of other coal than Welsh for steaming quality, there are some kinds which come near to it, but the best Welsh is, to the writer's idea, superior. It stows in less space, is practically smokeless, and has great calorific value.

Referring to Mr. W. Brander's remarks, there are also in South Wales at the pithead two men, representing the mine owner and the men, and they agree on the weights sent up by the miners; the writer's contention is that if less small were sent up with the large there would be the lessened chances of small passing into the wagons with the large. The writer agrees with Mr. Aukland that good surface ventilation is necessary where such tends to keep down the temperature and allows the gases to pass off, for if confined there is a great risk of

explosion. Holds are not always gas-tight, and there may be a leak into some part of the vessel where there is a light or fire.

It is generally accepted that spontaneous ignition is due to the heat developed by atmospheric oxidation of the organic substances of the coal. Cotton greasy with boiled linseed oil ignited in one-and-a quarter hours when kept at a temperature of 114° to 161° F.; with olive oil in five hours at same temperature. Coal air-dried is considered safe if containing not more than 3 per cent. of moisture. There have been cases of heating of waste heaps of small coal having lain for years and afterwards taking fire without any apparent cause.

I would emphasise the fact of the great difference in the weight of a coal wagon between a wet and a dry condition, and which requires great attention.

The Chairman's remarks on the old gentleman whom it was said wiped the lumps before shipment, also goes to prove that too much care cannot be taken to avoid breakage.

I apprehend that Mr. Thom would not mean that the very large pieces of coal should be put into the furnaces, and assume he considers three to four inches square about the best size for most purposes. Doubtless the Welsh coal, as supplied in London, becomes much broken up, but that could be considerably lessened by care—the comparative conditions can be seen in that sent by rail. Mr. Thom refers to the loading in New South Wales, where it was understood the wagons were lowered into the hold and discharged. There are a comparatively small number of sailing vessels where this can be done, and I have not seen one where the end hatches were large enough for this purpose.

Mr. Mather also refers to liability to spontaneous ignition, "the depth being an important point." The writer intended to refer to coal storage on land as well as to the depth in a vessel's hold. Referring to the breakage, these coals produce small every time they are handled or moved, and the greater the

care the less the breakage; and to lessen this the writer recommends a miner's pick for breaking the large.

In writing this paper I had endeavoured to put the matter as plainly as possible, for, as remarked by some of the speakers, "Coal" was certainly a subject that the marine engineer took a keen interest in, and, in reply to Mr. Bales, I did not describe the method of getting coal from the seam from start to finish, but may say that there are two or three systems as suitable to the district and conditions below as arranged by the mining engineer. When sent to the surface the coal is passed on to the screens, which vary in construction, some being at a certain fixed angle; others are balanced, and, after the collier's tram of coal is tipped into the latter, it is gradually lowered at the point, and the coal slides gently into the wagon, after which it is again raised to receive the succeeding tram of coal. The travelling table is an improved appliance, as described in this paper, in which the coal gently passes from the screen to the travelling table, is carried along and falls into the wagon. In the former it is possible for impurities to pass into the wagon, but with the latter every opportunity is obtained for detecting it.

Mr. Aukland remarks upon the generally assumed danger at the ends of a vessel. On this point the writer's contention is, that the liability to spontaneous ignition is less at the ends, but more liable to explosion.