

Mr. FLETCHER said, to insure the proper discussion of so wide a subject, it was requisite, that the branches should be considered separately. His experience, with regard to bag-ballast, was, that the bags were subject to great wear and tear, and were, consequently, better adapted for long, than for short voyages, as they would not then require to be so frequently shifted. He had experienced difficulty in the use of this ballast for flat-bottomed vessels. If the vessel happened to 'list,' during the discharge of the ballast, the bags got to the lower side, and it became difficult to empty them; Dr. White had, however, made an arrangement, by which the water could be discharged from the bags, at either side, and had thus remedied the inconvenience complained of.

Mr. R. STEPHENSON, M.P., V.P., agreed, that the subject was certainly wide, but the principal point was the question of expense. He believed the system of ballasting vessels with water, was extending very rapidly; but he did not know whether the arrangement introduced by Dr. White, would, eventually, prove the best. He had heard those who had made use of the bag-water-ballast, complain of the cost. The plan suggested and now being carried out by Mr. Scott Russell, in the large screw collier, of having compartments which might be used, either for water-ballast, or for cargo, (hold-water-ballasting), possessed some advantages; but it had the disadvantage of being liable to strain the vessel in heavy weather; this, however, might possibly be obviated to some extent, by extending the distance between the bulk-heads. There was also a question as to having a divided hold, which, for coals, was considered objectionable. He saw no difficulty in the way of ballasting vessels with water, instead of by the old-fashioned plan; but there was one question as to cost, which he did not quite understand; in making a comparison between the cost of sailing and steam vessels, why should 2s. 6d. per ton be charged for loading and unloading ballast in sailing vessels, and only three pence per ton for discharging coal from screw steamers? To put the two on a level, steam should be employed in ballasting, as well as in unloading coals.

Mr. ALLEN explained, that 2s. 6d. included the cost of the ballast, which was taken at six pence per ton, nine pence for discharging, and nine pence for loading; the other six pence per ton, was for the delay necessary for getting in the ballast. It was thus, practically, 2s. 6d. per ton for a sailing vessel, but would be more for a screw steamer, if ordinary ballast were used, because her time was more valuable. Nine pence per ton was the ordinary price of discharging coals, if done by hand, the same as for ballast; and it was only in the Tables, showing how the cost of transit might be reduced, that the advantages of using steam for the discharge of the cargo, were taken credit for; but in the comparative

expenses of working sailing and screw ships, the cost of discharging the coals, was taken at nine pence per ton, in both cases. Nothing whatever was specially charged for ballast in screw colliers, because the water was discharged without any expense. In a word, the cost of discharging the cargo had been put down at the same, both for sailing vessels and screw vessels, but the cost of discharging the ballast had been set at different amounts, because common sand-ballast was used in the former, and water in the latter. The item of discharging the cargo, had been put down at nine pence, but in using steam, there would be a saving of time and money, equal to six pence per ton, and thus, the cost of discharging by steam might be said to be only three pence per ton: but it was only in the improved system of working, that this reduction had been allowed.

Mr. CROOME said, he would confine his remarks on the statistical and commercial portion of the Paper, to the expression of a general opinion, that the results, in many instances, were so fully borne out by facts, patent to all who were commercially interested in screw colliers, that it was only fair to conclude, that the more minute details arrived at with so much evident care, were also entitled to respect.

The next subject treated of, was water-ballast, which might be divided into four kinds:—1st, water-tank-ballast; 2nd, water-bag-ballast; 3rd, midship-compartment-tanks, (which were alternately cargo spaces and water-tanks,) as fitted by Mr. J. Scott Russell; and 4th, the double water-bottom.

The Paper summarily disposed of the first as inadmissible, by reason of the cargo space abstracted from the hold; it then eulogised the water-bags, for the advantages they possessed in comparative first cost,—non-occupation of cargo space,—and the favourable comparison of the weight of the bags, with that of the water they contained; but it concluded in favour of the midship, or cargo-tank of Mr. Russell, the double water-bottom being open to the objection of increased cost, in the proportion of three to one. Now, in conjunction with his partner, Mr. Croome had been professionally concerned in the construction of thirteen, or fourteen of the screw colliers alluded to, and he had, at the same time, a knowledge of the practical working of these several systems of ballasting; he would, therefore, describe the results of his experience.

An arrangement of a double bottom with a timber ceiling, (instead of the iron deck, to which he would presently refer,) having been determined upon, in entire opposition to his views, the experiment was tried, and so far as the efficiency of the water-ballast was concerned, proved, in every case, a failure, as the timber seams could never be kept tight, for any length of time together. It then became necessary to provide a remedy for the

leakage, and a series of fore-and-aft-tanks were constructed, which were supplied and maintained by a tank in the fore-peak, and discharged by a small donkey-engine. This method of ballasting had not occasioned the slightest difficulty, and its management was so simple, that it was next to impossible, with ordinary care, that it could go wrong; moreover, so far from its having the objection that had been urged, of abstracting cargo space from the hold, there had been, in every instance, from 40 to 50 tons of disposable cargo space, with the vessel deeply laden to her fine-weather trim. It had, indeed, the advantage of rendering the ship easier, by raising the centre of gravity of the cargo.

With reference to Dr. White's water-bags, although he admitted the ingenuity of the invention, and its many possible advantages for long voyages, when it was not frequently disturbed, the result of his experience of it as screw collier ballast, when it had to be so frequently filled and emptied, and, consequently, to sustain so much wear and tear, had been anything but satisfactory. When the bags were somewhat worn, they were very liable to give way upon an emergency; and instances had been known, where, in bad weather, the working and weeping of the bags, had been watched with the most intense anxiety, by those on board, well aware that their lives were, in all probability, literally dependent upon the endurance of a thread. The bags referred to, in the 'Northumberland,' lasted about nine months.

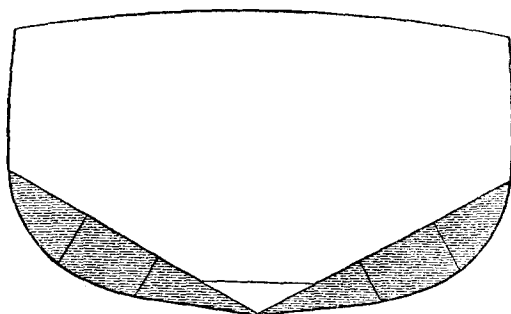
The principal objections to be urged against the large midship tanks, as fitted by Mr. Scott Russell, were, the injurious effect upon the ship, by carrying the whole weight in the centre, and the inconvenience of having three holds instead of one, which last, was a serious consideration. In loading very tender coals, these three breaks might make a difference of one shilling, or 1s. 6d. per ton; and it deprived the vessel of the many advantages of a clear and undivided hold, for all the other purposes for which a screw collier might be employed; as, for instance, the transport service, in which this advantage had been signally exemplified. Indeed, for any trade, or station, a single hold had advantages, that might make the ship available and productive, in cases where a divided hold would render it useless and unprofitable.

The double water-bottom with iron deck, or ceiling, combined, in his opinion, all the advantages of the systems previously referred to, with few, if any, of their defects. While it occupied a part of the ship not otherwise, to any extent, available for cargo, the increased depth of the floors, which it demanded, gave increased stability to the ship, when taking the ground, (which all colliers must do, more or less,) and particularly, when loading in berths, in which short vessels had been lying, and had so far imbedded themselves, that the longer vessel formed, as it were, a bridge over

the entire length occupied by the smaller one. The increased depth also admitted of a communication by man-ways, for purposes of periodical examination, cleaning, painting, and partially repairing the entire bottom of the ship: to this might be added, the comparative safety of a vessel with an inner, and a water-tight plating, under very extreme circumstances.

Mr. A. HENDERSON said, the failure of the system of a separate floor, when made of timber, could be accounted for, as when the vessel rolled, a vacuum was alternately created on each side, and the oakum was drawn through between the planks, with a force which no caulking could withstand. But it was possible to prevent this, by leaving apertures, fore and aft, so that no vacuum could be formed, and by providing a supply-tank, at the height of the load water-line. A vessel, designed by Mr. Hodgson of Liverpool, was now building, of iron plates only, without any frame, and with compartments, (as shown in Fig. 7,) along each bilge, down to the keelson, sufficiently capacious for the water-ballast. The question to be solved was, whether she would be sufficiently strong without the frame. She was constructed of stout wrought iron all round, from the head, down to the keel. The coal would lie in one clear central space, with the centre of gravity raised by the ballast arrangements, which would thus conduce to the better flotation of the vessel.

Fig. 7.



Mr. Hodgson's System of Construction.

Mr. SPENCER remarked, that it was important so to dispose the ballast in a ship, as to give her the best trim, and he could not conceive, that putting 160 tons of ballast in the bows, could be so advantageous as placing the bulk of the ballast in the centre; besides, a vessel in bad positions, would be more liable to injury, with the weight at the extremities, than if it were in the centre. He thought the plan adopted by Mr. Scott Russell, was excellent, and one by which all the objections mentioned, were removed;

inasmuch as space was obtained, available either for cargo, or ballast. As a general rule, a vessel would bear more, with the deck, or upper part, in compression, and the bottom in extension, than when it was overhung; and in that particular, he thought Mr. Scott Russell's plan had the advantage.

Mr. ALLEN explained, that his remarks in favour of hold-water-ballasting, applied only to vessels employed in the coal trade; he perfectly admitted, that it might be otherwise objectionable from cutting up the hold, and not rendering the vessel so generally serviceable. Bottom-water-ballasting was open to the objection, that vessels with shallow floors, could not take a sufficient quantity of ballast between the two bottoms. There was no doubt, that the double bottom, when made of iron, was a practicable plan, but the main objection was the first cost, which was considerable; also, it would not take a sufficient quantity of ballast, unless made deep for that express purpose, and thus necessarily occupying cargo space. He did not understand how, in that system, there could be so much spare space with a cargo of coals. It was well known, that colliers were filled up to the hatches; therefore, the space taken up by the ballast, must be in diminution of the cargo. He did not at all depreciate the value of the double bottom, but he preferred the plan of hold-water-ballast, because it allowed a full supply of water, and only required two bulk-heads, whether for 200 tons, or for 500 tons.

Mr. CROOME explained, that the flat water-tanks were not put into the bows, but were so fitted in either wing of the hold, that, when they were filled, the ship was in trim, which would not be the case, when all the weight was in the bows. The expense of constructing the double bottom had been much over-stated, for the cost had been analysed in the construction of the ships he had alluded to, and he was prepared to prove, that a double bottom, 2 feet 6 inches deep, with fore-and-aft tank, would not cost 5 per cent. in excess of any other mode of tank-ballasting. This small extra outlay insured a stronger, safer, and more weatherly ship, and a clear hold; advantages of far greater value than the slight difference in first cost.

Mr. FLETCHER, at the request of the PRESIDENT, gave details of some steamers built under the superintendence of his partner, Mr. J. F. Spencer, and himself:—the 'Arthur Gordon,' the 'Iron Age,' the 'Anne,' and the 'Auguste Louise.' All the four vessels carried bag-ballast, and the two former had water-tanks in addition; not bilge-tanks, like those spoken of in the Paper, but tanks placed completely underneath the ceiling.

The 'Arthur Gordon' had two water-ballast-tanks forward, and two aft, containing together 45 tons: the contract price at which they were taken, amounted to £8 per ton of ballast. The 'Iron Age' had six water-ballast-tanks forward, and four aft, weighing

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21 tons, which, at the contract price of £28 per ton, made £588, including all fittings and fixing. They contained 64 tons of water-ballast, which brought the cost to £9 per ton of ballast. The constant weight introduced into the ship by the tanks, was about one-third of the water contained in them: for every 100 tons gross weight, the tanks weighed 25, and the water 75 tons. The tanks were shallow, and carried up rather fine into the run of the vessel, and also into the bow, and thus were heavier and more costly, than water-ballast-tanks in general. He did not give these particulars as a partizan of the tank system, but furnished them as his actual experience of one of the methods of ballasting; and if others would lay before them the actual cost, &c., of the double-bottom, hold-ballast, and other arrangements, the Institution would then be able to judge of the comparative merits of the various plans.

The circumstances which led to the adoption of the tanks in the 'Arthur Gordon' and 'Iron Age,' were peculiar. They were designed and built exclusively for the iron ore trade, and it was at the express desire of the owner, that the tanks were introduced, because that system possessed three qualifications, which were requisite in the carriage of iron ore, viz.:—

1st. The cargo should be kept high, to make the vessel ride easily in a sea-way, with a load of such great specific gravity.

2nd. A cargo of iron ore required extra fore-and-aft keelson strength, as so much weight was, of necessity, concentrated on a small spot below the hatch, and both the vessels in question had to take the ground, when loaded. The sides of the tanks furnished the fore-and-aft keelson strength.

3rd. The register tonnage must be reduced; which was effected by ceiling the tanks, and making the engine-room unusually large.

It should be stated, that a tempting offer to charter one of these steamers for another service, had shown the inconvenience of building boats, adapted exclusively for one description of cargo: and there could not be much doubt, that the tank system would soon be superseded by the double-bottom, or hold systems.

The 'Anne'	had 60 tons of Dr. White's bag-ballast.
'Auguste Louise'	45 " "
'Arthur Gordon'	50 " " } in addition to
'Iron Age'	50 " " } the tanks.

The weight of the bags, including all fittings, did not exceed 2 cwt. per ton of ballast, so that in this particular, they had the advantage, as also in being applicable to any vessel, wood or iron, with little cost and preparation, and without destroying the hold room. For timber vessels already built, bag-ballast offered certain advantages, but it was doubtful, if it would stand the wear and tear

of short and frequent voyages, involving so much shifting, packing, and hauling about. The bags had already become leaky, in one of the vessels already referred to, but, no doubt, improvements would be made in the material of which they were made, and in the mode of general management.

Mr. CROOME replied to a question from the PRESIDENT, that he was not then prepared to state the expense of the double-bottom system, in terms corresponding with those already given. He observed, that the vessels just described were exclusively intended for the iron ore trade, whereas all the observations hitherto made, referred to screw colliers, which required an entirely different system of construction. The double bottom in the vessels alluded to, with fore-and-aft tank, must be made to hold about 180 tons of water. The excess of cost of that arrangement over the ordinary shallow floor, or such a large tank as was applied in Mr. Scott Russell's vessel, would be, as nearly as possible, 5 per cent. ; or say, in a vessel of 200 tons, £4 per ton : whereas Mr. Fletcher had estimated the cost of ballast arrangements in his vessels, at £8, and £9 per ton, which, in a vessel of 180 tons, would involve an expense of £500 for tanks. The increased weight of metal in the double-bottom plan, would be about one-fourth that of the water carried.

His previous remark, that in the midship-compartment plan, there were three breaks for the coals, had, it appeared, not been perfectly understood. In the section, (Plate 4,) there were three holds and three hatchways, into each of which there must, in loading, be a separate shoot. The first coals falling, were more broken than those that followed, and the breaking up of the lumps was a matter of considerable loss. It was, therefore, desirable to have but one hatchway and one shoot, that the coals might form an inclined plane, over which they might roll, without so much breakage as from a straight fall. Such an arrangement as three hatchways, was, therefore, to be deprecated with a tender coal.

Mr. R. W. JACKSON would not, on the present occasion, venture to enter into the question of ballasting, which he had not maturely considered, but with respect to sailing and screw colliers, he confessed he was still in favour of the former. He thought the capabilities of the screw collier, had been much overrated ; the quantities given as their capacity, would be found to have been erroneously stated, and an exaggeration of the defects of sailing colliers to have been indulged in. Ten voyages a year only, were awarded as the average of sailing colliers, but he thought, if similar advantages were given to them, as to the screw colliers, both for loading at the ports in the North, and for delivering the coals in London, the sailing vessel, instead of ten, would perform at least twelve voyages per annum, and probably fifteen. That

was the general opinion of their owners, and if such was the case, and it was taken for granted, that one screw collier cost as much as six sailing colliers, he was convinced, that by making twelve voyages per annum, they would bring more coals than the one screw collier, although carrying 600 tons, and accomplishing the maximum number of thirty voyages per annum. The sailing vessel had been tested for a great many years, and it was well known what she could do ; but it was not yet known what the screw collier would do, in a period of five years. Allusion had been made to the 'Hunwick,' of which he was the owner, and he could state from experience, that the cost of carrying the coal, was not quite correctly stated in that case ; and after a trial of four years, he considered it so disadvantageous to continue running her in the coal trade, that he had put her upon the Hamburgh mercantile trade. He felt convinced, that after a comparative test of five years, it would be found, that six sailing vessels costing £10,000, would be worth more, than the one screw collier costing the same sum. He thought, therefore, that the sailing vessel ought to receive the support which she had hitherto obtained, notwithstanding the experiments by which it was attempted to drive her completely out of the field ; while, at the same time, he admitted, that it was quite right to develop improvements, and to turn them to the best possible account.

The subject, he considered, might be divided into two sections ; nautical and commercial. With respect to the nautical part of the question, he thought that, before establishing a large fleet of screw colliers on the East coast, the harbours in the North ought to be improved, and rendered more capable of receiving such vessels. He was sure, that if screw colliers, to the number of only one-sixth of the present sailing colliers, had now to run for the harbours between the Tyne and the Tees, in gales from the North-East, the East, and the South-East, there would be far greater destruction among them, than had ever been experienced by the old sailing vessels. The harbours were not formed for receiving long ships, and in taking those bar-harbours and rivers, they would sustain more inconvenience than the sailing vessels.

With respect to the commercial part of the question, he had been connected, as owner, both with sailing and with screw colliers, and he had found, that the sailing vessel was the more profitable ; and at equal cost, and carrying equal quantities, he would assuredly give the palm to the six sailing ships, over the one screw collier.

Mr. BEARDMORE would call attention to the comparative cost of discharging, which was reckoned at nine pence for sailing, and only three pence per ton for screw vessels : this was hardly fair. In the first place, the cost of discharging the screw collier, could

not be brought down so low as three pence, inasmuch as the expense of the machinery, which could not be reckoned at less than 5 per cent., or three pence per ton, had to be taken into account, and ought to be added to the three pence, or rather $3\frac{1}{4}d.$, which was the charge in London for filling. He believed, that endeavours were being at present made, to add an engine for this purpose, to the old colliers, so that, eventually, the saving in that respect would not be greater in a sailing vessel than in a screw collier. If a donkey-engine was employed on both, they would then be placed on an equality, with regard to discharging.

An important consideration in this question was, the accommodation at both ends of the voyage;—in the North, and in London. The screw colliers were an entirely new class of vessel; they were longer than the old craft, and many of the docks would not admit them; they were most inconvenient in the Pool, and the present arrangements were not adapted for them. Another most important point had been lost sight of, in the previous remarks,—the punctuality of delivery by the screw collier. The coal trade in London, on account of the enormous consumption, laboured under this disadvantage, that when, from any cause, there was a sudden stoppage of the supply, the prices were seriously affected. That was a point of view, in which the screw collier was, to the London market, of incalculable value; and it was well known, that in the past year, during the prevalence of adverse winds, the total extinction of the gas lights of the Metropolis had only been prevented, by the punctuality and rapidity of the screw colliers. At present, there were frequently vast numbers of sailing colliers, detained in the Tyne by adverse winds, or by want of water on the bar; on a change of weather, they all got away, and a cloud of them arrived at the mouth of the Thames, up which river they had to beat for upwards of 100 miles, against a contrary wind, and on their arrival, caused a glut in the market, instead of merely supplying the regular demand; whereas the screw colliers made their passages regularly, and the only disadvantages they had to contend with, were those incidental to the navigation of long ships with deep keels, up a tortuous and crowded river.

Time was also an important element in the question of profit, when comparing the sailing and the screw vessel. It was not exactly so much a question of outlay upon the two systems, as of time; in proof of which, he would cite the difficulty of procuring screw colliers, since they had been established. They had been, for the most part, taken up by the large Gas Companies, and the great demand for the East, had also abstracted many from the trade, for which they were originally designed; the effects, consequently, on the general market had, as yet, been very little felt. But when there should be a powerful fleet of screw colliers, con-

stantly and punctually running, with commodious havens at each end, like the Victoria (London) Docks, now in course of construction; with every means for facilitating the rapid discharge of the cargoes into barges and railway trucks, to be conveyed to the various depôts; he had no doubt, that the advantages of the system would be duly appreciated. This alone could insure a constant supply of coal, at a uniform price, in the London market, and this could only be accomplished by screw colliers.

Mr. R. W. JACKSON explained, that he had intended to compare the amount of tonnage. Taking the screw collier as capable of carrying 600 tons, (which, he contended, was too much throughout the year,) and accomplishing thirty voyages per annum, it would give 18,000 tons, whereas six sailing colliers, costing the same sum as the one screw collier, would, at the Author's own figures, carry an aggregate of 20,000 tons in the year, if allowed twelve voyages; which, he believed, they were fully capable of performing. The inconvenience in the supply of coals to the London market, was, he submitted, not the question now under consideration. It was a question of cost to the owner, between the screw and the sailing vessel; not what was convenient to the consumer, in the London, or in any other market. By increasing the number of sailing vessels, the quantity of coals wanted in London, would always arrive, sooner, or later; and the advance in price did not concern the coal-owners in the North.

Mr. FOWLER, being the owner of a sailing collier, would give a few facts with respect to her working. He was afraid he might be divulging a secret of the trade, but at the risk of doing so, he would state, that the cost of his vessel was £1,000. She was the brig 'Anda,' twelve years old, and 227 tons register N. M., and had made three voyages from the Tyne and six from Hartlepool, (in all, nine voyages) to London, from 20th October 1853, to 20th October 1854, delivering, on an average, 335½ tons of coals, at 9s. 4½d. per ton, freight; grossing £1,416 3s. 1d. During the same period, the total expenditure was £1,149 13s. 1d., leaving a net profit of £266 10s., or 26½ per cent. on the original capital.

The expenditure was in the following proportions:—

	£	s.	d.	
Wages	364	0	6	or 31¾ per cent.
Stores and provisions	224	14	8	„ 19½ „
Port charges and discharging .	325	1	8	„ 28¼ „
Ballasting	67	2	0	„ 6 „
Wear and tear, (including depreciation)	66	13	0	„ 6 „
Insurance	102	1	3	„ 8½ „
	£1,149	13	1	100

If the proportions were taken on the gross receipts, they would stand as follows:—

	£	s.	d.	
Wages	364	0	6	or 25 $\frac{3}{4}$ per cent.
Stores and provisions	224	14	8	„ 15 $\frac{3}{4}$ „
Port charges and discharging	325	1	8	„ 23 „
Ballasting	67	2	0	„ 4 $\frac{3}{4}$ „
Wear and tear, (including depreciation)	66	13	0	„ 4 $\frac{3}{4}$ „
Insurance	102	1	3	„ 7 $\frac{1}{4}$ „
Profit	266	10	0	„ 18 $\frac{3}{4}$ „
	£1,416	3	1	100

Expenditure 81 $\frac{1}{4}$ per cent. on the gross receipts.

Profit . . 18 $\frac{3}{4}$ —or 26 $\frac{1}{2}$ per cent. on the original capital.

In the Table, given by the Author, the wages were put down at 32 $\frac{1}{2}$ per cent. : stores and provisions, 10 per cent., &c. : but his own costs showed some variations in these particulars. For instance :—wages, 25 $\frac{3}{4}$ per cent. instead of 32 $\frac{1}{2}$ per cent. ;—stores and provisions, 15 $\frac{3}{4}$, instead of 10 per cent., (which was probably assumed as an average, inasmuch as the cost under that head was much higher, during the last year ;)—port charges 23, instead of 17 $\frac{1}{2}$ per cent. ;—and ballasting, and wear and tear, 4 $\frac{3}{4}$ instead of 7 $\frac{1}{2}$ per cent. Then as to the most important item of profit ;—in his own case, he had made upwards of 18 per cent. upon the receipts, whilst the per-centage of profit upon the cost of the vessel, amounted to 26 $\frac{1}{2}$ per cent. He hoped this statement of profits, would not induce enthusiastic gentlemen to embark too largely as shipowners. As he had already stated, his vessel was twelve years old ; and after some little experience in the North, he should say, that for such ships, thirty years' duration was much too high an average.

Mr. HAWKSHAW would conclude from the Tables, that they were in error with regard to the depreciation of screw colliers, unless indeed, the figures were the result of facts ; but he did not think they had been running long enough, to allow of calculating this item from experience. There was danger in taking wear and tear, and depreciation, on the first cost, without reference to the duty performed. For instance, in the Paper, wear and tear was taken in all cases, in the screw colliers at 7 $\frac{1}{2}$ per cent., and in the sailing vessels, at 5 per cent. ; this was overlooking the fact, that the steamer was expected to run three times the number of miles, performed by the sailing vessel, when the wear and tear, and depreciation, would be directly in proportion to the performances of the vessels. If two locomotives of equal manu-

facture, were dealt with in the way proposed in the Paper, a great mistake would be committed. If both ran 10,000 miles in the year, then the same per-centage of depreciation would apply to each, but if one ran 30,000 miles, and the other only 10,000 miles, it was idle to take the same amount in both cases, but that, however, appeared to have been done in the Tables before them, which could not, therefore, be regarded as affording accurate data.

Mr. J. SCOTT RUSSELL doubted, whether the screw colliers had yet been employed for a sufficient length of time, to afford data, on which a decided opinion might be expressed, whether, under all circumstances, they were either more, or less profitable than sailing colliers. The evidence of one owner went to show that, in his hands, the working of a screw collier had been unprofitable; while on the other side, there were owners of screw colliers, who had employed them from their first introduction, and it might fairly be presumed, with profit. He thought, therefore, it might be taken for granted, that although their profits might not have reached the '26 per cent.' alluded to, yet that the profits were such as to induce the continuance of their use. Now in the consideration of this subject, two classes of individuals had to be considered;—those who knew thoroughly what a screw collier was, and how to order a screw collier, worthy of being so designated, and who, having a good trade, knew how to manage such a vessel;—and those who did not understand these things, and who, not having served their apprenticeship to such a trade, must expect to pay for their experience. He believed, that if the accounts of the owners of steam screw colliers, were examined, the books of the majority might, perhaps, show some loss, and those of the other portion, a very respectable profit. There were certain peculiarities which rendered screw vessels likely to be more remunerative than sailing colliers, and, on the other hand, there were circumstances under which a sailing vessel would pay as well, possibly better, than a screw collier.

A great many experiments had been made upon vessels, which had been called screw colliers, but which were not so in reality. Shipowners had looked at a vessel on the stocks, built without being intended for any particular trade, had thought that it would do for a steam collier, and had given orders for its being finished, as cheaply as possible, without regard to the special arrangements required for that trade. Many of the so-called screw colliers were built, with proportions, shapes, and arrangements intended for, and suited to some other purposes, but afterwards employed in the coal trade, under the notion, that anything was good enough for a screw collier. Again, some had been built even by the best constructors, under the impression, that a screw collier was only a kind of screw sailing vessel, and that any good screw sailing

vessel would make a good screw collier. Vessels, built for passengers, on which no expense had been spared, had been turned into screw colliers, and yet, for want of proper proportions, had turned out unfavourably. Several long, narrow, handsome vessels, with very fine ends, a great deal of form, and a small beam, which had been diverted to the purposes of carrying coal, had totally failed, being unfit for sea, when fully laden; whereas they were beautifully adapted for passengers, or a miscellaneous goods' trade. Now all this experience had cost a great deal of money, which was, perhaps, not actually thrown away, because the experience thus gained, although at large cost, had been taken advantage of as a warning. The question of profit must entirely depend upon obtaining a screw collier, purposely so designed, and fully fitted for the trade; otherwise, loss was nearly inevitable.

There was nothing which deserved to be more frequently repeated in this Institution, especially to the younger members of the profession, than that, whatever might be their preconceived notions of a new work, their first business was, not to be led away by theoretical opinions, but to set about acquainting themselves with the peculiarities of the trade, or matter, which they were called upon to undertake. He confessed, that he was entirely in ignorance of the necessary qualities of a screw collier, when he was first requested to design one. Looking at the numerous fleet of sailing colliers which covered the Thames, his only impression of a collier was, that she was about the ugliest vessel navigating the British Channel. In studying the subject, the first thing that occurred to him, was their strong resemblance to one another; they were all ugly in the same points, and presented a complete family likeness. Nor did the screw colliers, as a class, appear to much greater advantage; this induced reflection as to the cause, and, in order to judge for himself, he went down to Newcastle, and by personal examination in the yards of the oldest builders, he there found, that every point of ugliness in the screw colliers, was, in reality, a point of excellence, and that it was precisely because of those points, that they were suited to the trade. The peculiarities of a screw collier were numerous, and difficult to combine in the same ship. It was essential to expend the smallest possible capital, and yet to give the vessel, a maximum capacity for cargo;—that she should draw no more than a given quantity of water, regulated by certain tides in those harbours in the North, where the coals were loaded; whilst, at the same time, the vessel should not, when light, be too high out of the water. Then the length was generally limited, and account had to be taken of the usual qualities in a ship, of stability, stiffness, and ease in pitching and rolling. A screw collier, therefore, was anything but an easy vessel to construct. The old Sunderland colliers possessed all those qualities, and were able to stand

well up, when empty. They were able to carry their masts, yards, and rigging, and stand upright in a tolerable breeze, without any ballast on board. But there were further points to be regarded. A screw collier must be as strong as any other description of ship,—have as good machinery, and be as well put together,—have a moderate draught of water, combined with stability, not only when loaded, but when empty,—have considerable speed, without great exertion of power,—and be able to make full use of sails and screw. The practical points to be avoided, were, making such vessels very long, narrow, low, or sharp; and giving them instability when light, or rendering them sluggish when loaded. There were other points so opposed to one another, that the construction of screw colliers was altogether a difficult problem.

In building screw colliers, he had endeavoured to require as little ballast as possible, for it was so much dead load, or unprofitable cargo. But the desirability of carrying some ballast, arose from the circumstance, that vessels, sailing very light on the top of the water, although stable enough to carry masts, and to stand upright under canvas, yet owing to the small draught of water, made enormous lee-way. That was the only cause which rendered ballast necessary in a screw collier, and it must be loaded to a certain depth and have a certain hold upon the water, to prevent that action. It might be urged, why not make the colliers with a sharper bottom? But the sharpness necessary to get a hold on the water, would give so much extra draught of water, and render it impossible to get out of harbour.

He had tried all the various modes of ballasting. The first collier he had built, had no provision for ballast, and she made many voyages, without carrying any other than a small quantity of the ordinary kind, put in to make her hold the wind better; but the cost of taking it in and out was considerable; and finally, Dr. White's bag-ballast was adopted, and answered extremely well. It had, so far as he knew, but one fault, that of rapidly wearing out the bags, a point, which doubtless would receive the attention of the inventor. Some owners had, however, assured him, that it gave considerable trouble in the management.

He felt a strong aversion to a double bottom for ballast, especially in vessels of small size, and for this reason. In ships, as well as in machinery of every kind, one of the most material things to be considered, before beginning their construction, was, how the different parts could be reached for the purposes of repair, and how they could be kept from requiring it. The double bottom was not conveniently accessible, originally, for using the best workmanship during construction, and it caused great trouble when it was necessary to do any repairs.

He had also tried iron tanks in the bottom of the vessel, but to

those he had a great dislike, as they robbed the shipowner of a certain per-centage of profit, by occupying an amount of space, which he was always anxious should be filled with something more remunerative. It would pay a ship-builder better to put in the iron tanks, for they took a great deal of material, and wore out quickly. He, however, desired to construct tanks to hold remunerative cargo, and he had found, that the only way to do so, was to make them with an entrance large enough to get cargo in and out; and he further determined, that there should be no more difficulty in getting at that part of the ship, than at any other. He never placed ballast in the fore-peak of the vessel. He put the engine in the aft-peak, where the shape accommodated it very well. He then put in the boiler, and all the weight was at the aft end of the vessel. When there was no ballast in the middle, some little might be required at the fore-peak, to trim the vessel. That plan he had now abandoned, having introduced the system of ballasting in the middle of the ship; (Plate 4). In the centre of the hold, a little forward of the centre of gravity, were fixed two water-tight bulk-heads, made stronger than usual, with stays inside, and covered over with an iron deck. The water was let into this compartment by a cock, fitting in the water-tight hatchway, till it reached the external water level, and the remainder was then pumped in. The system was very simple, and had the great advantage, of putting the weight in the best place: the fore-peak was decidedly a bad place for water-ballast. It was erroneously shown in the diagram, (Plate 4). To objections against the height at which the ballast was placed, he would reply, that if a ship was built too narrow and too long, the ballast should be kept as low as possible; but if she had a proper beam, so that, when light, she would stand well up while under sail, ballast at the bottom would make her uneasy in a cross sea: and it would only be by raising the ballast, that the vessel would be rendered easy. He would observe, in conclusion, that from thinking the screw collier, one of the ugliest, he was now brought to consider it, if not one of the most beautiful class of vessels, yet one requiring consideration, care, skill and experience in constructing, beyond, perhaps, any other.

Mr. ALLEN replied, that as to the capability of sailing vessels having been under-stated, he must maintain, that ten voyages per annum was a fair average, and not twelve, or fifteen, as suggested. Twelve were, certainly, made by some small vessels, but the cost of transit would not be found to be less in that case, than in larger vessels, making only ten voyages. Fifteen voyages were made by only an exceedingly small number of vessels, out of those working between London and the North. Definite details of the working cost of the sailing vessels, would be more satisfactory than a mere

general statement, that they would be found more advantageous than screw steamers, after a test of five years.

The advantages of a small engine for discharging the cargo in sailing vessels, had not been overlooked; the comparative statements given in the Paper, set forth the saving which could be thus effected. The statements of the comparative working cost of sailing and screw vessels, were given, on the supposition, that coal-whippers were employed in discharging; and no undue reduction was, therefore, made in the case of screw colliers.

The want of success in working the 'Hunwick,' might partly have arisen from her being comparatively a small vessel, her average cargo being only about 480 tons; whereas that of most of the screw colliers, excepting the 'Lady Berriedale,' was nearly 600 tons. It was stated, that the owners of the latter vessel had, like Mr. Scott Russell, fully determined not to construct any more small vessels for steam colliers.

With respect to the objection of the assumed cost of discharging by steam, being too low, he agreed, that $3\frac{1}{2}d.$ per ton was the correct amount for filling; the other charges amounted to $1\frac{1}{2}d.$ per ton, making about five pence in all: this did not, however, include the wear and tear, and interest on the first cost of the engine; but, as before stated, discharging by steam was not reckoned in the statement of the working cost. Cargoes were often worked, by hiring hands not connected with the crew of the vessel. In addition to the saving effected by the use of steam in discharging, there was also the saving of time, which formed a material element in the question of expense: one-third of the time was practically saved, by the use of the cargo engine. A vessel of 600 tons would ordinarily be discharged by whippers in about thirty-six hours, whilst, with the cargo engine, and a few extra hands, it might be done in eighteen, or twenty-four hours. The saving effected, in discharging by steam, was stated at six pence per ton, as that would include allowance for the time gained, which appeared to be, one day per voyage. On the whole, he was inclined to think, that the advantage had been rather under, than overrated.

He could partly reconcile the apparent discrepancy in the percentages given by Mr. Fowler and himself, by the victualling having been included in the stores in the one case, and in the wages in the other. The calculations also were based on an average freight of eight shillings, instead of that obtained last year, viz., $9s. 4\frac{1}{2}d.$ The insurance had also been taken at a less percentage, in Mr. Fowler's statement, and so the profit would be increased. With respect to the port charges, he did not understand how so much difference could exist: but the whole of his percentages were roughly taken, and merely intended for a general rule of guidance.

He considered the advantage of the system of bag-ballast, had not been fully recognised, except by Mr. Russell. He could produce a great number of testimonials from the masters and owners of sailing vessels, all testifying to the advantage of the system. He would particularly allude to the case of the 'Temperance,' trading between Maryport and Belfast; the captain, who was also owner, having made three more voyages than he would otherwise have done, if ordinary ballast had been employed. This case confirmed what had been stated, as to the cost being saved in from one to one and a half year's working, irrespective of an allowance for saving of time; the cost of the bags, and the pump for discharging, originally amounted to £55, whereas the expense of ordinary ballast for the sixteen months, during which the bag-ballast had been used, would have been £66. Since then, the cost of bag-ballast had been reduced to £2 5s. per ton. No signs of wear were yet discernible in the bags, but the captain, being owner also, was of course careful that they were not ill used. He believed that, with reasonable care, the bags would last in steamers for three years, and in sailing vessels for about six years, as stated in the Paper. The only practical example of their employment in screw colliers, with which he was acquainted, was the 'Lady Berriedale,' which had had them in use for two years, and they were, certainly, in a somewhat bad condition now; but they had been manufactured according to Dr. White's first system: the present mode of making the bags, and of rendering them waterproof, was very superior.

As to the objection, that the length of the screw colliers rendered them unsuitable for the present harbours and docks, that only went to prove the necessity for more commodious docks, for so important a trade as that of the supply of coals to the Metropolis.

Mr. C. M. PALMER said, he had tried water-ballast in the 'John Bowes' screw collier, the ceiling being made of iron, but found it unserviceable, as it could not be kept tight: he replaced the iron ceiling by one of timber, but with the same result. He then tried large tanks in the sides, containing 70 or 80 tons of water, but was compelled to remove them, lest they should strain the ship. He then had recourse to bag-ballast, which he was eventually obliged to reject. For the steamers he had since built, he had adopted the plan of large flat iron tanks, running from one end of the hold to the other, with spaces underneath, so as to admit of painting and repairing, with other tanks fore and aft; and so far as his experience had gone, he had found it very efficient. He thought the plan adopted by Mr. Scott Russell, would not be found efficient, chiefly in consequence of the ship's hold being divided into three parts. Every coal-merchant must be aware, that with three breaks

in loading, and a necessity for trimming the ship three times, a great amount of breakage, and consequent loss, would be caused to the tender descriptions of household coal.

With regard to the number of voyages and the cost of working screw vessels, he could only give his experience respecting the 'John Bowes': she had been working for two, or three years, and the cost of bringing the coals to London, did not exceed four shillings per ton. He had no doubt, notwithstanding what had been stated, that, eventually, screw colliers would successfully compete with sailing vessels. It might be inconvenient to have screw colliers run to docks, where they disturbed existing arrangements; but where the loading could be expedited by hydraulic cranes, or steam power, or by double gangs of whippers, he had no doubt they must succeed, and that the greater proportion of sea-borne coals must, eventually, be brought to London in screw colliers.

Mr. CROOME wished to set himself right, with reference to the tank-ballast, of which the cost had been stated to vary between £4 and £9 per ton. He had given £4 per ton, as the cost of tank-ballast, placed in either wing of the ship. He had since estimated the cost of fitting seven vessels with these tanks, and had found, that £5 per ton was very near the amount. Upon going into the question of tank-ballast fitted to the seven vessels referred to, he found the following results:—

	Tons.	Cwt.
86 tanks, weighing	119	13
and containing water	442	14
In all	562	7

The cost of these tanks fitted on board seven ships, was £2,801 14s. 4d. For the sake of round numbers, the weight of the tanks might be taken at 120 tons, that of the water at 440 tons, and the cost at £2,800: then,

	£.	s.	d.
The cost of the tanks, fitted on board,			
would be	23	6	8 per ton.
„ of the water-ballast	6	7	3 „
„ of the tanks and water, or the			
ballast, exactly	5	0	0 „

In answer to questions, Mr. Croome stated, that £5 per ton was upon the ballast, complete, furnished with pipes, stop-cocks, connections, and fittings.

With reference to the system of ballasting proposed by Mr. Scott Russell, he perfectly concurred in the anticipation, that such a weight, so carried, would produce detrimental effects upon the

ship. A competent seaman would, certainly, not stack up his cargo in the centre of the ship, but would distribute it over the entire hold; and the same rule should be applied to the ballast. The great disadvantage attributed to the double bottom, was, that it could not be got at, to be cleaned, repaired, and painted. But, practically, a sufficient weight of water-ballast could only be obtained, by making it from 2 feet 6 inches to 3 feet deep, and it could then be provided with proper man-holes, and thus rendered perfectly accessible from one end to the other. So far, therefore, from being objectionable, it would appear to possess considerable advantages, and instead of being a burden upon the ship, this arrangement added greatly to its strength; in point then of simplicity, strength, compactness, and, as could be shown, economy, the system of the double bottom, was decidedly preferable, and produced the most serviceable vessel. He had calculated the cost of the double bottoms of the 'Black Prince' and the 'Firefly,' and found, that the extra cost for 160 tons of such water-ballast, did not exceed £300, or £320. By this system, 160 tons of ballast were provided, at a cost not exceeding bag-ballast, which, even at 45 shillings per ton, would only last about eighteen months.

Mr. BIDDER, V.P., said, he had hoped, that he should not have felt it necessary to offer any observations, knowing the considerable experience in that department of Engineering Science, of many of the previous speakers, but he confessed, that he did not think due justice had been done to the Paper under discussion. Among other points for consideration, was the very material one, —to what extent steam power could be economically substituted for the natural power of the air, in the transit of coals. The facts elicited on this point, had not been satisfactory, or conclusive. The figures, so far as they had gone, were perhaps in conformity with the facts stated; for instance, Mr. Fowler had confirmed the expenses of the sailing vessels, and Mr. Palmer had conveyed an idea of the relative expenses of the screw collier, which he had even placed at a less amount, than had been given in the Paper. But the question of the cost of conveying coals from Newcastle to London was, he thought, not the whole question, that should fairly be taken into consideration. The cheapness of an article depended not merely on the cost, but also on the quality. One very material point which had been adverted to, but had not been sufficiently discussed, was the regularity with which the supply could be maintained by screw colliers to meet the demand. Sufficient importance had not been attached to the derangements of the trade, under the system of sailing vessels. In the first place, sailing colliers were frequently prevented by foul winds, from getting out from the North ports, and when they did sail, they were often retarded from the same cause; and immense fleets of

colliers were sometimes detained at the mouth of the Thames, for many weeks, waiting for a favourable wind to bring them up the river. The market was thus glutted for a time, of which casual speculators took advantage, whilst the coal-owners and regular traders were seriously affected, and the legitimate interests of the trade suffered. But the consequences were also felt by those employed in the neighbourhood of the collieries, and on the railways connected with them: at one period, they were starving for want of employment, and at another, were taxed in strength and endurance beyond their natural powers. The application of the screw colliers could only, at present, remedy this evil to a limited extent; but if the whole of the present sailing vessels were replaced by steamers, the appliances at each end would soon be rendered more perfect, and the supply being uniform, the fluctuations in price, which had been experienced during late years, would no longer occur. As it was evident, that the mere cost of transport of coals by screw colliers, did not exceed that by sailing vessels, it seemed to him inevitable, that, before many years, the bulk of the trade must be conducted by steam.

Few practical points had been elicited in the discussion, with regard to the construction of vessels. He confessed, that he had been disappointed in his hopes of gaining practical information on this point, from those who had previously addressed the Meeting. With the appearance of sailing colliers, almost everybody was familiar. That vessels must not be built with too great a draught of water, for the ports they were intended to trade with, would be readily admitted, and, after one mistake, persons were not likely to make the experiment a second time. It was also generally admitted, that the vessels should be strong, as such vessels were the best and cheapest, and strength was, certainly, a leading element in a vessel intended for a heavy trade. It was also scarcely necessary to have been stated, that the vessels ought not to roll too much at sea, but ought to be able to stand well up under canvas; that they should not be too broad, nor too narrow, nor too long, nor too short; in fact, leading the imagination to figure to itself a form of something between a tea-chest and a coffin. Such, however, was the sum and substance of all the information to be derived, from most of the remarks on the construction of screw colliers, upon which much might have been said, with advantage.

He thought, that the application of steam power, as an auxiliary to the natural powers, had not yet been thoroughly examined, with respect to the proper power to be applied, or the speed to be maintained. All who had attempted to obtain an excessively high speed, knew that it could be done only at a vast expense of fuel, and of wear and tear of the machinery, and of the hull itself. At

the same time, there must be sufficient power to pass safely through, if not to contend with, the severity of bad weather ; and, in order to conduct the trade with regularity, there must be sufficient power to overcome ordinary contingencies. On the other hand, as against speed, must be set the interests of the owners of the vessels, and those engaged in their management. But the great point to be ascertained was, what would be the most desirable speed to be aimed at with a screw collier. An average speed of 9 or 10 knots per hour had been mentioned, but to carry coals at that speed was, he thought, absurd ; and 7 or 8 knots ought, in his opinion, to be the extreme rate of speed. It appeared to him that, after all, 5 knots, with available power to contend with adverse winds of an ordinary character, would be found the most economical speed for carrying coal.

Mr. HUMPHRYS remarked, that the proper rate of speed for a steam vessel was, at present, quite a matter of individual opinion. He thought 9 or 10 knots an hour, quite out of the question for colliers, as regarded economical considerations, or profit : a speed of 8 knots was the utmost that ought to be attempted, and that was not very expensive. In his limited experience with screw colliers, he had had more difficulties with the engine-men and captains, than with the ships themselves : pains must be taken to rear a class of men, who would take an interest in their charge.

With respect to the ballasting of colliers, he had fitted tank-ballast to three, or four vessels, and no complaints had been made against that system. It was a ready way of ballasting, both with regard to the construction of the ship, and to the operation itself. He saw much practical difficulty in rendering double-bottom-ballasting durable and water-tight, and from what he had heard concerning its employment, he thought it objectionable. His opinion was decidedly in favour of carrying the weight in the centre, which was the strongest part of the ship, rather than at each end. He had not yet had much experience in the working of these ships : they had only been at sea for six, or eight months, but, during that time, he had found nothing objectionable in them.

Mr. CROOME explained, that although the section showed a large quantity of weight at the two ends, yet, as it did not take up more than half the depth, the weight, in point of fact, was distributed all over the ship.

Mr. ALLEN gave the following particulars of the 'Northumberland,' whose average speed was about 7 knots per hour.

Length between perpendiculars	160 feet.
Beam	26 "
Depth	16 " 6 inches.

[1854-55. N.S.]

2 B

Mean draught, when loaded	.	13 feet.
" " " light	.	7 " 4 inches.
Registered tonnage	.	438 tons.
Tonnage, O. M.	.	520 "

The engines were of the kind known as 'inverted cylinder' engines. There were two cylinders of 34 inches diameter, with a stroke of 2 feet 2 inches; the average number of revolutions being 66 per minute, with a pressure of steam of 12 lbs. The screw was 9 feet 6 inches in diameter, and 15 feet 6 inches pitch.

The 'Northumberland' started on the 19th June 1853, and had made 33 voyages in 12 months, delivering 20,033 tons of coal. The direct distance run, was 22,700 miles, and analyzing the vessel's performances, it appeared, that the

	Hours.	Days.
Delays at London were	2,698, or say	112
" Sunderland	2,858	" 119
(Out of this latter, 17 days were spent at one time, in fitting the cabins and in making arrangements for the bag-ballast.)		

	Hours.	Days.
Time occupied on passage to and from London,	1,643, or say	69
" " " Sunderland,	1,560	" 65

Taking the direct distance, the above particulars gave 344 miles, for a single voyage, and the average speed at 7.08 miles per hour.

	Hours.
The shortest passage to London was	40
The longest	73
The shortest " " to Sunderland	31
The longest " " " "	104½

From the great difference between the longest and shortest voyages, he concluded, that she could not be considered over-powered, even as a collier, and he believed, that a speed of from 7 to 8 knots per hour, would be found the most advantageous.

Mr. WIMSHURST said, that colliers, by taking tank-ballast, did not lose so much stowage-room, as had been represented. This could be accounted for from the fact, that they were very seldom entirely filled. The specific gravity of water and coals being different, if a vessel was filled with coals, the deck would be nearly level with the water. Therefore, there was space to spare for tanks, and for other cargo, in addition to coals.

Mr. CRAMPTON observed that, three, or four years ago, he had the 'John Bowes' under his hands at Newcastle, and a difficulty being experienced with the long tanks, they were taken out, and

others, separate from the ship itself, were substituted. He thought, that, as at present constructed, long double bottoms were not to be depended upon.

Mr. ROBERT STEPHENSON, V.P., said, there were many present so much better acquainted with the working of screw colliers than himself, that he had not intended to offer any observations. He had hoped, that they would have afforded some definite and satisfactory information upon the subject; but Mr. Jackson had merely said, that after five years' working, he had abandoned the screw colliers, as unremunerative, whilst Mr. Palmer appeared, on the contrary, to be satisfied with the profit he had derived from them. He believed, that by means of his works at Newcastle, he was, in some measure, instrumental, in conjunction with Mr. Palmer, in first bringing into notice the system of screw colliers. The contest now going on between steam and wind, was very interesting; few positive facts had as yet been arrived at; all that could at present be done, was to collect information, for the purpose of forming a judgment hereafter, and he thought this Paper would have the tendency to elicit that information. It abounded in facts and calculations, as well as in a good deal of assumption, which, however, must, necessarily, be the case in a question of this kind.

The question of cost could hardly be settled at present, as such opposite opinions had been given on the commercial results. As far as his own knowledge went, he was inclined to Mr. Palmer's view, as he could hardly believe, that when steam power was brought into competition with manual labour, the former would not, eventually, be successful. The Author of the Paper admitted, that the accuracy of his calculations had not been tested, as to six sailing vessels being able to compete with one screw collier; the ratio of six to one was, in his opinion, over-estimated, for he thought it scarcely four to one. However that might be, the number of men required to work the sailing vessels, would have to be set against the comparatively small number required for a large screw collier. A proportionably larger capital was required in the enterprise, a larger interest would be looked for, and the wear and tear was greater; but still after all, it came to the simple question, whether steam would not, eventually, be successful against manual labour.

The question of speed must be taken into consideration. He agreed with those who preferred a slow rate of speed, but that was a question which would be settled by experience. Great speed at sea could only be obtained at a considerable expense, but he perfectly coincided in the opinion, that the regularity of supply was of as great, or even greater importance than the speed: whether coal was brought at four miles an hour, or at eight, or ten miles an hour, was almost immaterial, if means were provided, at both

ends of the voyage, for loading and discharging at a uniform rate. Now screw colliers must expend a large quantity of fuel to obtain great speed, and, in addition, there would be a great increase of the wear and tear; against which would have to be placed, the smaller amount of time for which wages would have to be paid. At double the speed, half the wages would be saved, but there might, perhaps, be a consumption of four times the fuel. Therefore, as between Newcastle and London, it was a question of fuel against wages. As between England and Bombay, where the coals would cost from £2 to £3 per ton, the case would be very different; but where the price of coal and the rate of wages remained the same, the question must be regarded in the light he had put it.

Another point for discussion was the best system of ballasting for colliers; and on this point, he was inclined to agree with those who considered, that a continuous floor, covering the water-ballast, would be the best; but in that case, the vessel, whether of timber, or of iron, must be regarded as a beam, and be so constructed. He could understand the difficulty of keeping the floor water-tight, because the beam was only as deep as the ballast, 3 or 4 feet, though in a vessel 200 feet in length; the upper part being in compression, and the lower part in tension. Therefore, until more care was devoted to the formation and staying of the deck, and to connecting it firmly with the sides and the bottom, the construction of vessels would be imperfect. It was not an uncommon occurrence to find the seams opening, and the deck even parting from the sides, when vessels got into a heavy sea; hence the cabins became uninhabitable, and this, no doubt, also occasioned the leakage of the ceiling of the double bottom. In his own yacht, in which he had lately been to the Mediterranean, the deck was very slightly built, and the sides were partially drawn away at the junction, causing great discomfort on board. A tank at the bottom, like that described, could not be kept water-tight, until the deck was made a part of the vessel itself. An iron deck, planked over, would be the most perfect, and there would be no more trouble with the ceiling for ballast. But a long beam, only 3 or 4 feet deep, was a mere ribband, in a vessel 160 or 200 feet long: the vessel worked, and sank in the middle, and it could not be expected, that with such a length, the vessel could be kept tight; but if the deck was constructed as a protection to the ceiling, and made sufficiently strong, all difficulty would be avoided.

The mode of ballasting, proposed by Mr. Scott Russell, might be said to have the disadvantage of bringing the weight in one mass a-midships, which was calculated to strain a vessel in a heavy sea. If she was always in smooth water, it would not be of much

importance, but vessels must be constructed for rough seas, and, therefore, the ballast ought not to be concentrated in one part of the ship. In a sailing vessel particularly, he was inclined to admit, that it would be an injurious plan, and he thought that, in screw colliers, it would increase the wear and tear. He believed the bottom floor of ballast was the right principle, as it then tended to ease the whole of the vessel; but, to keep it in its place, it must be protected, as he had already said, by putting a tight ceiling, or top to the beam.

Mr. ALLEN said, he thought that the alleged failure of the 'Hunwick,' as a screw collier, might have arisen from her small size; her average cargo, in 1853, being only 480 tons, whereas the average cargoes of the other screw colliers mentioned, were 600 tons. There was only one of those vessels, he believed, the 'Lady Berriedale,' that was of the same size as the 'Hunwick.' The cargoes of the 'Lady Berriedale,' in 1853, averaged only 417 tons, and in 1854, 448 tons. Those were the only two vessels that had been objected to, as not being profitable; he ought, perhaps, rather to say, that the 'Hunwick' was the only one, for no objection of that kind had been made against the 'Lady Berriedale.' It had, however, now been decided, not only by Mr. Scott Russell, but also by the owners, that they would not construct any more small screw colliers.

As to the question of speed, the smaller vessels had certainly the advantage of making nine, or ten knots an hour, but, in his opinion, such a speed was hardly desirable; he thought about 7 knots per hour, which was the average speed of the 'Northumberland,' would be found to be the most economical and the best.

In reply to an inquiry, Mr. Allen stated, that the nominal power of the "Northumberland" was 120 H. P., but that she was worked to three times that amount.

[March 6,