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Friday, June 29, 1888.

ADMIRAL SIR EDWARD G. FANSHAWE, G.C.B., Vice-President,
in the Chair.

ON FAST CRUIZERS.

By Sir EDWARD J. REED, K.C.B., F.R.S., M.P.

ON the 26th of November, 1884, I had the honour of reading a paper at this Institution, by the request of its Council, in which I gave the best answer in my power to the question put to me by the Council, viz., "What are the most urgent measures that should be taken for increasing Her Majesty's Navy?"

Although the subject for to-day's discussion is of a much more limited character, it may perhaps be well for me to mention on my way to it that there is great cause, I think, for congratulation in this Institution upon the consequences of the 1884 discussion in some important respects.

One instance may be found in the total change that has come over the administration of the Admiralty and of the dockyards in respect of the time occupied in building ships. That delays in completion due to want of guns are just as great now as ever, I am well aware, and our consequent weakness, and even danger, which would be felt in the event of war is well known to those here assembled. But as regards the quick building and completion of new ships in Her Majesty's dockyards, the evils of which I complained at length in 1884 have been terminated, and so great is the improvement effected that those two fine ironclads, the "Nile" and "Trafalgar," are to be finished in 1889 and 1890 respectively, although commenced only in 1886. I am pleased to say that this improvement has not been attended by any additional expenditure of public money; on the contrary, the Committee of the House of Commons on Navy Estimates, which is now sitting (and at which I ought to be present at this moment), has received evidence which proves conclusively that the quicker construction of our ships is attended by the economization of our money to a very large extent. It is not usual, I believe, and it is not necessary, to pay compliments at these meetings to the Executive Government; but as a political opponent of the present Government I may perhaps be permitted to say that these beneficial results are very largely due to two successive Secretaries to the Admiralty serving under Lord George Hamilton, viz., Mr. Ritchie,

who introduced some of the reforms, and Mr. Forwood, who has introduced others, and has carried them all forward with uncommon ability and perseverance. To Mr. Elgar, the new Director of Dockyards, we owe the clever carrying out with technical skill and on business principles of the measures authorized by the Admiralty, and the initiation of others for further promoting efficiency and economy.

The "Nile" and "Trafalgar" are themselves examples of another great change effected since 1884—I mean the construction of real, trustworthy, armoured line-of-battle ships fit to engage the enemy anywhere and at any time, in lieu of the ships of the "Admiral" class and some others, the chief defence of which in battle must certainly be looked for elsewhere than in the partial strip of armour amidships rising but a few inches above the smooth-water's surface which alone has been allowed them. I do not say that I consider the "Nile" and "Trafalgar" the best possible ships; far from it. I could take exception to certain of their features if the necessity arose; but this is not the occasion for doing so, nor is it, in my opinion, at all desirable to cavil at and criticize minor defects in Her Majesty's ships, provided they are in the main rightly designed. It is only when great and dangerous errors are made and persisted in that it becomes us to arouse ourselves; and thankful am I that, at length, after years of contention and complaint, a stop has been put to the building of first-class armoured ships so-called, with the armour on their sides so amazingly restricted in extent, as to leave the whole structure, and all on board it, an easy prey to a few light, quick-firing guns.

A third subject upon which we may congratulate ourselves, I think, as a result following very quickly upon our discussion of 1884, is the construction of faster ships for Her Majesty's Navy than had ever before been designed. The progress in this respect has not been nearly so satisfactory, as will presently be seen, as in respect of the other points then advocated—quick ship-building, and the designing of our new ironclads with side-armour enough to defend them properly; but there is no room to doubt that the discussion in question furnished the general basis of Lord Northbrook's additional programme, and greatly stimulated the production of fast vessels. The mode of carrying out the programme has been far from satisfactory.

My primary object in writing this paper is to put a further check upon the laying down of cruisers of insufficient speed, and to give a new stimulus to the construction of swift ones. It will help to illustrate and further these objects if we briefly review what has happened in respect of cruisers since my former paper was read here.

Dealing with armoured cruisers first, it will be remembered that my advice to the Admiralty was to build forthwith five large armour-belted cruisers of 8,000 tons, steaming 19 to 20 knots, to be "supplied with abundant fuel," and costing 500,000*l.* each fully completed. These cruisers would have had thick belts, rising 4 feet above water all along the broad central parts of the ship to within 40 or 50 feet

of the stem and stern; they would have had 15,000 ind. horse-power, and a normal coal supply of 1,000 tons, with the power to carry an extra supply of 500 tons in presence of the enemy, or of 800 tons (giving 1,800 tons in all) when proceeding abroad and not requiring to give battle. These objects could have been fulfilled with the proposed vessels of 8,000 tons normal displacement, and costing 500,000*l*.

The Board of Admiralty decided to build five fast armour-belted cruisers, as recommended, but were advised to construct them of a kind very different indeed from that just described. They fixed upon 5,000 tons displacement instead of 8,000; a comparatively thin armour-belt; a belt so shallow that its total width was only 5½ feet, of which 4 feet were to be under, and 1½ feet above water; a speed of 17 knots; an indicated engine-power of 7,500; and a coal supply of 500 tons. They were to cost (or are costing), when armed, nearly 300,000*l*. each. On the very face of these figures it was manifest that the ships thus projected never would or could fulfil the object which I had proposed, which you had ardently supported in this hall, and which they were avowedly designed to fulfil. As soon as their intended character became known to me, I wrote to the "Times," and protested against their insufficient speed. The Admiralty then announced that they should be made 17½-knot vessels. I again protested in the "Times," and a further concession was made; more powerful engines (of 8,500 indicated horse-power) were ordered for them, and a speed of 18 knots was secured, the coal supply being reduced to 440 tons. I need not trouble you with the whole story, for it is fully and most frankly recorded in the "Statement of the First Lord of the Admiralty explanatory of the Navy Estimates, 1837-88." The absurdity of giving to a fast armoured cruiser (which obviously needed a much larger supply of fuel than an ordinary armoured ship) a supply less in proportion to its indicated horse-power than had ever before been given in our Navy was apparent to the present Board, and they decided that to be of use as cruisers these vessels must be allowed to fill their bunkers (that had been made large for the purpose), and carry 900 tons of coal; and the net result of adopting so insufficient a design in the first instance was, in the language of Lord George Hamilton, this: "If the whole of the 900 tons, with the additional weights alluded to, be placed on board, instead of 440 tons, the top of the belt will be, on the ships first going to sea, 6 inches below the water." The five ships of this kind have been increased to seven in number, at an aggregate cost of over 2,000,000*l*.

FIG. 1.—Admiralty belted cruisers.

I need not ask any naval Officer, or indeed any man of common sense, whether the two millions sterling which have been expended on these vessels have been well expended. I venture to believe that in the discussion which is to follow the reading of this paper, not a single person will rise and say that the expenditure of the $2\frac{1}{2}$ millions which I proposed, upon five 8,000-ton 20-knot cruisers such as I described just now, would not have been vastly more valuable to the Navy than the expenditure which has in fact been incurred. It is true that the First Lord of the Admiralty, in the paper which I have quoted, tells us that "some persons claim" for the over-immersion of these ships "certain compensating advantages," and upon these I must briefly remark, for they are very remarkable.

The first is that there will be above the immersed armour-belt "a coal protection of $6\frac{1}{2}$ feet in height and of 11 to 17 feet in depth." But surely this is a new version of the "coal protection" doctrine. Hitherto we have been told that when armour protection could not be given to engines and boilers the protection of coal would be better than nothing, which is to a certain extent true. But this is a case in which the engines and boilers have already been protected by the armour-belt and thick deck, and that which has been left unprotected is the buoyancy, the power to float; and how on earth, or rather on sea, a ship's power to keep afloat when wounded under water, or at the water-line, is promoted by putting some hundreds of tons of coal in her, or by its being already there, is more than I can tell or can imagine. The First Lord must have taken this on trust, believing that, foolish as it seems, there must be some obscure reason for it. I must leave my hearers to judge whether the anonymous authors of this remarkable suggestion, which, as the Admiralty appear to accept and rely upon it, may lead to the sacrifice of several ships and many lives, deserve the trust reposed in them, or whether their names should not be given to the world as the authors of unheard of hydrostatic principles.

The second "compensating advantage" is that "the coal protection will not be disturbed until, by the consumption of coal in the lower bunkers, the ship had lightened, and the armour-belt had risen above

water." Reason and imagination alike fail me in attempting to put any honest meaning into these words. How can it conceivably be to the advantage of these long fine-line, not too stable, ships that the engineers shall, under all circumstances, be compelled to burn the coal out of the bunkers below before they disturb this huge mass of coal above the armour deck? The First Lord says of this coal that it runs along 140 feet of its length, for $6\frac{1}{2}$ feet in height and from 11 to 17 feet in depth, say, of an average depth (measured transversely) of 14 feet. One such block of coal would weigh over 300 tons; blocks like this along both sides of the ship, which is probably what is meant, would weigh over 600 tons. Their centre of gravity would be high up, at least $3\frac{1}{4}$ feet above the load water-line, when the belt began to emerge. Without calculating the stability of these ships, which I have not had time to do, I decline to speak positively on the point; but I put it to nautical men, who know that these ships are 300 feet long and 56 broad, with $22\frac{1}{2}$ feet draught of water, and with water-lines of almost unexampled fineness, whether it does not from the outside of the subject look as if it were rather dangerous treatment in a sea-way for such a ship, even in an uninjured condition, to insist upon the enormous top-heaviness which all this seems likely to imply. At any rate, it is contrary to all naval science and all sea experience to so build a ship as to force its Officers, as a means of securing safety in the presence of an enemy at sea, to leave several hundreds of tons of coal undisturbed high up above the water-line, and to take what they require from the lower bunkers alone. I will not put into language the humiliation which I feel, as a naval constructor, at having to witness and record such incredible things as part of the practice of the British Admiralty, and actually put forward by the highest authority, not as a matter fraught with danger, and to be deeply deplored, but as a "compensating advantage" for the loss of the above-water armour-belt.

The third "compensating advantage" which "some claim" is not the least curious of the three. It is "that a shot, which during a roll might have struck below the belt, would, in its present lower position, be deflected." This is perfectly intelligible, and stated with admirable candour. It means this: that this belt has been made so narrow that if you keep it up to its intended height above water, it may let shot and shell pass below it into the engines and boilers; and, therefore, when you have sunk the ship down until the whole of it goes under the water, so that she may be herself destroyed as easily as if she had no armour at all, then you get the compensating advantage of preserving the engines and boilers from attack below the belt!

Such as they are, the seven vessels of this class appear to be the only belted cruisers which are to be allowed to the British Navy, unless the "Impérieuse" and "Warspite," which have undergone various changes of designation, as well as of character, are again to be known as cruisers. They first appeared before Parliament as "armoured cruisers" of 7,390 tons. They then appeared as barbetto battle-ships, or something of that kind, of 8,400 tons, the increased

tonnage being obtained by the simple device of over-immersing them to the extent to which their partial armour-belt was intended to rise above water. The "*Impérieuse*" having left our shores with the top of her armour-belt just awash, she is deemed entitled to rank again with the belted vessels as a cruiser; and as an "armoured cruiser," and a "first class" one too, she, or rather her sister ship, the "*War-spire*," again appears in this year's Navy Estimates.

Finding no better results than the above ensuing from their repeated attempts to produce "belted cruisers," the Admiralty, not unnaturally perhaps, have decided to try no more, at any rate for the present, to produce anything so safe and serviceable. The 20-knot belted cruisers which I projected, and proposed to you in 1884, have not been built, and never are to be built, very fast belted ships being now deemed a luxury too great for the British Navy, and such as can only be allowed to other Powers to whom the combination of great speed and coal supply, with a fair amount of safety, is an object of more earnest pursuit than it is with us. Not a single armoured ship of any description, whether cruiser or battle-ship, has been laid down for the British Navy for more than two years past, and apparently none will ever be laid down again in this country until the public and the Naval Service take the matter into their own hands.

It is not surprising that men who consider it a compensating advantage to being certainly sunk in one way that you have not been destroyed in some other way, should get rid of armour altogether, and, having entirely abolished it, should tell you that they are building you "protected ships!" The "*Blake*" and the "*Blenheim*,"

FIG. 2.—Admiralty protected cruisers.

now to be built, are to be examples of this system; they are to be called "protected ships" precisely because, as ships, they will not possess any protection at all. Not a single inch of the surface of these two ships is to be protected even against machine-guns. What is to be protected is the space below a certain stout deck and its

contents, the said deck being itself several feet under water. The machinery and magazines will be protected against the fire of all guns of moderate power, and if the ship had been allowed the same advantage, all would have been well. But the ship itself, and its power to keep afloat, is not to be protected at all, so far as I know, certainly not by steel plating; and to my mind, at least, it is most extraordinary that men—any men, no matter who they are, or what offices they may hold—should be allowed, not only to deprive Her Majesty's ships of everything in the shape of protection, but then to parade them before us as "protected ships." Why the Navy itself does not demand the correction of this most misleading error I do not understand. Lloyd's officers have honourably refused to lend themselves to this, I see, in their invaluable "War Ships of the World." They designate this description of ship as "deck-protected cruisers," which, although not a wholly unobjectionable designation, is an honest attempt to describe them in a manner that shall not be dangerously misleading.

Before leaving this branch of my subject I should like to lay it down again clearly, that the sacrifice of side-armour protection involves nothing less than the sacrifice of the power to keep long afloat under the fire of light guns. Give a ship a belt of armour of proper length and depth, properly surmounted by a thick deck, and properly terminated, and she is perfectly safe against the fire of all guns that are unable to penetrate the armour-belt. Take away that belt, and substitute for it a low-sloping or curved protective deck, such as the "Blake" and "Blenheim" are I understand to have, and you at once offer her up as a victim to every description of shell-gun down to the smallest. It is upon the inviolability of that very triangle of buoyancy, so to speak, which you in this way sacrifice at the sides of the ship, that the stability and life of the ship depend; and to open this triangle up to the inroads of explosive shell and of the sea is to sacrifice her. I wish the Council of this Institution would take this matter up, investigate it for itself, and speak out its decision to the confusion of all who have attempted to mislead the Navy either way in this matter.

The question has been obscured by much idle writing, especially on the part of those who are either responsible for the deck-protected type in our own Navy, or who are engaged in building so-called warships for foreign navies, and who have no particular interest in the consequences, so long as they satisfy their customers. But the facts of the case are palpable, and incapable of permanent perversion. An armour-belt, of suitable depth, will keep out of the ship and away from her vital contents not only all those shells to which her armour is proof when struck square, but likewise all those still longer shells, which striking obliquely cannot penetrate it. In this way an armour-belt protects the floating power of the ship against all the quick-firing machine and other light guns at present afloat, and against many larger guns under ordinary conditions. In a ship with only a protecting deck over the machinery and magazines, on the contrary, all the shells of all these guns are received into the interior of the ship,

there to work any mischief of which by exploding they may be capable, and with the sea following in to occupy the space thus opened up to it. I say nothing of the "mélinite" shells, with which the French Navy is being supplied, and to which that truly gallant and patriotic young Officer, Lord Charles Beresford, has so persistently invited attention. I say nothing, for I feel that I need not say anything, as every Officer present must be aware that such explosive projectiles freely used would leave but little chance of existence to our armoured cruisers with their submerged belts, or to our deck-protected vessels which are in a still worse plight.

But although utterly unfit to fight a close action with a belted ship, and running many risks of destruction from raking and other fire, the "Blake" and "Blenheim," by virtue of their enormous speed, 22 knots, will be valuable additions to the Naval Service. I have not yet seen the design, but from what the First Lord of the Admiralty said of them in Parliament, they appear to resemble in a remarkable manner the vessel proposed by Sir William Pearce in 1883 or 1884, and rejected by the Admiralty Office in no very ceremonious manner. They come nearly four years after my proposal at this Institution, to build belted cruisers of 20 knots. It is, nevertheless, a satisfaction to know that at last we are to have two very fast ships, of some sort, to outstrip in speed the existing sea-going vessels of every other country. •

I now wish to invite attention to the waste of public money, as I cannot but regard it, which has taken place, is taking place, and is in contemplation in the production of ships of insufficient speed. In and since the year 1880 we have built or brought to completion, in addition to many other ships, the following of which I give the names, the years of completion, the speed, and the total cost up to the 31st March, 1887.

Names.	Year of completion.	Utmost speed in knots.	Cost roughly stated.
			£
Carysfort	1880	12·9	148,000
Champion	"	13·0	139,000
Curaçoa	"	"	150,000
Cleopatra	1881	"	140,000
Constance	1882	13·7	161,000
Conquest	"	13·0	141,000
Heroine	1883	"	96,000
Satellite	"	"	93,000
Canada	1884	"	170,000
Hyacinth	"	"	96,000
Rapid	1885	"	95,000
Calliope	1886	13·75	190,000
Cordelia	"	13·0	163,000
Caroline	"	"	106,000
Royalist	"	"	101,000
Calypso	"	13·75	209,000
Espiegle	1882	11·5	97,000
Mutine	"	12·0	95,000
Kingfisher	1884	11·6	76,000
Dolphin	1885	11·25	64,000
Mariner	"	11·5	75,000
Wanderer	"	11·25	52,000
Reindeer	"	11·5	70,000
Racer	"	"	74,000
Acorn	1887	12·25	63,000
Icarus	"	"	72,000
Swallow	"	13·5	80,000
Algerine	1881	10·5	57,000
Linnet	"	11·8	43,000
Rambler	"	10·75	60,000
Ranger	"	11·0	48,000
Swift	"	11·75	42,000
Banterer	1882	10·0	28,000
Bullfrog	"	9·8	32,000
Grappler	"	"	26,000
Wrangler	"	10·0	31,000
Espoir	1883	"	27,000
Raven	"	9·75	25,000
Starling	"	"	29,000
Stork	"	"	25,000
Cockchafer	"	9·8	31,000
Albacore	1884	10·75	36,000
Mistletoe	1885	"	36,000
Watchful	"	"	35,000
Bramble	1888	12·75	52,000
Lizard	"	"	56,000
Rattler	"	"	41,836
Wasp	"	"	39,857
		Total	3,807,293

Here we have nearly fifty vessels of war brought to completion in and since the year 1880, costing nearly 4,000,000*l.* sterling, and while not one of them attained even a measured-mile speed of 14 knots, thirty-two of them fell short of 13 knots; one-half of them fell short of 12 knots; and some of them as low as 9½ knots. Naturally enough many of them are already condemned as useless for war purposes.

My object in drawing attention to them is to show how unwise our experience shows it to be to lay down vessels of a speed which cannot be useful for war purposes should war arise. I am afraid that the very same error is about to be repeated. In the Navy Estimates for the present year provision is made for the expenditure of very considerable sums of money upon war vessels of speeds which it is already well known cannot be made available for war purposes. I take the following from the Estimates for H.M. Dockyards and Contract Work for 1888-89:—

Names.	Speed in knots.	Total cost (estimated).	Proposed expenditure for the year.
		£	£
Buzzard	14.5	63,116	(Vessel just completed.)
Daphne	"	63,082	17,155
Nymph	"	63,123	17,154
Beagle	"	61,000	Not given.
Basilisk	"	61,000	"
Melita	12.5	61,619	23,233
Pheasant	13.25	40,951	15,260
Partridge	"	40,934	16,629
Peacock	"	40,755	12,155
Plover	"	40,712	15,205
Pigeon	"	40,712	13,895
Pigmy	"	40,712	17,453
Magpie	13	41,839	25,311
Redbreast	"	41,839	23,244
Redpole	"	41,839	23,014
Widgeon	"	41,000	23,656
Lapwing	"	41,000	30,024
Ringdove	"	41,000	30,024
Goldfinch	"	41,000	27,687
Sparrow	"	41,000	29,507
Thrush	"	41,000	28,507
Total	..	1,001,295	388,146

Now I will not deny that there may be something to be said on behalf of some of these vessels, for something might be found to be said on behalf of almost any conceivable kind of vessel in a Service so vast and complicated as the Naval Service at present is. But I wish to take the sense of naval Officers on the question, and to ask them whether, looking to the utter disproportion of our fast cruisers to the services which will be required of them in war, it is or is not wise to

go on lavishing money in this way upon vessels not a single one of which reaches a 15-knot speed, and most of which are to be of only about 13 knots at their very best, which means only about 10 knots in regular sea service?

The problem of defending the mercantile marine of this country in war time—and the defence of that marine is for us a problem so vital that the matters upon which Parliament is expending its time and energy are, by comparison with it, trifles light as air—is one which, in my opinion has not yet been mastered, and indeed cannot have been mastered, for the simple reason that the many able and energetic men who have applied themselves to it voluntarily have had to do so with but an imperfect knowledge of official facts, while the official authorities have not even commenced, so far as we know, to organize a policy or a scheme for dealing completely with it.

One of the very first questions which has to be dealt with is, what is to become in war time of the vast number of sailing vessels and slow steamers which form so large a proportion of British merchant tonnage. The tables of Lloyd's Register Office furnish us with the following figures relating to the mercantile marines of Great Britain, France, Germany, Italy, and Russia:—

Nationality.	Total No. of steam and sailing vessels.	Total tonnage of steam and sailing vessels ("sailing" net, "steam" gross).
British—		
United Kingdom.....	9,091	9,127,454
Colonies	3,138	1,434,141
Total.....	12,229	10,561,595
French	1,479	995,918
German	2,056	1,387,365
Italian	1,700	895,459
Russian	1,228	430,300

I have placed these figures together to facilitate other objects than that immediately present to our view. But here we see that we possess, and have to give account in war time, in some fashion or another, of more than 12,000 steam and sailing vessels, but extremely few of which, even among the steamers, possess anything approaching to high speed. Of mercantile and passenger vessels of 19 knots speed and upwards we possess but four, viz., the "Etruria" and "Umbria," and the two Channel steamers "Victoria" and "Empress." Above 17 knots and below 18 we have five only, and these are all small, belonging to the South Eastern Railway Company and to the London, Brighton,

and South Coast Railway Company. Of vessels below 17 knots and above 16 knots we have 12, chiefly belonging to the P. and O., the Cunard, and the Orient Companies. Of 16-knot vessels we have 11, of 15½-knot 4, of 15-knot 23, of 14½-knot 20, of 14-knot 39, of 13½-knot 25, of 13-knot 46, and of 12½-knot 30. If, therefore, we strike off from the total number of ships, viz., 12,229, these 219 steamers over 12 knots in speed, we shall still leave more than 12,000 vessels of which a few, the fastest, steam only at 12 knots. Of these 12,000 vessels, 6,514 are sailing ships, of an aggregate tonnage of 3,698,000 tons; and the remaining portion, of about 6½ millions of tons, consists of steamers of 12 knots or less, the great bulk of them probably averaging 8 to 9 knots at sea. Taking again Lloyd's figures, our British merchant shipping is in itself worth about 93,000,000*l.*, and it imports property worth 349,000,000*l.*, and exports property worth 269,000,000*l.* every year.

In view of these mighty interests, and of the fact that at present 140,000,000*l.* worth of our imports are food, it is incumbent upon all of us to do the best we can to face and to assist in solving the problem of its protection. One effectual way of doing this will be to get all the money allowed by the country and Parliament for the purpose spent upon efficient ships. We have seen how money has been recently spent upon ships which do not fulfil the country's needs. Let us collect a few ill-spent amounts, including some now contemplated:—

	£
Expended on slow unarmoured vessels brought to completion between 1880 and 1888, as set forth previously in this paper	3,806,693
Proposed cost of comparatively slow ships now under construction or about to be built	1,001,295
Cost of "Impérieuse" and "Warspite," whose armour is now under water at load draught (including establishment charges) taken from Navy Estimates 1888-89	1,269,000
Cost of seven belted cruisers in similar plight	2,000,000
	<hr/>
	8,076,988

This sum would have secured to the country no less than 16 20-knot ships efficiently armour-belted, with very large coal supply (all as previously described), and I venture to say that whatever may be the opinions of those present on minor subjects, there are extremely few in this room who will not at once acknowledge that, could we at this moment exchange the motley lot of craft previously

¹ I take these figures from Lloyd's Register Office List, given in their "War Ships of the World" already quoted. They are not apparently as complete as they might be. For example, although most of what are known as our Channel steamers are given, together with the "Lily," "Anglesea," and "Shamrock" of the London and North Western Railway Company, the "Ireland" and other steamers of the City of Dublin Steam Packet Company do not appear to be included.—E. J. R.

enumerated for 16 ships of 8,000 tons each, such as I proposed to you in 1884, we should now be able, not indeed to rest upon our oars, or to cease to develop the war cruiser class, but to feel that we had made such a beginning as was in itself worthy of the Navy, and was such as might fairly be expected to stimulate the naval pride and ardour of the country.

But the pressing matter is to see if anything can be done in the way of advising or urging the abandonment of the slow vessels now commenced, or about to be commenced, in H.M.'s Dockyards. Some of them certainly could be stopped if desired, for in the Navy Estimates of the present year they are set down as not yet ordered, and the estimates of their cost had not even been made. These were as follow :—

Name.	Tonnage displacement.	Speed in knots.
	tons.	
Beagle.....	1,170	14.5
Basilisk	"	"
Widgeon	805	13 "
Goldfinch	"	"
Sparrow	"	"
Thrush	"	"

I know not how the matter may shape itself to the minds of those who are here, but to my mind it seems a deplorable thing to go on spending public money on craft like these, when we know that our deficiencies in respect of fast cruisers are deplorable when viewed in relation to the work to be done.

In the "Daily News" of Tuesday last is reported a conversation which appears to have been recently held in Colombo with Rear-Admiral the Hon. E. R. Fremantle, C.B., the Commander-in-Chief on the East Indian Station. He is represented as having referred to a Russian vessel-of-war that had recently visited Ceylon, and to have said: "That is the sort of vessel that would catch and take any one of my small craft, and do what she liked with any one of our post-captain ships, or 'corvettes' as they are called. She could run away with either of the corvettes, and do exactly what she liked with any others on the station. The worst of it is, ours are all an obsolete class of ships. We have got more of the useless class of ships than any other European navy. The ships of which the East Indian squadron is composed (eleven in number), in addition to the flag-ship, are all obsolete." The writer adds: "Admiral Fremantle declares himself 'a great advocate of speed,' and asks what a naval commander is to do in time of war with 'horrible things that cannot go fast enough to catch anything or run away from anything?'" I know not whether Admiral Fremantle used these words; but whether

he did or not, it is certain that they do not greatly, if at all, exaggerate our condition; and to my mind the only remedy for our deficiency in respect of fast cruisers is to induce the Admiralty to put a complete stop to the building of slow ones, and to expend the money voted by Parliament for cruisers only upon fast and efficient vessels.

Admiral BORS: I shall detain you but one or two minutes. I do not propose to go into the details of this able paper of Sir Edward Reed's; I will only say generally, that with reference to some of the statements as put before us by the lecturer, I feel bound to agree with him, but others appear to be so palpably inconsistent, that I cannot but think that there must be another view of the matter, and I hope that gentlemen present will join in the discussion, so that we may hear both sides of the question. There is only one other observation I have to make, and that is as Chairman of the Council for the year: Sir Edward Reed says, "I wish the Council of this Institution would take this matter up, and investigate," &c. Now I must point out that by our rules the Council cannot undertake such an investigation. We as a body do not express our opinions upon the papers that are read. I would also remind members that the Council do not hold themselves responsible for any opinions that may be expressed in this theatre, and, as stated on the cover of the Journal, "authors alone are responsible for the contents of their respective papers." I now hope that we shall have a full discussion.

Captain W. H. HENDERSON, R.N.: I am sure that 95 per cent. of naval Officers will endorse Sir Edward Reed's expressions in even stronger language than he has used. I have just come back from Portsmouth, and the expressions that I have heard used by Captains in the Service regarding vessels, especially of the "Beagle" class, is stronger than anything that Sir Edward Reed has made use of. They say that they are quite unfit for any duty they may be called upon to perform. With regard to first-class cruisers, I certainly agree with Sir Edward Reed; I think that four belted cruisers of 5,000 tons would be better than the seven 5,000-ton ships that we have. With regard to the construction that has taken place since 1880, I think the best way of illustrating what Sir Edward Reed has put forward is to draw attention to what Sir Geoffrey Hornby said the other day at the Mansion House. He asked for 180 cruisers for the protection of our commerce, and said we only had 42 fit to do the work, and therefore that we wanted 144 vessels in order to ensure proper protection. A great many people have gone away with the idea that he asked for 144 additional ships, and have said it is impossible to grant this. What he really asked for was the reconstruction of the cruiser class, simply because the Admiralty have for the last eight years and more built vessels of inferior speed and coal-carrying capacity. Just before I came down here I counted in the Navy List for this month the number of second and third class cruisers and sloops as 98; gunboats and gun-vessels, that is sea-going vessels (I am not including coast defence vessels at all), as 69; making a total of 167; so that, strictly speaking, Admiral Hornby was only asking for an addition of 19 cruisers to the number of vessels now on the Navy List, the greater part of which should be fit to take their part in the protection of our commerce. If the 167 vessels that we now have were of sufficient speed, we should not now want this enormous addition to our fleet. Reconstruction was what he really asked for, not addition. There is another thing which naval Officers are taught, and thoroughly believe: it is the lessons to be learned from the action off Iquique, between the Peruvians and Chilians, on the 21st of May, 1879, between the "Huascar" and the "Independencia," on the one side, and the "Esmeralda" sloop and the "Corradonga" gunboat on the other; the deduction is, that if a nation builds small unarmed ships inferior in speed to iron-clads, it must expect to lose them. That is what we are brought up to believe, and yet Sir Edward Reed has pointed out that vessels are continuously being built which are inferior in speed to the battle-ships. Another thing which I wish to speak about is as to the idea of building vessels for peace service. Where it comes from I cannot say: I can only imagine—I do not wish to be disrespectful—that some Flag Officers have given rise to the tradition in the past by trying to elevate the

peace duties of stations of which they have had command as of more importance than the war requirements of the nation, and consider that it is necessary to have a certain slow vessel to do the routine peace duties of a station. This is utterly absurd. If you possess a vessel of speed and coal-carrying capacity, she will get round her station, will show the flag, and will do, in proportion to her speed and coal-carrying capacity, so much the more work than a vessel of inferior powers. I was recently in Australia, which is one of the most distant stations where we have to keep the police of the sea in the Western Pacific, which as you all know is one of the most uncivilized parts of the sea. We had out there five schooners, and afterwards two others were sent out. These schooners could not do their work: they could not get about. You had no means of getting communication with them; they covered very little distance. Strong representations were made, and two gunboats were sent out, but I put it to naval Officers here, would not a decent steamer capable of going 14 or 15 knots have gone the rounds and brought constant intelligence and done the work of that station very much more efficiently than those vessels which, directly they left the Flag Officer's sight, were absolutely out of control? I think the construction of the "Beagle" class and the "Pheasant" class an utter waste of money. I have heard naval Officers say, "Burn them," and others say, "Throw them into the sea, for you might just as well do it as build them." I do not want to take up the time of the meeting by going into the particulars, but of the "Buzzard" class we have five vessels built and building, costing 69,000*l.* each, with 14½ knots speed and 3,000 knots radius of action, carrying eight 5-inch guns, and 16 vessels of the "Pheasant" and "Redpole" class, costing about 42,000*l.* each, with 13 knots speed, and 2,500 knots radius of action, and mounting six 4-inch guns, making a total expenditure of over a million, as Sir Edward Reed has stated, and on vessels inferior in speed to the battle-ship speed of the day, and obsolete in their inception. I must inform Sir Edward that the "Beagle" is well under weigh at Portsmouth; it is too late to stop her construction; she will be ready for towing out of dock before very long. Naval Officers say that none of these vessels should be inferior in speed to the battle-ships, and to say that vessels of the required speed cannot be built is preposterous, because we are building torpedo gunboats with a speed of from 19 to 21 knots, and with the same radius of action of 2,500 knots. I look upon this million as a sheer waste of money. Coming to the second-class cruisers, the "Medea" class, I wish to say a word on which naval Officers feel very strongly. Those vessels are 265 feet long; they have 2,950 tons displacement, 9,000 horse-power, carrying 400 tons of coal; they have 8,000 knots as their radius of action, and carry six 6-inch guns, at a cost of 152,000*l.* apiece. Now every naval Officer and every captain of a steam merchant vessel, or indeed any sailor, would tell you if you expect a vessel to keep the sea and make a passage, she must not be less than 300 feet long. We can all see these vessels 260 feet long are too short; they should have been made longer without increasing their armament. This increase of length would have made them efficient vessels, and by enabling an increase to their coal supply, would make up for their great deficit.¹ The test of a second-class cruiser should be that she should really be able to go at the same speed as the "Umbria," 19 knots; that she should be practically able to steam across the Atlantic with the best of our fast merchant steamers. With regard to the "Barrosa" and the "Barham" class of vessels, the "Barrosa" class comprises four vessels of 1,580 tons each, 3,000 horse-power, a speed of 16½ knots, and a radius of action of 3,400 miles, carrying six 36-pr. quick-firing guns. The "Barham" class have 1,800 tons displacement, 5,500 horse-power, a speed of 19½ knots, but only a radius of action of 2,600 miles. Those are third-class cruisers, and again there is some discrepancy, something wrong here; 19½-knot vessels, with only 2,600 knots radius of action. We say that second and third class cruisers of the present time should have at least 19½ knots speed with the greatest

¹ One great defect in the steaming power of all men-of-war is difficulty of coal supply to the furnaces, consequent on its distribution for particular purposes over so much of the length. This defect will never be satisfactorily remedied until increase of length enables large coal bunkers to be placed right across ships on each side of and between the sets of boilers.

radius of action you can give them. I think we all consider that speed is of the very greatest advantage possible; speed and coal-carrying capacity are the two prime elements necessary for cruisers, because when a vessel has superior speed she has the power of trying her gun-fire, of using her torpedoes, and of ramming, while a vessel of inferior speed has no choice in the matter.

Mr. BADEN-POWELL: It seems to me that the question of fast cruisers is a vital one. Sir Edward Reed, as I understand, proposes a speed of 22 knots. I should like to know how war-vessels are going to be built to be able to keep up a speed of anything like 22 knots with the coal capacity which they at present have. I have seen over and over again large mercantile vessels coal, and know that the average consumption of an Atlantic liner is from 250 to 300 tons every twenty-four hours. Now if you take a vessel to a distant station it stands to reason that she must be capable of taking in not only 1,500 tons of coal, but 1,000 over that, in order to enable her to get out to her station. That is a point which I think has not been duly considered in the construction of the cruisers which the Admiralty have been building, and it does seem appalling to me the small amount of coal capacity allowed for cruisers. There is another point that struck me very forcibly, that was that the lecturer has not mentioned how these vessels should be rigged. I know that there are nautical men who say that a fighting battle-ship should not have masts and sails. At the Naval Review last year, and since, we have seen many of these cruisers rigged only with small jury masts, and an apology for a foreyard; how are these vessels going to keep on their station? Are they going to eat the coal the whole time they are out on the station? Are they going to eat their coal on the way out, and then have to fight on an empty bunker? They cannot do it, they would be captured directly. I should like to know whether the cruisers that Sir Edward Reed proposes are going to be fully rigged so as to be able to keep the sea under sail; with possibly some invention of Sir Edward Reed's for starting fires in a hurry (like the steam fire engines do on shore), to promptly get up steam when the enemy heaves in sight, or is reported to have been discovered; but otherwise to keep the station in the old style under sail. These are important questions with regard to cruisers; one affects the question of our coaling stations, and the other affects the question of keeping seamen as seamen; I think they are of great importance to the country. There is only one other question that struck me very forcibly with regard to cruisers; I can scarcely believe it to be true to say that naval architects in charge of the construction of ships can go and immerse those ships in the way that Sir Edward Reed says they do, can go and put slanting armour decks below an unprotected water-line, which, if the sides are penetrated by quick-firing shell guns, must produce such a capsizing influence that the vessel will be in such circumstances utterly unseaworthy. I hope Sir Edward Reed has not been telling us yarns: we are not marines.¹

Captain CURTIS: Perhaps Sir Edward Reed would enlighten us a little more on this subject, about the 4 feet of armour in his proposed cruisers, because one would imagine that there was 4 feet of armour above water. He says, "The cruisers would have large thick belts, rising 4 feet above water, all along the broad central parts of the ship." Perhaps Sir Edward Reed will explain when the vessel is immersed in trim for sea, how much armour is above water, and also how much armour is above water when the ships are light, say with 50 tons of coal on board. I have heard Sir Nathaniel Barnaby lecture on his ships referred to here, and he

¹ I understand one of the assumptions in the Admiralty design—midship section of which was exhibited by Sir Edward Reed—was that the wedge space or wings above the slanting armoured deck were to be filled with coal as a protection, and kept full. But for a cruiser many days out on her station, and probably coming into action after a long full-speed chase, unless the coal below has been used first, which is very unlikely to be tried by sailors, though easily suggested from a chair on shore, the wing pockets might easily be filled with water when wounded. The case made out in the lecture simply reminds one at once of the almost similar conditions which capsized the "Austral," in the smooth water of Sydney harbour. A lopsided deck has poor manœuvring powers, and even if no worse happened than a heavy list, all broadside guns would be thrown out of action.—W. B. P.

stated his vessels were designed to carry about 400 tons of coal, and the authorities placed 900 tons on board, which fully accounts for the immersion of the armour. Then with regard to the armour itself, I have stated before in this Institution that I have seen at Kinburn a spar that a 68-pound shot fired from the "Hannibal" had passed through, the aperture had closed so small that one could not put his finger through the hole. Now it seems to me that wood of this kind might be placed outside these ships. Formerly we used to place iron outside the old wooden vessels, but if you place wood or woodite outside the iron it might act as a protection against leakage, and then as the ship gets more immersed, instead of getting less buoyancy they will have more. It seems to me that if you were to penetrate a ship with a shot, the specific gravity of coal being greater than that of water, the coal would go out, and the water would come in. The result would be that the ship would have rather an awkward list on the opposite side, and the guns would be out of action. You might just as well put water-casks inside a ship to give her floating power, if you anticipate any buoyancy from under the armour-deck, as it appears to be flush with the water-line. I would suggest that perhaps we might find some way of protecting ships by some other substance instead of iron, something in the way they are now doing it, by sheathing outside. I might also mention¹ that when the main topgallant mast went through three of the "Marlborough's" decks, the Officer said he could not put his finger through the holes. That is another instance of the wood closing up after penetration; a hole has been made through it.²

Sir E. J. REED: I feel very thankful to Captain Henderson for being good enough to come and make the statements that he has made, because they are obviously in furtherance of the aim that I have in view, and which, I have no doubt, naval Officers present have in view. As I think, owing to a slight want of clearness on one point, there might possibly be some misunderstanding, I should like to ask Captain Henderson if I understood him aright as to Admiral Hornby's views. What I think he seemed to say was that Admiral Hornby did not propose to add 167 cruisers to the existing Navy, but what the Admiral meant was that he should require the total number of cruisers which he stated, and that had the ships we possess been built of proper speed, then we should only have required about 19 more to bring our Navy up to what he considered necessary. You do not mean to imply that, having such vessels as we have, 19 cruisers would bring up our Navy to what it should be?

Captain HENDERSON: No.

Sir E. J. REED: I understood you to say that if the Government had previously built efficient ships, we should now have required to meet Admiral Hornby's views only 19 additional ships.

Captain HENDERSON: That is so.

Sir E. J. REED: I think Mr. Baden-Powell touched some very practical points. With regard to the vessel of 22-knot speed, I presume it is quite understood that the object of giving those high speeds to war-vessels is not that they may under any condition traverse larger ocean spaces at that enormous velocity; the object is, I apprehend, that while they perform this ordinary service with efficient speed, they should have the power, when the necessity of overhauling an enemy comes, of complying with that necessity. And one of the things that encourages me more than any other to urge the production of very fast ships is the striking economy with which a very fast ship will go slowly. I have had occasion lately, in designing some ironclad cruisers, to go into that very carefully, and I find that with such a speed as would be sufficient for a vessel in proceeding under ordinary circumstances to a foreign station, they can carry coal enough to go about 14,000 knots, and I myself think that even a supply of coal which would enable vessels to cross the Atlantic, say to go to the United States, at a speed of 14 or 15 knots, would be sufficient for the ordinary purposes of the Royal Navy. But I agree with Mr. Baden-Powell entirely in expressing astonishment at the coal supply of recent ships. One would

¹ This occurred in Sir William Parker's commission.

² No doubt in event of war these cruisers could have fittings outside, so as to cover any holes by penetration by placing plank sheathing; it appears quite feasible.

have supposed that, with this increase of speed, the necessity for which has been brought home to us, we should have made every effort to go on increasing the coal supply; but instead of that the characteristic feature of the modern fast vessels is that they have scarcely any coal supply at all. Now the ground of all that, or the excuse for it—for I cannot put it any higher than that—the excuse is the economy of the triple expansion engine; but then the utmost difference that one can anticipate in the consumption of fuel as between a good compound engine and a good triple expansion engine, is about $\frac{1}{2}$ lb. of coal per horse-power per hour out of the $2\frac{1}{2}$ lbs. a compound engine will consume. A triple expansion engine will run upon $1\frac{1}{2}$ lbs. per horse-power, whereas a compound requires $2\frac{1}{2}$ lbs. That difference is not so very large, and cannot possibly be made to justify the recent large reductions in the coal supply of Her Majesty's ships. And yet what do we see? We saw that in the case of those belted cruisers when the power was sent up from 7,500 to 8,500 horses, the coal supply was reduced from 500 to 450 tons, and there we were with engines of 8,500 horse-power—about three or four times the horse-power of the old line-of-battle ships—with 450 tons of coal! Captain Curtis very properly pointed out that the state of those vessels has been—not wholly, I may say, but very largely—brought about by the fact that the present Board of Admiralty have insisted on putting into these vessels a larger coal supply than was contemplated.

Captain CURTIS: I wished to exonerate the naval architect.

Sir E. J. REED: And that does largely exonerate the naval architect. It is a very delicate matter for me to discuss the responsibilities of naval architects, but what I should say is that I would visit upon any naval architect this measure of responsibility in the matter: and I would say every naval architect ought to remember that an armour-belt of only $5\frac{1}{2}$ feet in width is a sham belt and not a real one, and does not give you the power of meeting those many contingencies which beset ship-owning and ship-working; and, therefore, the complaint I would make against the naval architects of these vessels is this, that when it had been stated by another naval architect (myself) in this hall, that a ship to steam at the high speed that was desired, to carry a large coal supply, and to have an efficient belt, required to be a ship of 8,000 tons—a statement which was not at all contested here—that they should have set themselves up as so much cleverer than other people as to go and produce a ship of 5,000 tons, and pretend that with that vessel they could accomplish the object. That is where I blame them. A naval architect should have known that 8,000 tons was necessary for the speed aimed at, for the coal supply desired, and for the efficient belt. I must say it is a very unfortunate thing that any body of gentlemen—naval architects or naval Officers, or any other responsible persons in the Admiralty—should have placed the present Board of Admiralty in the position of either having to send these vessels, seven of them from our ports, with this enormous horse-power for their size, and with a ridiculously small coal supply; or else should have to accept the other alternative, namely, putting in a reasonable coal supply, and sending them out with their entire armour below water. I do not think we can quite relieve the naval architects of responsibility because they tried to do, or they undertook to do, what the laws of nature and the facts of science both would have shown that they could not do. However, I may say that this matter is quite incidental. It is perfectly true, as I have stated in this paper, that I never have allowed myself at any time to cavil about small questions, or to discuss any minor shortcomings in Her Majesty's ships. I think anyone who knows the circumstances will know that a man who has been fourteen years in the House of Commons, if he had had the disposition to agitate upon small shortcomings, would have had hundreds of opportunities such as I certainly have not availed myself of. All I have ever done has been to endeavour to put a stop to some extraordinary violation of common sense, and I am very glad to have the testimony of Mr. Baden-Powell to the fact that he can hardly understand any naval architect approving such arrangements as I have referred to. Well, that is precisely my difficulty. I know that the naval architects are sane, and that they do propose these things; but how, being sane, they do propose them, and persist in them, is a problem which I am quite unable to solve. I can only say that in my judgment the largest danger to this country is due to the fact that some

of these unaccountable things have been done. There was a time when one was fighting the up-hill battle of condemning the "Admiral" class because of their extremely limited surface of side armour. All necessity for that kind of effort is now gone, when we know, when you gentlemen know, when the world knows, that these [pointing to the belted cruiser with submerged armour, and to the deck-protected cruiser, with her defensive plating also submerged] are the sort of things to which the kind of advice acted upon of late years has brought us to. All the armour is put below water in order to carry even a moderate supply of coal to sea. When you see these things, you will, perhaps, think there is some ground for my apprehensions in the case of other vessels, although their armour may not have been put entirely out of sight. I would like to say one more word upon the question of coal supply. What I do not understand is why the coal supply has been kept down as it is; because nothing is more common in designing, nothing is more the daily experience of men engaged in the profession that I belong to, than the proof positive that some increase in length of ships and coal-carrying does not impose heavy penalties upon you in the way of the construction of ship or of construction of power to drive it. When you have got those long line-lined ships, you can very well afford to put a short length of middle body in in the middle of your cruiser. But unfortunately we have gone upon the opposite system, and making ever-increasing demands upon the ships' speed, we have taken the coal out of them more and more. That is not all. Mr. Baden-Powell has drawn attention to another thing equally unaccountable, and exactly of the same nature, and that is, that having crippled and paralyzed steam ships for want of coal supply, we have also taken away from them every possible means of helping themselves along by sail. I should be very sorry to express any strong opinion on the rigging of cruisers in the presence of Officers far more able than I to give an opinion; but I will say this, that when the line-of-battle ship "Derivation" was designed, I did not hesitate to deprive her of sail power. I have never been able to understand, and I do not now in the least understand, why these fast cruisers are deprived of all sail power. I am quite aware that it is easy to show what a long way a ship can go on a very small supply of fuel; but what makes me feel the difficulty a little more is this, that while we have taken out all masts and sails from this class of vessels, we have not taken away the seamen who are to work them; but to my surprise I find that the "Orlando," a vessel of this class, has no less than 158 Officers and men. Had she possessed some measure of sail power, she would not have required additional men. I state that with great confidence, because I have compared her complement of Officers and men with the complement of a ship that carries considerable sail power, and she has the same number within five: therefore she has a complement for working canvas if she had it. Captain Curtis drew attention to the probability of being able to assist a vessel with thin sides by employing wood or woodite or some other like material on the outside, because of the property which it possesses of closing up again. The difficulty I think in that matter is this, that the reason that an elastic substance like woodite, or wood, or sawn fir closes up again after the shot has gone through, is that it is able to yield more or less to the passage of the shot. And if it were a sheet of woodite fired at, I apprehend the shot would tear its way through, the woodite yielding, and flying back into its position and closing up, because what would have been made would be not a hole but a tear. But if you put that sheet inside of a plate, and then fire at it, you will make not a rent but a hole, because you will punch out the piece, and it seems to me the conditions of an elastic substance, backed by a rigid substance, are those which would deprive the elasticity of the opportunity of doing its work. I feel that difficulty, but at the same time I would point out that cellulose, which is being a good deal used in the French Navy, and is praised by French designers, is not used outside but inside, as woodite should be, and it has been proved by experience that when you put that inside, and a shell or shot passes through the plating outside, and then through the cellulose or woodite, the cellulose or woodite closes up afterwards, and keeps a great deal of water out. I am not an opponent of any device of that kind. But what I am an opponent of, is the substitution of any device of that kind for effectual modes of keeping out shot and shell, say the substitution of cellulose for steel armour, and

then for those who have made the substitution to have the effrontery to tell the world that they have "protected" your ship. In conclusion, I maintain that nothing has happened among us to make me hesitate for a single moment to believe that this country can perfectly well afford, and ought to expend, whatever money is necessary for producing the very ships that it desires and that it ought to have, and I do not believe that either common sense or any true spirit of economy has yet driven us either to india-rubber, or cellulose, or sir, or anything of the kind in substitution for the trustworthy defence of steel armour-plates, which we know cannot be penetrated by the minor armaments of the enemy.

The CHAIRMAN: It only remains for me (and I am sure you will wish me to do so) to thank Sir Edward Reed very cordially for his paper. It has not had the effect of producing a long discussion, but the remarks from Captain Henderson and Mr. Baden-Powell and others I am sure have elicited in the reply a still greater amount of valuable information. I do not think anything can be more certain than the closing remarks Sir Edward Reed made, that nothing should induce this country to grudge any amount of money that is necessary to produce the most perfect ship, whether battle-ship or cruiser, that science has shown can be produced.