

NAVIES OF THE WORLD.

I. GREAT BRITAIN—SECOND ARTICLE.

In the first chapter of this series (see issue of November 26) we discussed the armored ships of the British navy, under which head were included the battleships, coast defense vessels, and armored cruisers. We found that, after omitting the obsolete ships, Great Britain possesses or is building 54 battleships, 25 coast defense vessels, and 17 armored cruisers. In like manner, by applying a test of speed and omitting all protected cruisers whose speed falls below 15 knots, and all gunboats below 12 knots, we arrived at a total of 194 unarmored vessels, made up of 97 protected cruisers, ranging in size from small cruisers of 2,000 tons displacement and less up to great vessels like the "Powerful" and "Terrible," of 14,200 tons displacement, and 97 cruisers and gunboats below 2,000 tons displacement.

The distinction between an armored and an unarmored but protected vessel is very simple. Any vessel, be she battleship or cruiser, that carries a belt of vertical side armor at the water line is "armored." Any vessel that has a continuous protective deck of steel extending from stem to stern, but no vertical side armor, is "protected." The vessel that has neither steel deck nor side armor is "unprotected."

The imposition of a speed limit of 15 knots reduces the total number of protected cruisers from 226 to 194. The 32 vessels thus omitted are made up of cruisers of from 2,000 to 3,000 tons displacement and from 12½ to 14½ knots speed and a number of gunboats. They were built in the early eighties, and while they might be of some value in convoy-

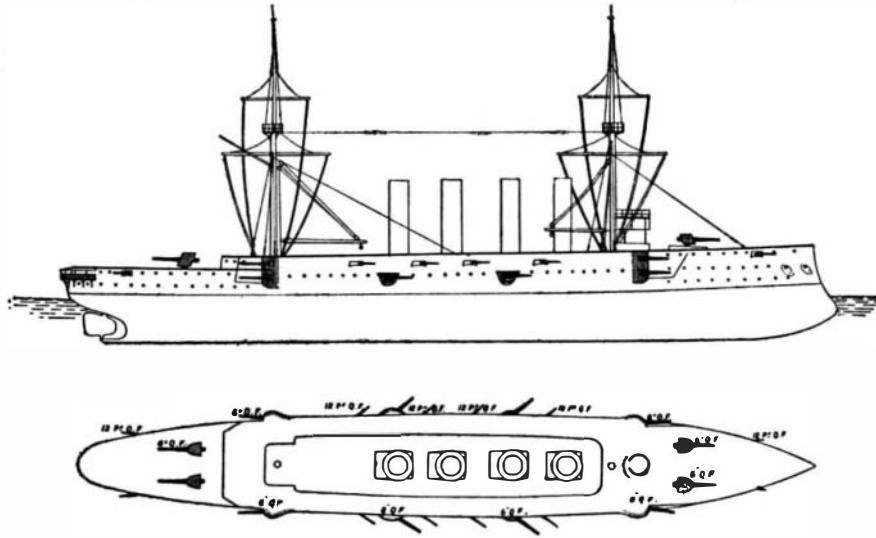
in many of the vessels being light in proportion to the displacement. Whether the British cruisers be compared with our own or those turned out by private English firms, such as the Armstrong Company, the weight of metal thrown compared with the displacement is light for all but a very few of the Admiralty designs. As an instance of this we present a comparison of the British protected cruiser "Edgar," of 7,350 tons, with the armored cruiser "Esmeralda," of 7,020 tons, designed and built by Armstrong for the Chilean government.

Now, at first sight, on comparing these vessels, one wonders what has been done with the extra 330 tons of displacement in the "Edgar." It is true the sloping

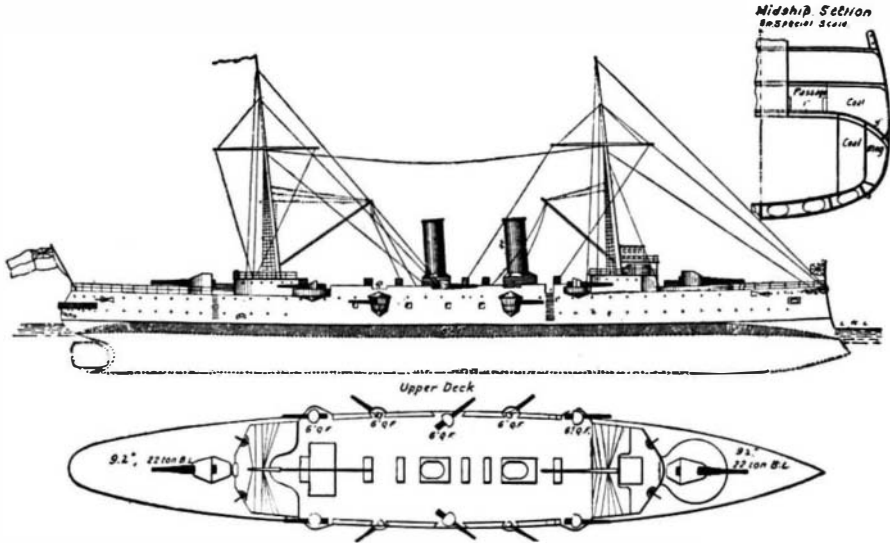
shields, whereas the "Esmeralda's" guns are mounted in the open and the crew are lightly protected by shields; but against this must be set off the fact that the two 8-inch and sixteen 6-inch guns, all rapid-firers, give the Armstrong vessel a great preponderance of offensive power. The larger coal supply of the "Edgar" may be set down to the larger displacement. Finally, the smaller vessel has an excess of 2½ knots of speed. There is one point of comparison on which we do not possess the figures, namely, the supply of ammunition—a feature of prime importance. In this regard it is likely that the government vessel is better provided.

It is the policy of Sir W. White, who has designed practically the whole of the modern British navy, as distinct from that of Mr. Watts, who designs the Armstrong ships, to provide a vessel with a moderate number of guns, thoroughly protected and well supplied with ammunition, rather than with an excessive number of guns, poorly protected and carrying a limited supply of ammunition. Which system is better, the supreme test of war alone can tell. If the past is any guide, we know that victory rests with the ship that can bring an overwhelming preponderance of fire to bear at the outset of the fight. It was thus we triumphed in the naval duels of the war of 1812, and the probability is that "Providence" will be found to be "on the side of big" batteries.

In keeping with the policy of mounting fewer guns but giving them thorough protection is the great pains that is taken to encourage good marksmanship in the British navy. It is not generally known, but is nevertheless a fact, that, as a result of the prizes that are offered for the

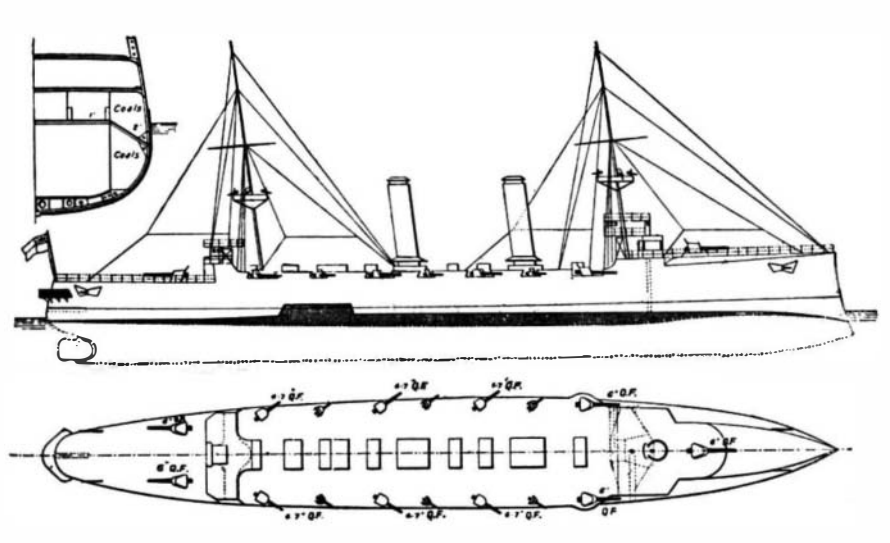


"Diadem" Class, 11,000 Tons, 20.5 Knots. Eight Ships. Also "Powerful" and "Terrible," 14,200 tons, 22.4 knots, with flush upper deck, and a 9.2-inch rifle substituted for the two 6-inch guns at bow and stern.



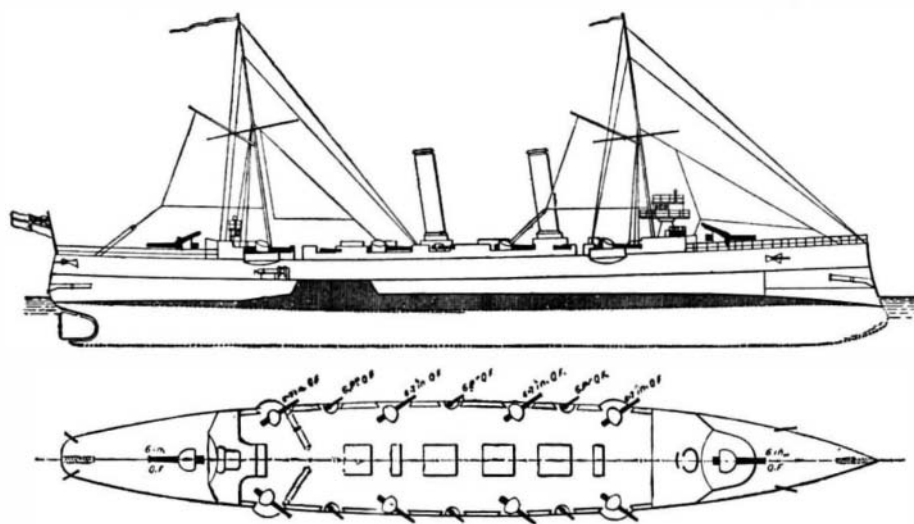
"Edgar" Class, 7,350 Tons, 20 Knots. Nine Ships.

Four ships of this class ("Royal Arthur" type, 7,700 tons, 19¾ knots) have a raised foreccastle deck with two 6-inch rapid-firers in place of the 9.2-inch bow-chasers.

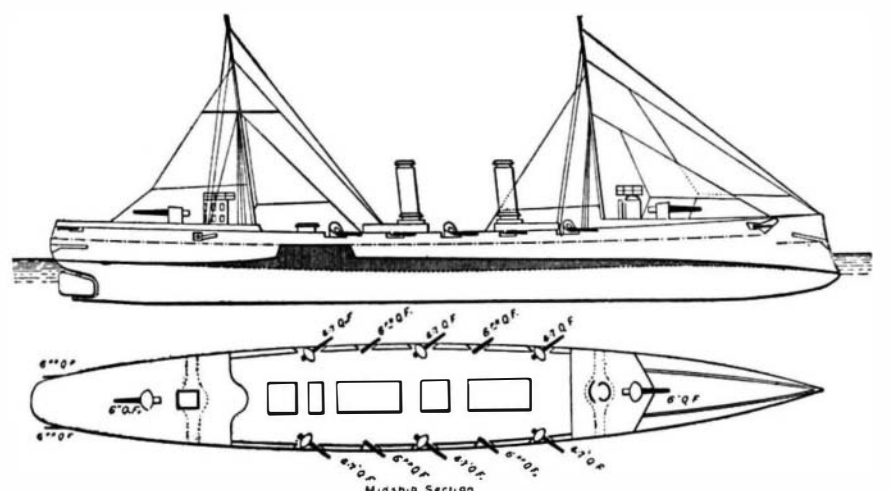


"Eclipse" Class, 5,600 Tons, 20 Knots. Sixteen Ships.

Four ships of this class ("Arrogant" type, 5,800 tons, with three smokestacks) are strengthened for ramming and carry four 6-inch and six 4.7-inch guns. Three of the "Eclipse" class carry eleven 6-inch rapid-firers in place of five 6-inch and six 4.7-inch.



"Astræa" Class, 4,630 Tons, 19.5 Knots. Eight Ships.



"Apollo" Class, 3,400 Tons, 20 Knots. Twenty-one Ships.

Ten of these ships are sheathed and displace 3,600 tons.

NAVIES OF THE WORLD—I. GREAT BRITAIN.

ing merchant vessels, they would be as helpless against modern cruisers as were Montojo's vessels at Manila. They are therefore omitted from the present estimate of fighting strength. Dividing the 194 cruisers and gunboats into classes according to their size, we get 10 ships of from 11,000 to 14,200 tons; 11 ships of from 7,350 to 9,000 tons; 30 ships of from 4,050 to 5,800 tons; 46 ships of from 2,135 to 3,600 tons; and 97 cruisers and gunboats below 2,000 tons.

Broadly speaking, the British cruisers exhibit the same distinguishing characteristics as the battleships. They are essentially sea-keeping ships, standing well up out of the water, and having good speed, a liberal coal supply, and generous berthing accommodation for the crew; but it must be confessed that in the main the vessels appear to be under-gunned, the armament

deck is 3 inches thicker; but this is more than offset by the 6-inch belt of the "Esmeralda." The guns are better protected in the "Edgar," being contained in closed 6-inch casemates or sheltered behind 6-inch

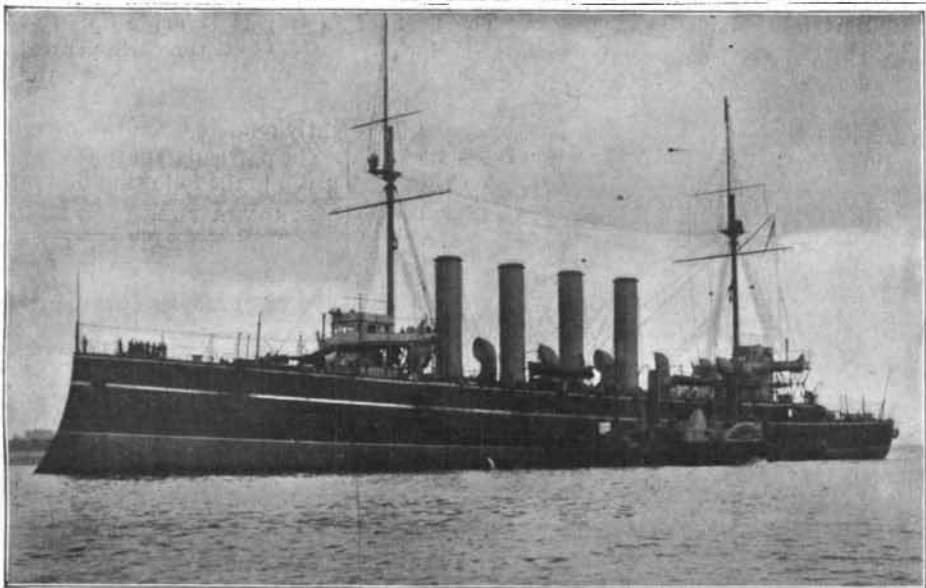
	"Edgar."	"Esmeralda."
Displacement	7,350 tons.	7,020 tons.
Speed	20.5 knots.	23 knots.
Coal supply (normal)	850 tons.	550 tons.
Armor: Deck	5-inch.	2-inch.
Belt	6-inch.	6-inch.
Gun position	6-inch.	Light shields.
Armament:	Two 9.2-inch Ten 6-inch rapid-fire. Twelve 6-pounders. Five 3-pounders. Seven machine guns. Four torpedo tubes.	Two 8-inch rapid-fire. Sixteen 6-inch rapid fire. Eight 3-inch rapid fire. Two 3-pounders. Four machine guns. Three torpedo tubes.

best target practice, a high state of efficiency has been reached by the British gunners, as the subjoined results of recent prize shooting in the Channel Squadron will show:

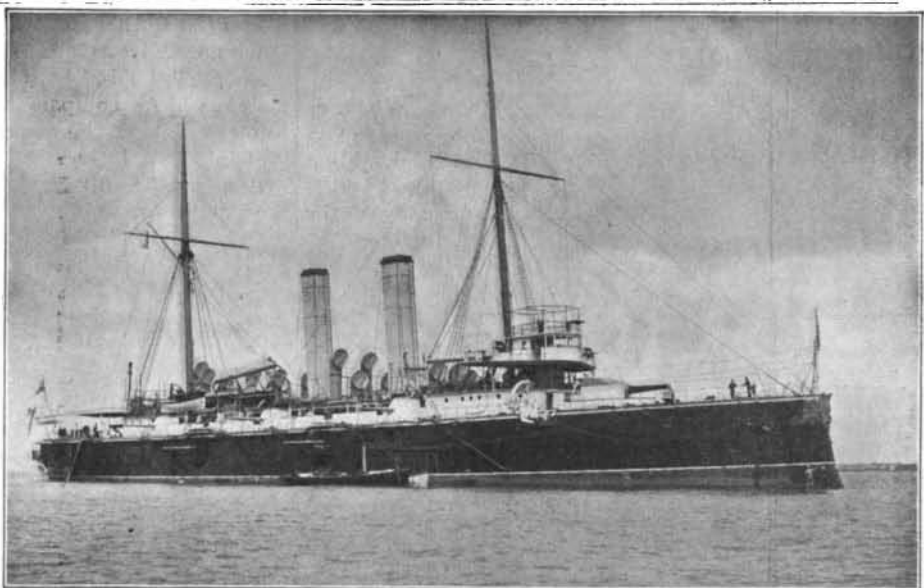
"Repulse"	23 rounds with 13.5-inch	guns scored 9 hits.
"Magnificent"	17 " " 12-inch	" " " 3 "
"Repulse"	86 " " 6-inch R. F.	" " " 18 "
"Magnificent"	97 " " 6-inch	" " " 14 "
"Pelorus"	89 " " 4-inch	" " " 25 "

These results were obtained in "dirty" weather when the ships were under way, and only direct hits were counted.

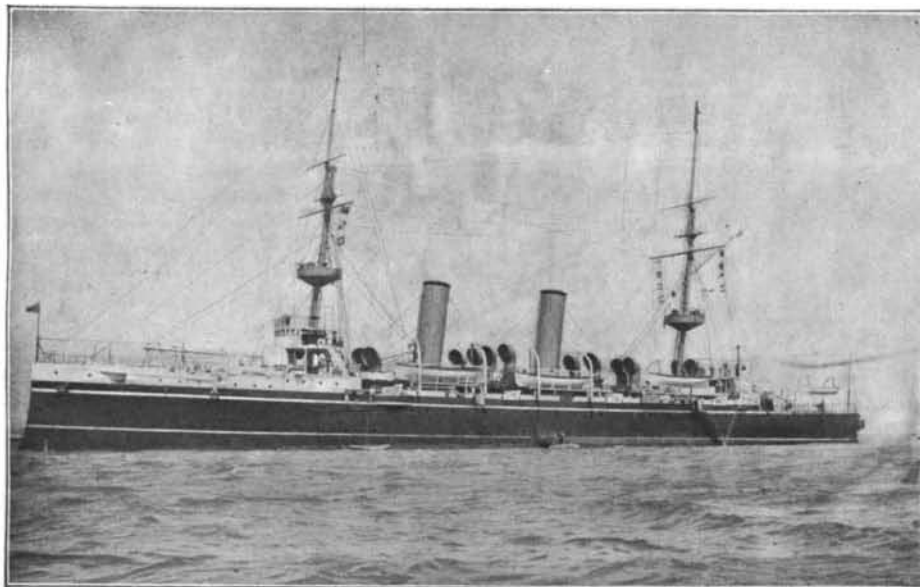
As will be seen by studying the cross section of the "Edgar" (see accompanying diagrams), the protection to the vitals of an unarmored cruiser consists of a steel deck which is flat in the center, but slopes to below the waterline at either side. The coal bunkers are



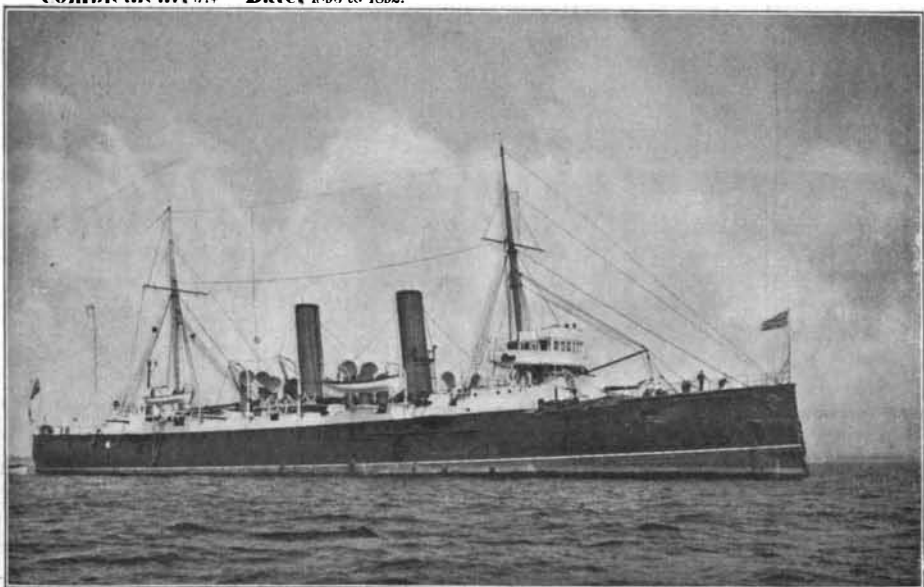
3.—First-class Protected Cruiser "Diadem." "Diadem" Class of Eight Ships. Displacement, 11,000 tons. Speed, 20.5 knots. Bunker Capacity, 1,900 tons. Armor: Deck, 2½ inches on flats, 4 inches on slopes; shields and casemates, 6 inches. Armament, sixteen 6-inch and fourteen 3-inch rapid-fire guns, twelve 3-pounders, two 3-inch boat guns. Torpedo Tubes 5 (two submerged). Complement, 677. Date, 1887.



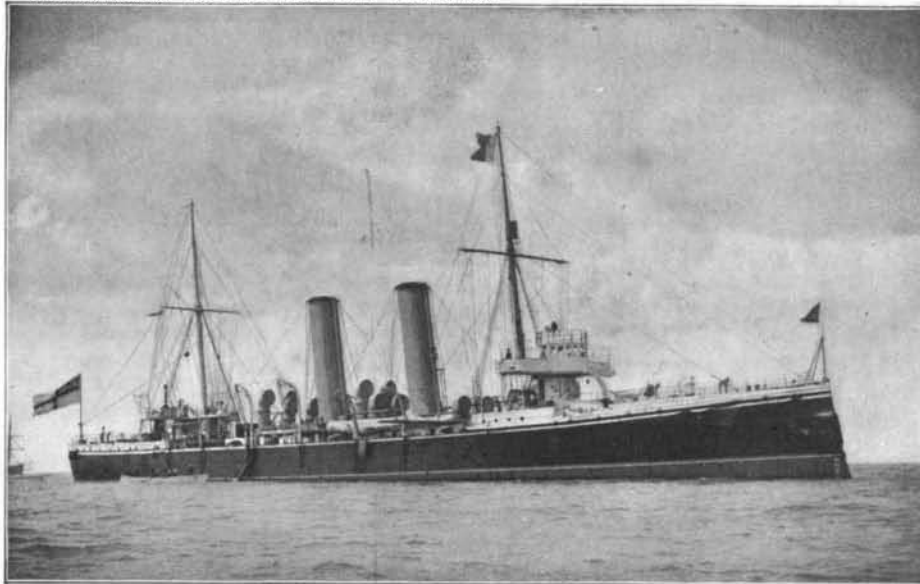
4.—First-class Protected Cruiser "Endymion." "Edgar" Class of Nine Ships. Also the "Blake" and "Blenheim" of 9,000 tons and 21.5 knots. Displacement, 7,350 tons. Speed, 20 knots. Normal Coal Supply, 850 tons. Armor: 1 inch on flats, 5 inches on slopes; gun positions, 6 inches. Armament, two 9.2-inch, ten 6-inch rapid-fire, twelve 6-pounders, five 3-pounders, seven machine guns, two boat guns. Torpedo Tubes, 4 (two submerged). Complement, 544. Date, 1890 to 1892.



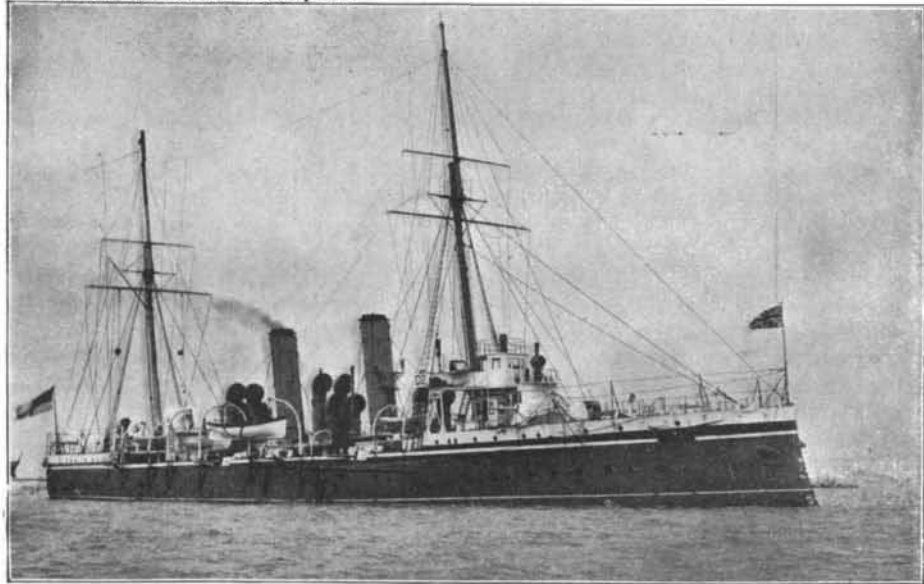
5.—Second-class Protected Cruiser "Diana." "Eclipse" Class of Sixteen Ships. Displacement, 5,600 tons. Speed, 20 knots. Normal Coal Supply, 550 tons. Armor: Deck, 1½ inches on flats, 3 inches on slopes; gun positions, 4½ inches. Armament, five 6-inch, six 4.7-inch, and nine 3-inch rapid-fire guns, one 3-pounder, four machine guns, one 3-inch boat gun. Torpedo Tubes, 3 (two submerged). Complement, 477. Date, 1894.



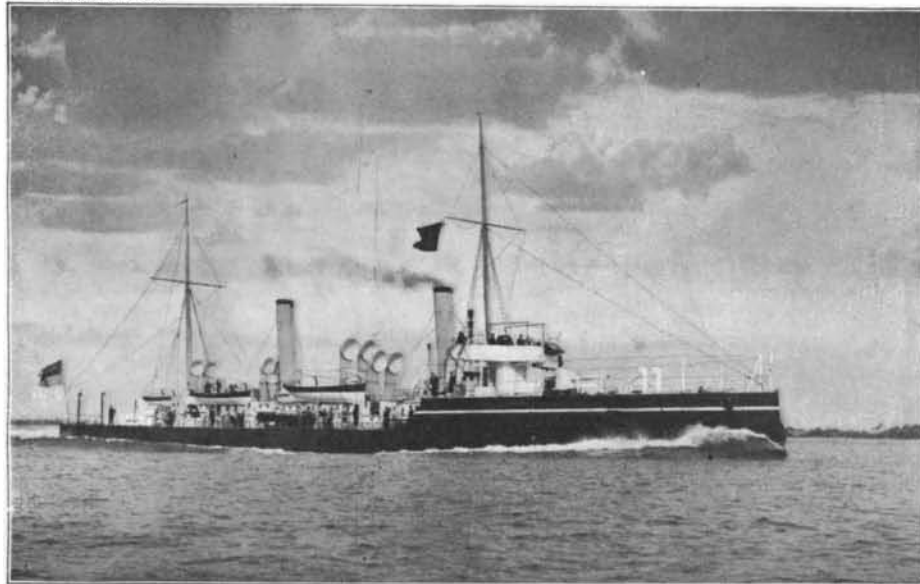
6.—Second-class Cruiser "Fox." "Astræa" Class of Eight Ships. Displacement, 4,360 tons. Speed, 19.5 knots. Normal Coal Supply, 400 tons. Armor: Deck, 1 inch on flats, 2 inches on slopes; gun positions, 4½ inches. Armament, two 6-inch and eight 4.7-inch rapid-fire guns, eight 6-pounders, one 3-pounder, four machine guns, one boat gun. Torpedo Tubes, 4. Complement, 312. Date, 1898.



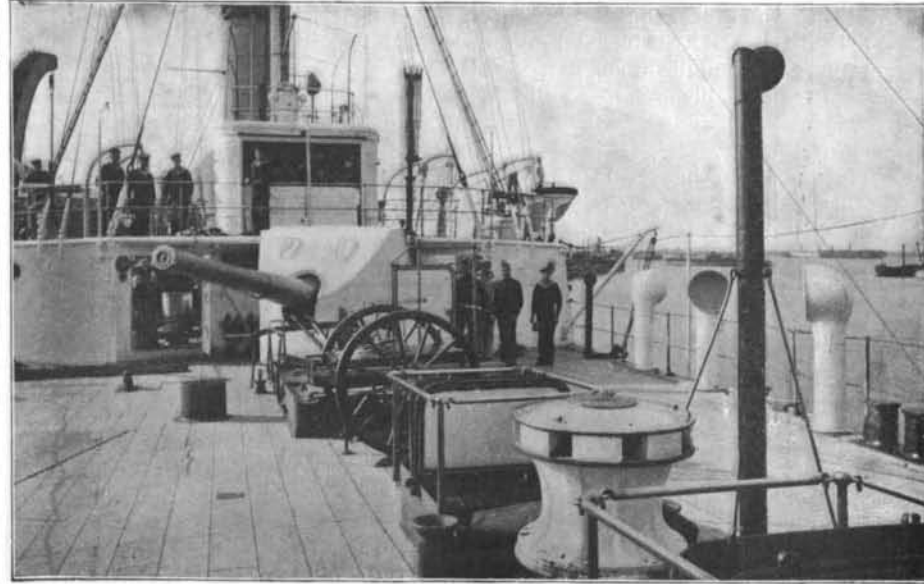
7.—Second-class Cruiser "Apollo." "Apollo" Class of Twenty-one Ships. Displacement, 3,400 tons. Speed, 20 knots. Normal Coal Supply, 400 tons. Armor: Deck, 1 inch on flats, 2 inches on slopes; gun positions, 4½ inches. Armament, two 6-inch and six 4.7-inch rapid-fire guns, eight 6-pounders, one 3-pounder, four machine guns, one boat gun. Torpedo Tubes, 4. Complement, 273. Date, 1892.



8.—Third-class Cruiser "Pelorus." "Pelorus" Class of Eleven Ships. Displacement, 2,135 tons. Speed, 20.7 knots. Normal Coal Supply, 250 tons. Armor: Deck, 2 inches; gun positions, 4½ inches. Armament, eight 4-inch rapid-fire guns, eight 3-pounders, two boat guns. Torpedo Tubes, 2. Complement, 234. Date, 1898.



9.—Torpedo Gunboat "Speedy." "Speedy" Class of Eleven Vessels. Also four "Halcyon" type, 1,070 tons and 19 knots, and thirteen of "Gleaner" type, 785 tons and 30 knots. Displacement, 810 tons. Speed, 20.2 knots. Normal Coal Supply, 100 tons. Armor: Gun positions, 4½ inches. Armament, two 4.7-inch rapid-fire guns, four 3-pounders. Torpedo Tubes, 3. Complement, 91. Date, 1898.



10.—After 6-inch Rapid-fire Gun on the Quarter-deck of "Charybdis." "Astræa" Class. Weight of gun, 6¼ tons. Weight of shell, 100 pounds. Length of bore, 40 calibers. Number of shots per minute, 6.

ranged along the sides in the wake of the engines and boilers and fill up the space between sloping deck and outside shell plating, and also the spaces between inside of slopes and engine and boiler rooms. When, as in the case of the "Edgar," the slope is 5 inches thick, this equals about $7\frac{1}{2}$ inches vertical, and, adding the resistance of the coal, we get the equivalent resistance of about 12 inches of steel placed vertically on the sides of the ship. It is better, however, to burst the shells outside than inside the shell plating, and hence the armored cruiser is coming increasingly into favor in the present day.

The duties of the cruisers of the British navy will lie chiefly in the direction of protecting her enormous maritime commerce. They will be disposed at important points on the great trade routes, which they will patrol as long as any cruisers of the enemy are at sea. Undoubtedly at the outbreak of the war an effort will be made to watch the hostile cruisers, and keep them shut up in their own ports; but should they escape, it will be the work of this big fleet of close upon two hundred vessels to capture or sink them as quickly as possible. The enemy's commerce destroyers of over 21 knots will be open to attack only by such fast vessels as the "Powerful" and "Terrible," of $21\frac{1}{2}$ to $22\frac{1}{2}$ knots speed. In view of the terrible havoc that a 23-knot commerce destroyer could work on British commerce, it is strange that the government does not build a few powerful vessels capable of overtaking a craft of this kind. Two 15,000 ton armored cruisers of 23 knots are to be laid down shortly.

It is a remarkable fact that nearly the whole of this large fleet of protected cruisers has been built during the past ten years. The start was made when the alarm of the British public over the defenseless condition of their maritime commerce led to the passage of the Naval Defense Act of 1889, when \$100,000,000 was voted for the construction of seventy new vessels. Previous to the passage of the act, the protected cruiser classes were represented by the "Blake" and "Blenheim," 9,000 tons, $21\frac{1}{2}$ knots; eight ships of the "Forth" and "Leander" types, of 4,000 and 4,300 tons and 17 and $16\frac{1}{2}$ knots; five ships of the "Magicienne" and "Medusa" types, 2,950 and 2,800 tons and 19 knots; the "Calliope," and "Calypso" (the former famous for its escape from Apia during the fatal hurricane), 2,770 tons and 14.6 knots; fifteen gunboats of the "Archer" and "Barracouta" classes, of 1,830 and 1,580 tons and 18.6 and 16.5 knots; besides some forty or fifty smaller and slower gunboats. Of these only the "Blake" and the "Blenheim" can be considered thoroughly up-to-date vessels.

The Naval Defense Act, in addition to 10 battleships, called for 29 second-class cruisers of the "Apollo" class, of 3,400 tons and 20 knots, and 9 first-class cruisers of the "Edgar" type, of 7,350 tons and 20 knots. Of these 29 second-class cruisers, 11 were built according to the original design, as follows: Displacement, 3,400 tons; speed, 20 knots; armament, 2 6-inch, 6 4.7-inch rapid-fire guns, and 14 smaller guns. Ten others were built of identical dimensions, etc., but were sheathed and coppered to fit them for tropical waters, the displacement being thereby raised to 3,600 tons. The names of the 21 vessels are as follows: "Æolus," "Andromeda," "Apollo," "Brilliant," "Indefatigable," "Intrepid," "Iphigenia," "Latona," "Melampus," "Naiad," "Pique," "Rainbow," "Retribution," "Sappho," "Scylla," "Sirius," "Spartan," "Sybille," "Terpsichore," "Thetis," and "Tribune."

To give them better sea-going qualities and a more powerful battery, the other 8 ships were built with 20 feet more length, the whole battery was placed on a flush main deck (instead of on a forecabin and poop and in a well amidships), and two additional 4.7-inch guns were added. These ships were known as the "Astræa" class. Their particulars will be found under Plate No. 6.

The names of these 8 ships are "Astræa," "Bonaventure," "Cambrian," "Charybdis," "Flora," "Forte," "Fox," and "Hermione."

The 9 first-class cruisers of the Naval Defense Act are known as the "Edgar" class. They are smaller editions of the "Blake," with the same battery, but $1\frac{1}{2}$ knots less speed and a smaller coal supply. The dimensions, etc., of the "Edgar" are given under Plate 4. Five of the ships of this class: the "Edgar," "Endymion," "Grafton," "Hawke," and "Theseus," are similar to the diagram shown on page 376.

To improve their seagoing qualities, a raised forecabin deck was added to the other four ships, the "Crescent," "Gibraltar," "Royal Arthur," and "St. George," and the 9.2-inch bow-chaser was replaced by 2 6-inch rapid-firers. They were also sheathed and coppered, the displacement being raised to 7,700 tons.

The next addition to the navy included 11 second-class cruisers of the "Eclipse" class. Nine of these

were built to the dimensions, etc., given below Plate 5. Their names are as follows: "Diana," "Dido," "Doris," "Eclipse," "Isis," "Juno," "Minerva," "Talbot," "Venus." As compared with the ships of similar size in other navies, the armament was manifestly light, and in three later ships of the class: "Hermès," "Hyacinth," and "Highflyer," eleven 6-inch guns were mounted in place of five 6-inch and six 4.7-inch.

The next important addition to the fleet cruisers consisted of two huge vessels, the "Powerful" and "Terrible," of 14,200 tons and $22\frac{1}{2}$ knots speed. They were the first warships to have the length of an Atlantic liner, being 536 feet long by 71 feet beam. As will be seen from the front page engraving, they are imposing vessels, of handsome design. They have a flush upper deck throughout the whole length whose average height above the water line is about 32 feet. The main battery of two 9.2-inch guns is carried on this deck, the axis of the forward guns being about 38 feet above the sea. The battery of twelve 6-inch guns is disposed on the gun deck and berth deck below, four of the guns being in superimposed 6-inch armored casemates forward and four aft, the other four guns being in armored casemates amidships on the berth deck. The battery of sixteen 3-inch guns is disposed on the gun and berth decks, eight amidships, four in the bow, and four in the stern. The fire dead ahead or dead astern is one 9.2-inch, four 6-inch, and four 3-inch.

Apart from their size, these ships are remarkable as having been the first large ships in the navy to be furnished with a complete installation of watertube boilers. They are sheathed and coppered and carry the enormous supply of 3,000 tons of coal—more than they require, in view of the frequency of British coaling stations.

The next lot of first-class cruisers, known as the "Diadem" class, were smaller editions of the "Terrible." The poop is cut away (see diagram), thereby sacrificing gun command and officers' accommodations in favor of a saving of 300 tons of weight, the coal supply is re-

duced to 1,900 tons, and the speed is reduced from $22\frac{1}{2}$ to $20\frac{1}{2}$ knots, with a consequent reduction of the displacement from 14,200 to 11,000 tons. The two 9.2-inch guns are replaced by four 6-inch rapid firers, with the result that these vessels carry sixteen of these effective weapons, besides fourteen 3-inch rapid-firers and fourteen smaller guns. The vessels are all sheathed and coppered. The vessels in this class are as follows: "Andromeda," "Diadem," "Europa," "Niobe," "Amphitrite," "Ariadne," "Argonaut," and "Spartiate."

In Plate 8 we give an illustration of the "Pelorus," which is a good representation of the latest third-class cruisers of this navy. They are trim little craft similar to our "Marblehead," which is greatly superior to them in battery but inferior in speed and protection. The battery of eight 4-inch and eight 3-pounders is mounted on a raised forecabin and on the gundeck amidships. There are 11 ships of this class, and, including these, there are 44 vessels of the so-called third class cruiser type. They vary from 1,600 to 3,000 tons in displacement and from $16\frac{1}{2}$ to 20 knots in speed.

Plate 9 shows one of the latest gunboats of the "Speedy" class, in which are 11 identical vessels of 810 tons and 20 knots speed. The 13 vessels of the "Gleaner" type are somewhat smaller, 735 tons, but have the same speed and armament. The four gunboats of the "Haleyon" type have a raised poop and displace 1,070 tons, the speed being 19 knots.

The torpedo flotilla of the British navy differs from that of the other Continental navies in the large number of torpedo boat destroyers that it includes in proportion to the number of torpedo boats proper. The official lists show 109 of the former built or building, against 187 of the latter; whereas the French navy has about a score of destroyers to 232 torpedo boats. Great Britain has practically given up the construction of torpedo boats, and has been content to increase her force of destroyers, for the reason that the destroyer is capable of running down and sinking torpedo boats, while at the same time it is capable of taking the offensive against battleships and cruisers, with at least as much prospect of success as the smaller, but slower, torpedo boat.

The torpedo flotilla is made up of 97 torpedo boats of the first class, which vary in speed from 19 to 23 knots, and 90 of the second class, with speeds of from 16 to

23 knots. The fleet of destroyers is made up of 42 boats of the "Hornet" type, 48 of the "Desperate" type, 5 of the "Albatross" type; a 33-knot boat, the "Express;" a 35-knot propelled by the Parsons turbine; and 12 vessels recently tendered for, of an improved "Desperate" type. The particulars of the different types of destroyer are given in the following table:

Name of Type.	No. of boats.	Length.	Displacement in tons.	Horse power.	Speed in knots.	Armament.			Complement.	Coal.
						12-pounders.	6-pounders.	Torpedo tubes.		
Hornet.....	42	180	240	4,000	27.3	1	3	3	43	57
Desperate.....	48	210	300	5,400	30	1	5	5	58	80
Albatross.....	5	227.6	300	7,500	32	1	5	5	60	80
Express.....	1	227.6	300	10,000	33	1	5	5	60	80
Improved Turbinia.....	1	.....	.....	.....	35	.....	.....	.....	.....	.....
Improved Desperate.....	12	.....	.....	.....	30	.....	.....	.....	.....	.....

Of all the elements of a modern navy, the torpedo flotilla is the most uncertain and undetermined as to its value; but there is no doubt that, for the duties of such a navy as Great Britain's, the sea-going destroyer is preferable to the smaller and unseaworthy torpedo boat.

Summing up our review of the British navy, we consider that, in addition to the advantage that comes from numbers, the best features are the excellent sea-going qualities of the ships; the large supplies of coal, ammunition, and stores carried; the uniformity in the types due to building the ships in classes; the small number of patterns of guns, thereby avoiding confusion and complication in ammunition; and lastly, and perhaps most important of all, the excellent personnel and the undoubted esprit de corps of the navy.

The defects are, in the battleships, the unarmored ends, the fact that the breeches of many of the large guns are unprotected, and in the later cruisers the total absence of side armor at the water line. Most serious defect of all, however, and one that cannot be too soon remedied in future ships, is the fact that the ships, both battleships and cruisers, do not carry as powerful armaments relatively to their great displacement as are found in ships of other navies of the world. Ship for ship, the "Majestics" would probably be a match for any French or Russian battleships they might encounter, but, with their excess of 2,000 to 3,000 tons displacement, they should carry an overwhelming preponderance of armament.

THE SIPHON OF THE CLAM.

BY C. F. HOLDER.

The interesting clam with elongated siphon shown in the accompanying illustration was taken at Long Beach, where the art of clamming is conducted in an interesting manner at times. Instead of the single clammer on the beach at low tide, often a picturesque object from the dunes, we see a man plowing a long furrow in the sands, hoping in this way to throw up hundreds of the succulent bivalves.

To those who frequent muddy shores at low tide, the hole of the clam is a familiar sight. Sometimes the latter is discovered near the surface, ejecting a spurt of water; and strange clicking, sucking sounds, the dulcet voice of the clam, have been heard by those who, out of curiosity, frequent its haunts.

In the accompanying illustration one of the most interesting features of bivalves is seen at its best, namely, the siphon, a singular continuation of the mantle, a fleshy chimney, so to speak, which enables the clam to rest at the bottom in security, and throw up this extension, and breathe and eat through it. The siphon in the cooked clam is a black, small, and retracted object, projecting but slightly from the shell; it is known as the head, a misnomer, as it is really at the posterior opening of the shell, and opposite the place where the head, if there were one, should be.

The siphon is a long, muscular, and exceedingly tough tube, really an extension of the mantle which incloses the clam, and, in this instance, divided into two tubes. To fully understand its office a glance at the interneconomy of the animal is necessary. Opening a clam, we find next to the shells a delicate gray mantle that encompasses the animal, so that it appears to be a bag holding the body of the clam and protecting it. At the posterior end the mantle is developed into the siphon, which contains two tubes. Opening the shell wider, we have the various parts before us. On the lower side is a muscular organ called the foot, that in some shells, as the razor clam, is an extraordinary member. This foot in some species, as the mussel, bears a remarkable gland which secretes a fluid that,



THE SIPHON OF THE CLAM.

SCIENTIFIC AMERICAN

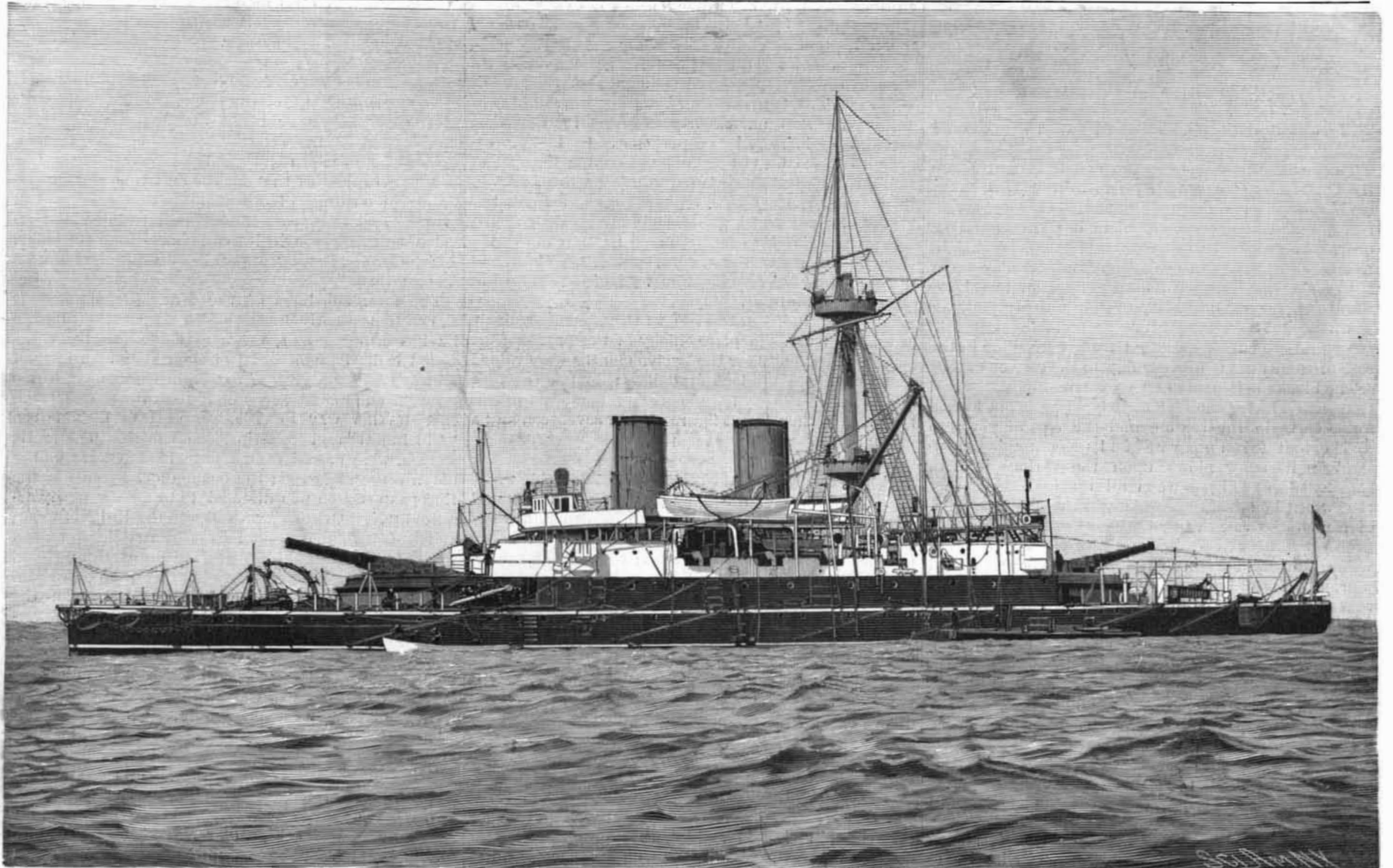
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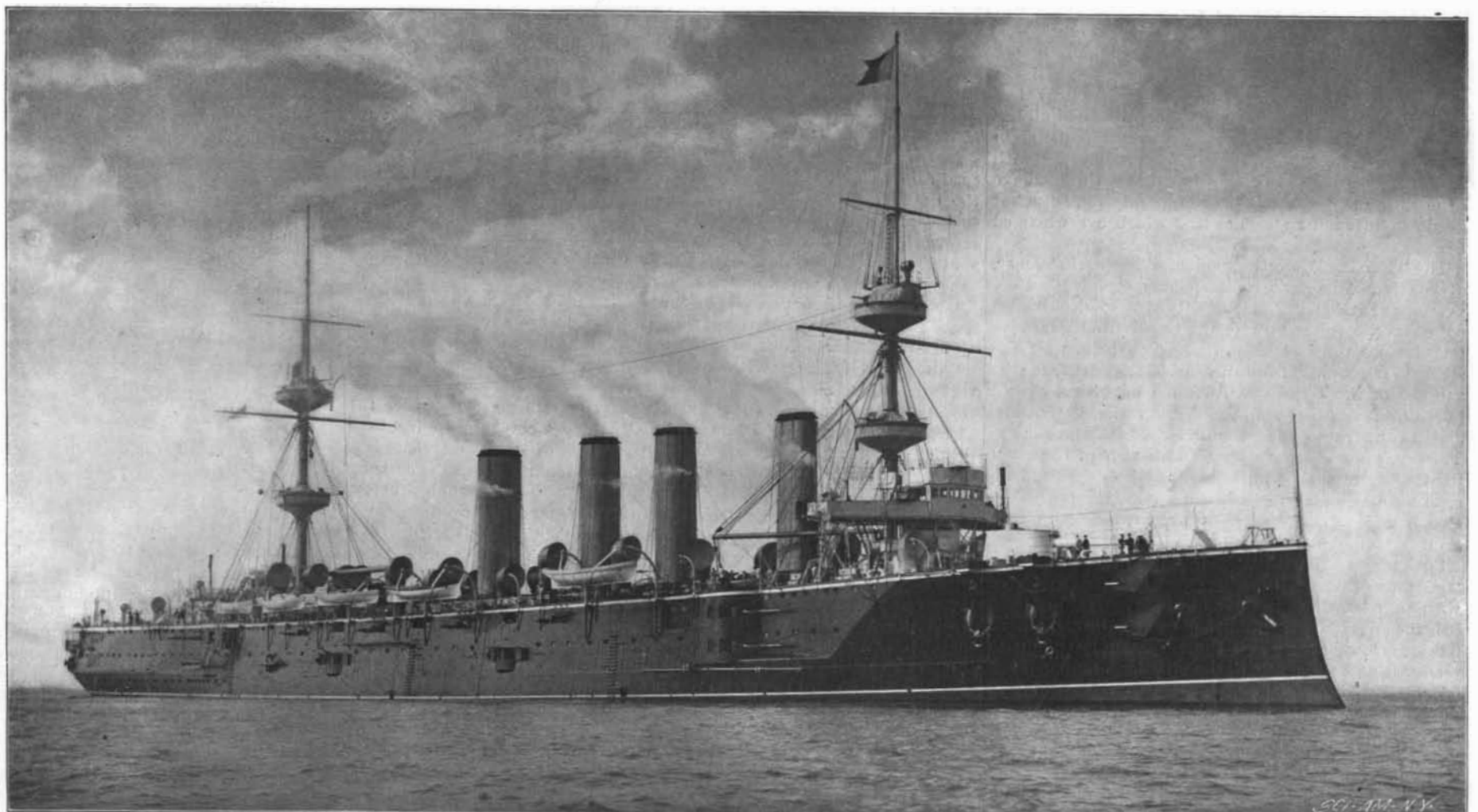
NEW YORK, DECEMBER 10, 1898.

[\$3.00 A YEAR.
WEEKLY.]



1.—First-class Battleship "Benbow." "Admiral" Class of Six Ships.

Displacement, 10,600 tons. Speed, 16-75 knots. Bunker Capacity, 1,200 tons. Armor: Belt, 18 inches; bulkheads, 16 inches; barbettes, 14 inches; deck, 2½ to 3 inches. Armament, two 16¼-inch 110-ton B. L. guns, ten 6-inch rapid-fire guns, ten 3-pounders, seven machine guns, two boat guns. Torpedo Tubes, 5. Complement, 509. Date, 1888.



2.—First-class Cruiser "Terrible." Also "Powerful."

Displacement, 14,200 tons. Length, 538 feet. Speed, 22½ knots. Bunker Capacity, 3,000 tons. Armor: Deck, 3 inches on flat, 6 inches on slopes; casemates and shields, 6 inches. Armament, two 9-2-inch B. L. rifles, twelve 6-inch rapid-fire guns, eighteen 3-inch rapid-fire guns, twelve 3-pounders, nine machine guns, two 3-inch boat guns. Torpedo Tubes, 4. Complement, 840. Date, 1895.

From photographs by Symonds & Co., Portsmouth, England.

NAVIES OF THE WORLD—I. GREAT BRITAIN.—[See page 876.]