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## Scientific American Supplement

**No. 1160.**

**For the Week Ending March 26, 1898.**

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### OUR RECENTLY PURCHASED WARSHIPS.

It may safely be said that Armstrong's is the only shipbuilding yard in Europe where we could have purchased two cruisers whose general features so closely approximate to the distinctive features of warship design as carried out in this country. From time immemorial American ships have been celebrated for their speed, and even more for the great power of their batteries. This was true in the days of the sailing frigate, when our ships were wont to crush their opponents with the weight of their superior gun-fire and their excellent markmanship, and the same powerful batteries are found on the ships of our new navy. The principle is a good one. It has proved effective in the past, and it will do so in our next naval war. The British "Magnificent" is half as large again as the "Indiana," yet the latter carries by far the heavier battery. The British "Blake" and our own "Brooklyn" are about the same size, yet the American ship is greatly superior in the weight of its guns.

Of late years the celebrated Armstrong firm, in the North of England, has been turning out ships which have carried truly enormous batteries compared with the displacement of the ships, and, at the same time, have shown themselves phenomenally speedy. The most noted instance of this is the renowned "Esmeralda," of the Chilean navy—not the old "Esmeralda," of the late Chilean war, but a new cruiser of 7,000 tons displacement. This vessel carries no less than eighteen rapid fire guns of the 8-inch and 6-inch sizes, besides eight 3-inch rapid firers and ten 6-pounders. From these guns she could pour into an enemy from either broadside during the first few minutes of the fight an amount of shell-fire whose total energy would be far greater than that of the biggest battleship afloat.

Our new acquisitions, the "Amazonas" and "Admiral Breu," are the very latest product of this yard and they exhibit the characteristic qualities of good speed and abnormally heavy battery, comparing in this respect with our own "Cincinnati." The principal dimensions, etc., of these twin ships are as follows: Length 330 feet, beam 43 feet 9 inches, draught 16 feet 10 inches, displacement 3,600 tons. They have twin screws and engines, the horse power being 7,500 and the speed 20 knots. Their normal coal supply is 700 tons, though they have stowage room for much more, and could therefore proceed at low speed far from our coal supply stations and reach hostile waters with a supply on hand. They are protected from stem to stern by a complete Harvey steel deck which is 3 inches thick where it curves down below the water-line along the sides. This 3 inches would present a sloping surface to the enemy, which would tend to deflect the projectiles. If they were not deflected the oblique 3 inches would be equal to a vertical wall of say 5 inches of Harvey steel. Before the shells could reach this deck, however, they would have to pass through 6 or 7 feet of coal which is stored in the wings of the ship abreast the engine and boiler rooms.

The battery, as we have said, is, for the size of the ship, very powerful. It is not only powerful in numbers, but owing to the fact that its guns are of the latest Armstrong pattern, they have vastly greater power for their size than guns that were built only four or five years ago. Armstrongs are the builders of the wirewound type of gun, which has shown results greatly superior to those obtained by the built-up type. Not only are these guns more powerful for their weight, but they have improved breech mechanism which enables them to be fired with greater rapidity. The following comparison of the Armstrong ship with one of the same size and type built for the British navy from government plans shows clearly the greater fighting power of the former. The figures are taken from the official tables of the British navy and the firm in question. The speed of fire is that actually obtained by crews on board ships in commission. The "Intrepid" is one of a class of thirty ships built under the late Naval Defense Act, and though not so up-to-date as the "Amazonas," may be considered as a good example of the average protected cruiser of the existing navies of the world.

COMPARISON OF TOTAL ENERGY OF FIRE DURING ONE MINUTE FROM EITHER BROADSIDE.

| | Number and Size of Guns. | Muzzle Energy. | Shots per Minute from Each Gun.* | Total Energy. |
|---|---|---|---|---|
| "Amazonas," 1897..... | Four 6-inch. | 4,840 foot tons | 6 | 116,160 |
| | Two 4·7-inch. | 2,158 " " | 12 | 51,792 |
| | Five 2·24-inch. | 280 " " | 20 | 28,000 |
| | | | | 195,952 |
| "Intrepid," 1892..... | Two 6-inch. | 3,356 " " | 5 | 33,560 |
| | Three 4·7-inch. | 1,494 " " | 10 | 44,820 |
| | Four 2·24-inch. | 137 " " | 20 | 10,960 |
| | | | | 89,340 |

* This rapidity of fire would not of course be maintained for any length of time in the excitement and slaughter of a modern sea fight. The figures, however, serve for the present comparison.

From this comparison then it is evident that although the two ships are of the same size, the "Amazonas" can deliver from her broadside more than double the energy of shell fire that the "Intrepid" can, although the latter ship was built only five years in advance of the former—such is the rapidity with which naval science and construction advances.

Foot-ton energy, which we have chosen as the basis of comparison, is the product of weight or mass by velocity; and as the weight of the shells for each caliber of gun is the same, the increase in energy is due to the very high velocities of the "Amazonas" guns as compared with those of the "Intrepid." Thus the 6-inch rapid fire Armstrong gun has a velocity of 2,642 feet per second, against 2,200 feet for the British naval gun; the Armstrong 4·7-inch gun has 2,630 feet per second, the naval gun 2,188 feet, and so on through the smaller calibers.

As further illustrating the development in naval design in a brief five years, we append a further comparison:

| | Thickness of Deck. | Horse Power. | Speed. | Coal Capacity. |
|---|---|---|---|---|
| "Amazonas"..... | 3 inches. | 7,500 | 20·00 | 700 |
| "Intrepid"..... | 2 " | 9,000 | 19·75 | 400 |

We find then that by the use of improved materials and methods the naval architect has been able, using the same capital (3,600 tons displacement), to produce a ship having superiority on every point of comparison—a ship with more speed, with 50 per cent better protection, 80 per cent larger coal capacity, and over 100 per cent more powerful armament.

We can imagine no more convincing argument for a systematic and continuous programme of naval shipbuilding than is presented by a study of these figures. The "Intrepid" was one of seventy-two warships which were authorized in a single appropriation and built with a rush. The present policy in England and Europe generally is to build so many ships each year, and thereby insure that each year's ships shall embody all the latest improvements. A similar policy will undoubtedly be adopted in this country, and its effect will be to bring the general average of the navy more thoroughly up to date.

### THE EFFICIENCY OF THE WATER TUBE BOILER.

The efficiency of the water tube boiler needs no demonstration at this late day; but the coal consumption trials which have lately been carried out on the new cruiser "Diadem" are worthy of note because of the size of the boiler installation and the high economy realized. The "Diadem" is a smaller edition of the "Powerful," which was of 14,000 tons displacement and 26,000 horse power, the displacement in the present case being 11,000 tons and the horse power 16,000. Like the "Powerful" she is furnished with the Belleville water tube boiler and carries such improvements in the way of economizers for heating the feed water and higher steam pressure as were suggested by the memorable boiler tests on the older ship.

The best results were obtained on a thirty hour test at 12,500 horse power—three-fourths of the full power—when the coal consumption worked out at 1·59 pounds per indicated horse power per hour. It is doubtful if this low rate is ever realized in the navy with the cylindrical boiler, and it is rarely reached with the same type in the merchant marine. The "Powerful" using the same boiler burned 1·83 pounds on a three-fourths horse power trial and the "Terrible" 1·71 pounds. The steam pressure on the "Diadem" was 280 pounds at the boilers and 245 pounds at the engines, and these pressures were maintained with little variation throughout the trial.

### IS OUR MARITIME COMMERCE VULNERABLE?

It is a fortunate fact that in the event of hostilities we should be practically invulnerable in a quarter where most nations would be open to disastrous attack. Great and rapidly increasing as is our foreign trade, only a very small percentage of it is carried in American ships. Although American shipping, inland, coastwise and deep sea or foreign, ranks in the aggregate next to that of Great Britain, we are secure from attack for the reason that the bulk of it is confined to the lakes and our great inland canal and river systems. As regards our foreign trade, for the year ending June 30, 1897, the proportion of foreign commerce carried by American ships was a fraction over 11 per cent, and for the month of December, the same year, it had decreased to about 7½ per cent. Thus it will be seen that in the fiscal year mentioned, for one ton of our commerce that was exposed to attack there were about nine tons which were safeguarded by the laws of neutrality.

Nor would our coastwise commerce, which is carried entirely in American bottoms, be so seriously affected as might be supposed; for the fastest of the ships which are in this trade would probably be utilized as auxiliary cruisers, and the merchandise, thanks to our superb system of seaboard railways, could be shipped by land.

Turning from the question of defense to that of attack, we note that the Naval Board appointed for the inspection and purchase of auxiliary cruisers has made a start by adding the late Ogden Goelet's fine yacht the "Mayflower" to the fleet. This is a brand new vessel of 2,400 tons and about 17 knots speed. The