

carrying a very light shield is demonstrated. Had there been no shield, the shell would possibly not have burst. The Chinese removed these shields from their 12-inch guns to avoid a similar catastrophe.

As evidence that some of our gunners must have got the range and direction with great accuracy, we direct attention to the concentration of shot-holes below the forward 5½-inch gun sponson, where there are seven holes made by a 6-pounder besides one 8-inch hole. Another concentration of fire is seen on the berth and gun decks below the sponson of the after 5½-inch gun, where there are nine hits by 6-pounders. In calculating the effects of these little shells, it must be remembered that they all passed through the unarmored shell of the ship and burst into flying fragments, one 6-pounder being easily capable of killing or disabling a whole gun crew.

It will be seen from the diagram that a considerable portion of the hull above the flotation line was submerged when the examination was made, so that it is probable that a dozen or more hits lay below the water and could not be observed.

The board consider that it "would be most difficult, if not impossible, to save this vessel."

"VIZCAYA."

Although the "Vizcaya" did not suffer so heavily from our gun-fire, she was so badly wrecked by fire and explosions that the board is of the opinion that it is inadvisable to attempt to save her.

So far as can be determined, the boilers and engines are intact, or, at least, not irreparably damaged.

**Effect of Gun-Fire.**—The "Vizcaya" received a larger proportion of large rapid-fire and 8-inch shells than any other vessel, being struck by no less than 16 of these shells as compared with only 13 hits by the 6-pounders. The effects on the crew were proportionately disastrous, and the report states that "it is evident that the fire of the gun crews of the 'Vizcaya' was very materially lessened and almost silenced by their not being able to serve their guns under the severe fire poured upon them by our ships."

The fact that evidence is lacking of the explosion of many of our shell should attract the attention of the Ordnance Department, though it is true that pieces of exploded shell may have struck parts since destroyed by fire.

The number of shell that struck the ship seemed to show by their direction that about one-half struck as she was leaving the harbor—the shell ranging aft; and the other half as she was attempting to run away.

"CHRISTOBAL COLON."

The board found the "Christobal Colon" lying on her starboard beam ends, the stern being about 150 feet from the shore, and her length lying in a direction nearly perpendicular to the line with the beach.

The depth of water at the stern is between five and six fathoms. The bow lies in a depth of about sixteen fathoms.

The deck is quite vertical. The battery on the port side, with the exception of the two forward 6-inch guns, is clear of the water. The forward and second 6-inch ports are submerged. The rest of the gun ports on the port side are out of water.

The bottom valves are supposed to be open. Many of the watertight doors were closed by the crew of the "Oregon" before the vessel capsized. The bilge keel is exposed, and also the port propeller and the propeller shaft.

There is no deformation visible in the deck or outside plating, except some dents where rock had touched the bottom, and there is no evidence of the vessel having sustained any structural injury. The extensive side armor will prevent local injury to the sides now bearing on the bottom, and the board believed that with the integrity of the skin plating and of the decks and transverse bulkheads, the vessel can sustain herself in her present position, even in a heavy surf, without injury.

Lieutenant Hobson is now engaged in the effort to

raise this ship, and should he be successful she will form a most valuable addition to our navy. The "Christobal Colon" was by far the best cruiser in the fleet.

The total number of hits that can be counted on the "Christobal Colon" is 8 or 9; but as only a small area of her sides is open to inspection, it is reasonable to suppose that she was hit more frequently than this. The most interesting hit was made by a 5-inch armor-piercing projectile, which struck the steel armor at the junction of No. 3 6-inch sponson at an angle of about 45 degrees, and after penetrating nearly through, rebounded. The hits on this vessel were chiefly received during the long chase by the "Brooklyn" and the "Oregon."

The conclusions drawn by the board from its examination are as follows:

That the use of wood in the construction and equipment of warships should be reduced to the utmost minimum possible.

That loaded torpedoes above the water line are a serious menace to the vessel carrying them and that they should not be so carried by vessels other than torpedo boats.

That the value of rapid-fire batteries cannot be too highly estimated.

That all water and steam piping should be led beneath the protective deck or below the water line and

ANALYSIS OF HITS ON SPANISH CRUISERS.

Size of gun.	Number of hits on each vessel.				Total number of hits by each caliber of gun.	Number of guns of each caliber in action.	Number of hits per gun.
	Teresa.	Oquendo.	Vizcaya.	C. Colon.			
6-pounder.....	17	43	13	4	77	42	1.83
1-pounder.....	2	..	..	..	2	13	0.15
4-inch.....	1	7	4	..	12	3	4.00
5-inch.....	3	3	7	2	15	3	2.50
6-inch.....	1	1	..	1	3	3	0.43
8-inch.....	3	3	5	1	12	18	0.67
12-inch.....	2	..	..	..	2	6	0.33
13-inch.....	..	..	..	..	..	8	0.00
Totals.....	29	57	29	8	123	103	..

is possible that the evidences of some hits have been obliterated—such, for instance, as may have been made by shells fired at considerable elevation from long range and have fallen on the decks or superstructure without penetrating the side plating.

Of the 123 hits recorded, 77, or more than one-half, were made by 6-pounders. Then come the 5-inch rapid-firers of the "Brooklyn," which evidently did splendid work against all the vessels, but especially against the

"Vizcaya," where seven 5-inch shells got home. The next largest number of hits is to be credited to the 8-inch and the 4-inch rapid-fire, the latter guns on the "Iowa" landing 12 shots. The 6-inch scored three hits, the 12-inch two hits, and the great 13-inch guns probably never landed at all. If they had, the mark of their 1,100-pound shells would be plainly visible on the vessels.

In studying the accompanying table of percentage of hits per type of gun, it is remarkable how closely the results agree with the forecasts as to what would happen in a naval engagement. On the theory that there will be a large number of misses for one hit, it is readily understood how the 13-inch guns failed to score a single hit—they did not fire often enough. Moreover, of the larger-calibered guns above 4-inch, by far the highest percentage of hits per gun was made by the guns of the rapid-fire type, namely, the 5-inch rapid-firers of the "Brooklyn" and the 4-inch rapid-firers of the "Iowa." Another curious fact is that if the percentage figure (0.43) for the 6-inch slow-firers be multiplied by the respective

rates of fire of the 4-inch and 5-inch guns, the result gives very closely the percentage of hits recorded for these guns, namely, 4 and 2.50.

We should naturally expect, arguing along the same lines, that the 6-pounder, on account of its very great rapidity of fire, would have shown the highest percentage of hits per gun engaged; that it does not is due, probably, to the fact that some of the fighting was done at ranges which were rather long for guns of such small caliber.

THE GUNDALOW.

To one who has had a passionate fondness for boats, who has sailed in all kinds of craft, from row-boat with homemade sail to yacht and coasting schooner, certain occasions stand out as real epochs in life. One may be the first sails in the easy-steering dug-out canoes and buckeyes of the Chesapeake and Hampton Roads, which glide along so quietly yet rapidly, one of the most interesting relics of the aboriginal life of the Southern coast. Another may be the first sight of a full-rigged ship under full sail on the Atlantic, a picture of incomparable beauty. Then may come the running through a fleet of red-sailed English fishing smacks in a dead calm in the British Channel, the tiny craft in color and contour delighting the eye. The Thames lighters, lying in the upper reaches of the Thames, with picturesque sloping gaff and brailed-up sail, or with their red sails spread driving up the river off Rochester and Greenwich, or beating like a fleet of yachts up the Medway, hold a warm place in the memory. Standing on the bridge at Rochester, near neighbor to or successor of the one on



THE GUNDALOW WITH LATEEN SAIL—A RELIC OF EARLY DAYS.

fitted with risers at such points as may be considered necessary.

ANALYSIS OF GUN-FIRE.

It is estimated that about 6,000 shells of all sizes were fired during the Santiago engagement, of which all but such as were aimed at the two destroyers, during the brief time that they remained afloat, were fired at the four armored cruisers. The diagrams of the shot holes show a total of only 123 hits as having been made on the metallic structure of the vessels. At first sight this would appear to be a very low percentage for such good marksmen as our American gunners are universally considered to be. There are modifying circumstances, however, which must be considered in connection with the accompanying table analyzing the gun-fire.

1. The first half of the battle, or that in which the "Teresa," "Oquendo," and "Vizcaya" were destroyed, took place under the confusion of a dense pall of smoke, none of these three or of the American vessels using smokeless powder. Moreover, what gentle breeze there was, blew off shore from the Spanish to the American fleet, bearing back both their own and the Spanish smoke upon the American gunners.

2. The smoke rendered it difficult to get the range of the Spanish vessels.

3. The diagrams show only the shot holes that were visible above water after the cruisers had settled more or less in the water.

4. There were a few hits on the starboard side that do not appear in the diagrams.

5. The woodwork having been all burned away, it

which Mr. Pickwick and the dismal man held converse, the writer learned to admire the Thames lighter, craft sacred to the memory of Jacob Faithful, and he still hopes to sail on one. The Venetian boats with painted sails, slender bowsprit and decorated bluff, high bows, the sailing gondola, and the hours spent in learning the mysterious art of gondoliering, when the oar persisted in slipping out of the shallow notch in the forcola, or rowlock, all are golden memories. A sail in the harbor of Levorno on a lateen-rigged open boat, the distant view of a felucca from the Riviera, bring to mind a railroad trip from Newburyport to Portsmouth, N. H., taken simply in the hope of seeing a gundalow, the only American representative of the Mediterranean felucca.

These interesting craft are nearly extinct. By special effort we secured the view shown of the gundalow "Fanny M." She was built in 1888. She is sixty-nine feet long, eighteen feet six inches beam, and four feet draught. The short mast rises twenty feet from the deck, and carries the great yard, sixty-eight feet in length, counterbalanced by iron weights at its lower end. There are 259 yards of duck in the sail.

We are indebted to her owner, Capt. Edward H. Dunham, for the following notes on gundalows, which form a most valuable contribution to the history of naval progress on this side of the Atlantic.

Gundalows were used on the Piscataqua and its branches before the revolutionary war. Gen. John Sullivan at the time of that war, with some men, boarded one at Durham in the night time, and went down twelve miles to Forts William and Mary, at the mouth of the Piscataqua, and captured a quantity of powder from the British. Returning to Durham with it, they hid it under an old church, whence it was drawn by ox teams to Concord, N. H., and Bunker Hill, Mass., arriving in time to reinforce the supply used in those momentous times.

They were short decked, bow and stern open, where the freight was carried and propelled by long oars and poles. These were not run with a sail, but later on they were rigged to sail with a short square affair to go in a fair wind.

The first one to go with a lateen sail was rigged by Dyer Foye, of Dover, N. H., about fifty years ago. They also then had a leeboard and rudder.

The ones rigged with square sail were pulled around with oars like a raft. The first boats had no rudder to steer by. A notch was made in the stern in which a steering oar was placed.

About forty years ago they were constructed with full deck. Since then the cargo has all been carried there. Sideboards are fastened up by means of hooks to form bunkers when coal is to be freighted.

Probably the lateen sail was taken from that style of sail used on a boat called a packet which was used to carry cotton to Exeter, Durham, Dover, New Market, and the heads of the streams from Portsmouth, returning thither with provisions. It was a short deck, keel boat. These were in favor, as the sail was portable in passing under the bridges.

It is true that there are very few gundalows left at all and only two that sail, one of which is shown in the cut. The reason of this is the large size of the boat of to-day, some carrying from fifty to one hundred tons. The average tonnage of the old time ones was about twenty tons, and the difficulty of navigating the large modern gundalows in the strength of the current which runs very swiftly is very considerable, especially through Dover Point Bridge, which was constructed in 1873-74. This is considered one of the hardest passes to navigate in the country, as the current runs counter and few care to undertake the task.

The few that do not sail are towed by small steam tugs, which makes the business from a lucrative standpoint less attractive than formerly.

**The Rays of the Glow-worm.**

The pale green light that shines from the posterior portion of the so-called "glow-worm" is said to be due to the emission of X rays. By the way, this creature is not a worm at all, but the wingless female form of a species of beetle, the *Lampyrus noctiluca*, and her luminosity is supposed to afford the means of attracting the non-luminous male.

Recently three hundred of these insects, according to the *Revue des Sciences*, were made the subjects of experiment by inclosing for two days in a dark chamber, sheltered from all foreign lights, and placing before photographic plates screened by several thicknesses of black paper, besides plates of brass, copper, and aluminum; also a piece of cardboard with a hole in it was interposed between the plates and the photographic plate. On developing the latter, it was found to be blackened, except at the part opposite the hole in the cardboard. The rays of the *Lampyrus*, therefore, appear to have penetrated the metal and excited luminosity in the cardboard. It was subsequently discovered, also, that when there was nothing between the sensitized plate and the "worm," the rays acted as do those from ordinary light, but in traversing cardboard and certain metals, they acquired the properties of the Roentgen rays. It is suggested that possibly

these creatures have the property of emitting both forms of rays.

The foregoing savors somewhat of the improbable, and the editor of the *Revue* suggests further and more definite experimentation; he also adds, as regards the power of emitting dual forms of rays, that there may be a third form that will prove explanatory.

**Oiled Clothing.**

A suit of oiled clothing such as is commonly worn by sailors, consisting of a coat and a pair of trousers, costs from \$1.50 to \$2.50, according to the quality; an oilskin sou'wester costs 25 to 50 cents. There are many makes of oiled clothing, including some whose trademarks have been familiar for many years. The oilskin coat hanging outside the outfitting and supply stores in streets along the water front has long been a familiar sign, says *The New York Sun*.

The life of an oilskin suit depends, of course, primarily upon the wear to which it is subjected, but largely also upon the care taken of it. An oilskin suit will last longer and keep much better if hung up when not in use than it will if rolled up, but it may be that the user has no place to hang it, or that he keeps it rolled up to be ready to carry with him at any time as a pilot would do. In dry latitudes, where a sailor has less occasion to wear them, his oilskins, if cared for, would, of course, wear longer than where they were often worn. Usually, the average life of an oilskin suit worn by a sailor would be about a year.

When a sailor's oilskins crack or get worn so that they are not waterproof, he oils them. They may need oiling two or three times a year. There are prepared oil dressings made for this use and put up in little tin cans. Some sailors use oils of one sort and another, and some sailors make a mixture of their own for a dressing. The sailor is likely to have a preference for some one brand of clothing and to stick to it. And he has his own ideas as to the best dressing for it, but he carries always with him a dressing of some sort. It is put on with a brush, the garments being hung up and painted with it.

Oilskin coats worn aboard ship by men before the mast are cut short, so as not to interfere in any way with their movements. The coats worn by the officers of a ship are cut longer. The officers in some cases wear rubber coats, but the oilskin is the coat they commonly wear.

While oiled clothing and the traditional sou'wester are most familiarly associated in the mind with ideas of sailors and of the sea, they are also, as a matter of fact, very largely and extensively worn upon the land by truckmen and car drivers, and many other outdoor workers and by sportsmen.

**Cycles for Farmers.\***

Appreciation of the bicycle has penetrated so deeply into the whole American public that one dollar wheat is likely to mean a great deal to the cycle trade, on account of placing cash money in the hands of a large class of the population whose purchasing capacity has heretofore been limited. "Kansas City, perhaps the most important market for agricultural implements in the country," says one of the commercial agencies in its weekly summary of conditions, "reports the demand exceeding all records and sales limited only by the ability to deliver orders." The West needs agricultural implements and, having the money, buys them. The rural population in the Eastern and Central States is better provided with the tools of agriculture and has less need of investing the money obtained from the sale of grain in this line of goods. The indications of unusual prosperity are therefore less pointed among farmers in the older States, but there is no reason to doubt but what a very gratifying amount of money is in circulation in country districts all over, and will be expended in part for a commodity like bicycles, which satisfies nearly all those cravings for fashion, utility, and sentiment that induce men to part with their money.

What preparations should be made for the trade which seems to be within easy reach under these hopeful conditions is a problem which is already occupying the attention of business men who have made it their particular line to supply rural trade. Catalogue and mail order houses are early in the field with cheap bicycles and undoubtedly will reap a harvest. Great efforts are visible in the advertising columns of country newspapers on the part of dealers in second-hand cycles, and these, too, will probably be rewarded by a good trade. The most salient point in the situation seems to be the fact that the affluence of the rural class is something already in operation and more strongly felt in general trade at the present moment than it is likely to be at any later period of the season. Nearly everybody has sold his wheat and has the money where it is instantly available. As time progresses there will be less to spare for purchasing cycle goods than there is now, and thus it seems to become the proper policy for manufacturers and agents to train their batteries on the new possibilities with as

\*The Cycle Age and Trade Review.

little delay as may be, and get a stock of suitable goods on hand ready for the very first manifestations of the demand which appears coincidentally with mild weather in each locality.

Dealers in small towns probably have it in their own hands to decide whether the business which is in prospect shall be done by them or by the department store in the nearest larger town. Unless they make a special effort to impress their rural neighbors with the merits of their line of goods and are fortified with a respectable assortment of stock to choose from, it is easy to predict that the real advantage which they may be able to offer to customers will be looked upon lightly by the class of people under contemplation, whose inexperience in cycling affairs makes outward appearances all-powerful for business purposes.

In certain territories the great need of immediate action, which is due to the momentary prosperity of the agricultural class, has apparently been realized, for dealers in these localities have lately been sending in many rush orders of goodly size, although previously they were found so callous to the arguments of the traveling salesman as to drive this usually suave and hopeful individual to despair. But in other localities that are blessed with very similar possibilities for a brisk business the agents are still sitting with their arms folded and looking unutterably suspicious when a reasonable wholesale price is mentioned. They may have determined to leave the bicycle business and allow it to drift into stronger hands than their own; but if this is not their plan, it would seem worth while for them to consider if there is likely to be any other period in the year 1898 when their chances for profitable trade will be as bright as just now. Having to deal largely with a new class of buyers and competing with large stores in the nearest large city, their success must depend upon their ability to impress the public forcibly with the commercial inducements at their command, so that the comparison which the rural customer draws between him and the large city store shall not be altogether in favor of the latter, but shall at least leave a lively doubt for his benefit on the score of intelligent selection of models and responsibility for their workmanship.

In this matter of helping the minor agent to hold up his head and maintain his commercial prestige in spite of a small stock and meager displays, manufacturers have done little, but the prospects of a rushing cash business which is most likely to go to the dealers that make the greatest showing and the smallest prices may perhaps this year induce a new order of things.

**The Current Supplement.**

The current SUPPLEMENT, No. 1184, contains a number of articles of unusual interest. "The Design and Construction of a Sensitive Laboratory Balance" is another practical article by N. Monroe Hopkins, who two weeks ago described an electrical furnace for the use of amateurs. With proper attention to the instructions any amateur can make, within a week's time, a balance which will be as good for all practical purpose as one for which he would have to pay \$125. The balance described is so delicate that when the pans are fully loaded they will turn, with the addition of one-quarter of a United States postage stamp, to either side. The article is accompanied by eight illustrations, giving the various steps in the manufacture of the beam, etc. We are sure that many of our readers will like to have a fine balance for laboratory use if they could make it themselves at small cost. "American Progress in English Industries" is referred to elsewhere editorially. "Something About Brass Furnaces" is an article which will interest all brass founders. "Prince Henry of Prussia, in China," is a handsomely illustrated article showing the summer residence of the Emperor of China. The late French architect Charles Garnier has an appropriate biographical notice accompanied by a portrait. "Experiments with Currents of High Tension of Great Frequency" describes a number of curious and interesting experiments. "Acetylene Burners" is an article giving detailed illustrations showing the construction of several leading types of acetylene burners. "Glacial Geology in America," by Herman L. Fairchild, is continued. This is an important address delivered before the Boston meeting of the American Association for the Advancement of Science.

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