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Price 10 cents. For sale by all newsdealers.

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LESSONS OF THE SANTIAGO NAVAL ENGAGEMENT.

The Board of Survey which has been examining the wrecks of the Spanish ships near Santiago has made certain recommendations regarding the future construction of warships. As reported in the press dispatches the most important suggestions are as follows:

- 1. That no wood should be used in the construction of battleships.
2. That the fire mains should be placed entirely below the protective deck.
3. That if torpedoes are carried on fighting ships, they should be below the water line.
4. That the rapid-fire batteries are of supreme importance.

The fact that each of these recommendations has been persistently urged of late years by naval constructors goes to prove that the art of warship building is by no means so tentative and theoretical as is commonly supposed. It is also noteworthy that the lessons of this fight as here given are the very same that were taught by the battle of the Yalu between the Chinese and Japanese fleets, and emphasized only a few weeks ago in the destruction of the Manila fleet.

Of the four suggestions of the Board, the abolition of wood is undoubtedly the first in importance. Anyone who understands how fierce is the heat engendered by the explosion of a shell will realize that the presence of wood, or indeed of any inflammable material in the proximity of the explosion, is more than likely to start a fire of greater or less intensity. If the ten pounds of powder were taken out of an 8-inch shell and burnt in the open, comparatively little heat would be noticeable; but when the charge is burnt in the closed chamber of a shell, the temperature increases with the increase of pressure until at the instant of rupture the heat is terrific—sufficient to cause any combustible material, such as wood, to burst instantly into flames.

Wooden decks, wooden partitions between staterooms, wooden furniture, should be absolutely barred from the interior of a ship which is intended to become the target for bursting shells, and particularly so if the shells contain high explosives. The suggestion to banish the time-honored wooden deck will raise a protest from any sailor who has never been between decks when shells were bursting there; but we think that the captains and crews of the fire-scorched "Vizcaya" or "Teresa" will, in the future, prefer to fight on plate steel decks, where wooden bulkheads and furniture are a thing unknown. There is absolutely no excuse for the presence of wooden bulkheads and partitions on a modern warship. In our reconstructed "Chicago," the staterooms are divided by partitions of corrugated iron; and if considerations of comfort in peace-time cruisers demand that wooden decks shall be laid, the planking should all be treated by some satisfactory fire-proof process. From Commander McGiffen's memorable account of the Yalu, it is evident that the Chinese spent as much time fighting fire as they did in fighting the enemy, and it was the same terrible foe that finally caused the Spanish captains to up-helm and run for the beach.

The wisdom of the second recommendation is evident from the experience of the "Maria Teresa." Soon after she came out of the harbor, a shell set fire to her after cabins, and according to one of Admiral Cervera's staff, when a signal was sent to the engine room to start the pumps, it was found that the fire mains had been broken by a shell. Fire mains are as much out of place above the protective deck as steam pipes; the hydrants alone should be exposed.

The third recommendation of the Board, that no torpedo tubes should be carried above the water line, is, no doubt, prompted by the fact that the bow of the "Vizcaya" was torn asunder by her own bow torpedoes, which were exploded either by being struck by our shells, or by the heavy concussions, or the heat of the conflagration to which they were exposed during the fight. The great risk to the ship itself in carrying torpedoes above the water line had already been shown at the Yalu, when a Chinese cruiser which attempted to ram was sunk by the explosion of her bow torpedoes, due to a hit by a Japanese shell. So greatly did the Chinese dread the risk, that in many ships they threw the torpedo warheads overboard before the fight. Until a sea fight takes place between two thoroughly efficient fleets, both manned by crews that can do good shooting and in the care of officers that are expert in the handling of their ships, it will be too early to say that the ram and the torpedo are to be abolished; but the absolute necessity for placing torpedoes below the water line has been recognized for several years, and submerged launching tubes are now installed in the latest foreign battleships. The more advanced of our experts advocated the installation of submerged tubes on the "Alabama," "Wisconsin," and "Illinois," but for some inscrutable reason were overruled. We are glad to know that they will be fitted on all of our new ships. The submerged tube is placed below the protective deck, and therefore below the water line; hence the torpedoes are never brought above the water line, and they are as completely sheltered from shell fire as are the engines, magazines, or boilers. Drawings of the submerged firing tubes as installed in foreign navies

will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

The supreme importance of the rapid-fire gun is once more attested. It was the 4.7-inch guns of this type on the Japanese cruisers that enabled them to crush the more heavily armed and armored ships of the Chinese fleet; and we have it on the word of the Spanish officers that it was the storm of well-aimed shells from our secondary batteries that drove the Spanish crews from the guns. The big 12 and 13-inch guns did not prove to be so effective as the secondary batteries. The ships appear to have been hulled by the 8, 6, and 4-inch weapons, while the superstructures were riddled by our 6-pounders, which are very effective at the close ranges at which the fight was carried on. If the report that the Spanish ships were rarely struck by our heaviest guns is correct, the fact furnishes another parallel to the Yalu engagement. Four of the Japanese vessels carried a 12½-inch Canet gun of 66 tons weight, which was, and is, one of the most powerful weapons in existence. Theoretically, they should have sunk every ship in the Chinese fleet; as a matter of fact, they did very little damage.

We know of no reason why a 13-inch gun should not reach the mark as certainly as an 8 or 6-inch weapon, unless it be that its slowness of fire, coupled with the enormous percentage of misses that occurs in the heat of an engagement, reduces its chances of scoring a hit to a very low figure. It is here that the incalculable value of rapid fire comes in; out of the storm of rapid-fire shells which poured upon the doomed Spanish ships a large number were certain to land, even if only one in ten found the mark.

Finally, we would draw attention to the great value of armor protection for the gun crews. The rapid-fire batteries of the "Vizcaya," "Teresa," and "Oquendo" were very inadequately protected, as the searching fire of our "pounder" guns soon demonstrated. The value of a gun is multiplied four-fold if it carries a stout shield and the sides of the ship in the wake of it are plated with a fair thickness of armor. It is contended by the English designers that if their ships do not carry so many rapid-fire guns as other ships of an equal or less displacement, the protection of the guns by 6 inches of steel more than offsets their numerical inferiority. One excellent feature of our latest battleships is the splendid protection afforded the 6-inch rapid-fire batteries. The murderous fire that drove the Spaniards from their guns would much of it be ineffective against the secondary battery of the "Kearsarge" or "Alabama."

CAMPAIGNING IN THE TROPICS.

It is a well known military axiom that one practical and experienced soldier in the field is worth from six to ten times the value of the new recruit. The truth thereof is patent, for were it otherwise there would be no need of military establishments of any kind, other than convenient depots for munitions and supplies.

Experience, the dearest of all schools, especially when had through repeated mistakes and failures, has taught that the soldier, in order to present the greatest degree of efficiency, must not be called upon, except perhaps in dire emergency, to perform duties that are foreign to his immediate calling; in other words, to quote a Turkish aphorism, "a good bayonet makes a bad plow." This has been recognized in the abandonment of the heartbreaking "attention" that in former days kept rank and file immovable for hours merely for purposes of pomp and show, and the doing away with unsuitable and glittering trappings that required constant labor to keep in order.

To-day, in the better regulated foreign armies, the soldier is relieved of every burden consistent with his career as a combatant. The uniform, especially that for tropical service, is designed wholly for utility; food is carefully selected to meet the requirements and exigencies of the climate; barracks, camps, billets, hospitals, tents, canteens, bath houses and latrines are arranged and cared for in a way to promote a maximum of comfort, freedom, cheerfulness, and health. The British or Dutch soldier in the tropics is no longer asked to waste his strength and vitality in road building, trench digging, or the upthrowing of redoubts; this is relegated to a native and acclimatized contingent, who individually are much more effective. The "kit," too, which, in the "light service order" of the British army, weighs but 25 pounds—everything, in fact, but firelock, cartridges, and water flask,—upon the march is now relegated to the baggage train or to bearers specially provided for the purpose, the latter also performing the bulk of the camp drudgery and routine. Thus individual healthfulness, cleanliness, and smartness is inculcated and enforced by constant salutary inspections, medical and otherwise, for even bathing is compulsory; at the same time the fatigues and accidents of the march are in great degree obviated, individual belongings preserved and made always available that otherwise would be thrown away and lost, and the strength of the command is conserved for those duties which are of a purely military character.

Fatigue and exhaustion, more than any other factors, contribute to the rise and dissemination of the diseases