

Scientific American.

ESTABLISHED 1845

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

TERMS FOR THE SCIENTIFIC AMERICAN.

(Established 1845.)

One copy, one year, for the U. S., Canada or Mexico.....\$3.00
One copy, six months, for the U. S., Canada or Mexico..... 1.50
One copy, one year, to any foreign country, postage prepaid, £0 10s. 5d. 4.00

The Scientific American Supplement

(Established 1876)

is a distinct paper from the SCIENTIFIC AMERICAN. THE SUPPLEMENT is issued weekly. Every number contains 16 octavo pages, uniform in size with SCIENTIFIC AMERICAN. Terms of subscription for SUPPLEMENT, \$5.00 a year for the U. S., Canada or Mexico, \$6.00 a year, or £1 4s. 8d., to foreign countries belonging to the Postal Union. Single copies 10 cents.

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(Established 1878)

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NEW YORK, SATURDAY, JULY 23, 1898.

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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 12 1/2-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

peculiar to hot climates or that are wont to ravage camps with unusual virulence; and these too often are the result of improper clothing and the burdens of equipment, supplemented, perhaps, by duties required that could be more reasonably and ably performed by natives. In this connection it may not be amiss to call attention to an incident in the French campaign in Madagascar, an island bearing a wonderful similitude to Cuba in that it possesses topographically the same general features, has like peculiarities of climate, and south of the equator has relatively the same latitudes and isothermals as has Cuba to the north of the line.

In 1895, the 200th Regiment Infantry of the Line, 1,200 strong, left Paris for Madagascar. It was composed of young soldiers, practically of the same material physically and socially as our own volunteers. "Robust, agile, and merry, they appeared able not only to defy the efforts of any human foe, but also to remain invulnerable to the onslaughts of a more potent enemy—the noxious emanations of marsh lands and pools." After an uneventful voyage and unopposed landing, this regiment was set to building a highway, whereby artillery and supplies might be transported to the table lands of the interior. In spite of rigidly enforced sanitary measures, suitable food, and appropriate clothing and equipment, the men died like sheep; heat-apho-plex, typhoid, dysentery, malarial fevers, diarrhea, each claimed its quota of victims. Eighteen months after leaving France, this regiment returned—it had not participated in a single skirmish—a mere handful of two hundred and odd gaunt, fleshless, yellow "convalescents," several of whom were to follow the thousand of their comrades that had "gone before." Why native laborers were not employed, which—as is also true of Cuba—could be had in abundance, is one of the mysteries of military administration.

Much has been said about acclimatization, immunes, etc., but it must be remembered no one is immune or acclimatized in the face of exhausting labor and un-called for hardships, or when camped in the midst of swamps, surrounded by camp effluvia and decaying and fermenting forms of luxurious tropical vegetation. Add to the foregoing terrific heat, improper head covering, deluging cold rains, and oftentimes unfit food, and one has a fair summing up of the conditions under which the army is operating in Cuba.

It is to be sincerely hoped that, with the fall of Santiago, the conditions surrounding the army may be so modified that the loss from fevers and exposure may be reduced to a minimum.

#### THE FALL OF SANTIAGO.

The capitulation of the city of Santiago de Cuba and its defenses, on the 14th instant, is a cause for general congratulation. Not only has the campaign in the province of this name been exceedingly brief, considering the strength of the fortifications and the topographical features of the country, but the victory has been obtained at an astonishingly small expense of life and blood. In less than a fortnight Cervera's fleet was destroyed, and the American ensign raised over Morro Castle and its outlying and contiguous fortifications—surely, glory sufficient for a campaign of scarce thirty days, made by a mere handful of troops that at no time exceeded 24,000 in number. Gen. Shafter has certainly permitted no useless delays, but has pushed his military operations with surprising vigor. Even the most sanguine, possessed of any appreciation of the difficulties to be encountered, dared not predict so speedy and glorious a result. The terms of capitulation are, moreover, creditable to the military genius of the nation and its humanity.

Gen. Toral and his entire command are to be sent home to Spain at the expense of our government—a procedure that cannot but commend itself to all. May those who fall into our hands by the future fortunes of war ever receive equal consideration, in degree if not in kind, remembering individuals are not responsible for the shortcomings of national administration, and that loyalty is at all times an honor and virtue.

The greater part of the province of Santiago, comprising the easternmost portion of Cuba, is now, actually or nominally, under the United States flag and American rule. Thus is established an excellent base for future military operations, whether they are extended toward Havana or carried across the Caribbean Sea to Puerto Rico.

Many there are who deem the capitulation of Santiago heralds the dawn of peace. This is devoutly to be hoped for, yet is exceedingly improbable. The terms Spain is now willing to accept and those the United States can offer are separated by a wide gulf. Yet the American people can afford to be generous, and an exorbitant indemnity, it is trusted, will not mar any negotiations. The Spanish people and nation have had their own troubles during many a decade. Misfortune has followed misfortune, and it is not becoming to us as a nation to unnecessarily add to burdens that are already extreme. True, the Spanish nation has no real conception of its losses or the utter lack of available resources, and there has ever been the latent hope of foreign intervention, which, after all, appears to

be carefully fostered in certain quarters, and for some political purpose that can only be surmised.

#### TWO INTERESTING DECISIONS.

Judge Lacombe has just handed down a decision in the infringement suit brought by the Welsbach Light Company, under United States letters patent to Rawson, No. 407,963, dated July 30, 1889, against the Apollo Incandescent Gas Light Company et al., in the United States Circuit Court for the Southern District of New York, denying a motion made by the complainant for a preliminary injunction. This patent is for the process of strengthening the mantles, used in the Welsbach and other lamps of that type, to protect them against breakage in transportation and handling, by coating the completed mantle with "paraffin or other suitable material, which is burned off when the mantles are erected." In an action brought by the Welsbach Company against the Sunlight Inc. Gas Lamp Company (83 Off. Gaz., 595), Judge Townsend sustained the patent, giving it a broad construction and holding that a solution of collodion and castor oil was covered by the claim for "paraffin or other suitable material." On the strength of Judge Townsend's decision, several preliminary injunctions have been granted by the courts restraining various manufacturers from infringing the patent. In this suit against the Apollo Company, it was contended that the Rawson patent was void because the alleged invention had been patented in France by Rawson on November 2, 1887, and that this French patent had lapsed because of non-payment of annuities. This point was not passed upon by Judge Townsend, and Judge Lacombe held that the question as to whether or not the lapsing of a foreign patent, subsequent to the application but before the issue of a United States patent, invalidated the latter, was so much in doubt that it should not be decided upon preliminary motion, but upon final hearing.

In the case Kellar vs. Strauss, also an infringement suit, the complainant annexed to the bill of complaint written interrogatories requiring the defendants to state, under oath, how many of the alleged infringing devices (one of which was annexed to the bill) they had made, used, or sold and how many they had on hand for sale. The defendants in their answer refused to reply to either interrogatory and the complainant excepted, insisting, upon the argument, that upon the authority of National Hollow Brake Beam Company vs. Interchangeable Brake Beam Company (83 Fed. Rep. 26), the defendants must be compelled to answer the interrogatories; but Judge Lacombe declined to follow the decision of Judge Adams in that case and overruled the complainants' exceptions, holding that the complainant was not entitled to know how many of the alleged infringing devices had been made or sold until the validity of his patent and his right to an accounting had been established at final hearing.

#### RESPONSIBILITY OF STEAMSHIP COMPANIES IN MARINE DISASTERS.

BY DR. C. E. DE M. SAJOUS.

The particularly distressing circumstances attending the loss of the "Bourgogne," and the suddenness with which she entombed hundreds of unfortunate passengers, recalls the following statement made nearly thirty years ago by the president of the British Naval Architects: "The passengers who pass to and fro are not judges of the question, they can take no precaution for their safety; it is to the skill and science of those who build these ships that the passenger trusts, and to the care which the legislature and the government are bound to take of their fellow subjects." An unbiased critic can but concede that the strides in naval architecture and engineering during the last thirty years are entitled to the highest recognition. In speed and comfort the high-class passenger ships of our day are marvels of ingenuity; and if human intellect required evidence of its greatness, none stronger could be adduced than that afforded by one of those imposing masses of steel, representing combinations whose description alone would fill a large volume. But can the same encomium be bestowed upon the life-saving means of these very ships? Have the improvements in their construction included correspondingly valuable modifications with a view to saving the lives of their passengers? Have the appliances, such as life-boats, life-rafts, life-preservers, etc., kept pace with those calculated to increase power, carrying capacity, and other purely commercial advantages? Surely inventors have done their share, and the Patent Office contains a multitude of models of appliances of value. But have the companies availed themselves of these? Have they devoted one-tenth of the energy in this direction that they have to the saving of—coal? In the name of the victims, their parents, their widows, their children, and their friends, I ask: Is everything that *could* be done by companies *being* done to prevent disasters such as that of the "Bourgogne"?—a mere repetition of that of the "Elbe" in 1895.

But little knowledge, but little research, but little observation, are required to warrant the conclusion that things about a passenger ship, having life in view,

are not much farther advanced now than they were during the earlier years of steam navigation. The old davits with tackle, the so-called ship's lifeboats, the main appliances in case of accident, are practically the same as they were in 1837, when the "Great Western" made her maiden trip across the Atlantic, while bulkheads were a prominent feature in the construction of the old "Great Eastern." Apart from the indirect protection afforded by increased size, what is there to prove that modern genius has been utilized in the interest of life as well as it has in every other direction?

To judge from results, collision bulkheads have rendered valuable service, whether the object struck was a vessel or an iceberg, i. e., under special circumstances. But a review of the collisions of the last thirty years tends to prove that vessels receiving blows, and therefore depending on the intervening bulkheads, sink faster than wooden vessels did. Bulkheads may be at fault, but other reasons are also given by naval authors. Sir Nathaniel Barnaby, K. C. B., late Director of Naval Construction, Whitehall, for instance, says:

"The fact is that the great majority of ocean-going steamships are not divided into water-tight compartments in any efficient manner, and many losses in collision, grounding and swamping are due to this. Although steamships have some bulkheads, and some have many bulkheads, they are as a rule distributed in such a way, or are so stopped below the water level, that for flotation purposes after perforation those lying between the foremost collision bulkhead, through which the screw-shaft passes, are practically useless."

If we add to this the facts that bulkheads are perforated for doors immediately above the level of the water line, that a column of water and increased weight cause listing and increased immersion, the rapidity with which the "Bourgogne" was submerged need not be wondered at.

As regards lifeboats, another eminent constructor says: "The number of lifeboats usually provided is sufficient to hold all hands on trading vessels, but on the passenger steamers which cross the Atlantic there is not davit room for boats enough to seat the passengers and crew. Moreover, it often happens that only the boats on one side, or in one part of the ship, can be lowered."

This might be adduced as an excuse. Anyone who has traveled to and fro a few times can but notice the paucity of lifeboats, and the fact that the davit room is not all utilized. The examination of fifteen photographs, representing as many liners, showed an average of seven boats on each side; one ship only showing an interrupted line of ten large boats on each side. What does this average of fourteen boats to the ship represent? The fact that only those on the lee side can be used in rough weather reduces the total to seven; two must be considered as sacrificed, smashed or capsized during launching. Five are left, with a capacity of about one hundred and forty persons—less than the ship's crew. Lifeboats? If they are lifeboats, why do they fill and sink with such rapidity? What use are rafts and life-preservers in such calamities as that of the "Elbe" and the "Bourgogne"?

The crew of the "Elbe" as well as that of the "Bourgogne" have been severely criticised. A closer study of the causes of this departure from duty, however, tends to mitigate too harsh a judgment. The passengers embark, trusting that amply sufficient protection for their lives is provided; the crew know the contrary. While hope sustains the passenger until the last minute, death stares the ship's company in the face from the start. Is it a wonder that the instinct of self-preservation predominates among the rank and file of a crew mainly made up of landmen, stewards, waiters, cooks, bakers, stokers, etc.? What is to be expected of such men when confusion reigns and impending death paralyzes their reasoning powers?

Bona fide seafaring men do their duty as a rule. As far as captains are concerned, there is not one commanding a passenger liner across the Atlantic in whom I would not place implicit trust, if courage and honor were the only factors needed to preserve life. In many minds, condemnation follows the captain of the "Bourgogne" to his watery grave. I knew him well, and no braver man ever walked a deck. Had this poor victim of duty had adequate appliances to save all, rewards would have been showered upon him as they were upon the captain of the steamship "Missouri," seven years ago, when he saved over a thousand passengers. Give those men the means; give their crews the chances that the average man has upon the battlefield—then judge with equity. If the crew of the "Bourgogne" is to be brought before a court, the responsibility of the company should not be forgotten, if justice is to prevail.

Indeed, it is time to realize that outside of the indirect influence of increased size and power, practically nothing is being done by steamship lines to improve the life-saving possibilities, and that increasing rate of speed and traffic are daily increasing the danger. The companies may do all in their power to mitigate the effect of such a murderous catastrophe as that of the "Bourgogne" upon the public mind: nothing can counteract truth, and the silent but crushing result is