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IRON-CLAD SHIPS AGAINST FORTS AND HEAVY ORDNANCE.

The recent naval engagement in Charleston harbor has not been without beneficial results of a practical nature. On that occasion nine devoted vessels assailed a granite fortress of immense strength, and were beaten off and compelled to retire from before it by sheer force alone. The vessels were iron-clad, and with one exception were supposed to embody all the latest improvements; the exception was the *Keokuk*, in which no one except the inventor thereof seemed to have much confidence. The Ericsson batteries, built on the *Monitor* principle and supposed to be invulnerable, were temporarily disabled and compelled to retire. There is no question of inability or mismanagement involved in this disaster; it was simply inevitable under the circumstances, and from reading the graphic reports of reliable persons in the daily papers we are compelled to assume that, with their present armor, iron-clad ships are no match for the heaviest artillery. On page 265, current volume of the SCIENTIFIC AMERICAN, in an article on national defenses, we said that our present forts were rendered of very little use by the adoption of iron-clads, and this is literally true, as heretofore all experience has shown that mailed vessels have successfully defied them. In the attack upon Charleston we may doubt whether the repulse which we received would have taken place had the channel been unobstructed and the vessels left free to run by the forts—at their peril of course.

The failure of the Ericsson batteries to accomplish what was expected of them has created much disappointment in the public mind, which is always ignorant of technical points and mechanical details and not qualified to judge in such cases. The *Monitors* in action were all disabled, more or less, and their weak points, as now constructed, are many; as, for instance, the turrets, the pilot-houses, and the main decks. The projectiles fired by the rebels were of the heaviest and most destructive kind, and we may well infer that the charges of powder which propelled them were not stinted in quantity. From conversations we have had with intelligent mechanics from near the point of attack, who have seen these vessels since their engagement, we can assert that they are not nearly as much damaged as has been represented, and that the most serious disasters were repaired in a few hours after the retreat. We see no reason for any discouragement or for depreciating the powers of those wonderful batteries. The inventor of these batteries recently stated through the daily press that the thickness of the turrets could be augmented as much as desired, without inconvenience to the stability of the ship, and that the other parts, the pilot-houses, &c., can be further protected to any reasonable extent. This is limitedly correct in the case of the batteries now afloat, and the public will remember that the original *Monitor* was materially strengthened by additional plates on the turret, after her fight with the *Merrimac*. The *Dictator* and *Puritan* are to have turrets 21 inches thick, it is said, or just 10 inches more than the turrets on the *Monitors*, and there is no question that if these formidable vessels were launched and equipped, as they shortly will be, they might successfully dare the passage of all the "Sumters" in the world. The other details of these batteries, such as the starting out of the fastening bolts through the turrets and pilot-houses, ought to have been foreseen and provided for before. The same misadventure occurred on the first *Monitor*, if our memory serves us; when these matters are properly disposed of, the efficiency of the crew within will be greatly enhanced. We do not regard the failure of the batteries to perform the work as inherent and ineradicable defects in the plans themselves, but rather that the inauguration of any new mode of warfare which revolutionizes the whole art of systemized attack, must necessarily take place by slow but certain stages. We cannot expect to attain proficiency by a single leap; even the mighty Achilles had his vulnerable heel, and our modern mailed warriors, though assailable in some parts of their ferruginous coating, will yet be rendered shot and shell proof. One fact should not be overlooked, however, and that is the reliance implicitly placed upon light angulated armor as a means of deflecting shot. The Whitney battery (*Keokuk*) constructed on this principle, went to the bottom soon after being riddled, and a very few minutes served to illustrate the unfitness of such armor for defensive purposes. All vessels with inclined armor are supposed to be so constructed that the shot will glance from them without doing any damage. If we conclude, for the purpose of argument, that the enemy will fire a round shot at a very low velocity, on a line with the horizon, then the assumption may be correct. The fact of the matter is, however, that inclined sides simply present, to barbette guns, the fairest target they could desire, and the supposed efficiency of the angle is utterly neutralized. The *Galena* at Drury's Bluff and other gunboats on the Western rivers have been repeatedly pierced by guns fired from elevations. Inclining the armor simply increases the thickness of the plating to be pierced when the shot is fired on a line with the horizon. A plunging fire is received by inclined plating fair and square, and there are no instances on record where acutely-inclined armor has resisted the impact of the heaviest rifled shot at a fair range. The Parrott 300-pounder is said to have pierced nine inches of iron inclined at an angle of 45°, and the Stafford projectile is known to have penetrated seven one-inch plates, heavily backed up with timber, at the same inclination. Inclined sides, with inadequate armor, are simply a delusion and a snare. The *Ironsides* is said to have been the least injured of the vessels; this is a little remarkable in view of the other facts connected with the bombardment, but we have no comments to make.

[Since the above was written we have received some very interesting details of the *Ironsides'* part in the engagement, which will be found on page 276.]

Several persons are quite certain that they saw a number of large holes in the walls of Fort Sumter; but as this seems to be mere assumption, there is nothing to be said until the future shall reveal the actual extent of the damage done to the fort, and we are also ignorant of any of the practical working of our large guns.

THE BOILING OF WATER AND STEAM-BOILER EXPLOSIONS.

On page 278, current volume of the SCIENTIFIC AMERICAN, will be found a communication on the above subject, from the pen of Mr. A. Guthrie, of Chicago. We have appreciated and supported his labors in reforming our general laws for the prevention of explosions in the boilers of steamboats; and we rejoice in the fact, that where explosions were once common on our Western waters, steamboat traveling has become comparatively safe. He states in his communication that nine out of every ten steam-boiler explosions are caused by the water becoming too low in the boilers. Probably he is correct with respect to steamboats; we do not question his statement. But he also states that some explosions take place from other causes, which he defines; and yet his letter was written chiefly to protest that no explosions do or can take place from another cause, namely, water in the boiler, being perfectly freed from atmospheric air, exploding when subjected to heat under certain conditions. His statements on this point exhibit a too hasty examination and consideration of the question. It never has been asserted that this was the one cause of steam-boiler explosions; and it never has been set up as a theory of the cause of explosions in general. It has simply been asserted that water entirely deprived of atmospheric air, subjected to heat under certain conditions, can be heated above 212° without boiling, and will explode violently. A few explosions which have appeared to be mysterious have been attributed to this cause. Now is it a fact, or not, respecting water exploding under such circumstances? If it is a fact, and if but a single boiler in the whole history of steam engineering has exploded from such a cause, every engineer should know it, and it is our duty as far as we can to inform all engineers, because it will tend to increase their watchfulness in performing their tasks. Even if it were a doubtful statement, we cannot see how our correspondent has come to the conclusion that the article to which he refers has "a direct tendency to mislead engineers" and "will be productive of the worst consequences." Mr. Guthrie has made a disparaging allusion to Prof. Donney; but in all the latest works on chemistry, it is admitted as a fact, that water deprived of atmospheric air may be exploded according to the discovery attributed to him. We quoted the statements of Prof. Miller on this subject on page 201, current volume of the SCIENTIFIC AMERICAN, and we will now quote from the very latest published work on chemistry to the same effect. On page 126 of Proffessors Brande & Taylor's "Chemistry" (issued last week by Blanchard & Lea, of Philadelphia) it says:—

"Water gives off a vapor at all temperatures, even at 32°. In its ordinary state, if exposed to heat in open vessels, it boils or is converted at 212° into steam, the barometer being at 30 inches. But the boiling point of water varies with the pressure, and is influenced by the air which the water contains, as well as by the vessel in which it is heated. When quite pure and deprived of air, water may be heated to about 240° before it reaches the boiling point; at this temperature, however, it is suddenly converted into vapor with explosive violence. If a piece of pure ice be heated in a vessel containing oil, the heat may be continued until the water from the ice has reached a temperature of 240° when the whole is converted into vapor with explosion. The tranquil ebullition of ordinary water at 212° appears, therefore, to be mainly dependent upon the presence of air."

Men of science must accept facts whether they suit preconceived theories or not. Is the above extract a fact or fiction? If the former, Mr. Guthrie has placed himself in opposition to scientific progress; if the latter, the very ablest chemists living are laboring under a delusion on this subject. The general cause of boiler explosions is an over-pressure of steam in proportion to the strength of the boilers. A boiler may be defective in form, in its metal, and in its general construction before it is used. While in use, its plates may have become corroded, its safety valve may be too heavily loaded, or it may be short of water. In any of these cases, an explosion may occur. We believe that most explosions are occasioned by an excess of steam-pressure not much above the ordinary working pressure; and an over-pressure of steam may be gradually or suddenly accumulated. These have been the views inculcated in our columns, and we have endeavored to present not only the most accurate information on this, as on other subjects, but the fullest knowledge possible.

TAPPING HOLES.

It is a fact, no less remarkable than true, that too little attention is given, in some machine-shops, to the importance of tapping holes correctly and properly. Not only are the holes drilled too large, but the tap is allowed to take its own course, and if the bolt which is to follow in the threaded hole works as it should, it will be more on account of good luck than proper management. It was only the other day that we saw a workman upon an iron-clad, tugging away at a one-handed wrench and endeavoring to turn a tap that was beyond his strength. The tool was working badly and he was doing much more harm than benefit to the job, and we could not but reflect how much it might cost to repair a piece of recklessness which should never have occurred.

The consequences of abusing taps might be enlarged upon at great length, but we forbear and content ourselves with simply remonstrating against threading holes out of all truth when they should be per-