The Scientific American.

MUNN & COMPANY, Editors and Proprietors.

PUBLISHED WEEKLY
At No. 37 Park Row (Park Building), New York.

O. D. MUNN, S. H. WALES, A. E. BEACH.

TERMS—Three Dollars per annum—One Dollar in advance, for our months.
Single copies of the paper are on sale at the office of publication, and at all periodical stores in the United States and Canada.
Sampson Low, Son & Co., the American Booksellers, No. 47 Ludgate Hill, London, England, are the British Agents to receive subscriptions for the SCIENTIFIC AMERICAN.
☞ See Prospectus on last page. No traveling agents employed.

VOL. VIII, NO. 18...[NEW SERIES.]....*Nineteenth Year*

NEW YORK, SATURDAY, MAY 2, 1863.

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-

fectly square—against drilling three-sided holes for a tap bolt—against drilling holes so small that the tap must be driven in with a hammer before it will "take"—against tapping holes in castings as they come from the foundry, full of scale (this we have repeatedly seen done)—and against the whole array of misuses to which these costly appurtenances of a machine-shop are subjected. It takes time to make a tap, and as a great deal depends upon having them in good condition, more attention should be given to the proper use of them.

GEOLOGY AND THE "KING CRAB."

"Visitors to the Aquarium House at the Zoological Gardens have no doubt noticed the living specimens of that curious creature, the 'king crab,' which are now in a tank alive and well. The most curious part of their structure is the eyes; they have four, which are composed of numerous lenses, like the dragon-fly or bee, and are so arranged that they can see objects on each side of them. Besides being interesting simply as living creatures, king crabs are the nearest existing relations to the ancient form of beasts called 'trilobites.'"—*The London Field.*

The king crab is what is commonly known here as the "horse-shoe." Such creatures are taken by thousands annually on the marshy coasts of New Jersey and Long Island, and are used extensively for manuring the land. No living specimens are now found in England, but their fossils are not uncommon. The past geologic age of Europe is similar in many of its features to the present in the New England States. Hugh Miller in his lecture on geology says: "America though emphatically the *New* World in relation to its discovery by civilized man, is at least in these regions an *old* world in relation to geological type; and it is the so-called *Old* World that is in reality the *new* one." Professor Agassiz says: "If we compare a list of the fossil trees and shrubs from the tertiary beds of Œningen with a catalogue of the trees and shrubs of Europe and North America it will be seen that the differences scarcely go beyond those shown by the different floras of those continents under the same latitudes. But what is quite extraordinary and unexpected is the fact that the European fossil plants of that locality more closely resemble the trees and shrubs which grow at present in the Eastern parts of North America than those of any other part of the world. The present Eastern American flora and fauna have a more ancient character than those of Europe. The plants, especially the trees and shrubs growing in our days in the United States, are as it were, old-fashioned." On this topic Hugh Miller again says: "Towards the close of the miocene period old Scotland exhibited features greatly resembling those presented to the Puritan fathers by the forest-covered shores of New England, little more than two centuries ago.

The Launch of the "Re d' Italia."

The powerful steam ram frigate, *Re d' Italia*, built by William H. Webb, Esq., for the Italian Government, was launched from the constructor's yard, at the foot of Sixth street. East River, at 5 minutes before 10 o'clock, on the morning of the 18th ult. The frigate is 280 feet in length, and has 58 feet beam. The sides of the vessel will be covered with 4½-inch iron plates; these, we believe, are to be made in France, and the combined thickness of the ship's sides, including all, will be 38½ inches; the backing is of wood. The frigate will be about 7,000 tuns burthen; she is to be propelled by two horizontal back-acting engines, having cylinders 84 inches in diameter by 45 inches stroke; furnished with surface condensers and all the modern improvements. The screw propeller is a massive brass casting and weighs nearly 30,000 pounds. It is a two-bladed, expanding-pitch screw, and will be fitted with patent hoisting gear, so arranged as to be hoisted out when under sail alone. All the work done upon the vessel, so far, is of the most substantial description, and will conduce greatly toward sustaining the builder's reputation abroad.

A large number of ladies and gentlemen were present on the occasion of the launch, which passed off very handsomely, and Mr. Webb may congratulate himself, under the circumstances, that Fortune favored all his efforts to attain success.

CAUSES OF THE PHENOMENA IN ORGANIC NATURE.—THE ORIGIN OF SPECIES.

Of late years men of science and others have wrangled much over Mr. Darwin's work on "The Origin of Species." In most of the English and American reviews his treatise has been severely criticized, as having an infidel tendency; not on account of the facts therein given, but the conclusions of the author. He appears to have been very generally misunderstood, judging from a most interesting little work just issued by D. Appleton & Co., this city, being the publication of six lectures delivered to working men, by Thomas H. Huxley, F. R. S., Proffessor of Natural History in the School of Mines, London. Broadly stated, the subject of these lectures consists of an inquiry into the origin of species and a discussion on the causes of the phenomena in organic nature.

The meaning of organic nature is something that grows, has life and reproductive powers. It is exemplified in the seed of a plant in contradistinction to a grain of sand. Organic nature embraces the vegetable and animal kingdom, as entirely distinct in functions from rocks, fluids, and what chemists call "elementary matter." Animals and plants are divided by naturalists into groups, and these into kingdoms, sub-kingdoms, provinces, classes, orders, families, genera, and species. It was once very generally believed (and many persons entertain such views still) that there was such a thing as spontaneous generation—that is, mere elementary matter, such as pure water or mineral dust exposed in favorable positions, to light and heat, would bring forth vegetation and animalcula spontaneously. Hence it has been asserted that, if there is such phenomena as the spontaneous generation of life, according to the "development theory" of some naturalists and the views of Mr. Darwin on the origin of species, man may have been developed from the lowest forms of spontaneous generation. If such views were founded on facts in natural history, pantheism, viz., that "God is nature and nature is God," would be supported upon a very firm foundation.

Mr. Darwin does not discuss the question of spontaneous generation at all, and science completely silences pantheism. Every organism commences existance in an egg-cell or seed, and each seed is believed to have been specially created, with special functions and powers of reproduction, as stated in the Scriptures. M. Pasteur, a distinguished French chemist, has lately made a great number of carefully conducted experiments to test the theory of spontaneous generation. The results of his labors seem to be conclusive against the theory; no such property as spontaneous creation belongs to elementary matter acted upon by the forces of nature. An old and bitterly disputed question thus appears now to be settled scientifically.

Another question of much dispute seems to be settled by Mr. Darwin; thus the Caucasian, the Malay, and the Negro, according to his facts, are varieties of species, and may all have descended from a single pair, as set forth in the Scriptures. On the other hand, Prof. Agassiz and others believe they have descended from different original pairs, and thus they would really be different orders. In 1793, a new variety of sheep was produced by Seth Wright of Massachusetts. He had a flock, the members of which were specially gifted with the power of jumping fences, and thus tormenting the proprietor and his neighbors. In one accidental buck lamb, which had very short bowed legs, the acute mind of Seth Wright saw a remedy for his troublesome fence-jumpers, and by careful breeding he at last obtained an entire flock of long-bodied short-legged sheep, called the "otter breed," from this single buck which could not jump a foot-rail. Various species of dogs, hogs, and pigeons have been produced in the same manner. In structure they are different from others of the same genus, but psycologically they are identical. There is a well defined limit to organic varieties in animals. Two entirely different races may mix; but their progeny, as in the case of mules, become sterile. Proffessor Huxley states that there are no reliable exceptions to this law.

The rapid powers of production in plants from a single specimen, is set forth by Prof. Huxley as follows:—"Suppose the habitable part of the globe to be 51,000,000 square miles, and the climate and soil equal over that space, it may be entirely covered in nine years from the product of a single plant bearing fifty seeds, each plant requiring one square foot of soil for support." It is hardly conceivable that the whole stated available surface of the earth could be stocked in about nine years from a single plant, yet the figures demonstrate such a possibility.

VALUABLE RECEIPTS.

Bronzing Metals.—The production of different colors on the surface of metals, such as works of fine art, &c., is called bronzing. Mere surface-coloring is executed with metallic powders mixed and applied with a varnish. But the most perfect bronzing is produced by chemical action on the metal itself—its own surface being thus made to form the bronze color. Dr. Ure says, respecting this art:—"Coins and metals may be handsomely bronzed as follows:—2 parts of verdigris and 1 part of sal-ammoniac are to be dissolved in vinegar; the solution is to be boiled, skimmed and diluted with water till it has only a weak metallic taste, and upon further dilution lets fall no white precipitate. This solution is now made to boil briskly and is poured upon the objects to be bronzed. These objects must have been previously cleaned and made perfectly free from grease and set in a copper pan. This pan, with the articles now in it, is put on a fire and the solution made to boil for some time. The articles, if made of copper, will acquire an agreeable reddish-brown hue without losing their luster; but if they are boiled too long, the coat of oxide upon them becomes too thick and looks scaly and dull; and if the solution is too strong, the copper becomes covered with a white powder which becomes green on exposure to the air. The pieces thus bronzed must be washed well in warm soft water and then carefully dried, or they will turn green. The antique appearance is given with a solution of three-quarters of an ounce of sal-ammoniac and a drachm and a half of binoxalate of potash (salt of sorrel) dissolved in a quart of vinegar. It is applied with a soft rag to the surface of the metal, then allowed to dry. Several applications are thus made until a coating of sufficient thickness is obtained. Copper acquires a brown color by rubbing it with a solution of the common liver of sulphur or sulphuret of potash."

The Chinese are said to bronze their copper vessels by taking 2 ounces of verdigris, 2 ounces of cinnamon, 5 ounces of sal-ammoniac and 5 ounces of alum, all in powder, making these into a paste with vinegar and spreading it upon the surface of the article, which should be previously brightened. The article is then held over a fire till it become uniformly heated, then it is cooled, washed and dried. It thus receives one, two or several of such coats until the desired color is obtained. An addition of sulphate of copper to the mixture makes the color chestnut-brown.

A good method of bronzing copper articles, such as tea urns, to prevent them tarnishing, is described in most all the best treatises on chemistry. It is as follows:—The copper is first cleaned, then brushed over with peroxide of iron (generally colcothar) made into a paste with water or with a dilute solution of the acetate of copper. The article is then placed in a muffle in a furnace and heated cautiously for some time, then taken out and cooled. Upon brushing off the oxide the surface underneath is found to have acquired the desired hue.

Another method of bronzing copper is to brush it over with a paste of black lead, place it over a clear fire till moderately heated, then brush it off. A very beautiful bronze is thus produced. The surface of the copper must be perfectly bright when the black lead is applied. A thin film of wax or tallow applied to copper and the article placed on a clear fire until the wax or grease begins to smoke, produces a bronzed surface. In all these operations great care is necessary in managing the articles properly when subjecting them to the action of heat.

The following is a receipt which we have been told will produce a beautiful dark bronze on brass:—To 1 pound of muriatic acid add 6 ounces of the peroxide of iron and 3 ounces of yellow arsenic; mix these together and let the solution stand for about two days, shaking it occasionally. The brass article, perfectly