THE

Scientific American.

MUNN & COMPANY, Editors & Proprietors.

PUBLISHED WEEKLY AT
NO. 37 PARK ROW (PARK BUILDING), NEW YORK.

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

VOL. X. NO. 10..[NEW SERIES.]......*Twentieth Year.*

NEW YORK, SATURDAY, MARCH 5, 1864.

Contents:

(Illustrations are indicated by an Asterisk.)

ARTILLERY EXPERIMENTS OF THE GOVERNMENT.

From time to time, during the last two months, we have published reports of Government experiments on iron-clad targets; these were accompanied by accurate illustrations, which were, in many cases, photographed from the targets themselves. The experiments alluded to, were all made with the eleven-inch gun, of Dahlgren, with an average charge of 30 pounds of powder, an average weight of spherical cast-iron projectile equal to 165 pounds, and an average range of 80 feet.

Under the above-named conditions, an experiment was made upon a composite target of iron and india-rubber, backed with timber. The iron was outermost, and was 2 inches thick; the rubber came next, and was $1\frac{3}{4}$ thick; the timber was 19 inches thick—in all $22\frac{3}{4}$ inches. The target was inclined at an angle of 15 degrees; and at the first fire the shot tore through the mass and penetrated the bank behind (a solid clay) 17 feet, being but slightly damaged in its passage.

Another experiment was tried with a $4\frac{1}{2}$-inch solid scrap iron plate, backed with 20 inches of solid oak, and the iron *faced* with rubber, 4 inches thick, the whole placed against a bank of solid clay; this resulted in the destruction of the target at the first fire, the charge being 30 pounds, the projectile, spherical cast-iron, weighing 169 pounds, and the range 87 feet. The shot did not go entirely through the target, but penetrated the plate and rubber, and lodged in the second course of timber behind. The rubber was entirely forced off, by the violence of the concussion, and fell fifteen feet forward of the target.

Still another target was made, of four one-inch wrought-iron plates, backed by rubber 4 inches thick in single sheets of one inch each; the whole backed by 20 inches of solid oak. The first four inches next the timber were composed of alternate rubber and iron, two inches of each; the wrought-iron was on the outer surface of the target when fired at. The whole was placed against a bank of solid clay. The charge was 30 pounds, the shot 169 pounds in weight, and the range 84 feet; at this distance, and under these conditions, the target had two clean, handsome holes bored through it—one of which was but slightly larger than the shot itself, showing it experienced but little resistance in its passage. A repetition of the experiment, with the target inclined at an angle of 45°, produced the same result; the target being penetrated, and much more injured than when vertical. It should have been stated, previously, that the target was 96 inches long, by 42 inches wide. In a comparative experiment, to test the value of india-rubber as a resisting agent, a target was made with with 4 single iron plates, each 1 inch thick; the results, as observed by competent witnesses, did not vary materially from those obtained with rubber, and little value is attached to it as a disperser of the force of shot.

Experiments to ascertain the qualities and value of iron armor faced with wood have also been made at the Washington Navy Yard, and the result has been the complete demolition of targets and theories. Without quoting specific or particular trials, of which there have been a vast number, on targets of all conceivable and inconceivable varieties, it is enough at the present time, to note this prominent feature—the excellence of the eleven-inch gun as a battering piece. During these trials it has developed a new quality which may or may not have been known to its constructors before; but, at all events, the proven ability of the eleven-inch gun to stand consecutive charges of 30 pounds each, must add very greatly to its value as a national weapon. No target of which we have yet any report has been able to withstand the impact of its shot with 30-pound charges, although it is possible to construct one which shall defy even this assault.

The "service" charge of the eleven-inch gun is ordinarily 20 pounds; but for battering iron-plates, 25 pounds is allowed, and not over 500 fires from one vent is permitted; two vents are made in each gun, one clear through to the bore, and the other given a proper lead, and but partially drilled. When one has completed its time of serving, the other one is opened, and when 1,000 fires have been made with the weapon, it is condemned as unsafe.

Doubtless there are other guns which have been tried at the Navy Yard, and have given as good results with less charges, at greater ranges. If so, we have not heard of them; the Government advertised some time ago for wrought-iron guns, and by this time it has doubtless received one or more; whether these have been tested, or what action has been taken with them, is not known to us; but we should be glad to hear that they have proved successful, and are to be adopted. A warrantable prejudice exists against the use of cast-iron ordnance; and many and loud are the complaints, attacks, and abuse which we have received for setting forth facts in relation to it. Such a course in no wise affects us. The tensile strength of the eleven-inch gun is enormous; and it would seem not an unwise plan to strengthen it yet further, for specific purposes, by the addition of a reinforce, carefully made and properly shrunk on.

THE CAUSE OF OUR MANUFACTURING PROSPERITY.

If we enter any industrial establishment, we find the proprietors overwhelmed with orders; and this applies not only to the great manufactories of iron and wool, but all other pursuits, with the exception of the cotton manufacture. Mr. Cobden tells us that all of this apparent prosperity is a delusion; but, as Mr. Cobden is a sound political economist, we think that if he was more intimately acquainted with the facts of the case, he would change his opinion.

In looking for the real causes of this prosperity, the first consideration is the great and rapidly increasing power of the country to produce wealth. When the only inhabitants of the land were Indians, there were no modes of producing wealth, but hunting, fishing, and the rude cultivation of a few very small patches of tobacco, potatoes and Indian corn. On the settlement of the continent by Englishmen, all the arts of Europe as they then existed were introduced; and the power of producing wealth was multiplied many thousand fold. But since that time these arts have been so revolutionized that it may be a question, whether our power of producing wealth does not bear as large a proportion to that of the first settlers as their's bore to that of the Indians. In spinning the material of our clothes, the spindles are turned by steam or water; one man attending 2,000, each of which spins more yarn than a spindle turned by hand. In preparing the material for our houses, the boards are smoothed by a revolving plane; one man finishing more flooring in a day than several hundred men could "jack down" in the olden time. In the great labor of transportation by means of canals, steamboats and railroads, one day's labor accomplishes more than thousands of days' work could effect without these aids. In short, in every department of industry, the great forces of nature, operating through means of mechanism, have multiplied from 10 to 10,000 fold the power of producing wealth.

A very large portion of this increased production is consumed as fast as it is produced. Only a small fraction of the community will save anything, whatever their incomes. But a considerable portion is saved; causing a rapid accumulation of wealth. In 1840 the inhabitants of Connecticut were worth an average of 450 dollars apiece; in 1860 the whole property of the State, if equally distributed, would have given 900 dollars to every man, woman and child. In no other country in the world was so large a portion of the accumulations invested in labor-saving machinery, manufactories, and other means of augmenting the annual product. A large portion was devoted to increasing the size of our cities; this mode of investment has been generally suspended, and the revenues have been diverted to the purchase of Government bonds.

Our manufactories and workshops are not turning out froth. Their products are as solid, substantial values as were ever produced. There is no delusion about it. The simple cause of our prosperity is the vast aggregate power of the nation to produce wealth; and that has resulted from the ingenuity of inventors, and the enterprising spirit of our people, which has put those inventions in operation.

THE ENGINES OF THE NEW FRIGATES.

The new frigates about to be built by Government—the *Wampanoag*, *Ammonoosuc*, and *Nishaminny*—are intended to be very fast; they are to have fine models and enormous engine power, and are expected to be a great acquisition to the Navy Department. The vessels themselves are of an entirely different class from any previously built for the service; being immensely larger than the new sloops, with heavier engines and larger boilers than any war vessel afloat, not excepting the *Dunderberg* and *Puritan*. The size of the cylinders and stroke of piston remains the same in all the ships just named, but the plans of the engines necessitate an immense additional weight which might be dispensed with. They also occupy nearly the whole of the lower part part of the ship—247 feet out of 340 being devoted to the engines and boilers alone.

DIMENSIONS OF THE VESSELS.

The hulls are 340 feet over all, 17 feet depth of hold from water-line, and 44 feet 6 inches beam. They are not iron-clads. The models are intended to be good for speed, this quality being the first consideration. The floors are nearly flat, and there is but little bilge where the sides rise. The frames of the *Wampanoag*, building at the Navy Yard in Brooklyn, are all up; and it was intended to have launched the vessel early in the spring; but the matter is somewhat delayed, we are told, at present, and no period is fixed for the time of completion.

THE ENGINES.

The plan of the engines is horizontal. They are also geared to the screw shaft at about 2 to 1, or twice as many turns of the propeller as the engine shaft makes. The cylinders are two in number, 100 inches in diameter by 4 feet stroke of piston, and are placed horizontally, working athwart ships. The connecting-rod proceeds directly from the crosshead, as in all other horizontal engines, and takes hold of the crank-pin in the same manner. On this shaft there is a large spur-wheel, built up in 9 sections, each section being one wheel itself, having teeth of lignum vitæ, or young hickory, boiled in oil. The diameter of this wheel is 10 feet 3 and 5-16ths inches at pitch line. The pinion this wheel works in is on the main screw shaft, and is 5 feet and 5-16ths of an inch diameter at the pitch line. There is one surface condenser, which is common to both engines, and is situated between them; in this there are to be 7,168 tinned brass tubes, 6 feet $3\frac{1}{2}$ inches long. The main steam valves are slides, worked by a Stevenson link. The valve face is on the side of the cylinder, and has an enormous area—the dimensions being $84\frac{1}{2}$ inches wide by 5 feet 6 inches in length. The valve is of the doubled-ported variety, and is carried on 17 hardened steel rollers, $2\frac{1}{2}$ inches diameter and 4 inches long. These rollers run on guides, and are intended to relieve the stem from the enormous weight and friction of the valve. The steam ports are 82 inches long by $2\frac{1}{4}$ inches wide, and the exhaust ports 4 inches by the same length, of course. The central exhaust is 18 inches wide. There will be 3 inches lap on the steam side and $1\frac{1}{2}$ on the exhaust side of the valve.

THE SCREW.

The propelling wheel is fixed in its place and can only be disconnected from the engines by a clutch coupling inside the ship. The thrust is taken by a large bearing, having a number of collars, and there is also a roller bearing in addition; this latter consists of a number of steel balls working between two grooved couplings or disks. The diameter of the propeller is 18 feet, and the pitch is expanding, having a mean of 25 feet. The wheel is four-bladed, and has no out-board bearing on the extreme after-end.

THE BOILERS.

There are no less than 8 main boilers in each of these ships, having one smoke-pipe serving for two boilers, or four in all. The pipes are 56 feet high from the uptake, 7 feet 8 inches diameter for the large boilers, and 6 feet 6 inches for the two forward boilers, which are smaller than the others. The safety-valves are 8 inches diameter of opening, and each boiler has one. The boilers are of Martin's patent with a total water-heating surface of 28,300 feet, and a grate area of 1,128 square feet. There are 16,082 vertical tubes, and 744 horizontal tubes in all the boilers, also 7 furnaces in each one. Steam is to be used superheated in these engines, and there are four superheating boilers next the engines, having a heating surface of 2,848 feet. All the boilers are to be tested at a hydrostatic pressure of 65 pounds to the square inch. By an act of Congress, the working pressure of steam boilers may be three-fourths the tested pressure; these engines can, therefore, have, in round numbers, 50 pounds of boiler pressure per square inch applied to them, provided the boilers stand the test. It is hardly necessary to say that this enormous pressure has never yet been applied to engines of a similar size. The boilers and engines are all to be of the best materials, and the cylinders and valve faces as hard as tools can work them. All bolt-holes are to be rimmed, and the workmanship otherwise according to the most approved principles of modern engineering practice.

THE BRITISH IRON-CLAD FRIGATE BELLEROPHON.

The London *Times*, in describing the progress which the British Admiralty is making towards the construction of a fleet of iron-clads, gives the following description of the frigate *Bellerophon*, now being built at the works of Messrs. Penn.

"This vessel is in point of strength intended to be a monster among these monsters, to be in fact, as terrible an assailant to iron-clads as an iron-clad would be to wooden ships. The object with which this vessel is designed is, in case of another great naval war, to avoid a repetition of the long dreary work of blockading an enemy's fleet by wearisome and dangerous cruising off the mouth of harbors. The *Bellerophon* is to be a vessel of such strength and speed and tremendous weight of guns as, in case of an enemy's iron fleet running into port, she can follow them with impunity, and at long range fight them at their moorings, till she either drives them ashore or forces them out to sea. Specially built for the discharge of such duties, it is almost needless to say how carefully every point in her equipment has been considered; and as Mr. Penn undertakes that her speed shall equal her strength, there seems to be very little doubt but that, with her impenetrable sides and her armament of ten 300-pounders and two 600-pounders, she will be the most formidable sea-going frigate the world has yet seen. The length of this vessel is to be 300 feet, and her breath 50 feet; her tunnage will be 4,246 tuns, her displacement 7,053 tuns; and though carrying the heaviest armor and armament ever sent afloat, her draft will be only 21 feet forward and 26 feet aft—less than the draft of ordinary two-deckers. The height of her lowest portsill from the water will be $9\frac{1}{2}$ feet, the distance between the guns 15 feet, and the height between decks 7 feet. Her midship section is smaller than that of the *Warrior*, and to that extent, therefore, she will be easier to steam and sail. She is to have four masts—only the first square-rigged, the three others carrying immense fore-and-aft sails, a rig from which the French have got such admirable results with their iron frigates under canvas. In the engines of the *Bellerophon* it is hoped to effect a great improvement as regards the consumption of coal. The *Black Prince*, which is now the fastest ocean steamer afloat, burns at the rate of $4\frac{1}{2}$ pounds of coal per indicated horse-power per hour, and on her trial trip, with her screw going 54 revolutions, she did $15\frac{1}{2}$ knots an hour, and can be depended on, at sea, to average as high as 13. In the *Bellerophon*, however, it is hoped, by working with superheated steam, condensation and expansion, to reduce the consumption of coal to $2\frac{1}{4}$ pounds per indicated horse-power per hour. If this great result be effected, she will carry 16 days fuel, instead of nine; and if, as is expected, Mr. Penn can get 65 or more revolutions out of her engines, she can be depended on at sea to average 15 knots, or nearly 18 miles an hour.

"The ribs and framing of the *Bellerophon* will be much the same as those of other iron frigates, with the exception that the stringer plates and diagonal bracings will all be of steel—that is to say, of less than half the weight, and more than four times the strength, of the present system of wrought-iron fastenings. Wherever steel can be used with advantage, in point of strength and lightness, it will be adopted in the frame of this new frigate and Mr. Reed estimates that by this method, and while making the hull infinitely stronger, he will save in weight two or three hundred tuns, which can be infinitely better bestowed in increasing the thickness of the armor plating. It is the first time that steel has ever been used in these vessels, and Mr. Reed deserves every credit foradopting it, though it was not difficult to foresee that it must soon have been extensively used.

"The armor of the *Bellerophon* is to be no less than 16 inches thick, and this is to rest on 10 inches of solid teak beams. This outer protection is quite formidable enough, but what it protects is of its kind quite as strong in proportion. The inner skin consists of two plates, each of $\frac{3}{4}$-inch thickness, with a stout layer of painted canvas between to deaden concussion. Outside the skin come single-iron stringers of the tough steel. These angle-iron stringers in any metal would be of immense strength, and project from the inner skin $9\frac{1}{2}$ inches and 10 inches alternately. Thus they form so many longitudinal shelves, of the depth mentioned, which run from stem to stern of the ship, two under each row of plates, and in these the teak beams are laid, the longitudinal layers of the angle-irons keeping the beams up to their work and preventing their lateral splintering, while they also support the plates with their edges and prevent their bending in unfairly on the teak. The *Bellerophon* is not thus coated from end to end and over all with this tremendous armor. In the centre and for 90 feet of her broadside she is thus protected, from 5 feet below the water line to the level of the upper deck. In this space are her guns, five 300-pounders, with one 600-pounder at each side. For the rest of her length there is only a belt of this massive armor, which goes to the same depth beneath the sea to six feet above it, so that she cannot be hit in any part where the water could enter."

[We have no broadside iron-clads building in this country that can compare with this frigate.—Eds.

How to discover Small-Pox.—*The Eclectic Journal* says concerning this matter:—"Now we offer this secret to the profession—as soon as the eruptions appear, and by pressure with the point of the finger may distinctly be felt the *small, hard substance, precisely as if a small, fine shot* had been placed under the cuticle of the skin. This peculiar appearance belongs to no other eruptive disease. We have applied the term *secret*, here; for whilst it is, and has been known to a few physicians, it is not mentioned in any of the standard authorities; nor does the writer claim the credit of the discovery. After this all works upon practice will add this unfailing diagnostic symptom."

New Green Colors.—At the recent annual meeting of the Academy of Sciences, in France, a prize of two thousand five hundred francs ($500) was awarded to M. Guignet for the preparation of a non-injurious green for printing on tissues, and another of one thousand five hundred francs($300) to M. Bouffe for having discovered a substitute for an arsenical green in the manufacture of artificial flowers.

RECENT AMERICAN PATENTS.

The following are some of the most important improvements for which Letters Patent were issued from tho United States Patent Office last week; the claims may be found in the official list:—

Device for amalgamating Gold and Silver.—This invention relates to a method of amalgamating gold and silver with quicksilver. It is well known that a strong affinity exists between quicksilver and the precious metals above mentioned; but chemical affinities take place at insensible distances; that is, upon contact of the two or more substances proposed to be united. To amalgamate gold or silver with quicksilver, therefore, in a manner so thorough as to extract all of those precious metals from the quartz or other earthy and mineral substances with which they are materially combined or mixed, it is necessary that every particle of the said precious metals should be brought into actual contact with an equivalent portion of the quicksilver employed for this purpose. This absolutely necessary condition of perfect amalgamation, it is believed, has never hitherto been effected; and hence it is that the said metals have never been fully extracted from the earthy and mineral combinations with which they are found in nature. This invention consists in pulverizing the quartz or metalliferous substances to an impalpable powder, and exposing this dust, either in a calcined or otherwise prepared condition, as it may be necessary sometimes to do, in order to isolate the said metallic particles from their sulphurous or other foreign combinations; or in an uncalcined state, as it may at other times be best to do, when unmixed with foreign bodies which hinder contact with the quicksilver, in a dry, sifted and finely-divided state, in a falling, moving or floating condition, in a close chamber or passage-way, to the hot vapor of distilled quicksilver, by which the two substances, namely, the hot vapor of distilled quicksilver and the pulverized quartz aforesaid, shall mingle together and interpenetrate each other, that every particle of the said precious metals contained in the said pulverized quartz must come into actual and direct contact with the finely divided particles of the quicksilver-vapor and effect a perfect amalgamation. Henry W. Adams, of New York city, and W. S. Worthington, of Newtown, N. Y., are the inventors of this device.

Firebox for Stoves and Furnaces.—The object of this invention is to facilitate the burning of fine coal in stoves and furnaces. The improvement relates to a novel construction of the fire-grate, whereby a large grate surface is obtained and a great circulation of air allowed through the fuel, thereby insuring a more perfect combustion of the fuel. The invention consists in constructing the fire-grate in horizontal and vertical sections so as to form horizontal, elevated and low portions connected by vertical portions, and using in connection with the grate, thus constructed, a series of perforated air-tubes or vent-ducts, whereby a perfect combustion of the fuel is obtained. William Bickel, of Pottsville, Pa., is the inventor of this improvement.

Steam Engine.—In all reciprocating steam engines heretofore constructed the movement of the piston has produced a concussion or shaking of the bed or foundation upon which the engine has been supported, and a tendency to tear the engine away from said bed or foundation, in many cases to the great detriment of the structure in which the engine is contained. This action has been especially injurious in the case of horizontal engines arranged transversely to the keels of vessels for driving screw propellers, and has been the great obstacle to the running of such engines at sufficiently high speeds to drive the propeller without the intervention of gearing or its equivalent between the crank shaft and propeller shaft. In such engines the weight of the piston and its attached piston rods and cross-head is frequently many thousand pounds, and the inertia of this mass, in the starting of the piston, re-acts against one end of the cylinder and tends to move the cylinder and bed of the engine toward one side of the vessel, and the force required to arrest the piston as it completes its stroke, after having acquired a great momentum, re-acts upon the framing and bed of the engine in the opposite direction to the re-action first mentioned, and tends to move the bed of the engine toward the other side of the vessel. In this way two distinct concus-