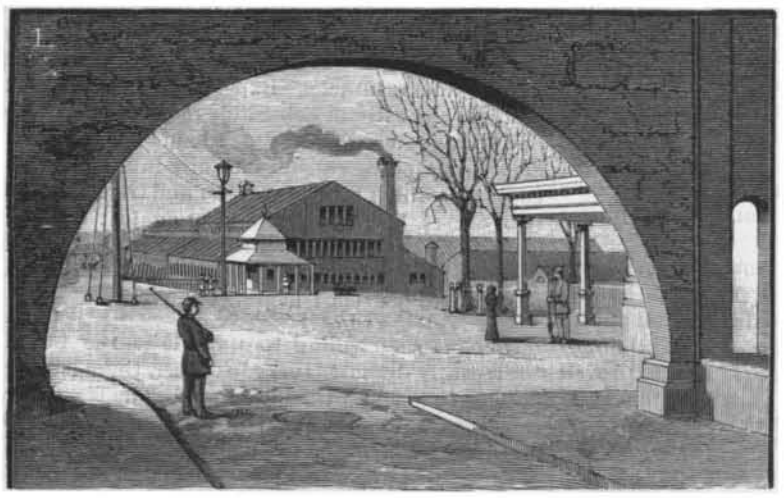
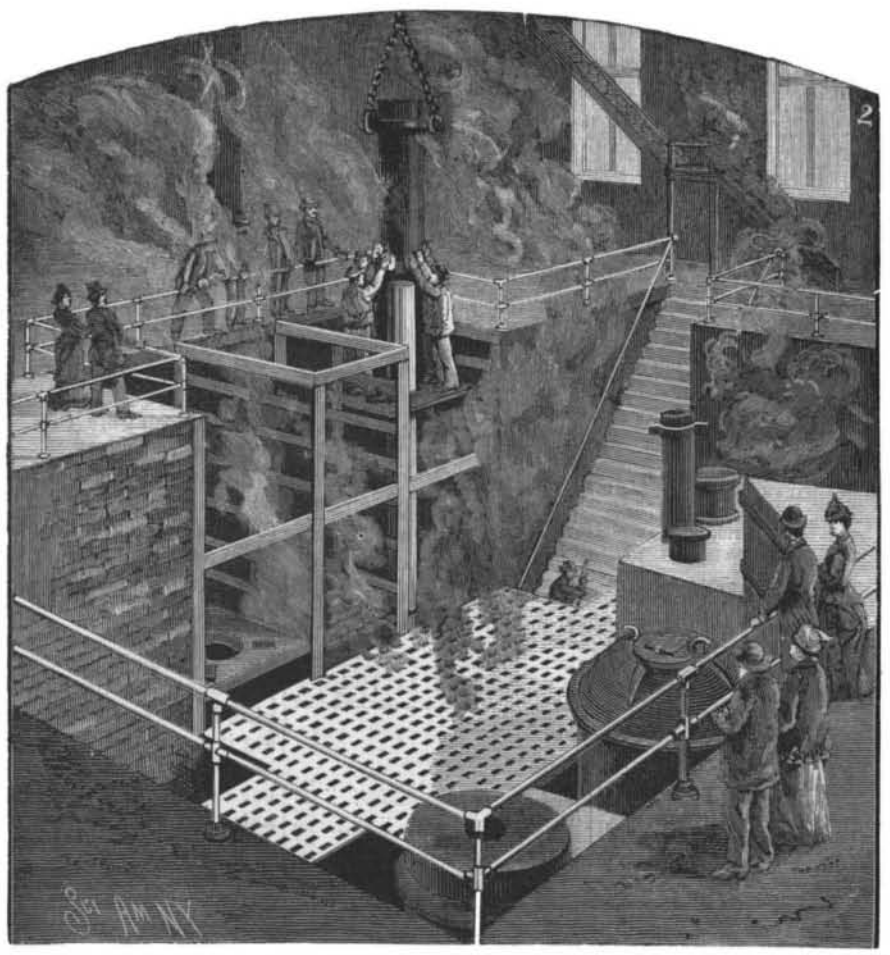
SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyrighted, 1891, by Munn & Co.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXIV.—No. 11. ESTABLISHED 1845. NEW YORK, MARCH 14, 1891. $3.00 A YEAR. WEEKLY.





MANUFACTURE OF HEAVY GUNS FOR U. S. NAVY.

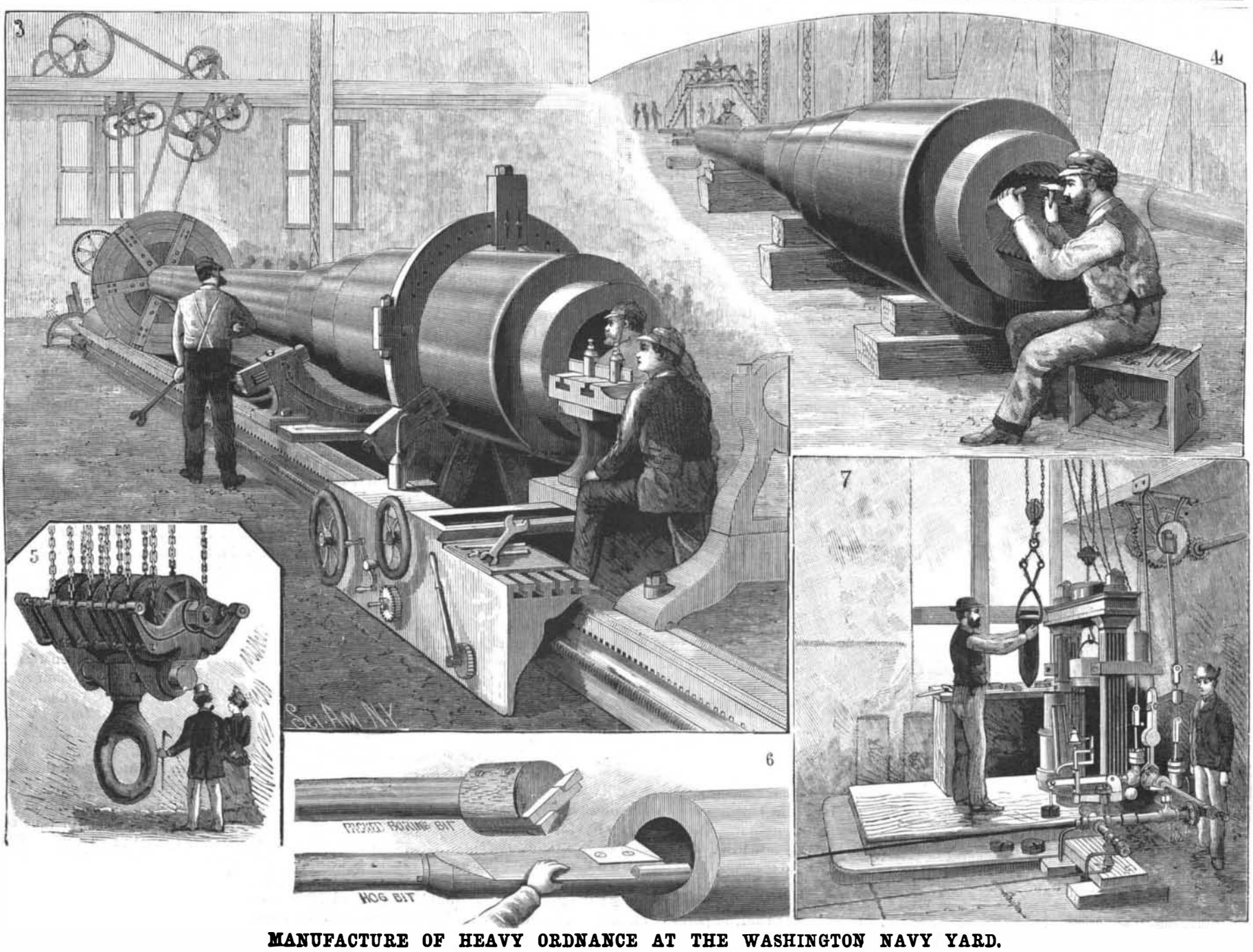
(*Continued from Scientific American, February* 28, 1891.)

Before entering upon a description of the assembling and finishing, let us consider the method followed to discover the physical characteristics of the steel. Those to which particular attention is given are tensile strength, elastic limit, elongation, and contraction of area.

From each forging several pieces are cut transversely to the axis of the bore of the finished gun, and of sufficient dimensions to be machined to cylindrical specimens 2 inches long between measuring points and ½ inch diameter. These are called test pieces, or test specimens, and have screwed heads at each end to fit the holders of the testing machine. They are stretched and broken, and their physical condition carefully observed and recorded.

The present requirements of the United States navy approximate those of the table on page 166.

(*Continued on page* 166.)



MANUFACTURE OF HEAVY ORDNANCE AT THE WASHINGTON NAVY YARD.

MANUFACTURE OF HEAVY GUNS FOR U. S. NAVY.

(*Continued from first page.*)

Characteristics.	Tubes.	Jackets.	Hoops.
Tensile strength..	70,000 to 80,000 lb	74,000 to 85,000 lb.	90,000 to 100,000 lb
Elastic limit.....	33,000 to 38,000 lb.	34,000 to 40,000 lb.	45,000 to 50,000 lb
Elongation.....	12 p. c. to 22 p. c.	10 p. c. to 20 p. c.	12 p. c. to 15 p. c.
Contraction of area.....	15 p. c. to 35 p. c.	12 p. c. to 30 p. c.	15 p. c. to 30 p. c.

The Washington Gun Factory, where all naval guns are now fabricated, is an outgrowth of the old Washington Navy Yard, and is very favorably situated because of its proximity to the control of the department and the inspection of Congress. It is reasonably secure from foreign invasion, in good railroad communication with the steel factories, and connected by water with its proving ground, at Indian Head, on the Potomac, 26 miles below Washington.

Approaching the arsenal by the main entrance, the most prominent object is the large new factory (Fig. 1), in which the heaviest guns are being manufactured. Commenced in 1886, it is now in full working order for the fabrication of guns up to and including 12 inches caliber, and there is every reason to hope that within the next eighteen months the lathes for the 13-inch, 14-inch, and 16-inch guns will be in such an advanced state that their erection can be commenced.

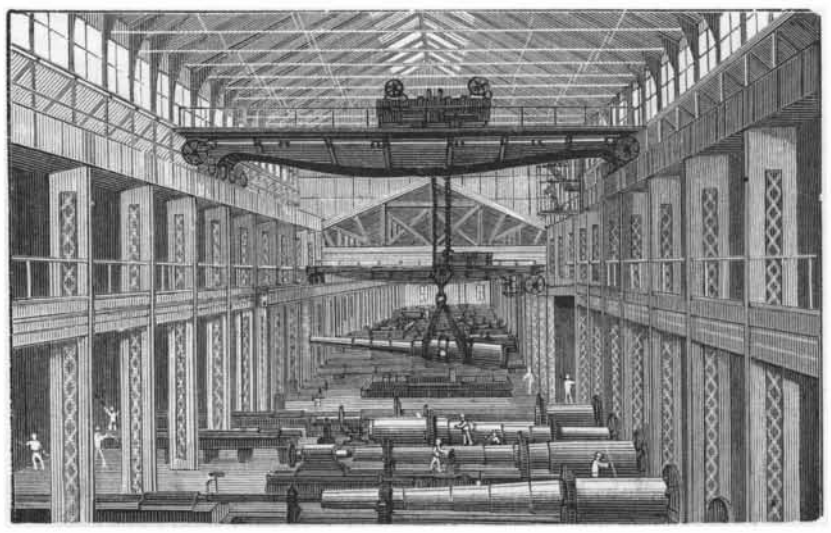


Fig. 8.—INTERIOR OF GUN SHOP AND MAMMOTH TRAVELING CRANE.

Fig. 8 shows the interior of the large gun shop, in the foreground of which will be placed, when completed, the heavy lathes mentioned above. These lathes will be served by the 110-ton overhead traveling crane recently erected and tested. This crane is composed of a bridge which travels lengthwise the shop, a trolley that traverses on the bridge, or girders, across the shop, and which is fitted with the gearing that hoists and lowers the weight to be moved. The power (steam) is transmitted through square shafting, the motions being controlled by clutches.

Fig. 5 represents the lower block of the purchase for hoisting and lowering, and will convey, by comparison with the life-size figures in the sketch, the enormous strength for which preparation must be made.

The two principal sections of the new gun factory are designated as the *north* gun shop, where the guns of the larger calibers will be completed, and the *south* gun shop, where the smaller calibers will assume their finished shapes under the service of a 40-ton traveling crane. Both of these cranes are seen in the cut, together with the lathes and other machines installed and in full operation in the south gun shop. All of these tools are set in the direction of the width of the building, much economy of space and better crane service being obtained by this distribution.

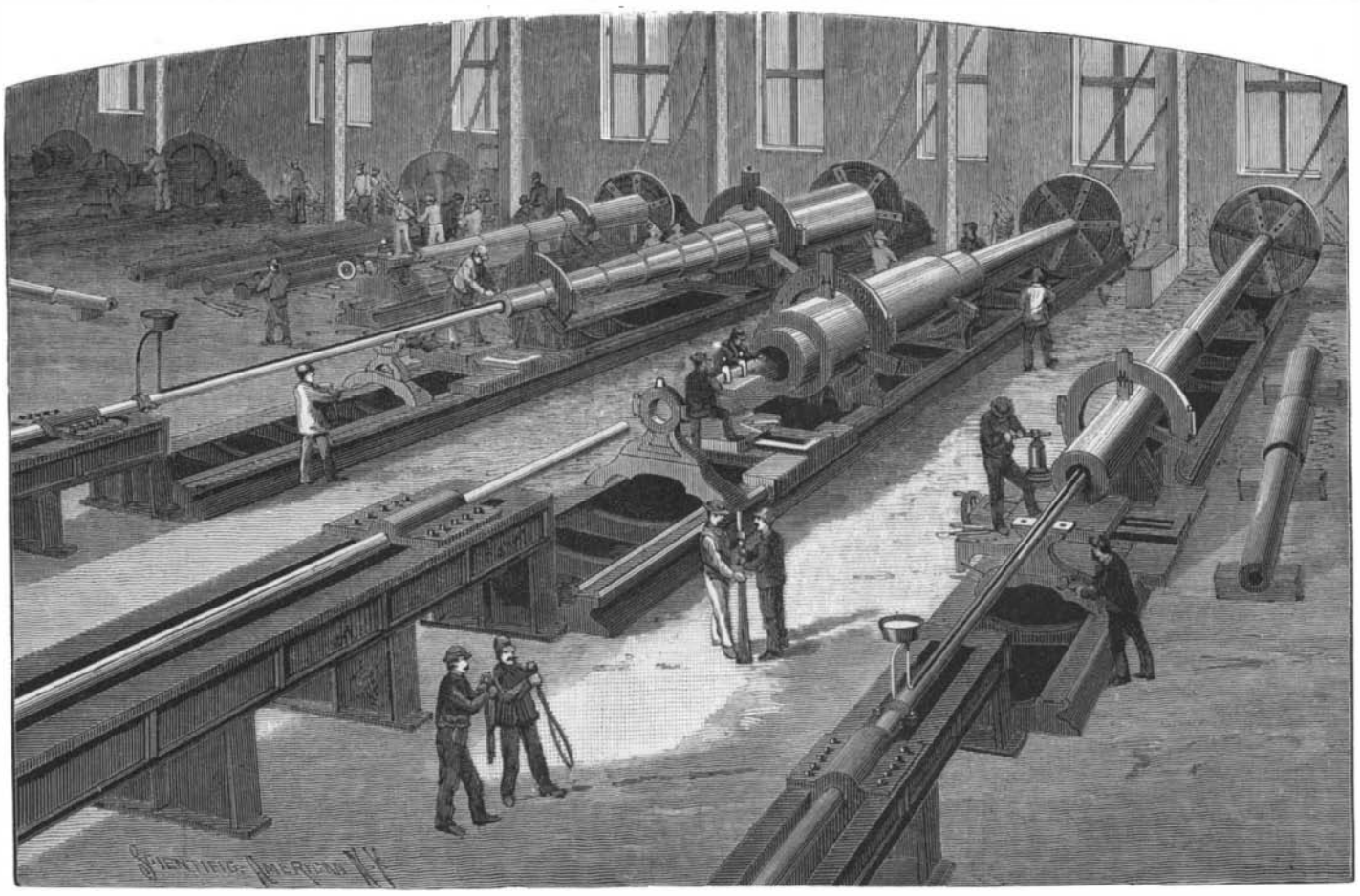


Fig. 9.—LATHES FOR BORING, TURNING AND CHAMBERING HEAVY GUNS, WASHINGTON.

On their arrival at the arsenal, the cars containing the forgings are run under the overhead cranes, which quickly remove and place the forgings in their respective lathes (Fig. 9) for boring and turning. Frequently these two operations are done at the same time, cutting tools shaving off the outside of the tube while the "hog bit" (Fig. 6) is taking its first and second boring cuts.

The tube is very carefully turned and accurately gauged for the reception of the jacket and hoops, which, after being as accurately machined, are to be shrunk into place.

The shrinking pit (Fig. 2) is a deep excavation lined with brick and fitted with adjustable platforms for adaptation to the lengths of the parts of the different calibers. It contains, also, furnaces of sizes adapted to the dimensions of the jackets and hoops to be heated previous to the assembling, which are expanded until they are large enough to be dropped easily over the tube, jacket or previous layer of hoops. Wood fuel is employed to raise these parts to the requisite temperature. Great difficulty was experienced in excavating the shrinking pit, and it proved to be an enormously expensive undertaking, owing to the existence of quicksand where it was deemed most advisable to locate it. The pit has proved, however, very satisfactory for all work thus far done, which has covered the assembling of guns of 10-inch caliber. When ready, the tube, breech end up, is placed in a vertical position by the overhead crane and the jacket lifted from its heating furnace and lowered over the tube into its proper position.

Water circulating through the tube causes a gradual decrease of the temperature until the jacket, which was machined to have an inside diameter slightly less than the outside diameter of the tube, grips the tube by a previously calculated shrinkage equal to the compression increased by the extension. The gun is then reversed for the placing of the chase hoops. These and the other strengthening bands may be assembled while the gun is in the lathe if this method should be preferred or if the appliances of the shrinking plant should be otherwise employed. For the heavier calibers, gauges are fitted over which the jacket and longer hoops are dropped before being finally placed on the tube itself. This is a very necessary precaution, as costly experience has already pointed out; for if any portion of the jacket should become set before the entire jacket has reached its proper position, it would probably have to be turned off in the lathe and be destroyed. The naval gun factory has thus far been very fortunate, and has, we believe, lost but very few forgings from this cause.

When all the parts have been shrunk in place, the trunnion band, when used, is screwed on, and in some types of construction assists to lock the parts together, the gun is finished turned and polished, and the final boring cut taken with a packed bit (Fig. 6). This last operation and that of rifling are conducted by very skillful mechanics, as any error in these, the finishing touches to the bore and rifling of the piece, would cause its ruin.

Fig. 3 represents the cutting of the chamber. This, as well as all others of the finishing operations, requires mathematical accuracy, the gun, when completed, being a much more perfect mechanical contrivance than the majority of timepieces on which we are accustomed to rely from day to day.

To rifle the gun, it is placed in a rifling machine (see Fig. 5 of our issue of Feb. 28, Vol. LXIV., No. 9), firmly supported in heavy steady rests. The machine is horizontal, carrying a bar whose cutting head operates during withdrawal. Various devices are employed for regulating the twist or inclination of the grooves. As a rule only a single groove is cut at a time, but a few machines employ a greater number of cutters in the head. The latter practice is followed at the Washington factory.

The rifling is right handed and begins at the forward end of the compression slope. In the latest designs for 6-inch it has a twist of one turn in 180 calibers, at a distance of 144 inches from the muzzle, and increases to a twist of one turn in 25 calibers. This increase gives greater steadiness in flight and the power to use longer projectiles than could otherwise be employed. The grooves are wider at the origin than at the muzzle.

We now come to the preparation and fitting of the breech mechanism, much of which has to be done by hand, as shown in Fig. 4.

The breech is closed by the interrupted screw system, universally known as the French, the De Bange elastic pad and mushroom head having been adopted by the United States as much the best of the several systems tried.

As soon as the breech mechanism is complete, the sights and elevating band are adjusted and a final examination made preparatory to proof.

The sequence of the operations above described may be varied to meet the conditions of the various machines through which the gun must pass during the different stages of its manufacture, but boring and turning lathes, planers, slotters, shapers and milling machines, drills, rifling machines, must each have their share in the final moulding to form, guided and governed by micrometer gauges and calipers to assist in securing the best ballistic results.

The gun is now taken to the proving ground for final test, previous to its finding its way to the barbette, turret, sponson or other support of the ship to which it may have been assigned. The responsibility of the steel maker will be appreciated when we recall the fact that the forgings of which the gun is composed are not finally accepted until the gun has successfully passed five powder proof rounds with service charges. As several months are required to assemble and finish the larger guns, it is evident that a long time must elapse before this final demand can be satisfied. The powder is manufactured by Dupont & Co., who have met with much success in developing progressive powders suitable for the various calibers.

The common shell and shrapnel are manufactured at the Washington factory.

Fig. 10 represents a 10-inch projectile in the lathe having its cone turned, while Fig. 7 shows the method of securing the copper bands which take the grooves in the bore of the gun and govern the amount of

twist. A cylindrical groove is cut near the rear end, into which the copper band is forced by hydraulic pressure.

The United States has not yet succeeded in securing a domestic supply of armor-piercing projectiles, but experiments are in progress which may result favorably.

But as far as that which concerns the supply of modern high-powered ordnance, our sketch shows how thoroughly the Bethlehem Steel Works and the Washington gun factory have released us from dependence upon foreign industries and what strides we are making to regain our lost prestige in the science and art of gun making.

The New Fire Boat New Yorker.

This splendid addition to the fire department of the city of New York, which was illustrated and described in the last number of the SCIENTIFIC AMERICAN, had the first opportunity to prove her efficiency at a fire on March 5. A large steamer, the City of Richmond, loaded with cotton, rubber, sugar, etc., took fire at a pier near the great suspension bridge over the East River. The fire spread with great rapidity, and the steamer was quickly enveloped in flames. As described by the New York *Sun*, "All was blazing merrily when the fire boat came up opposite the end of the pier, her whistle wailing like a lost soul. While yet a long way out in the stream she brought the fire in view. There was a movement of the captain in the pilot house, the men at the standing pipe at her bow gave a valve a whirl, and in an instant such a stream of water as the people along shore never saw before burst from the four and one-half inch nozzle. Over the corner of the pier, over the host of harbor tugs gathered there, and straight into the heart of the blazing mass of woodwork, the stream drove with all but irresistible power. It was as large as a man's body where it struck the fire. The flaming walls and bulkheads of cabin and staterooms about the bow went down before it like paper, and splintered boards were hurled in all directions. It was almost as if cannon were battering at the wreck. From a position on the port bow the New Yorker worked her way slowly into the slip among the tug boats until she had literally raked the City of Richmond from stem to stern. Next she turned her liquid battery on the nearest pier shed, tearing the blazing roof to pieces and drowning out the fire there before the spectators had noticed that she had left the steamer."

How to Cure a Headache.

In case of the ordinary nervous headache, from which women suffer so much, says an authority, remove the dress waist, knot the hair high up on the head, out of the way, and, while leaning over the basin, place a sponge soaked in hot water, as hot as can be borne, on the back of the neck. Repeat this many times, also applying the sponge behind the ears, and, if the assertion of the writer is not a mistaken one, in many cases the strained muscles and nerves that have caused so much misery will be felt to relax and smooth themselves out deliciously, and very frequently the pain promptly vanishes in consequence. Every woman knows the aching face and neck generally brought home from a hard day's shopping, or from a long round of calls and afternoon teas. She regards with intense dissatisfaction the heavy lines drawn around her eyes and mouth by the long strain on the facial muscles, and when she must carry that worn countenance to some dinner party or evening's amusement, it robs her of all the pleasure to be had in it. Cosmetics are not the cure, nor bromides, or the many nerve sedatives to be had at the drug shop. Here, again, the sponge and hot water are advised by the writer quoted, bathing the face in water as hot as can possibly be borne; apply the sponge over and over again to the temples, throat, and behind the ears, where most of the nerves and muscles of the head center, and then bathe the face in water running cold from the faucet. Color and smoothness of outline come back to the face, an astonishing freshness and comfort is the result, and if a nap of ten minutes can follow, every trace of fatigue will vanish.—*Analyst.*

A Smart Iowa Boy.

An ingenious youth out in Iowa tied a thread to a nickel, dropped the nickel in a slot machine, got what he wanted, then, withdrawing the nickel by the thread, repeated the operation until he had made a clean sweep of the receptacle's contents.

He was arrested on a charge of theft, but the judge who tried him held that he had committed neither burglary, larceny, nor robbery, nor even obtained property under false pretenses. He had merely done what the inscription on the machine told him to do—drop a nickel in the slot—and had kept on doing it. Nothing was said about leaving the coin where it was dropped. The decision will probably abate a nuisance.

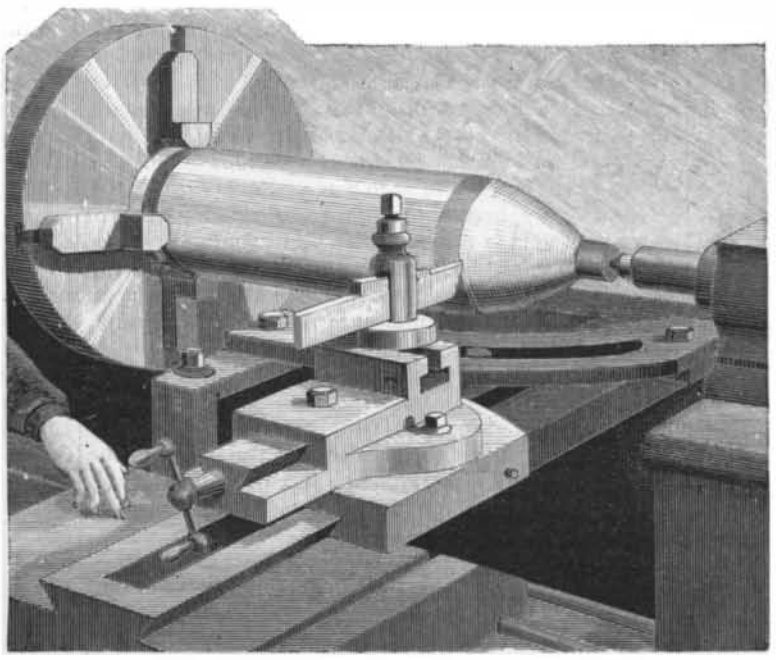
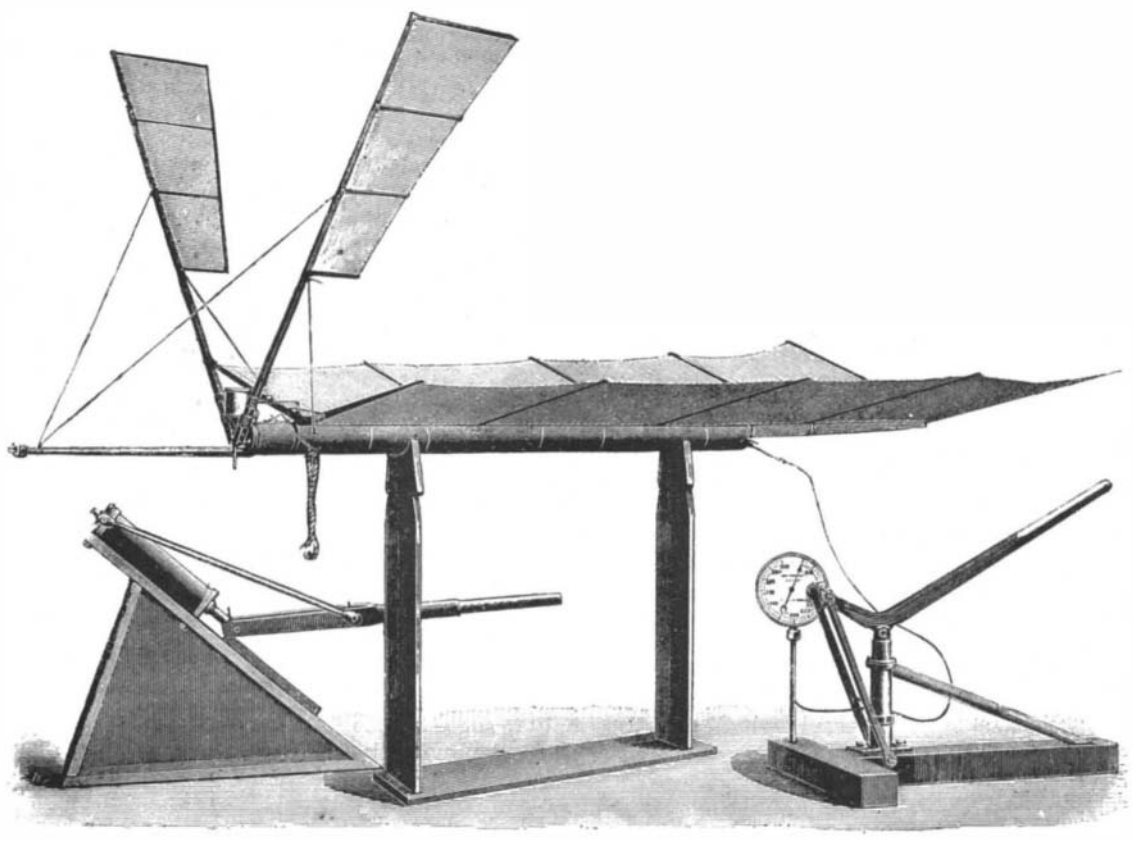


Fig. 10.—TURNING 10-INCH PROJECTILE.

A PNEUMATIC FLYING MACHINE.

This is a flying machine constructed by Mr. Lawrence Hargrave, of Sydney, N. S. W. It is propelled by an engine fed with compressed air, and, as will be seen from the engraving, which is from *Engineering*, the machine is a marvel of lightness and ingenuity.

The compressed air is stored in a tube which forms the backbone of the whole construction. This tube is 2 inches in diameter, 48¼ inches long, and has a capacity of 144·6 cubic inches. Its weight is 19·5 ounces, and the working pressure 230 pounds per square inch.



A PNEUMATIC FLYING MACHINE.

The engine cylinder has a diameter of 1½ inches and a stroke of 1¼ inches, while the total weight of the engine is only 6½ ounces. The piston rod is made fast to the end of the backbone, and the cylinder moves up and down over the piston. Two links connect the cylinder to the Canadian red pine rods which carry the wings. The air is admitted to the cylinder, and exhausted by means of a valve worked by tappets. The period of admission continues through the entire stroke. The cylinder and receiver ends are pressed, and the piston is made of vulcanite, with a leather cup ring for packing.

The wings are made of paper, and have no canting or feathering motion other than that due to the springing of the material of which they are made. The weight of the wings is 3 oz. To find how much the wings deflected, one was held by the butt and a weight of 7½ oz. was put on the membrane 24 in. from the fixed point and 1⅝ in. abaft the wing arm. The deflection produced, due to torsional stress, was 3½ deg. By moving the weight half way across the wing it was twisted 8¼ deg. The area of the body is 2,128 square inches; the area of the wings 216 square inches; and the total area, 2,344 square inches.

When first made, the machine had its center of gravity so placed that the percentage of area in advance of it was 30 per cent of the whole area, but continued disaster caused its reduction to 23·3 per cent. In a dead calm the machine flew 368 feet horizontally.

The engraving shows also two forms of pump for compressing the air. Each has a bent lever handle and long links on the principle of the Stanhope press, so that the most powerful leverage acts on the cylinder full of air when it is reduced to its smallest volume. The ram is 1⅜ inch in diameter, and the stroke about 4½ inches. The receiver is charged in six minutes to 230 pounds, and 400 pounds pressure can be obtained by this pump.

A New Name and Draught Law for Vessels.

By the act of Congress approved February 21, 1891, the name of every documented vessel of the United States shall be marked upon each bow and upon the stern, and the home port shall also be marked upon the stern. These names shall be painted, or carved and gilded, in Roman letters in a light color on a dark ground, or in a dark color on a light ground, and to be distinctly visible. The smallest letters used shall not be less in size than four inches. If any vessels of the United States shall be found without these names being so marked, the owner or owners shall be liable to a penalty of ten dollars for each name omitted: *Provided, however*, that the names on each bow may be marked within the year eighteen hundred and ninety-one.

The draught of every registered vessel shall be marked upon the stem and stern post, in English feet or decimeters, in either Arabic or Roman numerals. The bottom of each numeral shall indicate the draught to that line.

The owner, agent, or master of every inspected sea-going steam or sail vessel shall indicate the draught of water at which he shall deem his vessel safe to be loaded for the trade she is engaged in, which limit as indicated shall be stated in the vessel's certificate of inspection, and it shall be unlawful for such vessel to be loaded deeper than stated in said certificate.

Blowing up a Wreck.

Ever since the collision, on September 28, just off the New Jersey coast, between the steamship Vizcaya and a schooner, the wrecks had formed an obstruction to navigation, although the government had placed whistling and spar buoys near by. Considerable portions of the masts of both vessels projected above the water, which had gone down where the depth was about sixty feet. The Yantic, of the U. S. navy, was sent to remove the wreck, which lay quite in the line of considerable coastwise navigation. Two boats were sent out, with torpedoes, each containing thirty-four pounds of gun cotton, equal to four times that weight of gunpowder, and two of these torpedoes were sunk alongside the schooner's masts. An electric wire from the torpedoes was fastened to the stern sheets of the boats, and the latter were rowed a distance of about two hundred yards away, when the wires were connected with an electric battery. The circuit was then closed, the explosion followed, throwing up a great volume of water, and all signs of the wreck of the schooner had disappeared. The same course was then followed with regard to the wreck of the steamer.