

# SCIENTIFIC AMERICAN

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### THE THUNDERER GUN EXPERIMENTS.

The disaster which happened in gunnery practice on board H.M.S. Thunderer, on Jan. 2, 1879, at the Bay of Ismid, in the Sea of Marmora, has been repeatedly mentioned. One of the two great guns, each weighing thirty-eight tons, which were mounted in the fore turret of that ship, burst in firing with shell at a target, and the muzzle part of the gun was completely blown to pieces. Eleven men, amongst whom were Lieutenant A. H. Coker, R.N., Lieutenant Daniel, Royal Marine Artillery, and Corporal Bolton, with a gunner and seamen, were killed by the explosion, or by fragments of the gun, the shell, and the roof of the gun-turret. Both the burst gun and its companion piece, which remained uninjured, have been brought to Woolwich Arsenal; and the latter is now being subjected, in the Artillery Practice Marshes at Woolwich, to a series of experiments with over-loading and irregular loading, for the purpose of ascertaining how such a gun is likely to burst if it be inadvertently or accidentally mismanaged.

We now give an illustration of the actual state of the burst gun, as it appears at Woolwich Arsenal.

These guns were manufactured by the Elswick Ordnance Company at Newcastle-on-Tyne, and were mounted with the working and loading machinery, on the hydraulic system, devised by Mr. G. Rendel, of that firm. Each gun was 19½ ft. in length; the length of the bore itself was 16½ ft., and the diameter of the bore was 12 inches, rifled with nine grooves, upon the Woolwich increasing system, the twist being completed in a length equal to thirty-five times the width of the caliber. The guns were constructed on the Fraser system of shrunk wrought iron coils, having several short single coils and a forged breech-piece. They were fired with a charge of 85 lb. of powder and a projectile

weighing 700 lb. It is considered probable that the gun was twice loaded, which naturally caused it to burst.

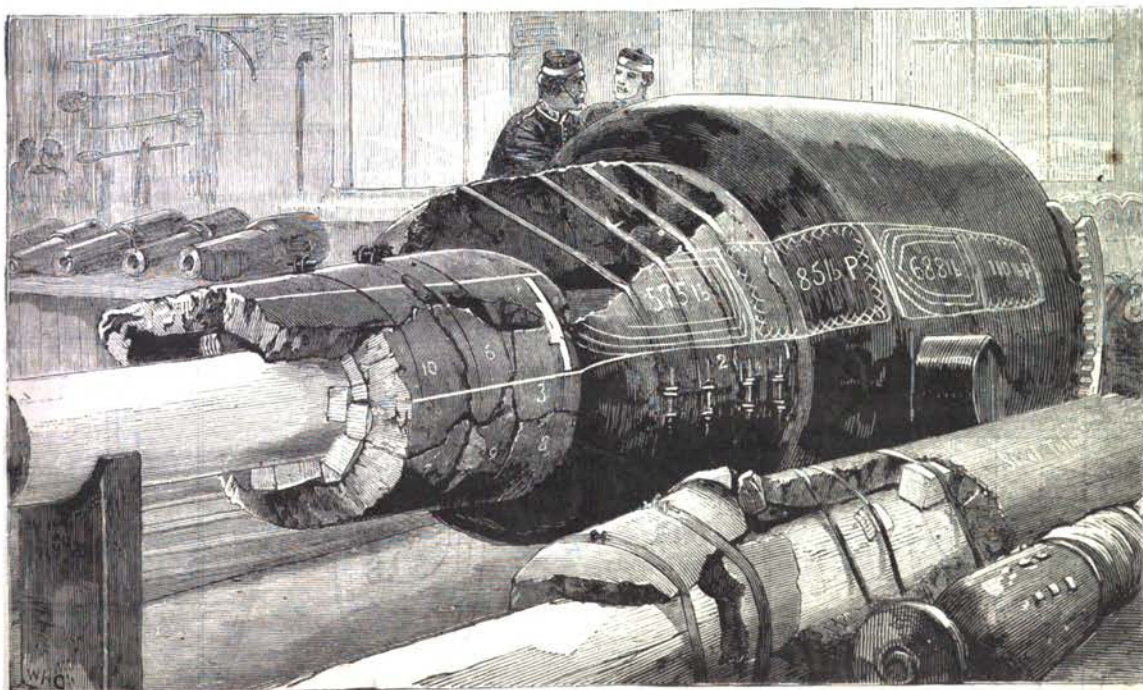
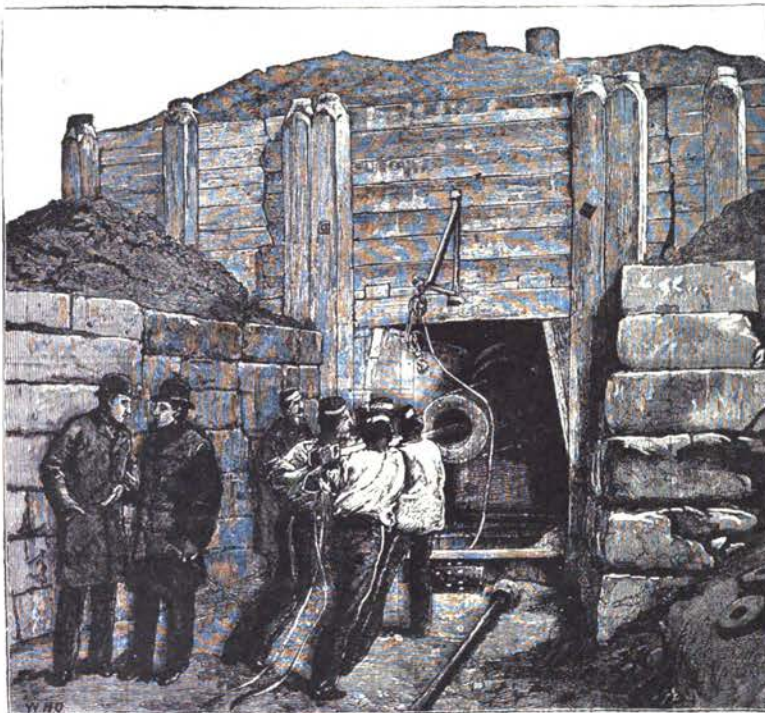
We also give an engraving showing the position of the companion of the burst gun, which, as before stated, is now being experimented with at Woolwich, under the direction of a government investigating committee.

The explosion had been caused, in the committee's opinion, by the gun having been inadvertently double loaded—first with a cartridge of 85 lb. of powder and a Palliser shell of 700 lb., and then with a similar cartridge and a common shell of 587 lb.—the ignition of the foremost charge occurring at a part of the gun where the thickness of metal was

inadequate to endure the strain. The Lords of the Admiralty on May 1 assented to the recommendation that the second 38-ton gun should be taken from the Thunderer's turret and subjected to a series of tests, in order to show that the accident was due not to any defect in the manufacture of the guns, but to circumstances entirely under the control of the gunners. One of the opposing theories was that the wad which is used to keep the projectile from slipping had by some means become displaced, causing the shell to jam, and so making the gun burst.

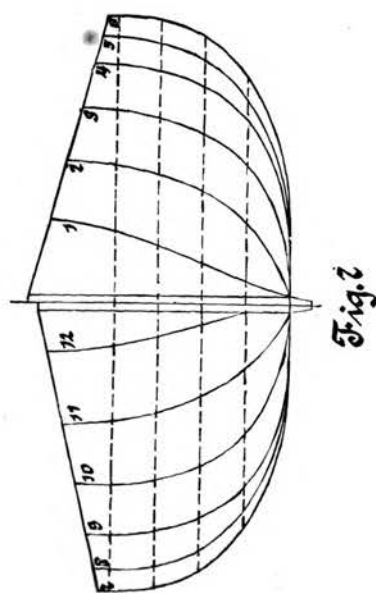
The 38-ton gun was placed in a cell in a mound facing the proof butts. It was mounted upon an ordinary naval carriage and platform, and all the arrangements were made to approximate as nearly as possible to circumstances on board ship. There was not much room to spare inside the cell, which was only about 10 ft. square at the front and some 30 ft. long, just sufficient to allow for the recoil. The interior is faced with balks of timber, overlaid with heavy pigs of iron and several feet of concrete, upon which earth is heaped until a hillock is formed 35 ft. in height and 200 ft. in circumference.

The experiments hitherto made have been chiefly designed to try whether or not the gun would burst with a considerable vacant space left between the powder cartridge and the shot or shell, as some persons were of opinion that, in the gun which did actually burst on board the ship, this derangement had accidentally taken place by the shell having slipped forward. It is now proved, however, that with an interval of six feet be-



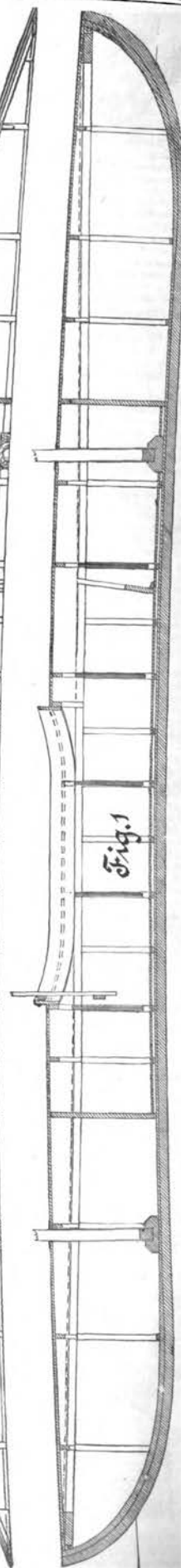
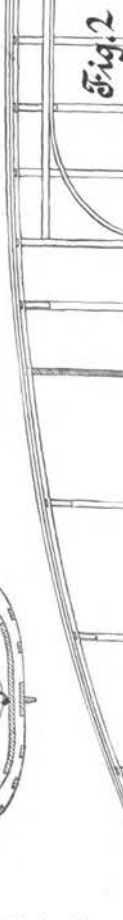
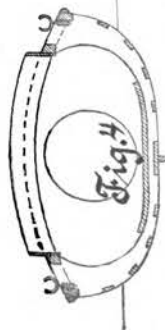
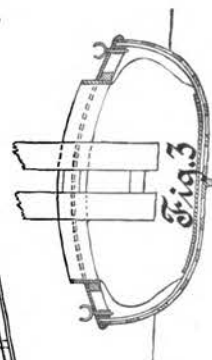
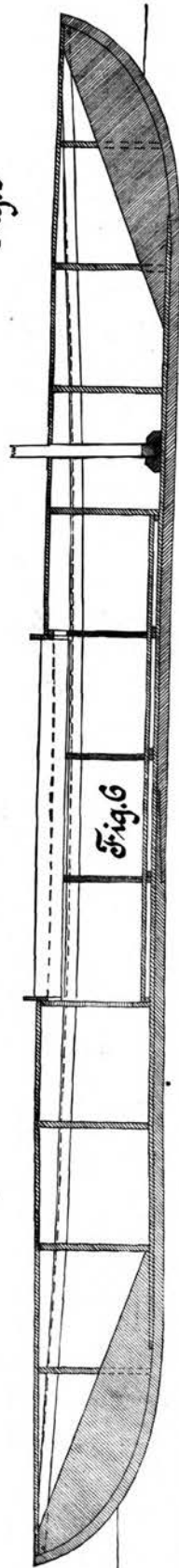
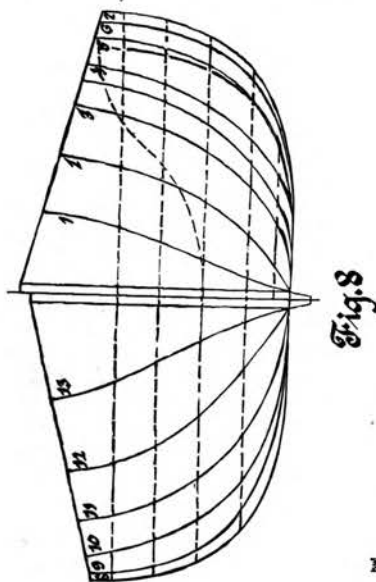
THE THIRTYEIGHT TON GUNS OF THE THUNDERER.





Canvas Canoes  
for  
Sailing and Paddling  
Designed by  
W. P. Stephens

Scale for Figs. 2 to 8  
12 6 3 1 ft.



12 6 3 1 ft.

ween the greatest charge of powder and the heaviest shot there is no injury to the gun, and the space will be increased to eight or ten feet, with little apparent probability of bursting. The committee will finally try if they cannot burst this gun by firing it with a double charge of powder and shells, as they suppose the other gun to have been twice loaded in the case of that lamentable disaster a twelvemonth ago.—*Illustrated London News*.

#### FINAL BURSTING OF THE SECOND GUN.

ADVICES from London, of February 4, state that on that day the final experiment was made which it was believed would settle the question as to how the first gun was burst. The gun, for the purpose of this experiment, was loaded and fired with a double charge of 80 to 110 pounds of powder, one 600 pound common shell, and one 700 pound Palliser projectile. The gun burst, as its fellow did on board the Thunderer, thus justifying the opinion of the committee of investigation as to the cause of that disaster. The muzzle of the gun and the projectiles were buried in the sand at the proof butts. The remainder of the gun, with the exception of its base, was blown to atoms.

#### THE CONSTRUCTION OF CANVAS CANOES.

The building of a canoe or other very light boat, of wood, requires not only considerable skill in the use of tools, but more technical knowledge of boat building than amateurs usually possess; so for the benefit of many new canoeists, who do not care to go to the expense of a wooden canoe at first, and of others, like ourselves, who prefer to build and equip their own craft, we will describe two canoes which can be built by any careful workman, and that, with reasonable care in construction and use, will make handsome and durable boats.

Though inferior in many respects to a wooden canoe, they will last a long time, one built by the writer in 1877 being still in use, and, after three seasons of rough usage, is apparently as sound as ever, and they have the advantage of being very cheap.

The larger boat is of similar model to the famous Baltic

Now take a pine board,  $\frac{3}{4}$  in. thick and 12 in. wide; mark and saw out the whole sections, Nos. 1, 2, 3, 4, 8, 9, 10, and 11 (leaving depth enough for the rise of the deck), and also saw out from oak or apple knees, two half sections each of Nos. 5, 6, and 7, the inner edges being of the shape shown in Fig. 4, joining each piece by a bottom. See Fig. 42.

Notches must now be cut in each section to admit the keelson and gunwales, and the latter, of oak,  $1\frac{1}{4}$  by  $\frac{3}{4}$  in., halved into the stem and stern, and the sections put in place and secured temporarily.

Now, the rib bands, 1 in. by  $\frac{1}{2}$  in., may be planed up and tacked in place, being spaced amidships as in Fig. 4, and about equidistant at the ends, and the points where they cross each section and the stem and stern marked, after which they may be removed and notches cut to receive them, so that the outer surface of the stem, stern, keelson, gunwales, rib bands, and sections will be flush and smooth.

The whole framework should now be examined, and any alterations that may be needed to make the curves true must be made, as there will probably be some errors in enlarging the body curves from so small a scale; then the stem and stern being vertical and the sections square to the keel, all may be fastened together with brass screws or galvanized nails.

Now cut a piece of board to the curve of the deck (26 in. radius), and set it in place amidships, and with a straight edge and the eye trim each section to shape, then set in the ridge pieces (Fig. 5) of  $\frac{3}{4}$  in. pine, and the side strips, over which the deck is stretched.

The well is strengthened by a piece of oak or spruce, 1 in. by  $\frac{3}{4}$  in., screwed to section 8 at one end and the deck beam, 1 in. by  $1\frac{1}{2}$  in., at station 5, and to the knees at 6 and 7.

The framework may now be removed from the stocks, and all inequalities planed down and the edges slightly rounded off, so as not to chafe the canvas, after which it is painted with two coats of white lead and oil, the canvas meanwhile being stretched on the floor and painted with a coat of raw linseed oil on the inside.

The canvas should be heavy, with a smooth hard surface,

bilge touches, and screw on each side a piece of oak,  $\frac{3}{4}$  in. by  $\frac{1}{2}$  in. and 4 ft. long, to protect the bottom. Holes are bored in stem and stern for the painter, and the boat is ready for the fittings described below.

Circular holes in sections 4 and 8, Fig. 5, give room for stowing small articles.

If the amateur wishes to build a lighter and roomier boat, he must first rig up a boiler and steambox, as described in SUPPLEMENT No. 30.

The keelson, stem, and stern are in one piece, of oak, 3 in. by  $\frac{3}{4}$  in. amidships, tapering to  $\frac{3}{4}$  in. by  $\frac{3}{4}$  in. at ends, steamed, and bent to the curves shown in Fig. 2.

The piece is set up as described, and sections 8, 10, and 31; cut out of  $\frac{1}{2}$  in. pine and put in place, the latter two forming permanent bulkheads, the other being removed as soon as the ribs and deck beams are in.

The gunwales and rib bands are now tacked in place, and the points where they cross the stem, stern, and bulkheads marked, and notches cut, after which they may be screwed together.

The rib bands next the keel are 5-16 in. thick, the others and the outer gunwales being  $\frac{1}{4}$  in.

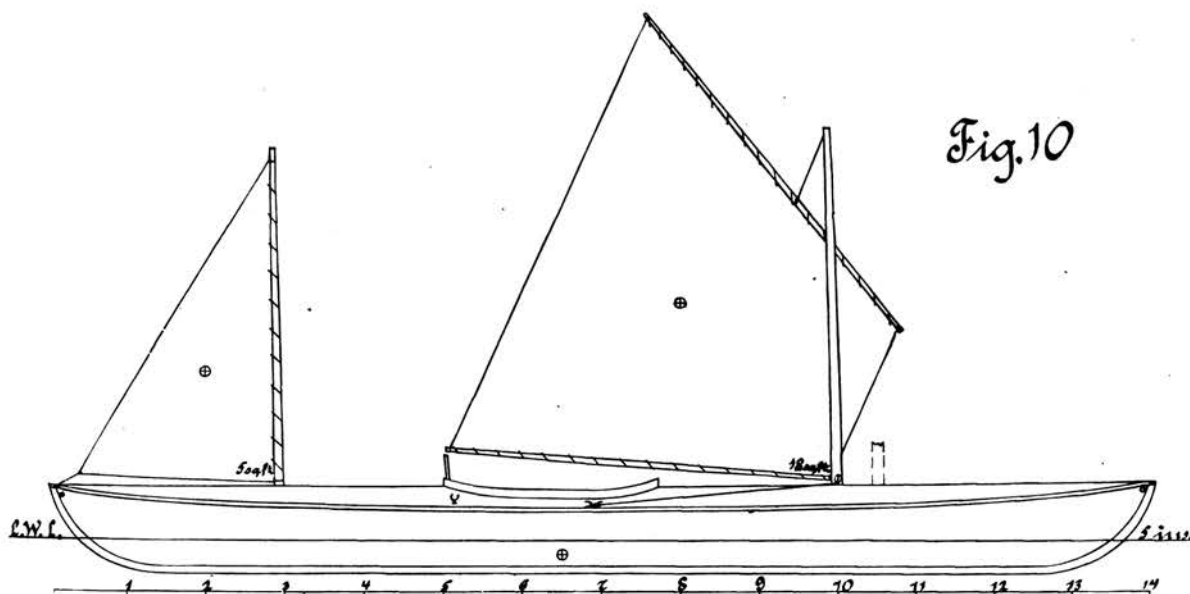
A wedge of pine, 4 in. long, is fitted between each pair of rib bands at stem and stern, and screwed to them.

The ribs are of oak,  $\frac{5}{8}$  in. by  $\frac{3}{8}$  in., steamed and bent; a number being prepared of various curves, barrels or any round objects being used to bend over them: the one nearest the shape required for any position is selected from the lot, and if it does not quite fit it may be bent back while cold without injury.

They are fastened by a copper nail through each rib band, riveted over a burr or washer, then after all are in, an in-wale of oak,  $1\frac{1}{4}$  in. by  $\frac{1}{2}$  in., is notched over each rib and riveted to the outer gunwale.

The mast steps are now put in, also the blocks for the stretcher, and the sockets for the steering crutch, and the floorboards of 5-16 in. pine screwed to the ribs or made movable, as in No. 164 SUPPLEMENT.

The deck beams of oak, 1 in. by  $\frac{1}{2}$  in., are next screwed to the gunwales and strengthened by knees, other knees being placed so as to support the well, and screwed to the



CANVAS CANOE.—DESIGNED BY W. P. STEPHENS.

Rob Roy, of Macgregor, but has a little more sheer and greater bearings, making it stiffer under sail and better adapted for rough water.

Its dimensions are: Length on deck, 14 ft.; beam, 26 in.; depth at bow,  $12\frac{1}{2}$  in.; stern, 12 in.; amidships, 9 in.; well, 18 by 32 in.; draught, 5 in., including an inch keel.

This class of boat is the best known for river cruising, exploring, and general work, where light draught, portability, and easy paddling are the chief requisites; and is by far the best boat for beginners, but for coast work or bay sailing cannot compare with the Jersey Blue.

Fig. 1 shows the canoe in section and also its port side in elevation; Fig. 2 is the half-breadth plan, with deck and deck beams removed, except at well; Fig. 3 is a cross section amidships, and elevation looking aft; and Fig. 8 an enlarged body plan, giving the curves at distances of 1 ft. apart from bow to stern, those forward of midships being on the right and those aft on the left.

The smaller boat is better suited for a boy, and will do for hunting, fishing, short cruises, or to take when camping out, its length making it very portable.

It is 12 ft. 6 in. long, 26 in. beam, and 12,  $11\frac{1}{2}$ , and  $8\frac{1}{2}$  in. deep.

Figs. 4, 5, 6, and 7 represent the same views respectively as 3, 1, 2, and 8.

For bending the ribs, keelson, combing, etc., a boiler and steam box are needed, but as they cannot always be obtained we give a method of building, shown in the drawings of the smaller boat, but applicable to either, whereby all bending is dispensed with; the boat being as strong and easier to build, but giving less room below decks.

The first step is to saw out from  $\frac{3}{4}$ -in. board two pieces for stem and stern; these are then screwed to the keelson of oak,  $\frac{3}{4}$  in. thick, 3 in. wide amidships, and tapering to  $\frac{3}{4}$  in. at each end, the three being then set up on a bench or plank as described in SUPPLEMENT, No. 30, page 472, Fig. 37.

Next, the body plan, Fig. 7, must be enlarged as described for Fig. 35, by drawing lines 2 in. apart on a large sheet of paper, and laying off the distance from the center line to each point of intersection in the small drawing, six times to the corresponding line in the larger one, and drawing fair lines through the points.

No. 4 Woodbury duck being a good size, and may be had of J. Boyle, No. 203 Fulton St., New York.

After the paint is dry, lay the frame in the center of the canvas, draw the latter around it, and secure it in place with a few tacks on the gunwales, then with a large needle and strong twine, sew both edges together with stitches about 8 in. apart, until the skin is laced over the frame as a shoe is over the foot.

When the string has been drawn tight, the canvas can be cut on bow and stern and tacked, being lapped and well painted, then go over the cord from end to end until every wrinkle is drawn out and the canvas is smooth and tight, when it may be tacked along the top of the gunwales, the cord removed, and the edges trimmed off, leaving about an inch, which is turned down and tacked inside the gunwales.

The canvas should also be tacked to each section intended to be watertight, which are Nos. 2, 3, 8, 9, 10, and 11, the deck also being tacked to them when laid, thus forming watertight compartments and lessening the damage in case of a rip or tear.

The floorboards,  $\frac{3}{4}$  in. thick, of pine or spruce, can now be screwed to the bottoms, the blocks for the footboard or stretcher, the mast step, and the combing of  $\frac{1}{2}$  in. oak projecting  $1\frac{1}{2}$  in. above the deck, put in when all is ready for the decking, this having been also oiled.

A heavy drilling or light duck, 28 in. wide, will answer, a hole being cut out for the well (leaving enough to turn up and tuck around the combing), and the edges are tacked to the outer side of gunwales, lapping over the outer canvas.

The boat should now have two or three coats of paint, each having time to dry, then a half round strip of oak,  $\frac{3}{4}$  in. diameter, is screwed along each gunwale.

The outer keel is of oak, 1 in. deep,  $\frac{3}{4}$  in. thick at back, and  $\frac{3}{8}$  in. on face, and must be bent; but if there are no facilities for steaming, it may be made from two shafts or sleigh runners, which may be had ready bent at any wheelwrights, and which should be first procured and the stem and stern pieces cut to fit them.

The two pieces are scarfed in the center and screwed to the stem, stern, and keelson.

Now lay the boat on a level floor and mark where each

side pieces, all being strongly fastened, as this is the weakest part of a canvas boat.

The frame should now be smoothed off and painted, the canvas laced and tacked on, the keel bent and screwed on, and the bilge guards put on as described.

The combing may be bent, as many prefer the oval well to a square one, it being more ornamental but no stronger.

The deck may be laid as above, but a better plan is to lay a thin pine deck, and after painting it, lay on the drilling while the paint is wet, tacking on the outer edge and around the combing, and then putting on the gunwale strips, as in the smaller boat.

The backboard is 17 in. long, Figs. 1 and 3, and is hung by a strap to the combing, and the stretcher is shown by dotted lines in Fig. 8, and rests against a cleat on the floorboards and a block on each gunwale.

A hatch of light wood is sometimes fitted over the well, but it is generally much in the way; a better plan being a piece of rubber cloth, fitting around the body and tied with loops of light twine to screw heads around the combing, so as to come off in case of an upset, the ends being tucked in between the body and the backboard.

No plan should be adopted that will not allow the canoeist to free himself instantly in an emergency.

The masts should step in copper tubes, both to keep water from entering around them and to preserve the deck in case the mast should rise from the step.

For the smaller boat the rig devised by Macgregor is used, the sail being of the shape shown in Fig. 10. Mast,  $1\frac{1}{4}$  in. diameter, tapering to 1 in. at 5 ft. 6 in. long; boom and yard each 4 ft. 9 in. long; luff,  $\frac{3}{4}$  ft.; leech, 6 ft.; the sail being of unbleached sheeting, the rigging of woven cord or troling line, and the spars of spruce.

The boom is fastened to the mast by a piece of soft leather lashed to both, allowing movement in all directions.

The mast in the old Rob Roy is stepped, as shown by the dotted lines in Fig. 10, so that the boom will clear the canoeist's body, but this has the great disadvantage of a strong lee helm, the only gain being that in jibing the boom pokes you in the eye or carcases the bridge of the nose, instead of striking the side of the head, as it would if stepped farther

aft; so to give more weather helm, and so allow the paddle to be held to leeward in steering, the mainsail of the larger boat is stepped farther aft and a dandy added, the latter not being used in running free.

The dimensions are: Mast, 5 ft. 6 in.; boom, 4 ft. 9 in.; yard, 5 ft. 2 in.; leech, 6 ft.; luff, 2 ft.; dandy mast, 5 ft. 2 in.; sail, 4 ft. on luff, 4 ft. 5 in. on leech, and 2 ft. 6 in. on foot.

No jib is used, as it is a constant nuisance and seldom of much use.

The paddle is of one piece of spruce, 7 ft. long, 6 in. to 7 in. wide, 3-16 in. thick at the edges, 1 in. diameter at center, and  $\frac{3}{4}$  in. by  $\frac{3}{4}$  in. at neck, bound with copper, and having rings of rubber to prevent the water dripping down.

For steering the paddle is used in a "crutch" or rowlock, being shifted to leeward in going about, a stroke or two also being needed to help her when "in stays."

When paddling to windward the sails and spars may be stowed below decks.

Cleats are screwed to the deck for the balyards, and a hole should be cut in the flooring to ball through with a sponge, being just between the canoeist's knees.

The builder may vary the model to suit his taste by setting

up the keel, stem, stern, and midship mould, and putting on the rib bands, securing them in the curves he wishes, and fitting the ribs or sections to them. This mode of building will answer equally well for any light craft with rather full lines, as of course the canoes cannot be tightened over a concave surface.

Care must be taken in building to have no sharp points or corners to cut the canvas, to keep the pieces square and in their proper positions until fastened, and also to put in the deck beams before putting on the canvas, so that the frame cannot spread.

A hole should be made in each compartment to air it when not in use, being closed with a plug, and no water should be left in after using, and the boat should be housed.

With these precautions, and touching up the paint from time to time where it may rub off, such a boat will last a long time.

Should any further information be desired the writer will be happy to furnish it.

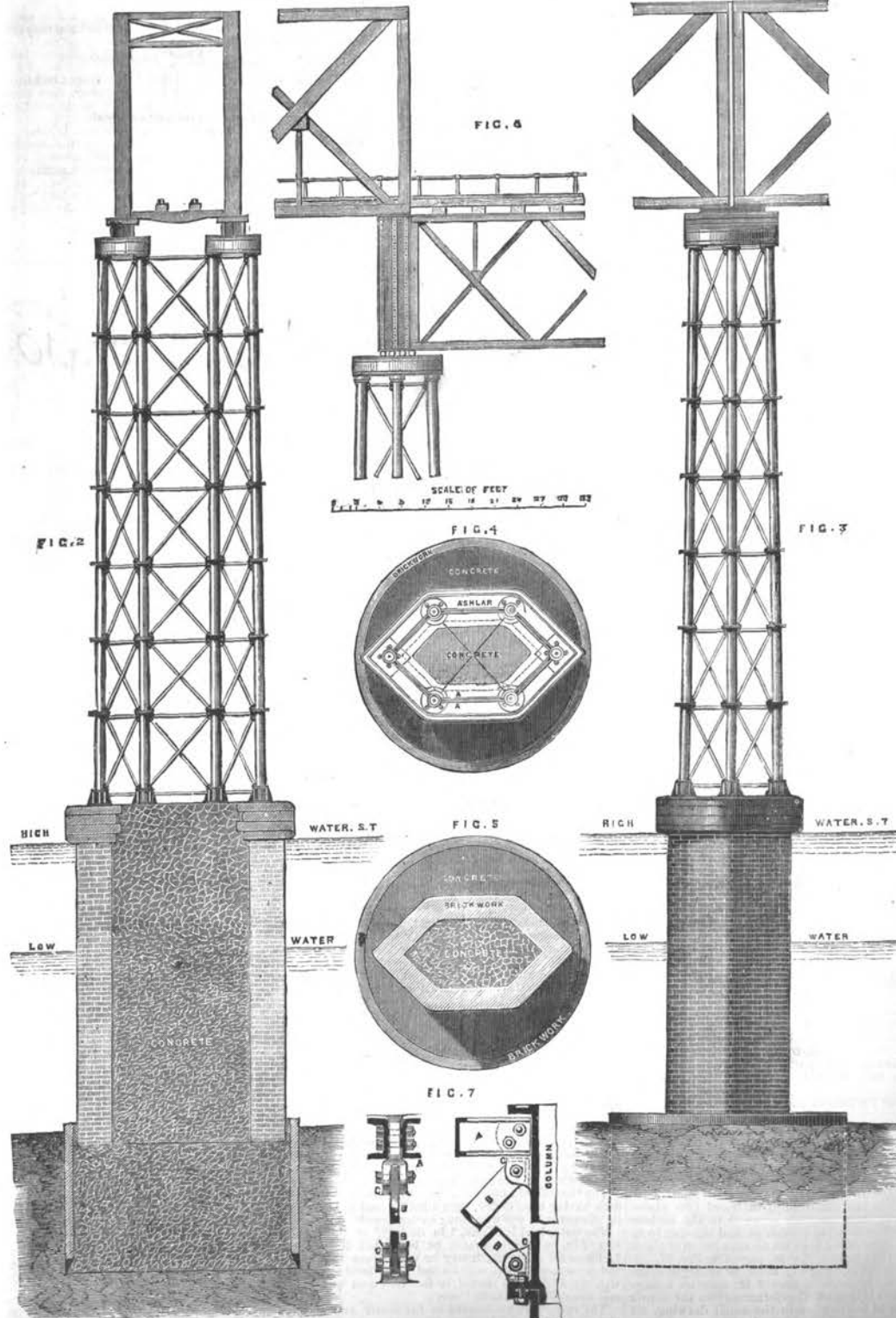
W. P. STEPHENS.

Rahway, N. J.

# THE TAY BRIDGE.

WHILE the Government inquiry into the destruction of the Tay Bridge (Dec. 28, 1879) is in progress, it is inexpedient to express any positive opinion concerning the cause of that catastrophe; but we should scarcely do our duty by our readers if we did not put them in possession of all the facts concerning the bridge itself which are available. We give this week, therefore, drawings which will serve to make the construction of that portion of the bridge which has failed perfectly clear; and we supplement these with additional drawings, showing the contiguous portions of the structure which have sustained no damage.

Some persons, whose geographical knowledge is imperfect, have a vague idea that the Tay Bridge is a link uniting England and Scotland; and it may be as well to explain here once for all that Dundee lies north of Edinburgh about thirty-five miles, and north of the Border by more than sixty miles as a crow would fly. It stands on the north shore of the estuary of the river Tay, which opens into the North Sea. The Tay flows almost precisely from east to west under the bridge, that portion which was destroyed running very nearly due north and south. The Firth of





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of the excessive weight of the paper tubes. This invention, however, will allow of the goods being furnished freed from the tube, and consequently they may be sent to a distance.

3d. In consequence of the great lightness of the tubes, it is possible to steam the threads, in order to fix the torsion, and render the threads less dry.

4th. The light tube completely traversing the bobbin prevents the loss in weaving, either from entangled bobbins or from the ends of bobbins having no tubes or having the ends pasted.

5th. This system of collar and footstep allowing of the driving of the spindle either by cord or gearing, or by heliocidal or worm gearing between the collar and the footstep, will prevent the vibration produced by the application of the driving means above the collar.

clergyman's peaceful study, but has on many occasions shown a refreshing adaptation to breezy places. On her cruise of the Winoski river, in 1875, she ran over the Bolton Falls, lost one of her sides and most of her cargo, but emerged no more used up than her gallant captain; was repaired, and in two days resumed her voyage as though nothing had happened. The Petrel carries no sail.

Two gentlemen of Nashua, N. H., have made a cruise up the Merrimack river in canvas paddling canoes built by themselves. These canoes were thirteen feet in length, and it is said that the midship beam was but fourteen inches.

The writer was one of a party of canoeists that, last summer, encountered on the Hudson a craft that was "propelled by a paddle that was used without a fulcrum fixed to the boat," and hence should be styled a canoe. It was thoroughly

warp, and shrink. The amateur must draught them by the eye. The deck width may be 11 inches and the depth 11½ inches. The four slots on each side must be just wide and deep enough to receive the lateral strips. The position of the strips is largely determined by these slots. They must be given easy, graceful curves, but must have no unsightly twists. The amateur is cautioned that until he has built one canoe and secured satisfactory patterns, it is better to reserve cutting the slots until by actual trial with the strips he has determined just where they should be.

The builder should now have at hand a hackmatack knee, or, perhaps two—the best material for stem and stern posts. It should be 1 inch thick and planed. Knees may be procured at any boat builder's shop or ship yard. If a hackmatack or chestnut knee cannot be had pine may be used, but it is imperative that it be thoroughly seasoned. The hackmatack knees afford a natural curve, and therefore possess great strength, while pine must be cut across the grain. To secure a pattern for the stem and stern posts draw upon a piece of thin, planed pine stuff two parallel lines, 13 inches apart and 24 inches long. Set the divider so that the points shall be 13 inches from each other. Place one point at the extreme right hand end of the upper line and the other point upon the same line. Then strike a quarter circle which will intersect with the lower line, and continue the curved line thus drawn by a horizontal line to the extreme left hand end of the lower parallel line. This gives the outer line of stem and stern posts. The head of the stem and stern posts is a semicircle 1½ inches in diameter.

To strike the inner line set the dividers so that the points shall be 12 inches from each other. Place one point on the upper line and the other one inch above and very slightly to the left of the point of intersection of the lower parallel line and the quarter circle already drawn. Then strike the second quarter circle from that point to the upper line. This second quarter circle is continued by a horizontal line, 1 inch above the lower line, to a point 5 inches from the line A, shown in the following diagram. From that point a perpendicular line should be drawn downward ¼ inch, and from its lower point a 5 inch horizontal line carried, parallel to the lower line, to the line A, giving the scarf.

This pattern should be sawed out. It should then be laid upon the hackmatack knee and its form traced with a pencil. The hackmatack must then be sawed out, of course. It will be observed that stem and stern posts are exactly alike.

The stem and stern posts are now to be neatly beveled down with drawing knife and plane, from 1 inch at the inner to ½ inch at the outer curved line, after which four slots, running from nothing at the inner curve to ¼ inch depth, may be made to receive the lateral strips, although, as has already been suggested, this part of the work may be deferred. The eye in the head of the post, intended for the painter, may be bored with a ½ inch bit.

The keelson should be 1 inch square, ash. Its extreme length is 10 feet 10 inches, 6 inches at each end being cut for the scarf.

The lateral strips should be clear, planed spruce, 1 inch wide and ½ inch thick. It is well to make the gunwale strips 1½ inches wide, and to put in an inwale. We are now ready to set up the canoe, and if the work has been well performed she will show graceful lines, even if she is only a skeleton. Bolt the stem, A, and stern, B, posts to the keelson, C, using two ½ inch bolts at each scarf, not forgetting to coat the scarf and the bolts with white lead. Neatly countersink the bolt heads, of course. Then set up the water-tight bulkheads, D D, 3 feet 7 inches from stem and stern posts, and securely fasten them in place with light iron angles. The midship mould, E, must then be set up at a point 6 inches aft of the true midship section, or, in other words, 7 feet 6 inches aft of the stem post. It is to be removed at a later stage of the work. The lateral strips are now to be put on. The slots in the stem and stern posts and water-tight bulkheads, into which the strips are fastened with brass screws, should be coated with white lead. The strips should be rounded off, that there may be no sharp edges or angles. The lines formed by the strips upon one side should correspond with those upon the other, otherwise the canoe will wobble when under paddle. Ribs, ½ inch wide and from 6 to 8 inches apart, may now be put in. They may be made of four barrel hoops, and should be fastened to the strips with copper tacks.

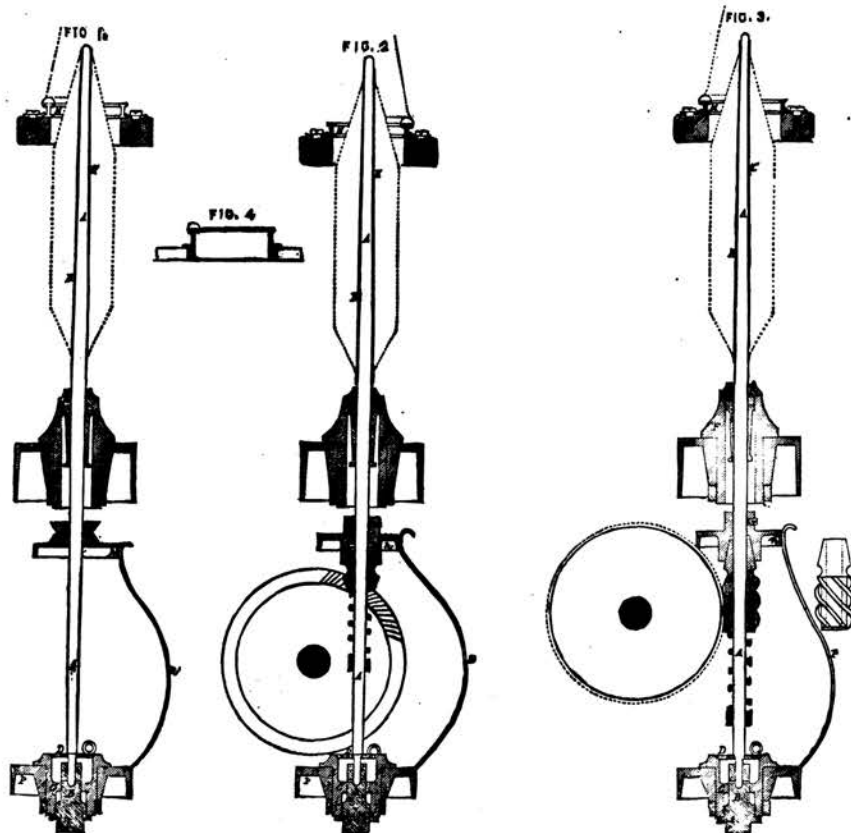
We now have the skeleton of an undecked canoe. The deck beam should be of pine, ½ inch square being quite heavy enough. The well hole, or deck opening, may be square or elliptical, as the builder fancies, the former being more easily finished. The deck canvas should be about 3 inches. A 1½ inch coaming, or washboard, should be run around the well hole. The midship mould may now be removed.

The floor board should be of pine, not more than ¾ inch thick, 3 feet 3 inches long, and 8 inches wide. It is screwed to two blocks that are firmly secured to the keelson.

The common stretcher, or foot-brace, may be fastened to the floor board.

The frame is now complete and ready for the covering. This is to be of canvas, not the coarse, heavy stuff of which ships' sails are made, but light, fine, and strong material. It must be of the very best quality. Canvas is the best of all low priced materials for the sides and deck of a canoe. It requires no waterproofing before it is put on. Every camper knows that common sheeting, that is much lighter and looser than canvas, will shed water for hours. It is superior to wood, in the respects that it will neither warp nor check. It yields readily to the bumps that any canoe must take in running rapids, but quickly springs back into shape. The canvas must be wide enough to cover the bottom and sides of the frame. The frame should be turned deck downward, and the canvas laid smoothly on. It is then to be tacked to the keelson with copper tacks, at intervals of every three or four inches, the points at which tacks are driven being first white-leaded. It is then to be cut to follow the stem and stern posts, to the face of which it is to be tacked. Then it must be drawn tight, and fastened in the same manner to the inside of the inwale or gunwale strip. It may be tacked to the bulkheads. The deck canvas is easily put on. It should be fastened to the outside—not the inside—of the gunwale strip. A narrow heading around the canoe at the top of the gunwale streak and around the coaming will conceal the tack heads and edge of the canvas. Nickel-plated round tack heads add a finishing touch. The stem and stern post bands should be of ½ round nickel-plated copper.

The canoe should now receive two outside light coats of oil and white lead. It may be well to paint the inside, but it must be borne in mind that white lead is heavy, and that the weight of it that an industrious piece of canvas will ab-



IMPROVEMENTS IN RING SPINNING.

6th. The device for arresting the spindle by a spring, leaves the operative perfect freedom for his hands during the joining of a broken thread.

7th. With this construction of collar and footstep, 7,000 revolutions may be readily attained without producing vibration.

8th. The footstep will not require to be supplied with oil more than once in two months, at most, and the foot of the spindle will suffer no appreciable wear, in consequence of its efficient lubrication. The collar needs to be lubricated but once a year, as the grooves in it will retain the oil.

9th. As the footsteps and collars can be displaced, it is always possible to place the rings exactly in the center at the top and the bottom, which is essential for good working.—*Mineral Engineer.*

#### A LIGHT PADDLING CANOE, AND HOW TO BUILD IT.

By CHAR. E. CHASE.

THE typical canoe of to-day is the solution of a complicated problem in average—a combination of dissimilar qualities to adapt the production to many different purposes. It is built to sail, paddle, carry stores, and to afford the canoeist comfortable lodging quarters, and its general utility is dependent upon adaptation to all these uses. A canoe that will outsail the Shadow can be built, but its better sailing qualities will render it slower under paddle, more unwieldy on the portage and in rapids. The distinctively paddling canoe—the Indian birch, of course, excepted—has not been produced in this country by a professional builder, although it is not unknown in England. The Rob Roy—that is, are flection of the shell—and variations of that model, is speedier under paddle than either the Shadow, Herald, or Nautilus, and are classed as paddling canoes; but they all carry sail, and are entitled to the distinction of being yachts. The classification, indeed, in England, and recently in the United States, is somewhat grotesquely into paddle-sailing and sailable-paddling canoes. In the United States there are no other classes.

A few amateur builders, however, have built paddling canoes and made cruises in them. The Stormy Petrel was built, in 1875, by Rev. Chas. A. Cressy. She is flat-bottomed, with almost perpendicular sides, the material used in her construction being three pine boards, deck canvas, a few screws and nails, and the paint necessary to impart the finishing touch. The little Petrel came into existence in the

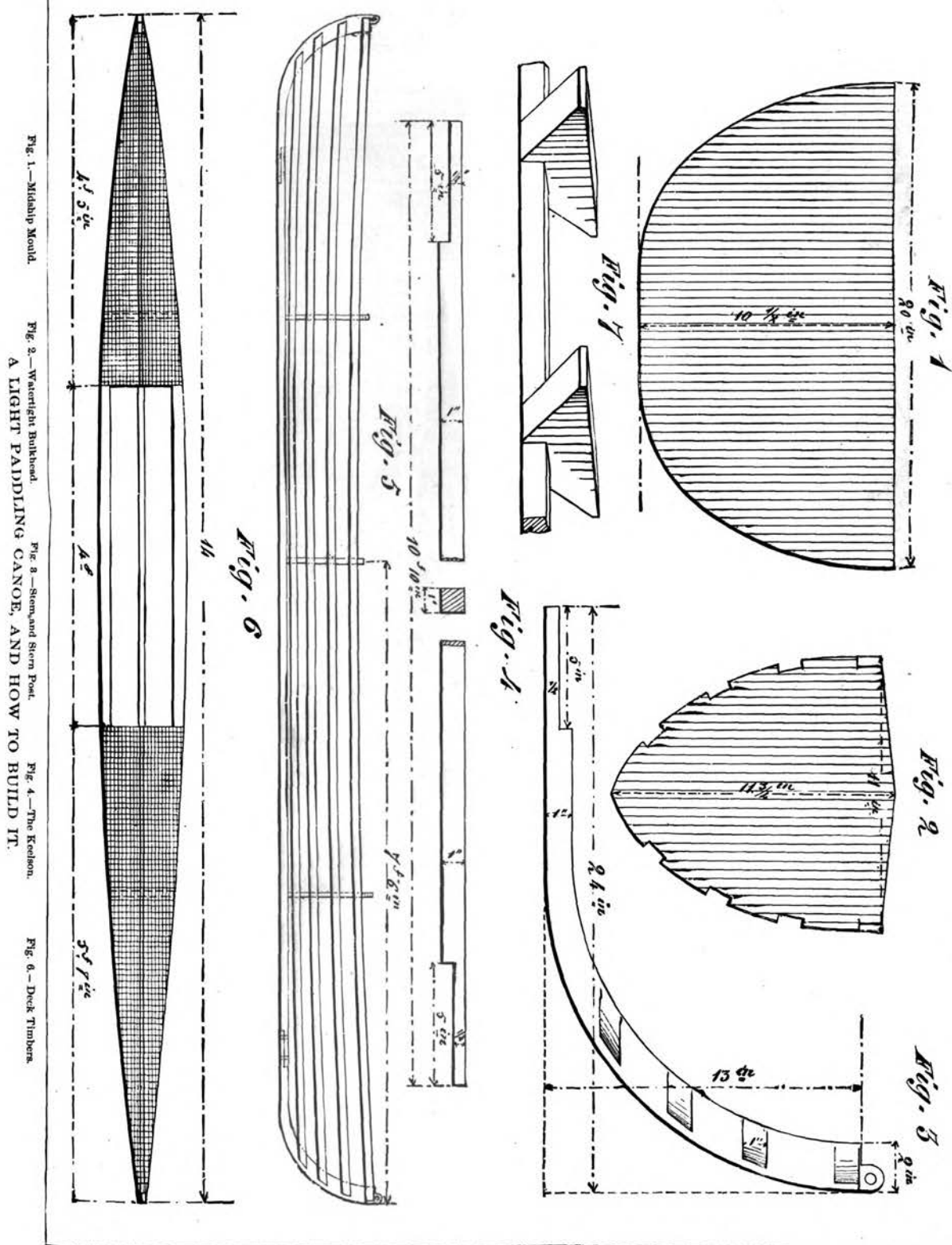
home-made—a fine specimen of jack knife carpentering. Its bow was like a toper's nose inverted, and with an accidental bend to right or left. The stern was the counterpart of the bow. The lines were equally peculiar, and reminded of nothing so much as the lines about the mouth of the unhappy man who has just tasted a green persimmon. The deck sagged just enough to hold a gallon or more of water, until it could be thrown into the lap of the canoeist by a vigorous wave. The paddle was a gigantic double-bladed pudding stick. The craft throughout was original even to the manner of its progress, which was by a serpentine course that made paddling very like sailing against a head wind. Her weight, however, was but 30 lb., and had she been constructed with somewhat greater mechanical skill five canoeists might not have left her as complacently as they did.

A high degree of mechanical skill is not required in the building of a serviceable canoe; indeed it may be assumed that any man who can put up a perverse stovepipe may turn out a fair canoe, in which he may make an all summer's cruise upon American rivers and lakes at a per-diem expense of not more than one dollar. His craft, when he begins his voyage, will not have cost him, counting his labor recreation, more than twelve dollars.

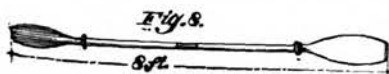
The amateur builder, we will assume, is provided with the tools in common use by wood workers—a jack-plane, smoothing-plane, small wrench, drawing knife, spoke-shave, gimlet, dividers, screw driver, ½-inch round file, ¾ flat file, 2-ft. rule, large and small hammers, squares, set of chisels, nippers, brace and bits, countersink, cross cut, rip and scroll, or compass saws, and a whetstone. The tool-handle, containing a dozen or more small chisels, gouges, and awls, will be found useful. The midship section or form should be made before work upon the canoe is begun, and upon its shape will largely depend the speed of the craft. Draw upon a ½ inch clear, planed pine board two horizontal lines 20 inches long. Connect them by a perpendicular line, as shown in Fig. 1, next page. Then draw a second line, from one end of the upper line to the lower end of the 10½ inch dotted line. The curved line represents the curve of one side of the canoe at a point six inches aft of the true midship section. The sides should be exactly alike, of course. Cut the semi-section in paste-board, and you have a pattern by which the other half may be marked.

Follow the lines with the compass saw, and you have the midship mould for a paddling canoe.

The two watertight bulkheads should then be made. They should be of clear, thoroughly seasoned planed ½ inch pine. If the wood is not well seasoned it will check,



sorb is only a little short of unlimited. The Mate, a canvas canoe of the Jersey City Canoe Club, has at this date ab-



sorbed twenty-two pounds, as is shown by the painter's bill. After the two light coats the canoe may be painted to suit

the fancy of the canoeist. Unpainted, this little craft will weigh no more than twenty-five pounds. She is built for speed under paddle, and carries no sail. The paddle should be double-bladed, jointed, and 8 feet long.

She affords no sleeping accommodations, but will carry a light camping outfit. She carries no rudder to be knocked off. She is the craft for small streams and frequent portages. She will run safely through rapids in which the heavier canoes will treat their captains to upsets. If her captain wants to make distance he can rely upon her—if he be in good form—for fifty miles per day and a half-dozen mile portages thrown in.

**IRON SHIPBUILDING ON THE DELAWARE.**—Shipbuilders on the Delaware appear to be tolerably well employed. We learn that at Mr. Roach's establishment a large steamer for the Oregon Steam Navigation Company will be launched in thirty days, and will be finished in April. A steamer intended for a Brazil line is partially in frame, while one for the Old Dominion Company will be launched in sixty days. Both the latter are of large dimensions and first class. In addition Mr. Roach has made a contract with Mr. W. Baedcar, a member of a large firm of stockbrokers, for a steam yacht of 600 tons and 170 ft. in length, to be finished early in the spring.