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A BOY'S WORKSHOP

WITH PLANS AND DESIGNS

FOR IN-DOOR AND OUT-DOOR WORK

BY
A BOY AND HIS FRIENDS

WITH AN INTRODUCTION BY
HENRY RANDALL WAITE

BOSTON
D. LOTHROP AND COMPANY
FRANKLIN AND HAWLEY STREETS

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INTRODUCTION.

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THE typical American boy, at some period in his life, has a taste for the mechanic arts. Before he is out of pinafores, he surreptitiously lays hold of edged tools, and with unlimited self-confidence tries to make something. If his success lies chiefly in the direction of making pieces of furniture and bric-à-brac, and the covering of his juvenile apron with gore, followed by a tableau in which a shrieking youngster, an angry sire, and a sympathetic mother are about equally prominent, the effect is merely to determine the amount of the boy's grit, and to prepare the way, in the battles of the future, for the survival of the fittest. While a certain number of the pinafored experimenters, pensively regarding healed gashes and flattened thumbs, will ever after sedulously avoid contact with chisels and hammers, the plucky boys, who form the majority, will hardly wait for the shedding of belladonna plasters, and the bleaching of gory aprons, before seizing upon the instruments of their discomfiture, with a firm determination (founded on the boyish belief in the intelligence and moral responsibility of inanimate objects) to let those tools know that they know how to handle them without getting hurt. After various efforts for the mastery, the implacable foes of the unskilful juvenile, such as the hatchet, the saw and the hammer, will shake their sides in malignant laughter over the final discomfiture of a second installment of the rising generation, and will own themselves partially subject to the ten and twelve-year-old veterans who have come triumphantly through the struggle, and can use such tools as happen to fall into their hands with a more or less murderous degree of execution. To this large class of boys, intrepid, ambitious, industrious, and full of manly instincts, America looks for its inventors, its engineers, architects, designers, skilled artisans, and most successful [6] business men in every walk in life. They constitute, in fact, what may be termed the "Honorable Guild of Amateur Artisans," and it is for the benefit of the members of this juvenile guild that "A Boy's Workshop" is sent forth, with the best wishes of its editors and publishers.

It will bring to thousands of lads just such information in regard to the first steps in the mechanic arts as they most need, and will enable them, with little other direction, if wisely encouraged by their elders, to so develop whatever mechanical ingenuity they may possess, as to make it easy to determine whether they shall ultimately join the ranks of those wholly devoted to the useful arts, or continue to be amateurs, using to good advantage whatever skill they have acquired in connection with other occupations.

But the parents and instructors of boys have no less reason than the boys themselves for awarding to this book a cordial welcome. In neither home nor school is adequate attention now given to the training of the hands to skill in the use of any of the tools employed in the industrial arts. It need hardly be stated that every boy should have at least a little training in this direction, while to thousands, such training is an essential part of their equipment as bread-winners and as useful citizens. "A Boy's Workshop" is calculated to meet a need in this important respect, and on this account alone, is worthy of a place in the library of every home and school.

The desire to turn the energies of hands and brain upon constructive work, is worthy and honorable. Let it have proper encouragement. We have too little of the industry which follows habits well formed, and too little of the thrift which follows skill. Society, the State, and the nation have need of the boy who has a workshop. May every boy who wants one, have one, and God bless him!

HENRY RANDALL WAITE.

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A BOY'S WORKSHOP.

I.—THE SHOP ITSELF.

IF there is anything a boy really likes to have, it is a workshop of his own.

But then it must be really his own; a place where he can pound and hammer, saw and whittle, and make all the litter and noise he wants to, without having to clear up things.

A boy likes a place where he can leave a thing half finished and be sure of finding it again. He wants a key to the door, so that he can lock up his treasures and know he shall find them safe the next spare hour he gets to work at some pet notion.

Housemaids, and sometimes even mothers, don't see the difference between unfinished work and rubbish, and off into the kindlings goes something that has cost a boy a lot of thought and work. No wonder a fellow who isn't a saint, but only a human boy, gets out of patience and wishes [8] emphatically, that "folks would just let his things alone!"

So I say, let every boy have his own workshop and a key to it.

Where shall the workshop be?

I don't think it makes much difference. There must be plenty of light, of course, and the room must not be damp. My first workshop was in the attic, with a skylight. I liked it first-rate; but it was a bother to bring the lumber up-stairs, and then, too, the shavings and chips had to be carried down. I got along with it capitally though for three years; but I like my down-stairs shop better. The noise of pounding and sawing never disturbs any one either, if it is below. One end of the woodshed can be partitioned off for a shop if there is no room in the house.

Now you've got your workshop, the next thing is, "what shall go into it?"

There are two ways to fit up a workshop. The easiest and the quickest is also the most expensive: *i. e.* get your father to tell the carpenter to fit it up, and then buy a tool chest. The objections are: [9] the expense and the doubtful quality of the tools in a ready-filled tool chest; then, to my thinking, you lose a lot of fun yourself. It is a good lesson in carpentry to make your own work bench and tool chest, and the money you save that way can go into better tools.

Every boy ought to remember this, a *cheap* tool is probably a *dear* tool. The very best is really the cheapest in the end, and you can't do good work with poor tools.

Of course the boys I am talking to are not in the infant class. A boy who has never fooled round with tools, who has never cared enough about carpentry to try his hand at tinkering up broken chairs and boxes, the boy who hasn't got past mashing his fingers when he drives a nail, and doesn't know the difference between cutting with a saw and whittling with a knife, isn't the boy to care whether he has a workshop or not.

But I should like to help the boys who have had "toy tool chests," and have used them enough to find out "they are no good," and are really ambitious to do neat, serviceable work, and to know [10] enough about the right use of good tools to be ready and able to do the hundred little odd jobs that come up in a house and can often be as well done by a boy carpenter as by a regular workman. I know one boy who in one year, doing odd jobs himself, saved the full cost of his outfit.

When I began I couldn't find anybody to tell me the things I wanted to know. I had to find them out for myself, and that is just what I am going to try and tell you. So we start with this understanding. You are in earnest; you wish to do good, substantial work; you haven't a great deal of money to spend, and you are willing to let patience and labor make up for the lack of money, knowing, too, that the lessons you will get making your work bench and tool chest will be worth considerable.

If your mother can spare you an old bureau, or an old-fashioned washstand with a lid and a cupboard, it will be handy in one corner of the workshop, not only to hold your tools till the chest is made, but to keep all sorts of odds and ends in by and by.

You ought to have a stout pair of overalls, or a workman's apron made of ticking, with a good [11] pocket. I have both, and find them handy. If it's a little job, I slip on the apron; if a long one it pays to get into the overalls. Your clothes keep clean, and there's nothing to do when the dinner bell rings but to slip off the working uniform and wash your hands. Carpentry is cleaner work than printing. I know, for I have tried both.

Now for the list of essential tools. If it sounds large and expensive, you must remember that once bought they will last for years, and are your capital, your stock in trade. From time to time you will add to them. If you live in Boston or the vicinity, I should advise you to go to Goodnow and Wightman's, 176, or to Wilkinson's, 184 Washington street, or some other first-rate establishment, and get what you want. On an order like this there would be quite a discount.

The prices vary from time to time, so those in the list are given simply that you may have a general idea of the cost.

I will say here that it will pay you to have two or three practical lessons in the use of a saw, a plane, and a chisel, from a carpenter. If you are in the city, there are regular classes where you [12] can get such instructions. It will save patience and tools.

Hammer	.75 to $1.00
Saw (cross-cut) 16 to 18 inch	1.25
" (splitting) " "	1.35
Chisel 1 inch socket firmer	.60

" ½ " " "	.25
Bit brace (plain 1.50) ratchet	2.00
Bits ⅜, ½, ⅝	.80
Small bits ¼ and less for screws, the set	.50
Screw-driver (at Wilkinson's ask for a gunmaker's and machinist's drop forged)	.40
Hatchet	.75
2 ft. rule	.25
Try square (9 inch)	1.00
Oil stone (1½ or 2 inches wide)	.40
Mallet (large wooden)	.35
Small iron Block Plane (Bailey's)	1.25
Jack or Fore Plane, Stanley's 20 inch	2.25
Draw Knife 7 inch	.70
	$15.10

Nails and screws of various sizes can be got at any hardware store. If you send an order through the village store, be sure to send to first-class establishments, and procure the following makes:

Planes, *Bailey's* or *Stanley's*, iron and wood; chisels and gouges, *Buck* or *Moulson*; braces, *Barber*; saws, *Henry Diston*; rules and squares, *Stanley*; files, *Stubs, Greaves and Sons*.

II.—MY SAWHORSE AND WORKBENCH.

[13]

NOW that you have a fair assortment of tools to work with, the next thing is to have a work-bench; for even an accomplished carpenter can't do much without a good, strong, firm bench. And of course you must have a sawhorse before you *can* have a bench; but a sawhorse is a simple affair to make, and I will tell you how to set about it right away, for you ought not to buy anything that with a little trouble you can make. Besides it will be good, plain practise with try-square, saw and plane.

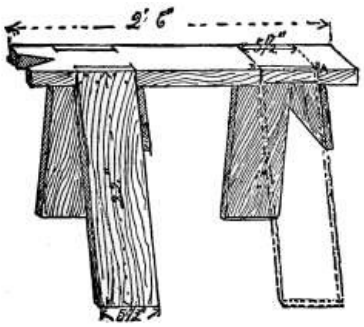

Fig. 1

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The sawhorse for the average boy ought to stand about twenty or twenty-two inches high, so that you can kneel with one knee on it easily.

You must get two pine boards:

A, 6 feet long, 6 inches wide, 1½ inches thick.
B, 12 feet long, 6 inches wide, 1 inch thick.

Take A, cut off two and one half feet: if not already planed, plane nicely on all sides. (Unplaned boards are cheaper than planed boards.)

Take this two and one half foot board and measure four inches from the end. Lay on try-square and draw a line across the board at dotted line. (*See right end of fig. 1.*)

Then measure five and one half inches more from this line: with try-square extend second line across the board. Measure one inch on all these lines from the outer edge of board, and connect by lines *b b* and *c c*. With cross-cut saw cut carefully through the one inch from *a* to *b*; then with chisel cut out on line *b b*. Don't cut quite as deep on the lower edge, for these openings are for the legs, and should slope out a trifle, that the legs may be farther apart on the floor than at the top when nailed on—one eighth of an inch will make difference enough for a good slant. All four leg sockets must be done alike, else your horse will be bow-legged and unsteady.

[15]

Now plane the twelve-foot board *B* (unless it is already planed). Square one end nicely; measure off twenty-two inches. Lay try-square and draw a line across the board. Take the cross-cut saw and saw neatly on the line. Smooth the end with a block-plane, bevelling it slightly, so it will fit firmly on the floor. This is for one leg. Do three more legs in the same way, always trimming the ends with block-plane, to make them stand upon the floor true and even.

One thing, boys, you *must* remember: In planing *across* the grain never plane to the end at first, for you will chip the corners and spoil the end. Keep reversing the block; *i. e.* first plane from *A* to *B*, then from *B* towards *A*. (*See fig. 2.*)

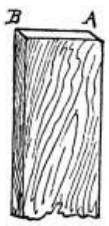

Fig 2

Before fitting the legs into their sockets, plane the legs to fit the five and one half inch spaces made in the first board. The inner upper edge of the legs must come exactly level with the top line of the board. The outer edge will of course be higher on account of the slope of the slot, and must be planed smooth with block-plane after the legs have been firmly nailed into place with three or four eight-penny nails.

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To keep the legs from spreading apart at the ends, you must make a sort of brace.

Fig 3

Take a piece of the board left after cutting off the legs, and fit it across the legs under the top board in this way: Hold it close to the board and against the legs, then draw a pencil line, following the outside slant of the legs. (*See fig. 3.*) Now with cross-cut saw cut across on this line; trim with block-plane before nailing; put one piece on each end, nailing through to the legs.

One thing more and then your horse is done; ready to stand if not to go.

Find the middle of one end of top board, draw a line three inches long down the board, with try-square. Then *on the end* measure one inch each side of this centre line. (*See fig. 4.*) Draw line from *a* to *b*, and cut on lines with splitting-saw; this will leave a triangular space which you will find very useful by and by in cutting small pieces of wood.

[17]

From board *A* there ought to be left a piece about three and one half feet long, and from board *B* a piece about two feet long. These you will put aside for further use.

Now for the Bench (with a capital B, because it is the principal partner in the firm of Carpenter and Co.).

Buy three good two-inch pine planks. Say two planks ten feet long, one foot wide, and one eight feet long, six inches wide. Ready planed, at the sawmills around here, these cost about eight cents a foot; a little less unplaned. Besides these, you want one ten-foot inch board, one foot wide; this should cost about four cents a foot. Before you really start on your Bench, look around your workshop and decide where you will have it stand. There must be a space ten feet long against the wall, with plenty of light. A window at the left is the best.

One thing you must have which I didn't reckon with the tools; but it is easy to prepare. I mean a *chalk line*. There are fancy ones, but the sort I'm going to describe does just as well.

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Get a piece of curtain-cord twelve or fifteen feet long, and make a loop

on one end; then provide yourself with a good piece of common chalk; when you want to use it, chalk the line well by passing the line over the chalk as you would wax thread; to use it put the loop over a nail at one end of the line you wish to chalk, hold the other taut, and snap the line smartly in the middle; it will leave a straight chalk line for a guide in cutting.

Fig 4

Now take the shorter of the two-inch planks, the one eight feet long, make a mark in the middle of each end, drive a small nail in the left-hand end exactly in the middle; having chalked your line well, slip the loop over the nail, draw the line taut down the middle of the board to the other or right-hand end, holding the line close to the board; pluck the string sharply in the middle and you will find an even chalk line the whole length of the board.

Put one end of the board over sawhorse, take the splitting-saw and cut carefully down the line, holding the saw a little more vertical than you would a cross-cut saw. [19]

Having divided your board thus, lengthwise, you will have two strips eight feet long, three inches wide, two inches thick.

With large plane smooth the rough sides of these strips as well as you can, resting the boards on the sawhorse. One end of each strip must be good and square: if not so already, take small block-plane and square it as best you can.

From the squared end measure thirty inches; draw a line across the board. Then by aid of try-square make another line one eighth inch beyond. This makes it easy to saw straight across the wood with a cross-cut saw. Take block-plane and square the end nicely.

You have now prepared one leg of your bench Cut another thirty-inch length in the same way from the piece left. Repeat this with the other strip. You now have four legs for your bench just alike with nicely squared ends. [20]

For cross-pieces cut from the pieces that remain two lengths of nineteen inches each; cut and trim as before.

Take one pair of legs (*i. e.* two of the thirty-inch strips), lay them on the floor on the *two-inch* side, just *nineteen inches* apart. At one end, between the legs, lay one of the nineteen-inch pieces *also on the two-inch side*, so it will be flush with the squared ends of the legs; hammer the legs on to the ends of the cross pieces with two or three twenty-penny nails. This job ought to be done very neatly and accurately, so that the shape will be exactly like fig. 5. If you are careless and let the legs spread while nailing, your Bench will be hopelessly rickety.

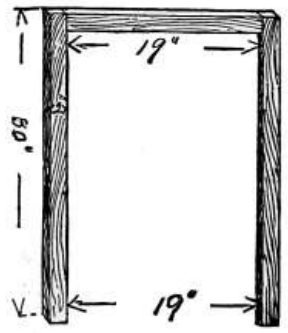


Fig 5

III.—MY SAWHORSE AND WORKBENCH. (*Continued.*)

[21]

TO give greater firmness to the bench there must be some brace made this way: Take the ten-foot inch board; square one end; measure twenty-three inches with try-square; cut off nicely with cross-cut saw. Now you have a board twenty-three inches long and twelve inches wide. Divide in middle at each end; connect the points with chalk line, then cut down this line with splitting saw.

You will have two pieces twenty-three inches long and six inches wide; these are the two end braces. Lay one of these pieces across the legs you have just joined, at the closed end. All the edges must be flush; if not, plane them and make them true. You will see that if you have measured and cut carefully they will come right, for the legs are each two inches thick, making [22] four inches, and the cross-piece is nineteen inches, making twenty-three in all; just the length of your brace. Nail the brace firmly into both legs and cross-piece with six-penny nails. Do the same with the other set of legs.

Now in the space you have chosen for your bench, stand up both pairs of legs endwise to the wall, and six feet apart, leaving full two feet clear beyond, as your bench will be ten feet long when done.

Take the two big planks (the ten foot ones, two inches thick), measure two feet from each end of each plank: draw a line in direction *a a*. (*See fig. 6*.) Then parallel to *a a*, draw another, *b b*, one inch farther toward the middle of the board; then another, *c c*, an inch beyond that, always measuring away from the ends. On these lines *a a* and *b b* mark the places for your screws in alternate spaces, thus—

Remember always that screws or nails put in diagonally like that hold more firmly than the same number in a straight line.

Before putting in the screws, see that the legs stand parallel and close to the wall; put the first [23] board on the legs so that the back edge of board is even with the back edge of the legs. Screw firmly into place, taking care to have the outer edge of the legs directly under the first or dotted line; this brings the screws evenly along the cross-piece.

Lay the second board close to the first, securing in same way; the front edge of this second board ought to project one inch beyond the legs. The heads of the screws on the top of the bench must be sunk. You have left a board eight feet long, one foot wide, and one inch thick.

This board is to be put on in front directly under the top board and against the legs. It should come flush at the *right end* only, leaving space of two feet at the left. Nail this board on to the legs with six-penny nails. You have now a capital bench, which only needs a vise to complete it.

Cut from the board *B* (left from sawhorse) a length of eighteen inches. Square both ends nicely; lay this against the left hand front leg, flush with the outer edge and coming close under the front board, and nail firmly on to leg.

For seventy-five cents at a hardware store, you can buy a wooden screw about two feet long for [24] vise, with shank one and three fourths inches diameter.

On the front board, ten inches from top of bench, and about five inches from left edge, draw a circle one and three fourths inches in diameter; this circle when cut out should come as close to the leg as possible without cutting it.

To cut this hole take a five eighths bit and bore a series of holes round the inside of the one and three fourths inch circle. (*See fig. 7*.)

The piece in the middle will fall out and leave a rather rough hole; but the edges can easily be trimmed.

Then take the board *A* (the three and one half foot piece), cut it thirty-one inches long. Square one end and then round it as at *D*. (*See fig. 8*.) On the back side draw a pencil line through the middle; place the board against the left leg, with the sharp edge flush with *top* of bench, so that the pencil line will bisect the circular hole. Draw a similar circle on the board, and cut out as before.

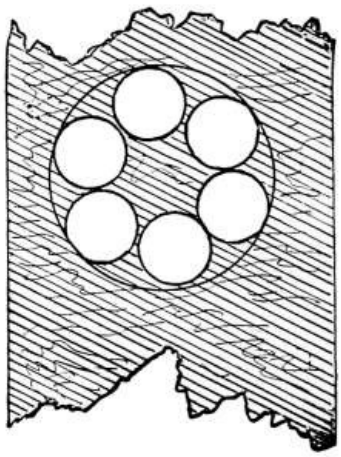


Fig 7

[25]

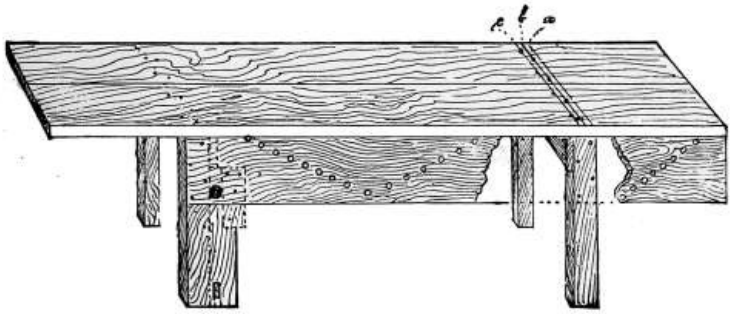


Fig 6

Be careful in the doing of this, as the two holes must be exactly opposite for the screw to pass through. You ought to have two bits of wood left after cutting the legs and cross-pieces. Take one of these bits and put behind the front board on its two inch side and about three inches to the right of the left leg and parallel with the leg. It should just clear the hole. Fasten securely, so that it will cross the joint *A*. It will serve as a brace, and also give a level bearing for the wooden nut which comes with the screw and is wound on the end of screw after it passes through the two holes. [27]

Your vise as it is will work all right for small pieces, but if you have a large article to hold, the loose board *b* will not keep its parallel position, for the thickness of the object you have in above will throw out the top end, and the lower end will of course swing in. To remedy this and make your vise adjustable to work of any size, you must do one more thing:

A little to the right of leg, and one inch from the lower edge of the fixed upright, cut a slot two inches high and one inch wide; make a corresponding hole in the loose upright. [28]

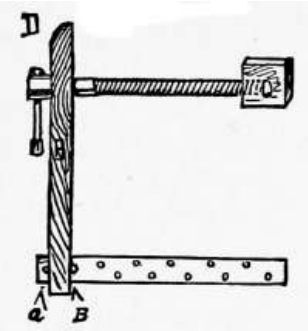


Fig 8

Take a strip of board two feet long, two inches wide, and one inch thick. On a line drawn lengthwise through the middle measure one inch from end and mark; then two inches from that point on same line make a second mark; at both those points bore holes with half-inch bit and fit in a peg at each hole. The pegs will be one and one half inches apart.

Then at intervals of one inch bore two alternate rows of holes with half-inch bit, as far as the length of the strip allows. Run this strip through the slot in loose board as in *fig 8*, and through the corresponding slot in upright put a peg in *a* in *front* of loose board and a peg in *b behind* loose board; these pegs will hold the strip firm in the slot in the loose board.

According to the size of the object to be held in use, draw the loose board toward you and put third peg into hole at proper distance to keep the loose board parallel with the fixed upright. [29]

You see by having holes enough in the strip you can adjust the vise to any size. Of course you understand that this is not needed in small work.

If you look closely at *fig 6* you will find that there is still one thing unexplained: the rows of holes in the front board.

When you have some long piece of work in your vise you will find it troublesome to keep it level; if you have a number of holes bored in the front of bench, with a good peg to fit, by changing the peg according to the height desired, you can raise the right end of your piece of work to the right level.

A plain hook is a desirable addition to the work-bench: its use is to hold a board when you wish to plane the surface. It is adjustable according to the thickness of the board, and should be set in and screwed on to the bench at point Y. It will cost at hardware store about seventy-five cents.

> NOTE.—In *fig. 1* (the sawhorse) one leg is drawn in dotted lines to show the way the leg is fitted into the hole, and the right slant. In *fig. 6* the broken space in front board is to show the position of brace on right leg.

IV.—USE OF TOOLS. [30]

WE begin with the saws, of which you have two: cross-cut saw, and splitting saw.

The use of a cross-cut saw, as the name implies, is to cut *across* the grain or fibre of the wood: it is one of the most indispensable tools we have. The teeth are finer and closer together than those of the splitting saw, which, as the name describes, is intended to cut *with* the grain, usually lengthwise, of a piece of wood. Never try to substitute one for the other, for you would injure your tools. When you want to use a cross-cut saw, the saw should be held at an angle of about forty-five degrees, and must also be held steadily without swerving to the right or left; otherwise the teeth of the saw will stick, and you cannot make a clean cut.

You will observe in looking at a saw that the teeth are *set*, as it is called; every other point turning a little away to the right or left of a straight line; the reason of this is, to make the cut [31] wider than the saw blade; otherwise after cutting in a little way the friction would make the blade bind. Saws are, or should be, in proper condition to use when they are bought; if not, or if by any accident the teeth should get bent, you must have the saw *set* without meddling with it yourself.

A splitting saw is used differently from a cross-cut saw; it should be held more nearly upright; the cutting is always done on the *down* stroke. Never press the saw against the wood; the teeth will catch, and the saw bend, and the wood won't be cut if you add any weight to that of the saw itself.

There is a certain amount of knack required in order to saw well, but practise will improve even the most awkward workman. Always saw slowly and easily, in a sort of regular time. Be sure the wood is held firmly and doesn't *hop*.

USE OF PLANES.

We have jack-planes, smoothing-planes, and block-planes. When you want to make aboard thinner, or smoother, it has got to be planed; also the sides and edges of a board are sometimes [32] rough, or you wish to bevel them.

If the grain of the wood is perfect, there is no trouble about planing in either direction, but generally the grain runs in a slight slant or angle to the surface of the board instead of parallel to it. If, then, you start your plane and plane "against the grain" of the board, the edge of the plane will catch in ends of the grain lines, and the surface will be chipped instead of smoothed. If, however, you start it and plane "with the grain," the ends of the grain lines are smoothed down, like the feathers on a bird's wing when you stroke it down instead of up. So it is well to be sure about the grain before you begin to plane. Sometimes the grain is twisted and runs one way in one part of the board and another way in another part in a wavy line. Then you must vary the planing according to the surface. You would soon learn these simple things perhaps, but to know them at the outset will save you some vexation.

The smoothing-plane is much shorter than the jack-plane, and is used for smoothing smaller pieces which would be lost under the jack-plane, and also for smoothing inequalities left by the [33] jack-plane. I have put no smoothing-plane on your list, as for ordinary work the block-plane can be used as a smoothing-plane. Thus: Turn the small thumb-screw at the front of the block-plane and press it forward; this opens the mouth of the plane so that the plane can be *set* more and cut a larger shaving.

Now for the proper use of the block-plane, remembering to restore it to its original *set* if you have been using it as a smoothing-plane. To smooth the ends of boards you need a small plane which can be *set* very fine; i. e., with the blade projecting very little from the face of the plane, and with the mouth so closed that the blade will not chip in cutting.

One important principle must be practically learned before you can do good work: *Everything in carpentry from beginning to end must be done on the square.* In planing, above all things, the square must begin every bit of work, and end it, and be used to test it, all the way along; it is just what the name implies, a *try square*; so perhaps the next thing explained had better be some of the uses of the square.

To give all the uses of this apparently simple tool would be to give you a thorough knowledge of [34] geometry, and fill a volume. I will, however, give some of the more common uses:

1. In sawing across a board, if you wish to have the cut true and even, you must use the square. One edge is, of course, already planed, and from this all your lines are drawn. You wish, we will suppose, to saw three inches from the end of your board; lay the thick or handle part of the square close against the even edge of the board, three inches from the end; you will find that the blade lies flat across, the board at a right angle with the edge, and a pencil line drawn close to the blade will be a guide for cutting.

2. To test the evenness of the end of a board which you have been trimming with a block-plane: Apply the square to the side and edge of the board; if the work is true, the blade will be level with the end of the board; if uneven, the defect is quickly seen.

3. It is well to test your square itself; thus: Lay your square snug against a straight edge with the handle to the left; draw a line where the edge of the blade comes: then reverse the square, having the handle to the right; draw a similar line: if the square is true the lines will coincide; if [35]

they diverge ever so little the square is imperfect, and you should buy another.

4. In planing the edge of a board, put the handle of the square against the *face* of the board; the blade will then go across the edge, and you can soon see if it is even; i. e., at right angles with the face of the board.

Hammering a nail seems a very simple thing, but there's a right way and a wrong way to do that, as you'll find for yourself after you've split two or three bits of work; but you might as well learn the right way at first.

If you look at a nail of any size, from a brad to a twenty-penny spike, you will find that the sides are parallel and straight, and two are wedge-shape or sloping; also one of the straight sides is finished smooth, the other is rough. A nail is virtually a wedge. Now the principle of the wedge is to split things when the wedge goes with the grain, as when you split a board with an axe or hatchet; for an axe is a wedge, as you will see if you think about it.

If, then, your nail is put in wedge-fashion *with* the grain, ten to one the second good tap with your [36] hammer splits the board; if, however, you turn the nail the other way, so the wedge side is *across* the grain, and the straight side *with* the grain, the nail is held firm by the grain pressing against the wedge, and the board doesn't split. This is the reason that fine work is done with brads better than with tacks, for tacks are wedge-shaped on all sides, and in driving them if the wood is thin it is very apt to split.

Always *start* a nail in the direction you mean to have it *go*, and don't depend on straightening it afterwards. If, however, it gets a wrong slant, don't bend it back with your fingers, nor hit it a knock sideway with your hammer which will likely enough break the nail short off; but with every regular stroke of your hammer give an inclination in the right way, and it will get there.

Don't hold on to the nail too long; in soft wood the second hammer tap ought to find the nail firm enough to stay. Don't make the first or the second hammer stroke a long hard one; if you do, likely as not you'll mash your fingers. The first tap should be light and short; get the swing [37] gradually, a few inches first, adding a few inches more with each stroke; by the time you want full force to drive the nail home, you'll find you can't hit anywhere but on the head of the nail. This is something that practise alone can make you perfect in. If you watch a good building-carpenter, it seems as if he threw the nail into place with one hand and hit it on the way.

Don't think you must look at each nail in order to place it right. Your eyes must be in your finger tips; *the smooth side goes with the grain*.

Always keep the different sizes of nails separate; then you won't be bothered by finding the wrong nail in your fingers when you are in the midst of a job.

In using chisels and gouges never strike with a hammer, but always with a wooden mallet; the hammer splits the handles.

In most chisel work it is better to put the bevel edge to the line you wish to cut until you have cut out most of the wood, then finish with the other edge and the pressure of your hand instead of the mallet.

It will be easier to explain the use of the other tools as we come to them in construction.

V.—HOW TO MAKE A TOOL CABINET. [38]

NOW that you've got some very good tools, it is time you knew how to take care of them as well as to use them.

The best tools will grow rusty and dull, and shabby, also, even if they don't hide away out of sight just when you most want to use them, unless you have a proper place to put them and *always remember to put them in that place when you have done using them*.

I suppose you think you must have a tool chest for this; now a tool chest is a very good thing if you want to carry your tools on a journey, i. e. if you are a city boy and want to take your kit up into the country and have the tools safe from jarring under the hands of the baggage-smashers; but I've found that a tool chest isn't as handy to have in the work shop as a tool cabinet; so I'm going to tell you how to make a good tool cabinet with less expense of money, material and labor [39] than a tool chest would require.

But you must be more exact and careful in measuring and cutting than you had to be in making the sawhorse and bench. In getting your materials, try to have the boards fully one foot wide and three fourths of an inch thick. It is easier to make estimates on these dimensions, and foot boards are usually the easier to obtain; so all the measures for the cabinet are made with reference to these dimensions. If you happen to have boards that are wider or narrower, you must do a little figuring on your own account and make the proper allowance.

For a tool cabinet three feet three inches long and two feet wide, which will hold all the tools on the list given in the first paper and leave room for several more that you will be likely to own by and by, you must have one six-foot board fully twelve inches wide and three fourths of an inch thick; one seven-foot board, twelve inches wide, one half inch thick; one nine-foot board, twelve inches wide, one half inch thick; also a number of three fourths inch screws which you are supposed to have in stock; one pair brass (or iron) hinges for three fourths inch board, and a [40] hook for fastening, unless you prefer a lock.

Take three fourths inch board (the one six feet long), plane both edges; then by aid of chalk line and splitting-saw, cut off a strip two and one half inches wide, running the whole length of the board.[A]

The board that remains should be nine and one half inches wide. Smooth the edge with plane enough to remove the roughness left by the saw; then cut off another strip two and one half inches wide like the first. Smooth the edge of the remaining seven-inch board; then divide this seven-inch board into two even strips which will be six feet long and about three and one half inches wide, perhaps a trifle less, from the loss in planing.

All these strips will have one edge that has been planed and one left rough by the saw. If you lay them together you will find that you have two pairs of strips; one pair two and one half inches wide, and one pair three and one half inches wide. *Each pair* must be alike in width, otherwise the cabinet will be uneven and lobsided; so before going any farther lay the strips together and [41] plane down any inequalities.

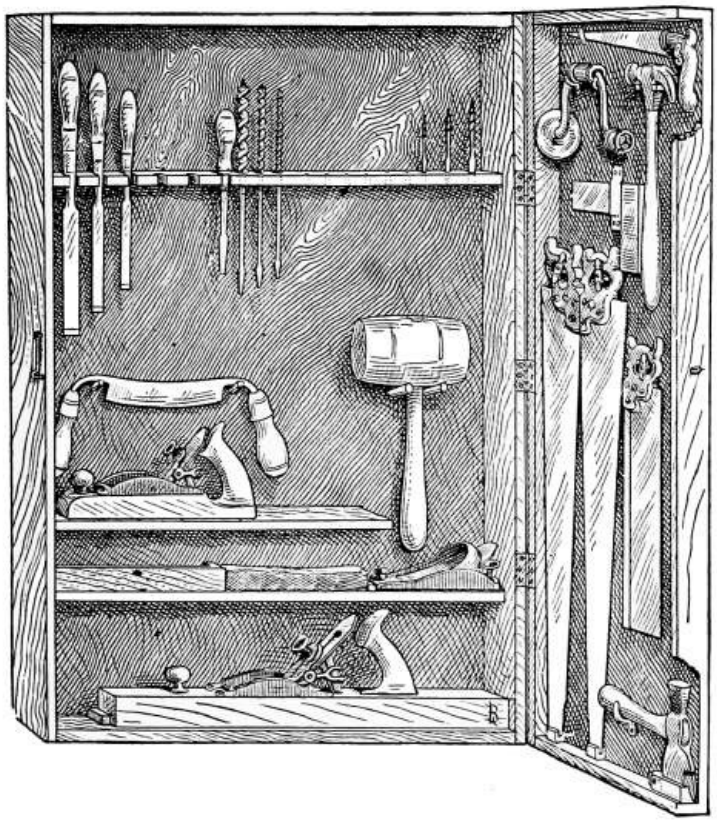
Now take one of the three and one half inch strips with try square and block plane. Square one end; measure three feet three inches from squared end and allow one eighth inch for waste in cutting.[B] Cut off square with cross-cut saw. Square end of piece cut and also of piece remaining. Measure twenty-two and one fourth inches and cut and plane as before. Do the same with the other three and one half inch strip. You have now two sides and top and bottom of main part of cabinet, and some small bits left for which we shall find a use, i. e. you have two pieces three feet three inches long and three and one half inches wide, for sides, and two pieces twenty-two and one fourth inches long and three and one half inches wide for top and bottom.

Now take the two and one half inch strips; cut three feet three inches off each, also twenty-two and one fourth inches as with the others. Each set of pieces must be alike in length and width; [42] you have two pieces three feet three inches long and two and one half inches wide, and two pieces twenty-two and one fourth inches long, two and one half inches wide; these are for sides, and top and bottom of door of cabinet. Lay these four pieces aside while we get ready for the back of the cabinet and front part of door.

From the seven-foot board (after planing and squaring one end) cut off three feet three inches; plane square the ends and cut off another piece three feet three inches.[C]

From the nine-foot board in the same way cut two similar pieces three feet three inches; smooth edges, planing off as little as possible.

[43]



THE TOOL CABINET OPEN.

The piece remaining will measure about two and one half feet in length; from this cut off a piece twenty-two and one fourth inches long. Saw strip three and one half inches wide, which to save confusion we will mark *A*; plane edges, cut off another strip two and one half inches wide; mark this *B*. Next a strip three and one half inches wide; mark this *C*. Cut *C* so as to measure [45] seventeen and one half inches in length.

The cabinet is now mostly cut out; the next step is to put it together.

Take pieces for sides and top and bottom of cabinet. Lay two sides parallel at a distance of twenty-two and one fourth inches apart; put top and bottom in so they will be flush with end of sides. Nail the sides on to ends with six or eight-penny nails. Take care to keep the corners square, as they will be if the edges are even and kept flush.

Before nailing on the back test the squareness of the frame in this way (unless your eye is very accurate; even then it is a good thing to get in the habit of measuring exactly): measure the diagonals from the opposite corner. If the measures are alike, all right; if, however, one diagonal be longer than the other, make it right with gentle, steady pressure on each corner with both hands. When the diagonals are exactly alike the corners will also be right angles. Now lay on two of the two and one half inch pieces (those three feet three inches long and one foot wide); be sure [46] and keep all the edges flush and nail firmly.

Do the same with pieces prepared for doors, and you will find you have two shallow boxes three feet three inches long and two feet wide (outside measure); one will be three and one half inches deep, the other two and one half inches deep.

Now take piece marked *A*, which is for a shelf in the cabinet; measure and mark six and one half inches from right hand end (this is the length for the small plane); then measure and mark another one half inch beyond this point; from this *last* point measure length of your oilstone, which is probably six or eight inches. The space remaining will make a sort of box, or tray, for rule, chalk line and reel, pencils, etc., when you have made some use of the bits of wood you had left after cutting the shelves.

In the one half inch space between place for plane and oilstone put a little block one half inch wide and one inch long. At the end of space for oilstone nail a strip an inch wide across the shelf, and a similar strip in front. This makes one side and front of tray; the other side and back will be formed by the cabinet itself.

VI.—HOW TO MAKE A TOOL CABINET. (*Continued.*)

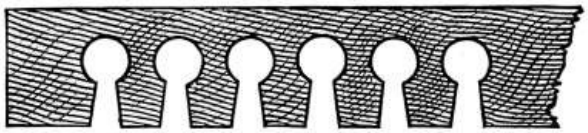
[47]

AFTER shelf *A* is fitted in this way, you will nail it into its place in cabinet so that the top of shelf is just seven inches above top of lower shelf, or bottom of cabinet which serves for a shelf.

After the shelf is fitted into its place in the cabinet, you will find that at one end you have a convenient little tray to hold such things as chalk-line, rule, pencils, and other small things that are always getting out of sight when you most need them. The plan for *A* is just six inches above lower shelf (or bottom of cabinet).

N. B. All measurements now are inside measurements.

B is twenty-two and one fourth inches long and two and one half inches wide. Draw a line down the middle of this strip (i. e., one and one fourth inches from each side). Measure one inch from [48] left-hand end and mark. Then from this point on pencil line measure one and one half inches and mark again. Repeat this until you have six points marked on the pencil line, with one and one half inch spaces between. From the last point measure one inch, and mark. Repeat at intervals of one inch until you have thirteen with inch spaces. This should leave about three fourths of an inch on right end.



TOOL-DOORS.

On the first six marks (those one and one half inches apart) bore five eighths inch auger holes. These are for tool sockets. First two for the chisels you have already; next three for the chisels or gouges you may have; the last for the screwdriver.

There must be doors for the tools to enter by; so you must cut openings one half inch wide from the front of shelf to each hole. This is easily done with your cross-cut saw, leaving spaces as in drawing.

You have still thirteen marks with inch spaces. Bore nine holes a trifle larger than the shanks of [49] the bits you are to place therein; three of these bits you already have; the other six spaces are for the bits you are likely to purchase by and by.

The four remaining marks are for holes graduated in size, thus: First, one with three eighths inch bit (one of those belonging to smaller set); second, with one fourth inch; third and fourth, with the next smaller sizes; each bit going into a hole a size larger than itself. These smaller bits go in *point down*. It will be a great convenience to mark the numbers of the bits on the shelf against their sockets.

Shelf *B* is to be nailed twenty and one fourth inches above shelf *A*.

Now for shelf *C*. Ten inches from left-hand end, put small one half inch block for same purpose as similar block on shelf *A*; i. e., to keep plane from sliding. Nail shelf *C* three inches above shelf *A* in left-hand side of cabinet. This little shelf of course does not reach across the cabinet like the others.

Six and one fourth inches above shelf *C*, and four inches from left-hand side of cabinet, bore hole with one half inch bit, which shall have a slant downward. Parallel to this, and eight inches to the [50] right, make another hole just like it. Insert in these holes wooden pegs two inches long. Be sure they fit firmly with back of cabinet. These pegs are for the draw-shave to hang upon, as seen in diagram.

Ten and three fourth inches above shelf *A*, and three inches from right-hand side, make one half inch hole slanting down; one and one half inches beyond make another; insert pegs three inches long. These are for the mallet.

The body of the cabinet is now fitted, and we will go to work on the cover.

Take two blocks one inch square and one and one half inches long; draw a line lengthwise exactly in the centre of each; cut down the line one half inch deep the length of block. Put one of these blocks slit uppermost on bottom shelf of door four inches from left-hand corner. Five and one half inches to the right, put the other; fasten into place with screws.

Twenty-one inches above first block, four and one half inches from side of door, put block one inch square, one and one half inches long. This goes on horizontally, parallel with lower block. In [51] centre of this make small hole, say one fourth inch deep, with smallest bit.

Make a second block just like it, and place five and one half inches to the right of the first one.

Then from one half inch wood, cut two little strips two inches long, one half inch wide, for buttons. In the middle bore hole large enough for screw to turn freely; attach to middle of upper blocks with screws. The tips of the saw-blades go into the slits in the lower blocks. The openings

in the handles slip over the wooden buttons which you have just made, and which are horizontal when the saws are put on, and are then turned like the button on a barn door to hold the saws firmly in place.

Now we must provide for the hatchet, so it will not get harm nor do harm.

Take block of one inch wood, five inches long, three inches wide; plane one half of one face in a slant from the middle, so one edge will be three fourths thick, leaving one half the block one inch thick, as at first. Bore two holes in the half that is still square, big enough for two screws to go through and fasten on to lower shelf or bottom of door. This block in its place is one inch wide at [52] the bottom, and three fourths inches at top, leaving a kind of bevel five inches long for hatchet-blade, between block and back of door. Put hatchet in; hold it upright and mark where handle needs support to keep it horizontal; probably about nine inches from blade; with screws fasten on two small brackets, or else put in slanting pegs, if you do not care about the looks outside.

Four inches from top, and five and one half inches from left-hand side, put similar bracket or peg; three and one half inches further, on the same line, put another; these will serve to support the bit brace, and I have left enough room for the keyhole-saw, which you can see in the diagram, and which some time you will like to own.

Now cut a piece of wood three inches long, two inches wide, and three fourths inches thick; draw line across one end and down the edge two inches long.

Cut this line out as you did for the slits for the saws, and then (slit up of course) with two screws [53] put through the lower part, fasten block at point ten inches from right-hand side, just far enough above the saws to clear them. This is for the try square, the slit being for the blade.

Fifteen inches from left-hand side, and four inches from top, put a bracket; on the same line, one and one half inches farther from the left side, put another; these are for the hammer.

You now have all your tools in place. You will in all probability have had some tools in the house before we began, such as pincers, gimlets, perhaps a saw; but of course I have not a list of those things.

So I have simply given you a good deal of room to put them in, and by this time you ought to know how to secure them in their places.

VII.—HINGES AND LOCK. [54]

TO make the tool cabinet complete there must be hinges and a lock. These you can get at a hardware store. Ask for hinges for three quarters inch wood, and about three inches long; you will need three hinges, and the screws to fit the holes. Brass hinges are best, and look neater and more tasteful than iron, though iron will do. If the screws don't come with the hinges, then look out some that will fit, from your stock on hand.

The first thing for you to settle is which way you wish the cabinet to open; i. e. to the right as in the diagram, or to the left as might be if the only place for your cabinet happened to be a corner which would not admit of opening to the right. Suppose the door is to open to the right. Find the middle of the front edge of the right hand side of *cabinet*. Mark across the edge, then measure one and one half inches *each way* from that line and mark. This is the place for the middle hinge. [55] Five inches from the lower corner on the same side, and five inches from the upper corner measure and mark; then measure three inches further from these last lines and mark; these are for upper and lower hinges. In these three spaces, so marked, cut out rectangles as deep as the thickness of one wing of the hinge.

Repeat these measurements, markings and cuttings on the *left* hand side of cover or door. Be careful in measuring so that the two halves of the cabinet will come together and exactly match.

Now to put on the hinges: Take one hinge, shut it together *tight*, so as to be sure you are folding it the right way; then open till the wings are at right angles. Lay *left* wing into space cut for it in *right* side of cabinet. Take care to have the wing fit neatly, letting the round edge of hinge project. Screw firmly into place. Put all the hinges in place on the cabinet before beginning on the cover.

Now lay the cabinet down flat on your workbench, or on the floor. Put the cover down beside it, with a bit of board or blocks underneath thick enough to bring the hinge places of the door on a [56] level with those of the cabinet. Then fasten the *right* hand wings of hinges into the places prepared on the *left* side of door. Be careful, as before, to have the round part of hinge project so that it will work freely and have the *wings flush* with inside of cabinet and door.

When open, there will be a narrow space between the door and cabinet, but when closed they will fit tight.

Now for a fastening: If you simply wish to keep the cabinet closed when not in use, you can put a hook on the door, the eye on the cabinet. If however you wish to lock up your tools for safe keeping, you must invest in a good lock and key. The best sort for your purpose is what is called a chest-lock. (*Fig. 1.*) They come in various sizes, so I can't give exact measurements. It must of course go in the middle of the side opposite the hinges.

FIG. 1.

As you look at the lock you will see that one face is smooth, and the other side, where you find the keyhole, is irregular. This irregular part is the one [57] that sets into the wood. From the inside of cabinet (opposite the middle hinge) cut a place to correspond in size with the lock so that it will fit neatly. The opening for the key must of course be cut through on to the outside of cabinet. Be careful to do this neatly and cut out no more than is needful for the key to pass in freely.

By and by, on a bit of nicer work, I will tell you how to put on a scutcheon to guard the keyhole, but it isn't necessary for this. The other part of the lock which has the tongue, or tongues, is fitted into the door of the cabinet in the same way; the tongues of course projecting from the edge of the side. Be careful to have them come exactly opposite the openings for them in the cabinet side. *You cannot be too exact in carpentry.* The next thing is to fasten the cabinet securely against the wall. Of course you can stand it on the end of your bench, but it is better on the wall.

You will need four strips of brass four inches long, one inch wide, and about one eighth thick, with four holes for screws bored in each piece. Two of these go on the top corners, and two on the lower corners of cabinet. Put them on so that the screws will go through into the inch-thick [58] side of cabinet, not merely into the thinner back. Half the length of the brass piece with two holes must project above on the upper corners, and below on lower corners. (*Fig. 2.*)

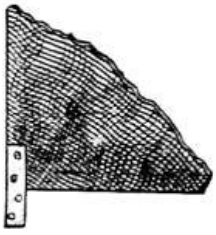


FIG. 2.

You will want some one to hold the cabinet steady for you while you secure it with long heavy screws, two at each corner. Of course your tools are not in the cabinet while you are at work upon it.

One word of caution: If the cabinet is to go in a corner, leave a few inches (i. e. the thickness of the door) measured outside between the wall and hinges, or you'll find you can't open the door.

If you have carefully followed all the directions, you have now a good, plain, serviceable tool cabinet.

If you would like to stain it, which would improve the looks, I will try to tell you how. You must not get discouraged if the first attempt doesn't turn out very well, for one must practise even to stain well; but the cabinet is a good thing to start with. Of course the staining is easier done before the cabinet is hung; but a neat workman can do it on [59] the wall.

First determine the color you wish your stain to be. I should say black walnut, as it is the easiest to put on, and you will not be likely to tire of it. The quantities I give will do more than the cabinet; but if stoppered tight will keep for future use, and for very small quantities you have to pay exorbitant prices.

I haven't much faith in home-made stains; they cost about as much, and are not very satisfactory. At any oil or paint shop, get a quart of stain, which will cost forty or fifty cents; one fourth pound *clear* glue for sizing—this ought not to be more than eight or nine cents; one quart nice varnish (what is called *inside* coach varnish is the best), this will cost about seventy-five cents; at same time get a small piece of putty, same color as the stain; the man at the paint shop where you get your stain, will color the putty for you. With this colored putty fill up all holes made by nail heads or screws.

If you are on good terms with a painter, he will likely enough lend you a couple of brushes. If you have to buy them, get one large and one small, costing from fifty to seventy-five cents.

See that the surface of the cabinet is free from dust; to make sure, wipe inside and out with soft [60] cloth. Stir the stain up thoroughly from the bottom of the can with a small stick; repeat this frequently, otherwise your stain will not be even colored.

With the large brush put on one coat of stain, remembering always to draw the brush in *one direction* and *with the grain* of the wood.

Put on as evenly as possible; always pat and press the brush on the side of the can so it will not drip, otherwise your stain will be streaky. Let this dry thoroughly for half a day where no dust is flying. Prepare the size by melting glue in warm water, add boiling water till thin and smooth, then add a spoonful of lime water.

Clean the stain brush in warm water and use it for the size; one coat put on evenly so as to cover every part stained; clean your brush again in warm water. Next day put on the varnish; this requires especial care. It must be a *thin*, *even* coat if you wish to have a creditable job. It is worth taking pains. It ought to have a day or two to dry in a place where no dust is flying.

If you are in a hurry, you can use shellac, which dries almost instantly; but for this very reason, is [61] much harder to put on well. I always prefer the coach varnish.

The small brush is handy for the shelves and corners.

Make a neat job, and don't let the size or the varnish get into lumps in the corners.

VIII.—CURTAIN POLES. [62]

PERHAPS this paper will sound more like upholstery than carpentry, but there is carpentry in it, and of the sort too that boy-carpenters can do just as well as men-carpenters, and make changes in accordance to the requirement of the windows for which they are planning, the material at hand and their own taste. Always remember that mere rules for such work are not enough, and that you must keep on hand a good supply of *common sense*.

If you should look in the yellow-covered Farmer's Almanac, hanging by a loop in the chimney corner, you'd see, "About this time look out for clearing weather;" that means clearing out and cleaning up and setting the house in order inside, as well as old Mother Earth outside: what our mothers call "spring cleaning." Curtains come down to be washed and put up again, and it's a good time, too, to put up curtains where there never have been any, for nothing makes a room [63] look more homelike and inviting than drapery of some sort or other, no matter how simple.

It used to be the fashion to tack curtains across the top of a window-frame with a strip of stamped brass-work called a cornice, or a bit of bright chintz, or turkey red, or something like a ruffle, to cover the edges; but curtain poles, or rods and rings, are the fashion now. They are prettier than the other things, and have one advantage beside: the curtains can be pushed quite to one side when one wants more air or light, and can be drawn close together again when more perfect shade is needed.

Suppose you want to fix up your own room to look pretty and not cost very much. I found it good fun to make something useful out of something other people had discarded as useless. I'll tell you how I made my room look cosey, and what I did it with. It had just one window, a half-dormer as they call it, and looked to the west, out over the hills; but the sun shone in very bright and hot in the afternoon, and I had to have a dark shade which I fitted myself from one that had belonged to [64] a larger window. It kept the sun out, but it was not pretty, and I was determined to have some draperies. Of course I could not make curtains, for a boy is more handy with a hammer than a needle; but when mother found what I was up to, she said she'd give me the curtains if I could do all the rest. They were very simple, just cream-colored Nottingham lace, and cost $1.00. They might have been made of unbleached strainer cloth at six cents a yard, with a ruffle, if this had been for your mother or sister who didn't mind sewing; but it is the pole I mean to tell you about.

I'm sure to look at it you would never guess what that pole was, or where I got it.

Up in the attic, in one corner, I found an old United States map, so old, so out of date that as a map it had been useless for years and years, for it was printed when the State of Ohio was "way out West." The map used to hang in grandfather's library half a century ago. It had black rollers with acorn knobs on the ends. I thought right away that the smooth slender pole would be just the thing for a curtain pole if I could get the map off without splitting the roller which was of soft [65] pine stained black. A sharp knife and a little care did it. One of the knobs was easily loosened. Then I measured carefully over my window and cut the pole the right length and fitted the knobs smoothly into place. A little sandpaper and a coat of varnish made my stained pine roller look like ebony. But what was I to do for curtain rings! The pole was too slender for the heavy wooden rings sold by the dozen at the upholsterer's; besides I did not want to spend any money. Back to the attic I went and rummaged in what we call the "trumpery box," full of the odds and ends that accumulate in an old house. Among a lot of brass knobs and hooks and hinges, I came across a lot of dingy metal rings tied together with a bit of stout string. The rings were about an inch and a half across; I could not tell what the rings were made of, they were so black, but I thought a good washing would bring out the complexion, so I put the rings into a bath of ammonia and soda, which soon showed that under the black coating was something very much like brass. A stiff brush and a little fine pummice gave me a dozen glittering rings, six for each curtain. I divided [66] the curtains evenly; with strong thread fastened the rings in place on the upper edge of each curtain and slipped them on to the pole. Two inches from the ends of the pole I screwed the little rings through which the cord had passed when the map was hung. A little hook at each end of the upper window frame served to hang my pole, which of course was very light, but heavy enough for muslin or lace. In the same "trumpery box" I found two brass knobs (door knobs, I guess they were). I screwed one of these each side of the window and looped back my curtains. There was my window, as new-fashioned or as old-fashioned as you choose to call it, but very pretty and inexpensive.

There are few old houses in the country that would not give at least as much to work with as I had. The old rollers on old-fashioned paper shades, such as you will find in lots of up-country attics, would make just as good poles stained and varnished. Even the acorn caps are not essential, for many of the most fashionable *portieres* and curtain poles, nowadays, especially those of bamboo, have no caps at all on the ends: only then you put a screw in at right angles, to [67] keep the end ring from coming off.

That was the first curtain pole that I put up. The next room I tried my hand on had a bay with three windows, and was harder to manage, but it did not cost very much after all. I saw an advertisement of an odd lot of curtain poles with rings and brackets complete for seventy-five cents apiece. Since then I have seen them advertised for sixty cents, which is cheaper than you can get the wood and turn them for yourself.

I found that two poles would do for the three windows, for the side windows were narrow, and half a pole was enough for each. I only wanted two ends instead of the four that belonged with

the poles, so a trifle was allowed, enough to give me some extra rings and two extra brackets.

The first thing to do was to get the angle of the bay: this I did with some mathematical instruments, but you might not have those handy, and this way will give it near enough. Take a good-sized piece of stiff paper (stout wrapping paper will do), lay a straight edge on the floor against the mop-board of the middle window, and fold the end of the paper to exactly fit the side [68]
mop-board, something like this. Then fold the straight edges together and you will have the angle shown in the dotted line.

Measure length of middle and side windows and cut the poles at the angle shown by the folded paper: a few brads will secure the slanting ends when they are neatly put together.

The brackets that come with these cheap poles are iron spikes bent up at one end. Two are used for each pole; they are driven into the wall about four or five inches from the ends of the poles, and the poles rest on the brackets; of course the joined corners count as ends, and are supported in the same way. Some prefer to put ring-headed screws into the poles and slip the rings over the ends of the spikes; and more expensive poles have brass “cup brackets” which of course are ornamental, but also expensive.

The wooden rings have ring screws on which to fasten the curtains. The number used is a matter [69]
of taste and depends upon the stuff the curtains are made of, the size of the folds you want, and the number of rings you have. Five or six do very well for a yard-wide curtain. Be sure and divide evenly; put one ring at each upper corner and the rest as they come; a few stitches with coarse thread will secure them, or better still, an inch of tape slipped through the ring and fastened by the doubled ends on to the edge of the cloth. You can buy curtain hooks if you like, and have them sewed on. These are something like big dress hooks: the advantage is, that when you want to take curtains down you just unhook them from the rings without taking the poles down at all.

I know a boy who made a pretty pair of curtain-poles out of two straight, slender beech saplings; he twisted rings out of stout wire and wound them with crossway strips of dark cloth. For muslin curtains, loops of bright ribbons instead of rings would be prettier still on such rustic poles.

Would you like to know what curtains went on to my sixty-cent poles? They are very “æsthetic” in [70]
color, but are just soft Canton flannel at a shilling a yard. The centre of olive, the sides dark crimson with bands between of darker olive. These are looped away on either side with bands made of the flannel and underneath are full curtains of six-cent scrim, (unbleached).

But curtain-making belongs to the girls, so having told you how to make the poles and put them up, I will leave the rest to them.

IX.—BOOK-REST.

[71]

PERHAPS you would like now to make something useful and pretty for your father or your big brother, so I will try to tell you how to make a book-rest like one I made myself for Christmas. It has no fancy carving about it, but is made (as you can see by the illustration) of straight pieces.

The directions for finding the angles might be given mathematically, so that you could get them for yourself with a little figuring, but it will be easier practically to find the angles in the way I describe, and they will be accurate enough for this piece of work.

For the book-rest you must buy some planed whitewood which is preferable to any other on account of staining. A piece eighteen inches long, twelve inches wide and one half inch thick, will be enough; it will cost about ten cents.

Lengthwise with chalk-line mark off eleven strips five eighths inch wide; cut them with splitting-saw and plane, the sides cut with fore-plane, making each strip JUST one half inch in breadth as well as thickness. [72]

We will begin with the uprights for the front.

Take one of these strips, square one end: then measure a little over one half inch down the stick, and with try-square make a continuous line around the stick.

Find the centre of the end just squared by drawing diagonals, and then either with block-plane or knife, point the stick by putting the edge of knife on the continuous line on one of the faces of the square, and directing the blade toward the centre of end; a steady, firm pressure will give a good bevel. Finish the other three sides in the same way, and you will have a pyramid with square base for one end of your stick: cut the stick off square thirteen inches from the point. Finish two more sticks in the same way, and you will have your three front uprights.

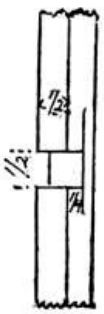


FIG. 1.

Now take another piece; square one end as nicely as possible (everything depends in this job on the neatness and accuracy of your work), measure seven and five eighths inches from squared end; cut off and square: you will have a stick seven and one half inches long. Make another like this from the piece left. These pieces we will mark *A*: they are the short uprights in diagram. Now cut two pieces twelve and one half inches long: square both ends; find exact middle, measure one fourth inch in each direction from middle and draw lines with square *across* the stick. Right and left on the side faces (*not* the one underneath), draw lines parallel with top face one fourth inch from it. These last lines show how deep you are to saw on the first two lines with cross-cut saw. With chisel remove the little piece one half by one half by one fourth. Take care not to cut the stick deeper than the lines indicate. The sticks will look like fig. 1. These are the cross bars, *BB*. [73]

From another stick cut three pieces six inches long: square both ends; these are marked *CCC*; two belong to the back, and one for the front connecting *CC*. From short pieces left cut two pieces two and three fourths inches long, of course squaring the ends: these are *DD*, and go at side of front.

For uprights of back cut two pieces ten inches long: square ends. On a board or piece of paper mark on a line two points three and one half inches apart. From the right-hand point draw a perpendicular, the line connecting the two points being the base of a triangle. Lay one ten-inch stick from the left hand point to the perpendicular, making the hypotenuse of a right-angled triangle. You will readily see how much of a bevel is required to make the lower end set firmly. It will probably be about one eighth of an inch; make the same bevel on the other ten-inch piece: these we will mark *EE* (the uprights for the back). Bevel the lower ends of the three-pointed sticks (the uprights for front) in the same way. (*See base of fig. 2.*) [74]

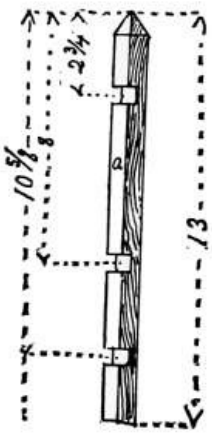


FIG. 2.

On one front upright, measure two and three fourths inches from point on face *A*: cut out bit one half by one half by one fourth as in piece *B*. Repeat at eight inches; again at ten and five eighths inches from point of stick. This completes middle upright.

Now to return to pieces *EE*. On a board or paper mark in line three points three and one half inches apart. Hold beveled end of pointed upright on point one, so that a point *Y* ten inches from bevel will be perpendicular to point two. Stand bevel end of *E* on point three, so that the other end will rest against point *Y*. You will then see the bevel needed on upper end of *E* to make it fit against point *Y*. It will be about an inch long. [75]

Treat the other *E* in the same way, taking care that both bevels start from same face of stick. Square end of new stick: cut off six inches and square again. At point three inches from end cut out bit one half by one half by one fourth, as in *B*. This is the stick *F*.

Cut two sticks ten inches long: square ends. These are *GG*.

The pieces are all cut out; now of course you had more whitewood than these measures, but it is so cheap it seemed best to allow for mistakes, and the spoiling of two or three sticks in cutting bevels, etc. The bits left always come handy. [76]

In putting the parts together you must be very careful. You

will need some one-inch brads and some seven-sixteenths or three eighth ones also, and about two feet of brass spring wire, two French screws one inch long (slim ones), and two five eighths inch ones.

Take first the pointed piece for the middle of front: the one with the squares cut out of it: fit one of the *B's* into the upper place and the other into the lower one. Put piece *F* into the middle slot; put two brads through each piece (*BBF*) and into the pointed one. Turn the whole over so the face *A* is down.

Take two pieces marked *A*; with inch-brads fasten pieces *D* endwise, so that upper face of *D* will be two and one eighth inches from end of *A*.

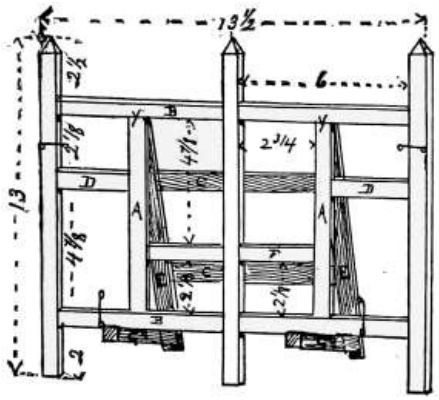


FIG. 3.

Place one *A* between the two *B's* on the right of pointed stick with *D* pointing to the right; you will find that the end of *F* touches *A* at a point two and one eighth inches from the bottom, so that *F* and *D* divide *A* plus one half inch (eight inches) into thirds. [77]

Place the other *A* and *D* facing just opposite on the other side of pointed stick. You will find that the ends of the *A's* touch the *B's* at a point half-way between the end of *B* and the pointed piece. Secure in position with inch-brads.

Place one of the other pointed sticks to the right, the other to the left of ends of *B* and *D*, and fasten so that the end of upper *B* is two and one half inches from point, and *D* two and one eighth inches from upper *B* and lower *B* *slightly* over two inches from bottom of bevel. In placing these two pointed pieces *be sure* and have the face *a* (*fig. 2*) down.

Now for the back. Take the pieces marked *E*; measure two and five eighth inches from upper ends; fasten one of the pieces *C* by the ends to these points, and the second *C* at a point a *little* over two inches from bottom.

Fasten upper beveled ends of the *E's* to backs of points *x* (*see picture*) with short brass screws and a couple of brads.

Next take pieces *G*, and measure two and three fourth inches from end: bore holes large enough to admit long screws; with brads fasten third *C* at points one and one half inches from ends of *G*, and one and one fourth inch from holes. (This is to support the book.) Then screw *G*'s directly under *B* and *A*, the long ends directed backward. You will find the seven-inch ends will touch the lower part of pieces *E* about one half inch from bottom. Fasten with brads. [78]

These two pieces (*G*) serve to keep the back from spreading away from front and make the rest strong enough to support quite a heavy book.

This is really a very simple thing to make, for the lines are all straight, and if you are careful in cutting, fitting and joining, you will feel paid for the trouble.

X.—BOOK-REST. (*Continued.*)

[79]

YOU now have the book-rest all put together ready for finishing. The first thing now to do is to sandpaper it. For this you must buy some (o) or (oo) sandpaper, and go over the whole thing, being careful not to round the corners. You can accomplish this by stretching a piece of sandpaper over one of the little bits that remained after cutting: this will make a flat, firm surface, and will not be so liable to round the edges as if stretched over your thumb.

Before staining, you must make the brass springs to hold the leaves back.

[80]

Cut six and one half inches of your spring wire, (which should be about one sixteenth of an inch in diameter.) At a point five eighths of an inch from end, bend the wire into a right angle; two and one fourth inches from that point give the wire a turn round a small nail, or piece of telegraph wire (you cannot turn it evenly with your fingers alone); this is to give the wire a spring, and will enable you to lift the end of the wire on to the leaves of the book. Now turn the end of the wire in so as to make a rounded end. It will then look like *fig. 1*.

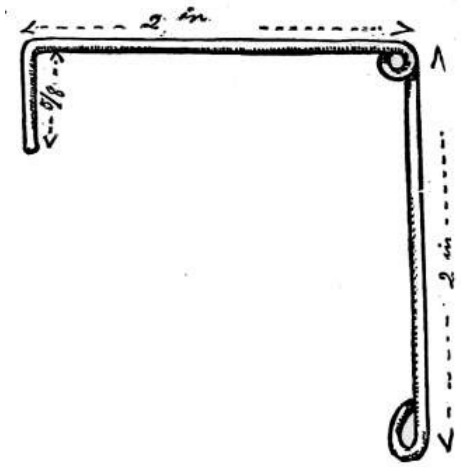


FIG. 1.

Make another spring exactly like this one: then cut off a piece five and one half inches long, bend to a right angle at a point five eighths of an inch from end. Then at a point two inches from angle, give the wire a turn as in the other set, and turn the end in. Make a second one like this of the remaining piece of wire.

To fasten these springs on to the rest, you must bore a hole one-sixteenth of an inch in diameter through the sides of the two *end uprights*, at a point just below the end of piece *D*. Insert the five eighth inch ends of the larger set of springs into these holes, from the outside. You will find that you can lay the springs back when not in use, and [81] that you can turn them out and lift the ends over the edges of your book, so as to keep the pages down when you do need to use them.

The smaller set can be fastened in the same way under lower *B* or under *G* if you prefer, at a point near the lower ends of *A A*.

If you are going to stain the book-rest, it is better to do it before fastening in the springs.

I think ebony stain goes best, and as you can make it yourself, it would perhaps be cheaper.

First you must get some logwood chips (about a teacupful); after boiling them in a pint of water for an hour or so, apply with an old brush (not the chips, but the decoction you have made by boiling the chips!). You can put on two or three coats of this, letting it dry each time.

The next part will perhaps be the hardest. Get some iron rust or old iron filings, put these in strong vinegar or acetic acid and let it stand a day or two; if by this time the liquid is not of a reddish-black color, add more iron rust.

After the two or three coats of logwood, your wood will be of a dark yellow color, but this will [82] immediately turn to a fine black when you apply the iron. Only one coat of this is needful, because it does not soak in. You might try the logwood and the iron on a small bit of wood first, and then you will see if the solution of iron is strong enough for a good black.

When the book-rest is *perfectly* dry, rub on some thin shellac with a soft cloth: this will make the dull finish now considered so desirable.

This book-rest is very convenient to use round the house at home, and is, as you have seen, very easy to make: but it as an awkward thing to pack away in a trunk if you are going into the country, for instance, or are travelling.

You may like to make another, if you have been successful with this one, and this time you can make it with hinges, so as to fold up compactly, by making the following alterations:

The front will be the same and the back also, with the exception of the uprights *E E*, being hinged instead of screwed on to upper *B*.

The two *G's* must have a one fourth inch hole bored one fourth of an inch from the back end, and [83] a corresponding one bored through *E* about an inch from the bottom; these holes are for pins, on which the *G's* may turn.

Instead of the six-inch *C* which joins the two *G's* at a point one and one half inches from outer end, there should be two pieces seven inches long fastened with brads, at points respectively three inches and six and one half inches from outer ends of *G*. The piece six and one half inches from end *can* be left out—though it looks neater with it—but the back will shut closer without it.

Now put the peg through the *G's* and into the *E's*.

Draw the back of the book-rest from the front, put ends of *G's* through the spaces bounded by pieces *A*, *B* and *D*, and you will find that the *G's* rest in the corners made by *A* and *B*.

When you want to shut up the book-rest, you must draw the *G's* out, and turn them away from front on to the back of the *E's*, and then shut the *E's* up on to the *A's* as in figure.

I don't think this quite as pretty as the fixed book-rest, and there are of course other ways of changing the original plan which would be more ornamental; but this is very easy and will answer the purpose. You will find it good fun and good practice to experiment on changes in any of the designs given, after you have mastered the simple forms and the plain directions given in these papers.

FIG. 2.

XI.—A BED TABLE.

[85]

THE accompanying figure shows you a very useful but rather peculiar piece of furniture quite simple to make; if you are ever ill in bed yourself or any one in the family is obliged to lie in bed and have meals brought to them, I think you will say it is a handy thing to have instead of a waiter that joggles and tips on one's lap in the bed, instead of even a table at the side of the bed that compels one to twist round uncomfortably in order to reach.

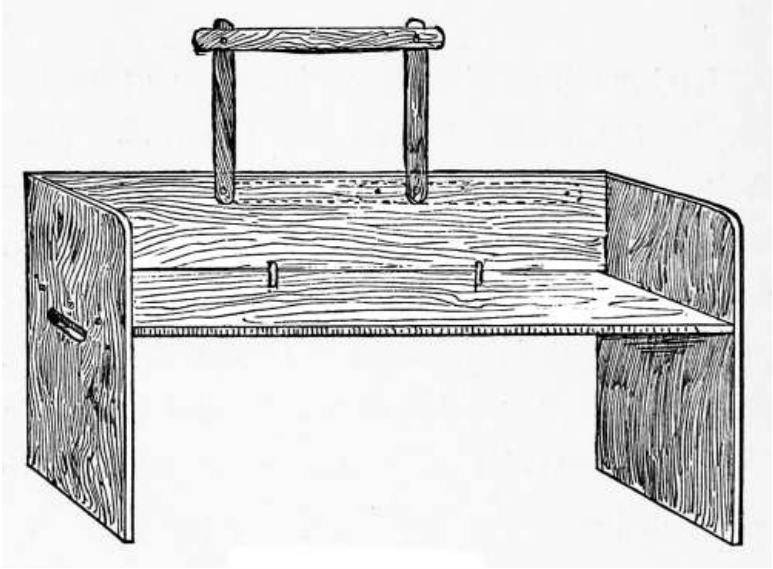
It explains itself, almost; but a few directions and dimensions will help you.

As you can see, it is a tray with legs to set over the lap in bed, with a rim to keep things from sliding off, and is light enough to be carried by the side handles; a tempting breakfast for the invalid can be arranged neatly upon it instead of a waiter.

[86]

It can be made of any kind of wood, but black walnut is as pretty as any and enough can be bought for it, for about fifty cents.

You will need two boards, each two feet long; one should be one foot wide and one half inch thick, the other one and a half foot wide and one half inch thick.



BED TABLE.

Take the first one; plane nicely, being careful to have the ends and edges square. Set this aside for the top of tray.

[87]

Plain one edge of second piece (the one and one half feet wide); with splitting saw cut off strips twenty-four inches long by four inches wide: square ends and plane edges of piece left. Measure one foot from end, square and cut off. You will have two pieces alike for the ends or legs, and one strip two feet long, four inches wide, for back.

Round off one edge of top (the piece two feet long by one foot wide) with small plane, and sandpaper smooth. Take two side pieces; find points nine inches from bottom and respectively four and eight inches from side of leg; bore holes with largest bits, split out piece between, enlarge and smooth with gouge or knife to fit the hand. These are to slip the fingers through to hold the tray.

Draw a line parallel with, and ten inches from, bottom of legs and fasten one leg on either end of the two foot by one foot piece, using three one inch screws for each leg.

Fit the back piece neatly on to square edge of top and fasten with four screws; put a screw on upper corner of each of the sides, through into end of back to make it steadier.

If the corners of the sides are rounded as in picture, it will look a little better.

[88]

You can make this bed table even more useful by attaching a simple book rest which will be a great comfort to an invalid who is able to read yet finds it fatiguing to hold a book.

Cut two pieces one quarter inch thick, one wide and seven inches long, and one piece nine inches long; one half inch from bottom of the two seven inch pieces, bore holes large enough for seven-eighths inch screws to play in.

One half from ends of nine inch piece, make some smaller holes, and also two holes one inch from top of back (on inside) and eight inches apart.

Screw ends of seven inch pieces into these holes and the nine inch piece into the other ends of the seven inch pieces; of course the screws must play easily. When not in use the rack will fold over and lie inside the back as shown by dotted lines.

To keep the book from slipping forward insert two movable pegs about three and a half inches

apart in front of middle of back.

XII.—CABINET.

[89]

I HAVE often been asked to describe a “Cabinet for Specimens,” such as I made for minerals. It would be equally good for shells, eggs, coins, or even for a bookcase. The shelves hold the specimens protected from dust with glass doors, and from meddling fingers with a lock and key. The cupboard (or drawer if preferable) below holds duplicates useful in making exchanges, and the needful tools for the specialty which interests you.

The cabinet of course can be made of black walnut or any other hard wood, but for lightness as well as cheapness I used pine (stained) and put in a back of dark-brown cambric instead of wood, the cambric costing fifteen or twenty cents, where the wood would cost nearly a dollar and a half.

I can’t give you close estimates about lumber either as to price or lengths, because at different mills boards vary greatly in dimensions, and values at the West or in Maine are unlike those in [90] cities. I will therefore describe my own, feeling sure that by this time if you have made all the other articles in the series you can alter the pattern I give you, or follow it accurately, according to the purpose you have in view.

My cabinet fits easily in an alcove six feet, six inches high, and four feet, six inches wide; and is large enough to hold an interesting collection. For convenience in cutting, the seven boards I used were selected according to the following dimensions:

A—12 feet by 12 inches.
B—6 feet by 10 inches.
C—8½ feet by 12 inches.
D—12 feet by 12 inches.
H—4 feet by 13 inches,
and 2 boards for shelves 8 feet long by 1 foot wide.

If possible, get three-fourths-inch board, as it is both lighter and cheaper, but inch-board is often easier to get and my measurements are for that. Get it all as clear as possible.

Besides the boards you will need two pieces of two-inch moulding six feet long, and two pieces of [91] three-fourths-inch about eleven feet long, to hold the glass in the doors, and three pair of hinges; also lock and key if you desire all to be secure.

Take *A*, divide in two, plane edges and square ends for sides.

Take *C*, cut two boards, each four feet two inches long, and one foot wide, for top and bottom.

From *B* cut two pieces that shall be six feet long, and four inches (for sides of door casing), then from remainder cut strip three and one half feet by one inch, to go behind lower moulding for hinges of *E*.

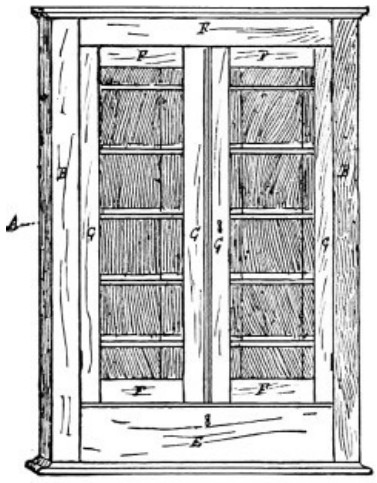
From board *H* (which is four feet by thirteen inches) cut out block at *each end of one edge*, three inches long by one wide.

Nail *CC* on to top and bottom of *AA*, taking care to put top and [92] bottom (*CC*) *on* and not between uprights *AA*.

At point nine inches from lower *C*, nail board *H*, with the projection facing outward. On each side on front nail strips *BB*. You will find they fit into cuts made in *H*.

Nail the three and one half feet strip close to bottom *C* between *BB*.

From remainder of board *B* cut piece three and one half feet long; with splitting-saw divide this into two boards, one eight inches, one four inches wide. Nail the four-inch piece directly under *C*, between the *BB*. This finishes the front for the doors.



THE CABINET.

Now for the mouldings: from one of the two-inch strips cut piece four feet, four inches long; cut ends at angle of forty-five degrees; cut two pieces one foot three inches long: have right-hand end of one and left-hand end of other cut at angles of forty-five degrees, i. e., one half of a right angle. Cut a second similar set of mouldings, nailing one set to top, the other to bottom of cabinet.

The piece three and one half feet by eight inches is a kind of door, which is hinged to the strip behind the moulding at the bottom. In my cabinet I have it for a cupboard, as I said before, but [93] you can put in a drawer in its place if you prefer.

For the doors, cut from *H* four pieces four feet, ten inches long by three inches wide, and four pieces one foot, nine inches long by three inches wide.

The best way of putting this together is of course to mortise it. To do this, draw lines at each end of one of the long pieces on the edge one fourth inch from each side; then draw lines *across* the edge at points three fourths and two and one fourth inches from end.

This rectangle must now be cut out. Bore three one half inch holes one and one half inches deep: then with chisel split out the remaining wood and smooth as nicely as possible. Repeat this on all

the long pieces.

To make the tenons or tongues which fit the mortises, measure one and one fourth inches from ends of short sticks, and with try-square draw line all round the stick. On sides of stick saw in one fourth inch deep; on edges saw three fourths inch deep. Then, parallel to sides, draw lines one fourth inch from sides of stick on the end, and two more lines three fourths of inch from and [94] parallel with edges of stick. Place edge of chisel just outside of lines and chip off the little blocks, gradually shaving the tenons down to the lines.

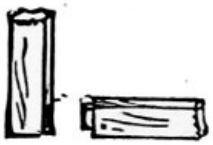
If this is nicely done, the tenons will fit into the mortises so that the side edges and ends of the four long sticks will fit snugly on to the short ones. Put a peg through long and short pieces at the tenons to keep them from coming apart.

This can be done in another way that is also somewhat easier, by cutting from the sides at the ends of the pieces squares three inches by three inches by one half inch and screwing together.

If you have only one light of glass to each door, there will be no need of a cross-piece, so you will simply have to put the moulding round on the inside of the door frames. If you have smaller panes, you will need the crossbars.

For the four shelves you will require you must cut the two eight-foot boards into four, and make cleats to support them. These are merely narrow strips of wood nailed on inside of *HH* (at the height desired) on which the ends of the shelves rest. The staining is done by the rule given in a former paper, and the hinges and lock are set as in the tool cabinet. [95]

About four yards of dark cambric tacked on the back will finish a neat, simple, but serviceable cabinet like the illustration.



TENON AND MORTISE.

XIII.—A BOY'S "CATCHALL." [96]

THERE is no better way for a boy to spend his evenings, half-holidays, and vacations, than in making some useful and pretty articles of furniture for his own room, providing he has an aptitude for such work, and the mechanical ingenuity and natural patience to do it with neatness and accuracy. Yet a boy should not—if he takes pleasure in such work—become discouraged if his first attempts are not wholly attended by success, as no success comes without perseverance; and perseverance, if the love for the work be not wanting, will inevitably bring its own reward.

The average boy is not usually blessed with overmuch room in which to bestow his many treasures—his bats, balls and marbles, his collection of butterflies and bugs, relics of many a pleasant tramp through field and wood, and last, but far from least important, the treasured [97] books of tale and adventure, so dear to the heart of a genuine boy; therefore the little case or cabinet of the illustration has been contrived, for his own making, as a resting-place for all these and more, and to prove the happy truth of the old adage, "A place for everything, and everything in its place."

SKETCH NO. 1.

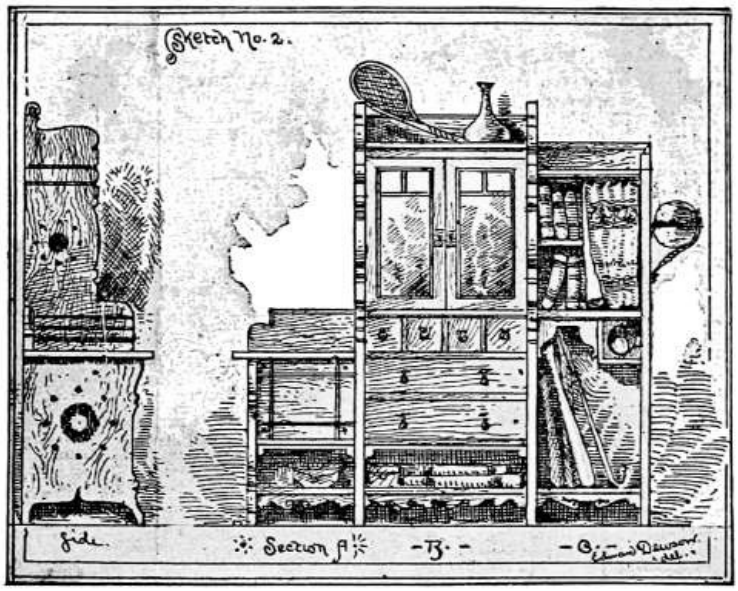
It may be constructed of nicely-selected pine, for this is easily obtained, is cheap, and any little [98] mistake will not entail too much expense if the work has to be done again, and also it is easily worked, and takes a beautiful golden color when "filled," and finished with shellac. Pains must be taken not to mar the wood with tool-marks. To make a nice piece of work, you will not use any nails, but put the case together with dowels, screws, and glue.

Now look over the drawings together. *Sketch No. 1* shows the completed case as it should look when finished and in place. The first section, *A*, (*Sketch No. 2*) is a fair-sized box with lifting cover, and a shelf beneath. This will be found handy for many odds and ends of boyish treasures too cumbersome to be stored away in drawers and boxes. *Section B* contains the specimen, or butterfly case, with a row of small drawers below, these drawers being handy receptacles for marbles, tops, twine, or like odds and ends that make a troublesome litter when thrown together in a large drawer. Two large drawers below these, and the shelf, will find their uses, without doubt. *Section C* has a couple of shelves for books, with storage room for bats, hockey sticks, etc., below; and in one corner is a small box large enough to hold two or three balls; outside of [99] this, as the other plans will show, is a receptacle for a foot-ball, made of bent wire. This, if not a desirable addition, may be left off.

Having looked our case over in a general way, let us now go into the details of construction and finish. In *Sketch No. 2* will be found all the general measurements. The figuring and lettering on the *Detail Sketch* all refer to this drawing. We will first get out the stock for the side-pieces of the various sections, four in number, and two of them—those belonging to *Section B*—of exactly the same size and shape. These should be of one and one fourth inch stock, and of the dimensions given in *Detail Sketch No. 3*. Mark out carefully the simple outline indicated for each piece, using

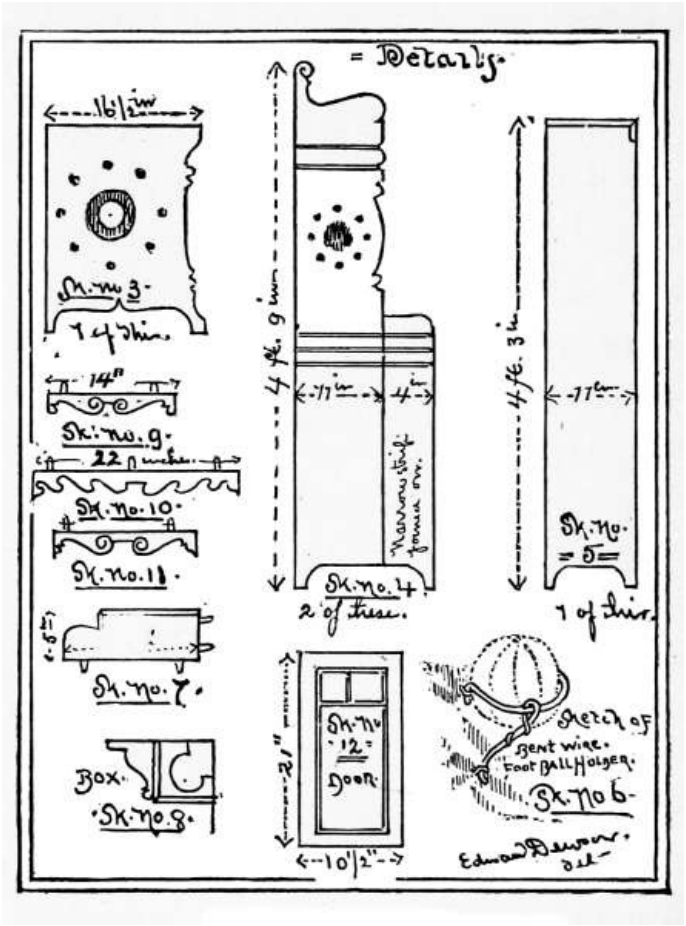
a piece of charcoal, so the line may be easily wiped out and corrected if unsatisfactory. Go over the corrected outline with a soft pencil to preserve them, and then saw them out. This must be done with care, to keep the edges even and true, using either a draw tool or small saw on the finer outlines.

[100]



SKETCH NO. 2.

The half-trefoil on side of *Section A* at the bottom should be drawn with a compass, or scribing tool, and cut with a hand scroll-saw; and the simple pattern on the sides should first be marked out with a compass, the larger hole carefully cut out with a sharp tool to the depth of one fourth inch. The smaller holes, surrounding it, bore out to about the same depth with a small auger-bit. The straight line decoration on sides of *Sections B* and *C* are first neatly lined with a pencil, and then cut with a sharp tool, one fourth inch wide, and about as deep. The cover of *Section A* [101] should be of seven eighths inch stock, and should project fully an inch over the side and front. The back piece, on which the hinges are fastened, should be two and one half inches wide. This will allow ample room for the back board, and give to the cover, when open, sufficient slant to lean easily against the wall. This piece should be well glued and doweled into place, and two neat brass hinges set in, to hold the cover. The bottom of box and bottom shelf of this same section are of same thickness as top, firmly doweled and glued into place. The front panel is of same thickness, and cut to fit exactly into place, doweled and glued. The small jig-saw patterns at bottom of *Sketches No. 8*, *9*, *10*, are cut from one half inch stock, and glued on firmly. *Section A* is now ready to attach to the side piece of *Section B*. This must be neatly and firmly done with dowels and glue.



SKETCH NO. 3.

In *Section B* first get out the top, centre and bottom shelves, as well as the narrow strip division for the drawers; these last need not run back more than three inches, excepting for the row of small drawers. This division should run entirely from front to back, the same as the shelves. The [102] thickness of all the shelving is the same throughout. Having framed together our sides with the centre and bottom shelves, and drawer partitions, next place the two narrow uprights, on which the doors are to be hung, in position. These are one half inch wide and firmly doweled and glued [103] into sides; the doors are hung with simple brass hinges and made to lap one over the other on one fourth inch rebate, and shutting against an upright post about three fourths inch square. Glue a strip one inch wide and one half inch thick around the sides and back piece, for the top to rest upon and be fastened to, by one fourth inch dowels, and glued; this strip should, for further security, be fastened by a number of small screws. Space will not allow the details of construction of drawers; but if the lad will look at any well-made drawer, he will easily find out for himself.

We have already got out the side for the book shelves and bat holder, *Section C*, and have only to dowel and glue shelves firmly into place, put the back boards in position, having got them out the size and shape shown by *Sketches 7 and 8*.

Now our case is well framed together and it only remains for us to finish various small details. After fitting a one fourth inch shelf into the specimen case midway, the next move is to line the whole of the specimen case and the two long drawers beneath with thin, flat pieces of cork about [104] one eighth inch in thickness. First apply to the whole surface to be covered, a thin coating of hot glue, fitting in the piece of cork while the glue is hot; rub well into place, and apply an even pressure, to be left until the glue is thoroughly “set;” when this is done cover all the cork with nice white paper, applied with flour paste. Frame up the door as shown in *Sketch No. 12*, of one half inch stock, setting the glass in from the front into a narrow rebate. Then glue a narrow moulding on the outside to prevent the glass from falling out. Hang the door with brass hinges and fit a small lock into place; then dowel neatly into place the under brackets, *Nos. 9*, *10*, *11*, in their respective positions, place pretty brass pulls on all the drawers, and the case is nearly ready for finishing.

In the book case *Section 6*, the simplest way of arranging the shelves is to bore a row of one fourth inch holes front and back and at both sides, and fit little pegs into these for two shelves to rest on. These may be raised or lowered by changing the positions of the pegs. Make a little box as shown of one fourth inch stock, fasten this neatly with small screws into the left-hand upper [105] corner of the bat holder under the lower shelf; this is to hold the base and hockey balls. The back of the case may be made of narrow strips of one fourth inch sheathing, held in by screws.

Fill the woodwork thoroughly with a good filler; Wheeler’s is good. After it is wholly dry, go over the case with a good coat of white shellac, and when dry, rub it down carefully with powdered pummice stone, oil and emery cloth. A second coat of shellac carefully rubbed down, will result in a rich golden brown hue, that will improve with age. This case, when complete, will cover a small

space of four feet nine inches by three feet three inches.

In buying stock, select the best pine for all portions that will show. Get the stock well planed and smooth it down.

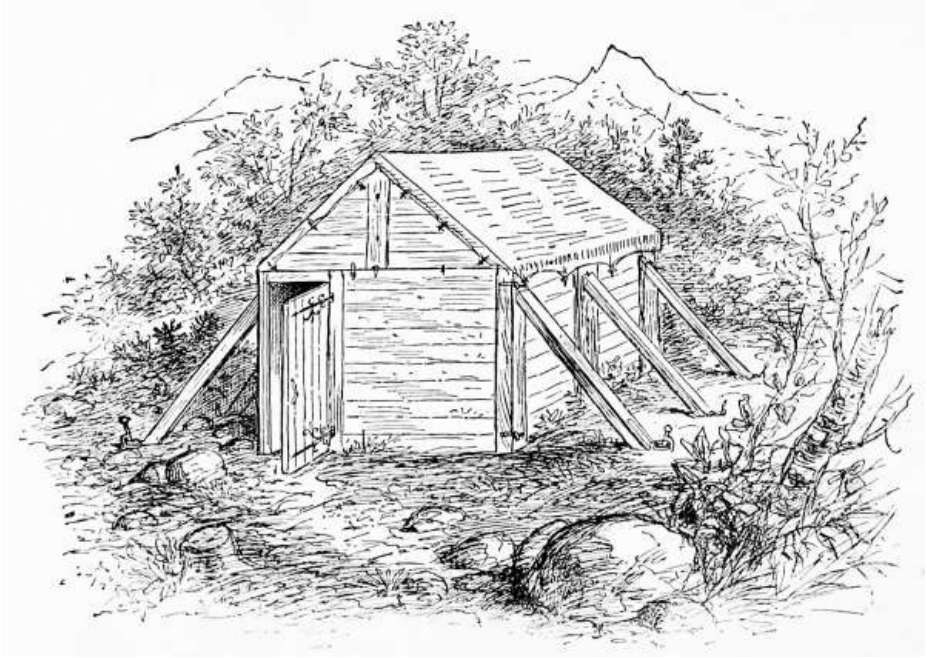
If made by a carpenter, twenty-five dollars would be the smallest payable price for a good job, so that the price named is not at all excessive for a really good thing.

This case being somewhat elaborate is intended both in design and instructions here given, for those boys who have a fair knowledge of construction, and some ideas as to the best way to set about it; and it must be borne in mind although pine is soft and easily worked, it is also easily soiled and injured by tool marks more readily than the harder woods. [106]

The general schedule of material and cost given below will be found useful in buying.

SCHEDULE OF COSTS, ETC.

50 feet, ⅞ inch pine,} at 6c per foot, 25 " ½ " " }	$4.50
Sawing, if done at a mill, about	1.50
Finishing and filling the wood in four coats, about 1 quart of shellac, etc.,	1.50
Hardware, locks, hinges, drawers, pulls, etc., etc.,	1.50
Glass for doors,	.50
Cork, paper, glue, etc., about	1.50
Total,	$11.00



A PORTABLE HOUSE.

XIV.—HOW TO BUILD A PORTABLE WOODEN TENT. [107]

WOODEN tents such as I am about to describe, are in use by the contractors who are building the western extensions of the Denver and Rio Grande Railway in Colorado. There are no towns there ahead of the railway, and it is necessary to provide sleeping-quarters, provisions and eating-houses, for the engineers and road-makers. It is therefore needful to have a style of building which can be put up and taken down easily, and, above all, which shall be capable of transportation over the frightful mountain roads. The result, it seems to me, might be useful to bevies of boys, to schoolmasters and pupils, and to families who camp out every summer for some considerable time, and really need to take to the woods a house somewhat better than a cloth tent, where they can live in warmth and comfort, and which shall be a cosey headquarters for storing supplies, and to which they may return. My object now is in these papers to instruct our [110] young home carpenters how during their winter leisure to get one of these comfortable wooden tents in complete readiness for summer transportation. It can be done very cheaply; if you can improve on it, so much the better. For my part, I have never seen or heard of the like anywhere else, though I believe that circus sideshows sometimes have a far more cumbersome arrangement answering the same purpose.

Boys might club together, not only to own such a portable house in common, but to build it—a jolly way of spending Saturdays in some great wagon-house or tool-chamber where there is a big workbench and a good tool-chest.

This movable house consists wholly of wood except the roof, which is canvas, and the floor, which is dirt, unless you choose to plank it. It may be made of any size you see fit, it only being necessary that all the parts are adjusted to the scale decided upon. The dimensions I give, however, are measured upon a plan twelve feet square, because that happened to be the actual size of the one nearest to me. The railway men generally join from two to half a dozen of these [111] together, end to end, making a long and commodious building. A half-dozen congenial families could do the same, insuring endless good times in the forest solitudes. One twelve-foot length is then known as a "section." If you would rather have an oblong figure, make your ends shorter and reduce the length of your rafters; or, if you don't like the pretty low pitch of the roof which my measurements imply, lengthen your uprights and rafters to suit your own ideas of the right angle.

Now for my details:

The walls of your tent-house, six feet in height, are to be made of inch-thick matched flooring twelve feet long. They should be No. 1 pine, best quality. Fasten these firmly together, to the width of six feet, by three dressed cleats, six inches wide, one at each end and one in the middle, and do this on both sides. Make three of these platforms, or walls, which will furnish three sides of your house. For the fourth side make a similar platform nine feet in length, filling out the remaining three feet with a door.

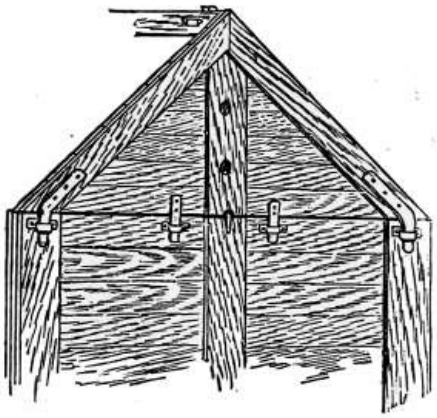


FIG. 14.

This door swings *out*, and the hinges should be very [112] strong, preferably of the kind used on barn doors, so that it can be lifted off its hanging with ease, and so that the long shaft of the hinge will act as a support to prevent undue sagging. An arrangement must be made to lock this door. It can easily be secured on the inside by a bolt, and outwardly by hasp and padlock.

There remain, now, the peaks or gables at the ends, to be provided for. Many of the railway men get their roof canvas sufficiently large to come down and cover this, but I think a better plan would be to make two triangular platforms of boards, fitted to your peak, cleating them together just like the lower walls. Then place about four flat staples in the outside of your end walls, and let iron [113] hasps bolted to the lower edge of your peak boards drop into them. This would hold the bottom of the peak and the top of the end wall squarely together. In addition to this a couple of bolts should pass through the upright and be secured by nuts, so as easily to be unscrewed. (*See fig. 14.*) There should be no middle cleat on the inside of the gable. The general character of these walls appears in several of the illustrations, but the cleating is shown in *fig. 1*. Screws should be used throughout instead of nails. The woodwork remaining to be shaped, consists of the uprights, or centre-poles at each end, the ridgepole, rafters and braces.

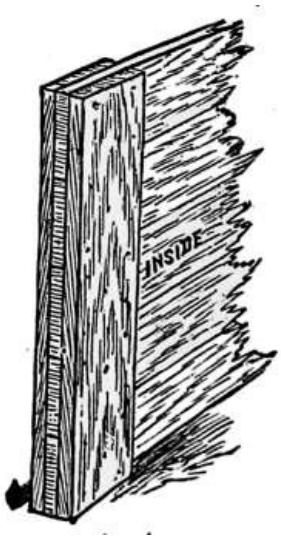


FIG. 1.

The two uprights in my model were 8 feet and 9 inches in height; a greater length would add pitch to the roof. These uprights should be made of clear, firm stuff, 4 inches by 2,

FIG. 2.

and should be thickened at their lower ends by adding pieces of similar size, as shown in *figures* 2 and 4. This upright stands inside of the wall, and edge-wise. Into its upper inner edge must be set two iron “eyes” having an inner diameter of three quarters of an inch. (*See fig. 3*). The uppermost of these is placed about two inches from the top of the stick, and the second six inches below. These eyes should pass clear through the timber and be held by nuts on the other side. Six feet from the bottom of the upright, a hooked bolt should be passed through the timber, the hook facing outwardly, and having enough space between it and the wood to allow the wall to come between. Its purpose is to hold the end wall snugly to the upright: therefore it must be loose enough so that it can be turned up while the wall is being put into position, and then turned down to clamp it firmly, as in *figure 4*. [114]

Having made both uprights alike, you now turn your attention to the ridgepole. This ought to be somewhat heavier than the uprights, two by six scantling being none too strong for the strain which the weight of your canvas and an occasional gale of wind will put upon it. It is twelve feet long, of course, and six inches from each end will have an iron pin 18 inches in length driven through from its upper side, intended to go through the eyes at the top of the uprights. This is shown in *fig. 5*. [115]

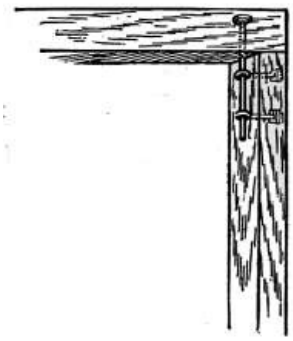


FIG. 3.

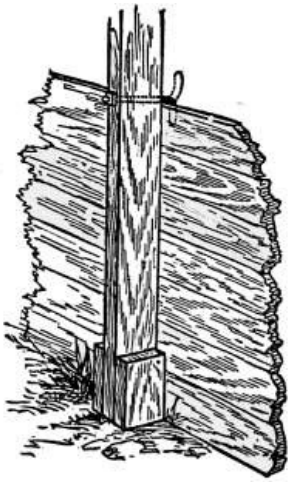


FIG. 4.

On each side of this ridgepole screw in four stout staples or eyes, one at three inches from each end, and the others at equal distances between; to these the rafters are to be attached. (*See figs. 3 and 5.*) Similar staples must be placed an inch below the upper inside edge of the side walls to contain the irons at the lower end of the rafters, as in *fig. 6*; of course, therefore, it is necessary that the staples in the walls should fall exactly opposite those on the ridgepole.

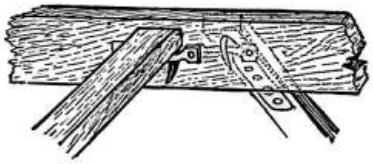


FIG. 5.

The rafters themselves, eight in number, may be made of the same sized stuff as the uprights, or lighter, if a tough wood like elm or ash is used instead of pine; and each will be 7 feet and 4 inches long unless you want a pretty steep roof, in which case you must lengthen them somewhat. To the underside of the upper end is fastened a strong curved hook, which hangs in the staples on the ridgepole (*fig. 5*); while to the lower end is fastened a pointed iron three inches long, and set at such an angle that it will stand vertical in the eye on the wall (*see fig. 6 next paper*) when the rafter is in place. [116]

XV.—HOW TO BUILD A WOODEN TENT. (*Continued.*)

[117]

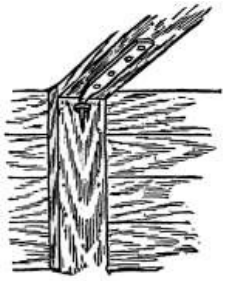


Fig. 6.

THE braces are intended to serve the same purpose as the guy-ropes of the ordinary wall tent, and are three in number on each side. They consist of stout sticks (two by four inches is a good size) long enough to reach the ground from the top of the wall (five and one half feet in the present case) at an angle of forty-five degrees. At the upper end, underneath, which is beveled to stand flat against the face of the wall, the brace is armed with a strong hook. This hook sets into an eye inserted into the top of the outside cleat, just as the rafters are hooked to the ridgepole. At the lower end, which also is beveled off to fit the ground, is fastened a large ringbolt. This is on the upper side, so that when the brace is in position, the ring lies [118] flat on the ground beyond it, and through it is driven a barbed pin of iron. These braces not only hold the wall from sagging out, but equally prevent it from pulling in, which is just as great a danger. How they are arranged is seen at a glance in *fig. 7*.

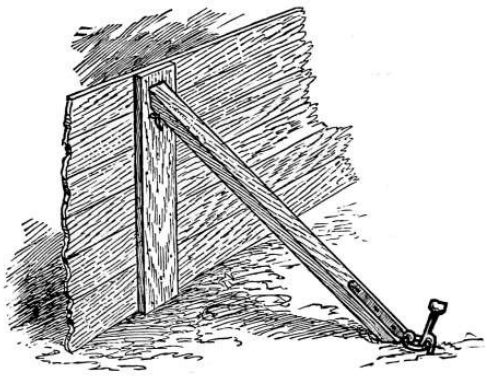


Fig. 7.

There is also another brace which goes across from the corner of the side wall over the doorway to the upright, where it is hooked into an eye placed six feet above the ground. This cross-brace forms a lintel to the door, and serves to make solid the otherwise somewhat shaky end of the right-hand siding.

Now comes the setting up and roofing; but before you [119] can do that you must provide fastenings at the corners of your walls. I have reserved this for the last, since it is the most difficult bit of mechanism.

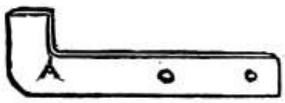


Fig. 8.

Go to a blacksmith and have him forge for you six pieces of iron of the shape shown in *fig. 8*, each about an inch and a half wide, and an eighth of an inch thick; the shafts, or straight ends of three of them, should measure six inches from the point marked *a*, while the shafts of the others should be nine inches in length, the elbow being alike in both cases. In the shaft should be punched two holes big enough to pass stout bolts through; but in both sizes these holes should be within six inches from the straight end. Having provided yourself with these bent irons, bolt one of the *short size* upon each end of the [120] *outside* of the *rear* wall of your house six inches from the lower border, and in such a way that the bent end which is to be turned *upward*, shall project beyond the end of the wall just enough to leave a space of a quarter of an inch between the inside of the curve and the edge of the cleat to which it is bolted. Draw the nuts on your bolts very tight. Now take your remaining short one, and put it upon the lower corner of your front wall, so that its lower edge shall be just seven inches from the bottom of the wall, and with the elbow projecting as before, but *turned down*.

Fig. 9.

Fig. 11.

You have now left your three longer pieces of iron. One of these must be placed on the lower rear end of your right-hand side-wall (as you face the door) at seven and one half inches above the bottom, and with the elbow turned *down*. The other two go on opposite ends of the left-hand wall, that at the rear end turned *down*, and that in front turned *up*, the former seven and one half, the latter six inches above the bottom edge. But *all these long ones must project* three and one quarter *inches*, because they must reach past the edge of the adjoining wall, as you will see when you stand the walls up; the edge of the rear flush with face of the sidings, and lock them together, as shown in *fig. 9*.

Fig. 10.

[121]

Though I have seen the same arrangement at the top, yet a better way is as follows: (*Figs. 10, 11 and 12.*)

Have your blacksmith make three flat pieces of iron, each six and one half inches in length, having a closed loop turned up at the end, which carries a link six inches long, as in *fig. 10*. Bolt this piece of iron near the upper corner of each of the

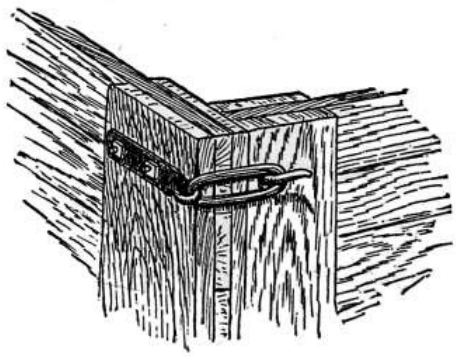


Fig. 12.

[122]

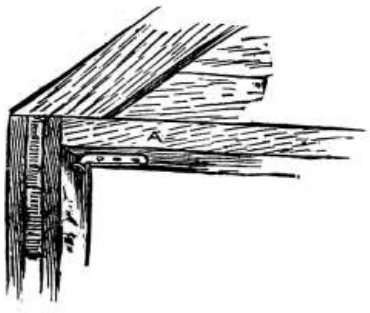


Fig. 13.

end walls—that is, above each of the *short* hooks, allowing the loop in which the link hangs, *and no more*, to project. Get at the same time three squarely bent hooks of round iron (*fig. 11*), with a thread and nut at the long end, and the bent-up point no longer than the inner diameter of the link, lengthways, so that it will freely pass through the link. Set these hooks in those unprovided upper corners of your remaining walls that come opposite your links when the walls are set up, at such a distance that when the link is bent around the corner it will snugly fit over the hooks. In order to do this, however (and you can see what I mean by a glance at *fig. 12*), you must set your hooks so loosely that you can turn their points backwards. The link is then slipped over, and the reversion of the hook to the position shown in *fig. 12* [123] binds the two walls cornering there as securely together as the interlocking hooks hold them at the bottom.

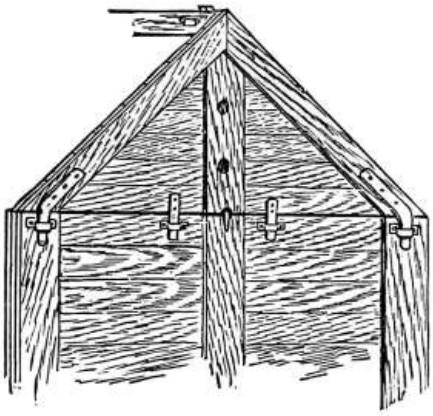


Fig. 14.

You will notice that I have no clamps or link at the front end near the door. There is no chance for any. Instead we trust for solidity to the outside brace, which is specially important, and to the horizontal brace which extends across from the top of the wall to the forward upright. (*See fig. 13*.)

The next thing is your canvas. Measure how much you need for your roof, and determine how far down your walls you want it to extend. If you are going to camp in very cold weather, you would do well to have it all the way to the ground. It would add greatly to the warmth. As a rule, though, you will only want it to come well over the top of the siding, with some lapping in front and rear to keep out driving rains. When it is sewed into a big sheet you must [124] attach to it at frequent intervals a short stout strap. Opposite these straps (*fig. 15*) nail to the outside of your walls straps containing big buckles (*fig. 14*) whereby you can buckle down taut your canvas roof. I know of no more secure and convenient method of holding the tent cover than this; but I would advise you to experiment on the reach and "full" of your cloth before nailing the buckles to the wood work.

Fig. 15.

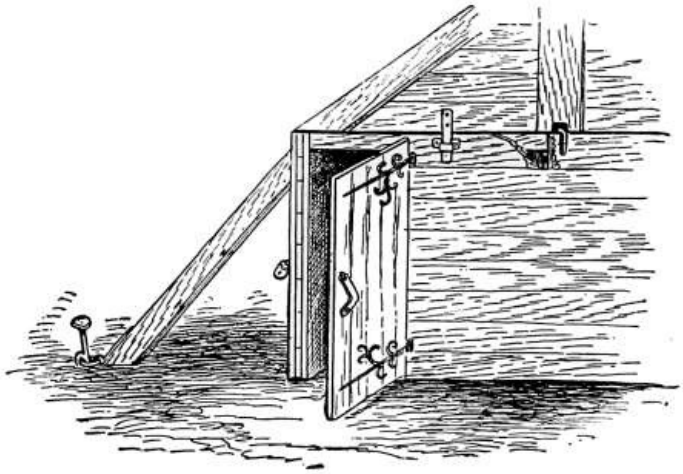


Fig. 16.

Now comes the setting of your tent-house up. The first consideration is the position. I can only say that it should be level, and where water will not drain into it in case of heavy rains. The next thing to be decided is, Will you have a floor? If so, lay it a few inches larger than your building, set your house on it, and nail down a narrow cleat all around inside close to the wall; an upright [125] bolt dropping into the floor in the centre of each side, will be well also.

First set up the centre poles and ridgepole, placing the latter on top of the former, and sliding the iron pins down through the eyes. (*Fig. 3*.) Then place in position the *rear* wall. The side walls will

come next, their clamps dropping easily at the corners into those of the end wall, and holding them firm while you slip the links over their hooks and twist them tight. Then set up the braces at the door end, and put up the front wall, turning down the tent pin on the ridgepole, to hold it firm, and locking the whole structure with the last link. Next, hook on the rafters, bolt the triangular gable walls to the upper part of the ridgepole, and set your braces at the sides. Nothing remains but to draw over your canvas, put your door upon its hinges, and hang up your hat. You are at home; a home you have put together at leisure hours in your barn or woodshed during the winter, have taken to the woods in a lumber-wagon, and set up with the help of a single companion; and when you are done with it you will carry it back to town and store it away in the woodshed or stable again. [126]

In respect to the cost, I can give no estimates so good as in a few moments you can compile for yourself. It all depends on the price of materials and the cost of blacksmithing in your own neighborhood. The weight and breadth of the canvas purchased is also to be estimated variously, according to your selection, and the expense will be increased according to the degree of finishing, painting, and decoration put upon the structure. If I should make one for myself in New York or New Jersey, I should not anticipate its costing me more than twenty-five dollars ready for setting up; but this includes no floor and no painting. The interior furnishing of cots, cupboards, tables, stoves, *et cetera*, I presume you will understand as well as I. Also that you can contrive to put in windows as you want them, and provide a means of carrying your stovepipe through a tin ring in the canvas roof so as to be safe from ignition. I only wish I might help enjoy all the fun you will have!

XVI.—HOW TO MAKE A FERNERY.

[127]

AUTUMN is the time to be getting ready for your fernery—all you who are off in the country (or who live there), or are just getting back from your summer vacation, with a big parcel of ferns and things which you collected at the White Mountains, or among the Green Mountains, or the Berkshire Hills, or at Mount Desert, or in some woods, or by some pond, or by the sea, or somewhere, no matter where—lovely things were around you wherever you went.

I know what you have been doing: for, have I not seen in my summer trips for these twenty years, how you young people do; how it seems as if you wanted to carry all the woods home with you; how, hot and tired, but happy, you have been seen coming back to the farmhouse or hotel where you boarded, with your arms full; how you put your treasures safely away in the coolest, shadiest [128] corner of the back piazza, and asked anxiously if they would keep till you could get them home? And when the morning of packing up came, what a stir to get them all into the smallest possible compass; for were not the older folks of the party all complaining because the boys had cut so many cones, and the æsthetic grown-up daughters had such bundles of cat-tails and sun-flowers, so that the "baggage" was already beyond all bounds of reason!

If it should happen that you have not secured what you would like to stock your fernery with, you can do it now: and if anybody should tell you that those frail-looking things will not stand the journey home, you can answer, on my authority, that they are mistaken. Just get the roots, and you are all right. I have not much doubt that there are ferns growing in a Western city to-day from some dry-looking roots which a lady from New England took out with her, and after being a week on her journey, distributed among her friends, so that the ferneries all about the city were beautiful with them by Christmas time.

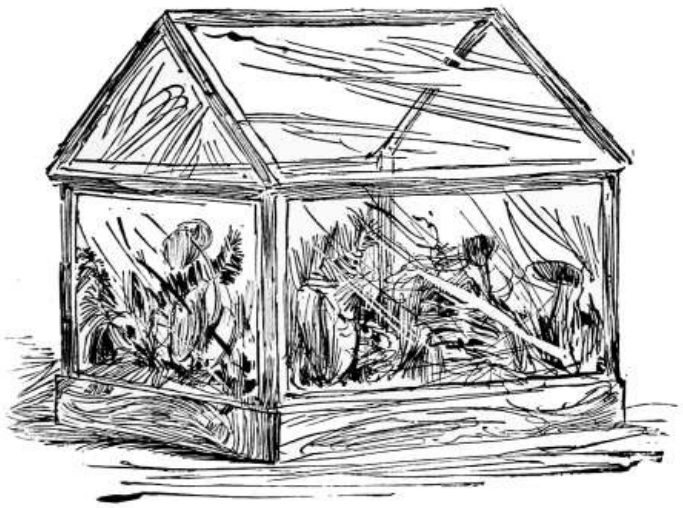
There is a good deal of vitality in roots: their hold on life is something wonderful. Plant them, and [129] you will hear from them, as Doctor Franklin did from a seed or two he found in a piece of broom corn, to which, I suppose, all the brooms in the United States may be traced.

Therefore, collect, and have patience. The way is to tear up a whole mass of the greenery from some moist knoll or hummock, moss and all. It will be sure to be full of things, gold-thread, bunch-berry, partridge-berry, mitre-wort and dew-berry; and every one of them will blossom in a fernery in winter. No knowing what will come up out of the moss. Get also from the woods the two-leaved Solomon's seal—you will know it by the bunch of finely speckled berries; the Indian cucumber root, the rattle-snake plantain, lady's slipper, wake robin, chick-weed, winter-green, princes' pine, pyrola. All these and many others will bloom there, and violets. I might make a long list of flowers, besides nearly all kinds of ferns, and mosses. But it is well to get any and every little delicate woods' plant that you like; roll them up in moss, which will keep them damp enough, and when you get home, fit up your fernery.

But first—in accordance with the principle laid down by the famous Mrs. Glass, in her cook-book, [130] who says about cooking a hare, "first, get your hare,"—you will first *get* your fernery.

Many persons would have one quickly enough but for thinking the expense too great. But it is not at all important that you have one of those nice black walnut cases with the costly oval or round glass. A home-made one is more convenient, and much cheaper.

This, which the artist has drawn from one in use, is, as you notice, proportioned like a house with a steep roof. The frame is of hard wood—a mere sash to hold the glass (for it is really a glass house), so are the bottom or floor, and the base, which is about four inches deep. A groove is cut in the sash, in which the glass is set firmly; no putty was used, though I should suggest it as being more secure. All the corners are dovetailed together and made sure by little brads.



A FERNERY.

The roof is separate, so as to be lifted off; and when on, is kept fast in place by means of two little corks the size of a pipe stem, which are fastened to the pieces of wood at the bottom of the roof, [131] and shut into holes made for them in the strips on which it is set, so that when closed not so much as a crack is to be seen. This is eighteen inches long and fourteen wide, and from base to top is twenty-four inches. The glass sides are about ten by sixteen; the ends ten by twelve; the sides of the roof are ten by sixteen, and the triangular pieces at the ends, ten by ten. One could be more elegantly proportioned if the roof was not so steep. These figures are given as a guide. This is very roomy, especially in height; but that is no disadvantage, because a tall fern can be set [132] in the middle and have space to spread off at will, or some little hooks can be screwed into the ridgepole (likening it to a house), and tiny hanging things suspended from them.

The glass is of the common window-pane kind, and was about eleven cents a pane; eight panes were required, and the man who had them for sale cut them to fit the sash. The wood was maple, and was hunted out of the odds and ends in the loft of the wood-house. Any thoroughly seasoned wood, even pine, is suitable, and the cost is not worth mentioning. The frame should be neatly finished and joined, should be strong and firm on account of the weight after the earth and plants are in; and before the glass is cut, should be stained, or oiled, or painted, outside and in. A pretty stain is made by stirring a tablespoonful of burnt umber into a cup of vinegar, more or less, according to whether you wish the color to be lighter or darker. Stir vigorously and put it on with a little swab: it will dry in the course of a few hours, and then can be varnished if you like. Five cents' worth of umber is enough to do your fernery, with plenty left for three or four brackets [133] besides.

All the work should be faithfully done, for you want no shrinking or gaping or warping afterwards. You must remember that it is to be subjected to dampness within and dryness without. Once done well, your fernery will last for years, and you can have something beautiful in it from January till January comes again, a perpetual delight to all who see it; and costing so little.

Now, an important part remains—the movable zinc tray, which must just fill the wooden bottom, and be of the same height, but not fit so closely that you cannot take it out when necessary. Ours cost fifty cents, but may be made for less; any tin-man will make it.

There you have the figures. You can proportion one as you like, but this is large enough unless you wish to set little flower pots in; but a larger one would be heavy to move about, and instead of a fernery one would need a Wardian case.

Now, for the fitting up. Last October we removed the roof and the tray and washed the glass, preparatory to having everything fresh and clean for the coming winter. The old contents were [134] emptied, and we began anew. The first thing was to place a layer of broken brick, and small pebbles and gravel, on the bottom of the tray for drainage, perhaps an inch and a half deep, over which we scattered bits of charcoal to keep all pure. We had previously collected a great store of things from the woods with which to stock it, taking up a whole mat of moss with all that therein grew, and everything with a little of the woods' mould on the roots; also we had a clump of pitcher plants from a cranberry meadow, and some rattle-snake plantain. Altogether for our fourteen by eighteen accommodations, I should judge that we had about a wheel-barrow load of material to select from; but we were in the country then.

It is always desirable to use the rich, mellow leaf mould that is found in the woods. You can easily take up your plants with enough of it clinging about them; and it is so loose and light it will not add materially to the bulk or weight. Not much is needed for the fernery; two or three inches of it only above the bed of drainage, mixed with a little sand. In the cities it can be obtained from [135] greenhouses. Many of the plants would flourish if only moss was put in.

In ours we placed a good layer of such soil; and the first plant we set out was a tall, beautiful fern which reached nearly to the roof, for we wanted it to look pretty all at once without waiting for things to grow. Then a pitcher-plant, purple polygala, creeping snow-berry, lots of partridge-berry, with the scarlet berries on, and nearly all of the wild things I have named. Then we went into the garden and dug up lilies-of-the-valley that we were sure were going to bloom, which is indicated by the bluntness and plumpness of the crown just above ground (the leaves were gone), also roots of pansy and fragrant single violet. These we put into the corners where they would have the most light. We packed the tray full, too full, perhaps, not forgetting roots of maiden-hair fern. We had not much faith in trailing arbutus, though we set out a root or two; our hopes for that sweet flower we based on the clusters of buds we gathered from the woods, and these we put in a small tumbler of water and set among the greenery.

Then we gave our little garden under glass a thorough sprinkling, put the roof on, and set it in [136] the light. Occasionally we raised it and admitted the air for a short time, but it does not answer to do this often. It must be kept covered, watered perhaps once a month, kept in the light and warmth.

The result to us was beyond our highest anticipations. Though the pansies did nothing but grow tall and rank, there was always a violet to give a friend—a delectable violet which made the room fragrant when it was taken out; there were "many flowers" week after week; mitre-wort bloomed, princes' pine, gold-thread, and other little things; and while snow yet lay on the ground, the lilies-of-the-valley blossomed. Greatest success of all, and to our utter amazement, the pitcher-plant flowered, maiden-hair thrived, the great fern spread off till its tips touched the glass, the rattle-snake plantain sent up a spire of bloom, and everything was beautiful.

I have told you now the method, the expense, and how simple a thing it is to fit up a fernery. Another winter we shall put in tulip bulbs and some other garden plants there may be room for.

Things will bear packing quite closely if you are careful to keep those that like the shade in the background, and let the others have the best chance for the light. Occasionally the fernery needs turning so the sun can reach all; otherwise it requires but little care. [137]

XVII.—A BOY'S RAILWAY AND TRAIN. [138]

IN a certain old-fashioned house that I visit, a large attic is set apart as a playroom for the boys, in which to keep their tools, their jig-saw, and their treasures of all sorts, dear to the hearts of young people.

All around the edge of this room runs a small railway with curves and switches complete, with bridges and tunnels, and an elegant station, made of a deserted dog house, and painted in the newest style.

Over this track, propelled by boy-power, runs many times a day, a train of cigar-box cars, engine and tender, baggage and passenger cars, all in order. And everything about it, from the ties to the latest parlor car, was made by two boys under fourteen years of age, at a very small cost.

FIG. 1.

[139] These boys are no wiser or more skilful than other boys, and there is nothing about it hard to make. I thought many of you young readers of mine would like to copy it, and so I have studied the thing, taken my instructions from the builder himself, and here it is, so plainly told that no ordinary boy of twelve need make a mistake if he follows directions exactly, although to make it perfectly clear, I have to use a good many words which make it *look* hard. To begin with the track: first, come

THE TIES.

To make ties for a single track, take a board one inch thick. Saw from the end a piece five inches long, and split it with a chisel into ties an inch square. The number you will need depends, of course, upon the length of your road. Having these ready, the next thing is the

RAILS.

[140] Buy at a tinner's sheets of tin which come fourteen by twenty inches in size, though any other size may be used. If convenient, have the tinner cut each sheet into eleven strips twenty feet long and about one and a quarter wide. You can, however, cut them yourself, with a pair of old shears, first measuring carefully, and ruling the sheet off.

Along one side of each strip of tin, near the edge, punch nail holes; one close to each end, and four between, making thus six holes about four inches apart.

To bend the rail to shape, take a ruler and scratch a line the whole length one quarter of an inch from the edge which has no holes. Lay this edge on a straight board, with the mark exactly on the edge of the board, so that the quarter of an inch sticks out beyond the board. Then tack the tin with two or three tacks, to keep it from slipping, while you take a hammer and pound the tin down over the edge till it is bent at a right angle to the rest. Then take out your tacks, and laying the tin on the board, pound this turned-up edge over till nearly flat. This makes the top of your rail, as you see in *fig. 1* (which shows the end of a rail) at *a*.

[141] To make the bend *c* (*fig. 1*) draw a line the whole length half an inch from the edge where the holes are. Again tack the tin to the board, with the half-inch sticking out beyond, and pound this edge over into a right angle. This completes your rail, the holes being along the edge marked *b* in the figure.

TO LAY THE TRACK.

Place a number of ties side by side, and with a ruler and pencil draw two lines across them, three and a half inches apart, having about three quarters of an inch beyond the lines at each end. These marks are to guide you in laying the track straight. When you have thus prepared a number of ties and rails, fasten them together by nailing, with small-sized carpet tacks, through each punched hole, on to a tie, being careful that the *end* of each rail reaches no more than half over its tie, so that the next rail may join on right (*fig. 2*). The tacked edges of the two rails turn towards each other on the inside of the track, and thus do not show when a train is on, and the angle *c* rests exactly on the line drawn on the tie. Go on in this way till your rails are all used, or [142] you come to a curve.

TO MAKE A CURVE.

Take a cold chisel, or an old common chisel, and one of your finished rails. On the flat side (from *b* to *c*, in *fig. 1*) cut slits reaching from *b* to *c*, and half an inch apart. Lay a row of ties in the curve you wish to make, and bend the rail to fit them. The slits will enable you to bend them nicely, on one side by gaping apart, and on the other by slipping over.

If you want a guard rail to keep your train from running off at this point, lay an extra rail fastened in the same way inside of each rail on the curve.

TO MAKE A SWITCH.

Select a point where two rails join, for a switch, and take one length of rail for the purpose. This length, which includes both rails, of course, is to be movable, and so must slide over the common ties, and not be fastened to them. To keep them in place they must be tacked to special ties, [143] much thinner, and coming between the regular ties that they slide over. Having prepared this length, put a tack, smaller than the hole you have punched, through the end hole at *a* (*fig. 4*), so that the switch will move easily on it.

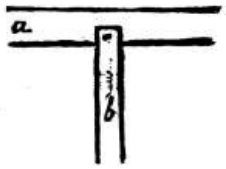


FIG. 2.

At *b.* (*fig. 3.*), where your two tracks come together, you must put pegs (*b. b.*) to keep the switch from moving too far either way, and throwing your train off. Also, from this point, the ties must be long enough to hold the side track till it is clear of the regular track (*fig. 3*). The curve of this side track is made, of course, by the directions for making a curve. The last special tie at *c* (*fig. 3*) must run out far enough to take a hold of, to move the switch.

TO MAKE A FROG.

At the point where the rails cross (*d*, *fig. 3.*) you will need a frog, to allow your train to go smoothly over. To make this, you cut your side rails square off at *d*, and begin it again on the [144] inside of the rail, leaving a space of a quarter of an inch open to let the flange of your car wheels pass through.

Also, you must cut a notch in your regular track at the same point, so that the wheels on trains switching off may go through (*fig. 4*).

Now your track is ready, you may begin on the train; and first the trucks.

TO MAKE THE TRUCKS.

For wheels you need a lot of rather large spools with quite thick shanks, unless you can afford to have brass or wooden ones turned for you. The best spools come in the shops of New York, with French sewing cotton, and next best are those which hold the knitting silk, so much used nowadays by ladies. [145]

Ask your mother and sisters, and all your fancy-work loving friends, to save their spools for you, and it will not be long before you have enough.

Saw each spool into three pieces, as at *a, a* (*fig. 5*). The outsides form the wheels with their flanges *c, c,* and the middle piece *b*, you will need later.

Now for axles, the best are cheap lead pencils (cost one cent each), but you can use common skewers such as butchers use, whittled down to fit. The axles are to fit tightly into the wheels, and turn with them.

Now take a block an inch thick, four inches long, and two and a half wide, to hold the wheels. In each corner of the underside of the block, three quarters of an inch from the end, screw a very light wire screw ring (or screw eye) with a ring a half-inch in diameter.

The axles run through these rings with the flanges of the wheels next to the block, to run inside the track. [146]

Next comes the car itself.

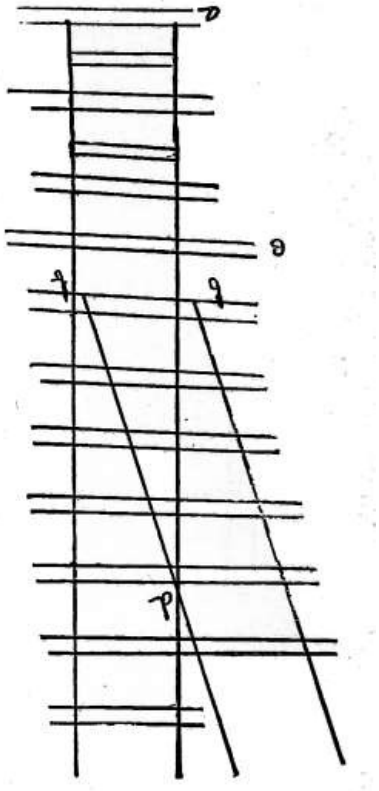


FIG. 3.

TO MAKE THE CARS.

Cigar boxes are nice for cars, being already very neatly made. You can get at the cigar stores, at small cost, if not as a gift, any number of boxes with square ends, that is, with the ends of the box as high as they are wide. After you have washed off the paper, get two boards, one a quarter or three eighths of an inch thick, and the other somewhat thinner, both being the width of the box. Saw off pieces three inches longer than the boxes, for platform and roof.

First fasten your trucks under the thicker board, which is the bottom. To do this, bore a gimlet hole exactly through the middle of each truck block; put a six-penny nail from the bottom, first through the hole in the truck block, then through the cast-off part of a spool (*b*, *fig. 5*), or half of it if too thick, or a small twist spool a half-inch high. Nail one to each end of the board loosely, so [147] it will turn.

Now, carefully take apart your cigar box, and mark on each long side a row of windows, like a passenger car, and in each end piece mark a door. Saw them out on a jig saw. (If you have no saw you can paint windows on the outside.)

After cutting the windows and doors, put the box together again, with the brads which held it before, and laying it on to the platform board, so that each end of the board projects for a platform, nail them together. Then open the cover (which must never be broken off) and nail the roof board on to it in the same way; that is, so it will project at each end. Use brads for this nailing. The object of fastening the roof to the cover is that you may open your car and fill it with passengers if you choose.

TO MAKE THE COUPLINGS.

Take pieces of stiff copper wire three inches long, and with pliers bend over one end of each to form a hook, and the other ends into a small ring. Turning your car upside down, lay one of these wires in the middle of the end, with only the hook sticking out, and fasten it by a small screw through the ring (*fig. 6*); do the same at the other end, and then with some small brass curtain rings, which cost two or three cents a dozen, you can couple your cars nicely. [148]

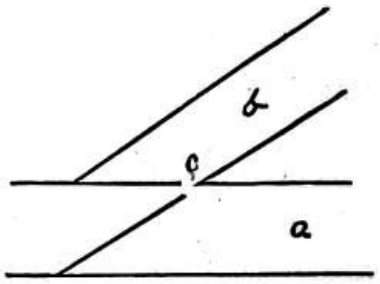


FIG. 4.

Baggage and freight cars you can make in the same way, only cutting one large door in the side. You can make the cars as showy as you please, with paint of different colors, and finish them with a piece of muslin glued part way over the windows inside for shades. And now last comes the engine.

TO MAKE THE ENGINE.

For the foundation take a board one foot long, and three inches wide, which I will call the platform. To make the boiler, have a cylinder turned of wood, two and a half inches in diameter, and eight inches long; or take a square piece of that size and shave it down yourself to a cylinder; or—what is less trouble, and costs little—have a tinner make one for you, open at both ends, of course. [149]

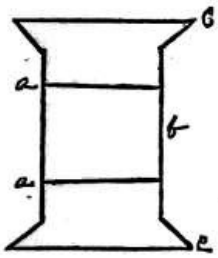


FIG. 5.

The one I will describe, since it is the most simple to make, is the wooden one. Nail it to the platform board in such a way that the board will project in front one inch. You will have to nail it from the bottom of the board.

Now take a three-quarter-inch auger and bore a hole one inch deep, in the top of the boiler, one half inch from the front end. This is to receive the smoke stack. To make the smoke stack, get a piece of dowelling three quarters of an inch thick, and four inches long, or use a bit of broom handle of that length. Shave the end down till it fits nicely into the hole on top of the boiler. Have it reach to the bottom of the hole, so as to be firm, and leave three inches standing up.

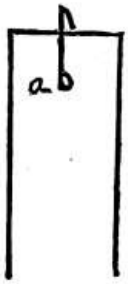


FIG. 6.

To finish the smoke stack, and make it look like the newest fashion in American engines, you must nail on to the top, with brads, a round piece of wood, a quarter of an inch thick, and a quarter of an inch larger all around than the broomstick itself. Behind the boiler [150]

MAKE THE CAB.

This is a peculiar thing, and the boy builder of the cigar-box train insists that it must be done exactly as he directs, in order to make a really *proper* cab. To proceed, then:

For the front piece take a board a half-inch thick, three and three quarters inches high, and two and a half wide. Cut with a jig saw, near the top, two windows, one on each side, to overlook the engine. Nail this to the back end of the boiler, and to the floor. Make the two side pieces of the cab of cigar-box wood three inches wide and four inches high. In these cut two windows, also near the top. Before you nail these side pieces on, make a third piece out of half-inch wood, two and a quarter inches long, by two and a half wide, and nail it with brads to the front piece of the cab, one inch from the floor, like a shelf. This is the real floor, and without it your cab will be a mere toy, and not at all the correct thing. Having this shelf in place, nail on your side pieces, both to the front piece, and to the shelf. [151]

The roof requires a piece of thin board, two and a half inches wide, and four inches long, so that it will project one inch beyond the sides. Remember it must be put *between* the side pieces, and on *top* of the front piece, and nailed with brads.

TO MAKE THE DRIVING WHEELS.

The engine wheels are four in number, made by sawing from half-inch board four circles four inches in diameter, and from cigar-box wood an equal number four and a half inches in diameter. Each wheel is double, you see, to form the flange which keeps it on the track. Nail with little brads, each larger circle on to a smaller one, so that the former will project equally all around. Then bore a hole exactly in the middle of each, and your wheels are ready. With lath nails fasten one pair of wheels to the platform board at the side of the cab (flanges inside, of course), and the other pair to the same board in front, and so far that the rims of the two wheels on one side will be about two inches apart. [152]

TO MAKE THE COW-CATCHER.

For this very important addition to the engine take a piece of wood three inches wide and two inches thick. Saw it on *both* sides to a point (*fig. 7*). First shave it down on top so that it forms a sharp point at *b*, *fig. 7*. Then draw a line through the middle of the top (*a* to *b*, *fig. 7*), and shave down each side so that it shall present a sharp edge all around from *c* to *b*, and from *b* to *d* (*fig. 7*). Nail this to the front end of the platform board with inch-long brads.

TO MAKE THE TENDER.

This is very easily made of a cigar box, one of the low sort, the same width as your cars, but only half the height. Remove the cover and take out one end board. Put the box on a board a half-inch longer than itself, and finish with trucks as you did your cars. [153]

At the back end of this tender—the closed end—fasten couplings like these on the cars, but to the engine it may be fastened by a common wire hook and eye. The hook being on the engine.

This completes your train, and if you wish to make a double track, you need only make your ties long enough to allow trains to pass, and then lay your tracks side by side.

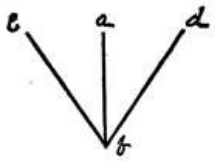


FIG. 7.

With a little ingenuity, you can make bridges and tunnels, freight trains, and gravel trains, and can, in fact, increase your “rolling stock” to any extent.

I hope you will enjoy building this railway and train half as much as did the boys in the attic in New York City. With them the building and improving, the running of trains and the adding of new facilities, make a never-ending entertainment.

XVIII.—HOW TO MAKE A GOOD FLY.

[154]

FLY-FISHING is poetry; ordinary angling is prose. The latter looks to the catch; the former to skill shown in the capture. There is more sport in hooking and playing one single bass with a light pliant fly-rod, than in dragging in a dozen by mere muscular force. To cast a fly lightly to a chosen spot, to note instantly the swell indicative of a "rise," to strike at once, but deliberately, to keep your rod bent, your line taut, and your fish in the water long enough to exhaust him, all require judgment, skill and self-control.

But after you have put up your rod for the season, you may still extract pleasure from mending your tackle, putting reel and rod in order, and last, but not least, in making a supply of artificial flies for future fishing.

[155]

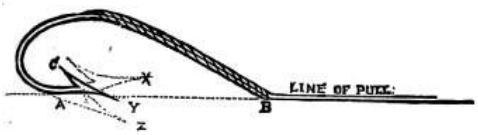


FIG. 1.

The articles necessary for making flies are hooks, silk, white wax, silkworm-gut, tinsel-feather fibres—dubbing for the bodies of fur, wool, silk or feathers—hackles for legs, and larger feathers for wings.

First, get a good hook. The good hook is as sharp as a needle, and the barbed end points nearly exactly in a line with the end of the shank; not inside of the "line of pull," *a*, *b* (see fig. 1), lest the point come not in contact with the fish; nor too far out, lest the barb be pulled flatwise against the fish's mouth, and thus not pierce it readily; nor exactly *in* the line of pull, for, though in that case it would pierce anything between the point and end of shank, it might slip out without touching the unclosed jaws before the jaw had passed the line of pull. A point like *x* would be bad, so would one like *z*; but one like *y* would be about right. Now take the hook between the forefinger and thumb of your left hand, the shank pointing to your right, as in fig. 2. Say the end of a strong piece of silk, well waxed, on the hook near the bend, and, holding it firmly with your forefinger and thumb, wrap it tightly around the hook nearly to the end of the shank, as in fig. 3. Now coil a piece of silkworm-tug that has been soaked ten or fifteen minutes, and lay it on the hook with the coil to your right, and wrap it with your silk carefully and firmly down to the bend of the hook, cutting off the silkworm-gut a little before you get to the bend, so as to cover it well with the wrap, like fig. 4, at first; it looks like fig. 5 after wrapping. Now take two of the fibres of a peacock's feather, technically known as peacock's herl, and a piece of silver or gilt tinsel; lay the tinsel on near the bend, and then, after two wraps of the silk, lay on the two pieces of peacock's herl, which must be fastened by two or three wraps, as in fig. 6. Now fasten in with a turn or two of the silk the dubbing for the body of the fly. Supposing it to be peacock's herl, three or four pieces will do, as in fig. 7. Then take a hackle-feather, shaped like fig. 8, from the neck or rump of a gamecock or brown leghorn, and fasten in the point with three wraps of your silk, as in fig. 9.

[156]

FIG. 2.

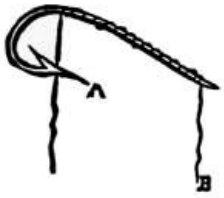


FIG. 3.

[157]

FIG. 4.

You have now a hook, *a*, wrapped with well-waxed silk, *b*, with a piece of silkworm-gut, *c*, a piece of tinsel, *d*, two tail-pieces, *e, e*, dubbing for body, *f, f, f* and hackle for legs, *g*.

Now for the wings. Strip off or cut from a hawk's feather, like fig. 10, a clipping or two, like fig. 11, and fold it into a convenient width, and clip the ends square, like fig. 12. Lay them on the shank of the hook, butts to the left, points to the right, and fasten with three or four firm wraps, as in fig. 13. Now draw the silk under the wing, between them and the hook, to hold them temporarily, and going back to the bend of the hook, wind the dubbing, *f, f, f* around the hook over and to your right as far as the root of the wings, leaving the hackle out; fasten the dubbing with one or two wraps, taking the silk from under the wing to do the wrapping. Next wind your tinsel *d* up to the same point and fasten in same way. Now wind your hackle towards the right, twisting the quill as you wind to keep the fibres sticking outwards, and picking out any fibres that get entangled with a dubbing-needle (a needle stuck in a piece of soft pine, like fig.

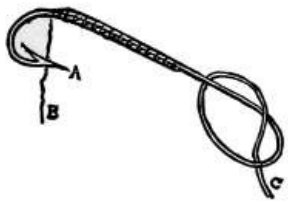


FIG. 5.

[158]

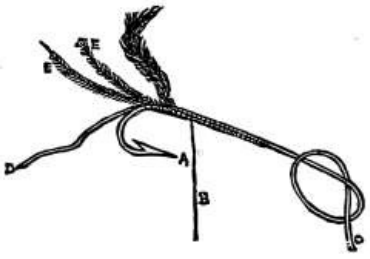


FIG. 7.

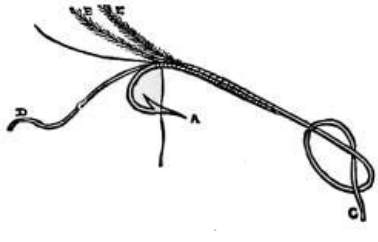


FIG. 6.

14) and fasten. Now turn back the wings with the points to your left, towards the bend of the hook; fasten back with one or two wraps, passing the silk through an opening between the wings made by the dubbing-needle, to separate them. Finish by making two loose wraps, like fig. 15; then draw the silk through them tightly, like fig. 16. Touch this fastening with a drop of gum-shellac, and it will not slip or be affected by water. Gum-shellac dissolved in alcohol can be gotten at any drugstore, and should be rather thick. Your fly will now look like fig. 17.

FIG. 8.

[159]

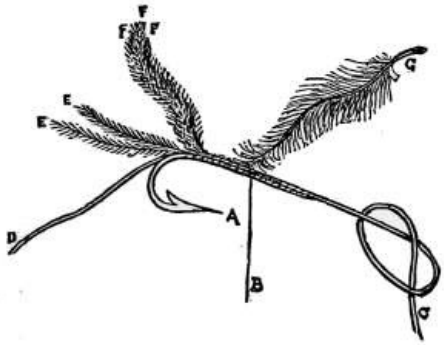


FIG. 9.

FIG. 10.

Your flies should be *rough* imitations of any water-flies you see in your tramps, in *color* and *number* of *parts*; outrageously colored flies will be taken by black bass, who seem to bite at anything that has the nearest apologies for body, wings and legs. All game-fish bite readily at a simple hackle wound from bend to shank around any attractively colored body in the form of a caterpillar; a good one for black bass is made with one reddish-brown hackle and two black ones; and a body of peacock's herl wrapped with green or red silk is a good imitation of a caterpillar common here (in Virginia) in November.

[160]

FIG. 11.

Anglers also make something having no counterpart in nature —a winged hackle—by tying the hackle in a winged fly back from the bend to the end of shank—a sort of winged caterpillar. Some fish, no doubt, are affected by it as by a caterpillar; others as by a fly; others just strike out of curiosity, as a kitten plays with a ball. Should you buy your tackle, buy from tackle-makers who angle occasionally themselves. They know more "wrinkles" in their "line" in a day than ordinary makers learn in a year. Some of the best houses in Boston, New York and Baltimore derive their most valuable specialties from the presence of one or more actual anglers in the firms.

FIG. 12.

[161]

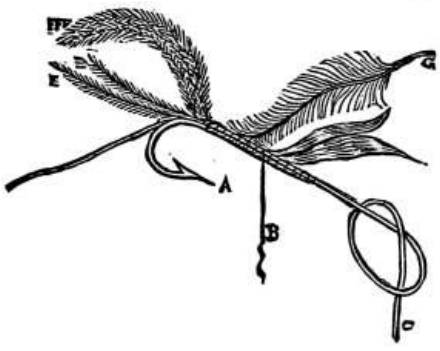


FIG. 13.

FIG. 14.

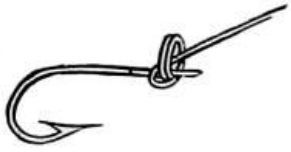


FIG. 15.

Water-flies have generally, like the Mayfly, fig. 18, a body, wings, legs, and tail-like appendages, technically, so you will not be far wrong if you make your fly have those parts, though fish bite at flies with less than these enumerated. For black bass, greens, yellows and reds seem the best colors, though white and black are often used. I like, however, flies that are combinations of bright and sober tints. A favorite fly with me has a body of peacock's herl brown; wings, yellowish-white feather of chicken-hawk with discolorations on them; legs, a reddish-brown hackle from a gamecock or brown leghorn cock; tail-pieces, two fibres, like wings. I put a red

[162]

streak in each wing. I call it the “academy,” after a school once under my care.

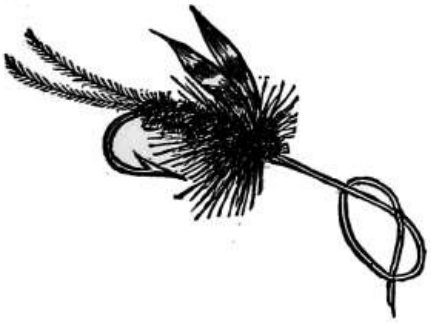


FIG. 17.

FIG. 16.

FIG 18.

XIX.—HOW TO BIND MAGAZINES.

[163]

IT is often the case that in households where even several magazines are taken, that little money can be afforded for the purpose of binding them; and it follows that they are soon destroyed, or else stored away and never looked at. The pretty covers provided for most magazines by the publishers are of course preferable; but they also, of course, cost something. Therefore I have concluded to tell you of a durable, cheaper, and on the whole, pretty way of binding your yearly, or half-yearly volumes.

For several years we have made it a business to bind up our magazines every spring before cleaning house time; and we proudly exhibit to our friends our collections of neat, strong books which would look well in any library. We usually turn a corner of the living-room into a bindery, as we have no workshop.

We bring in the work-bench with vise attached, pile our magazines on it, sort them into volumes, [164] remove the covers and advertising leaves, put the engravings in their proper places if they are not there, place each volume according to date or page, lay the title page and table of contents at the top of each pile, and there are our magazines ready to bind. We have meantime a little pot of good glue in readiness on the stove, which, after it is dissolved thoroughly, is better to be kept only warm. A little good twine, a few strips of strong cloth, about an inch wide, a handsaw, a pair of shears, and some of the old covers and leaves are also at hand on the bench. Also we have two bars of wood an inch thick, two or three inches wide, and about two feet long, fastened together at one or both ends (one end only is necessary if a vise is used) by a bolt five or six inches long—this is the press.

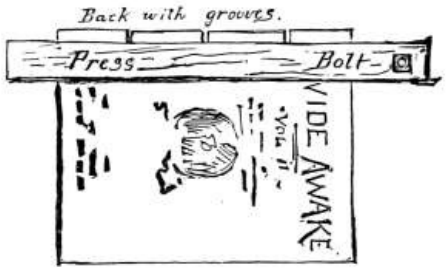


FIG. 1.

Now we take a volume of the magazines, lay an old cover on each side. Making sure that the numbers are perfectly [165] even at the back and upper ends, we place them in the press with the backs projecting a quarter of an inch at least, placing them in the vise with the backs in a horizontal position (*see fig. 1*) and screw up pretty tightly. Then we saw into the backs as far as they project in three places (*fig. 1*). Next we dip a piece of cord into the glue, and wind it back and forth once or twice in the grooves made by the saw. This, as you will see, binds the volume firmly together.

Now we take as many strips of cloth as there are grooves, each about six inches long, and gluing them in the middle, place one in each groove (*see fig. 2*). Then we cut a strip of strong paper, and glue it on the back of the volume.

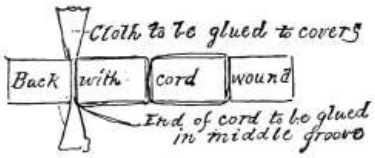


FIG. 2.

The book may be taken immediately from the press, though it is better to not handle it for a little while, and another set of numbers be put in. Several volumes may be bound in a short time, and if these directions are followed the binding is altogether as durable as that done at a bindery would be. [166]

The next thing in order is to smooth the edges; this we do by placing each book in the vise again —the tighter the better now—front edges up at first, and projecting far enough to allow them to be made even. Now we rasp them off even with the press, with a coarse furniture rasp, or the side of a saw. Sometimes we leave it thus, and sometimes we spatter-work it by dipping an old toothbrush in ink and drawing it across a sharp edge of wood, allowing the spatters to fall on the book before it is taken from the vise. The ends we treated in the same manner.

Now we have a pile of books, without covers, to be sure, but even at this stage they are more available than if they are not bound at all. However, we provide covers without expense. We use old paste-board boxes for this purpose, cutting them a little larger than the volume they are intended for. We lay these covers in place, cover and fasten them by gluing the edges of the strips of cloth upon the *outside* smoothly; the cover goes as far back as the cloth will permit. Then we make a cover of cloth for the back, usually using black or brown cambric, or selesia. The [167] back cloth is always at best an inch longer than the covers, and about three inches wider than the back; we cut coarse twine into bits a trifle longer than the book is thick, using as many as we may choose.

We dip these twines in paste, one at a time, and lay them crosswise of the cloth, one at each end, at least, and just as far apart as the covers are long (*fig. 3.*), laying the others between. Then we cut a strip of strong paper as wide as the cords are long, and just as long as the covers, and paste it over the cords, and then we paste the cloth down on the paper at the ends, and pin the completed back tightly around a stick—a broom handle is good—and let it remain there to dry. When we take it off we slip it over the back corners of the covers and fasten it strongly down with glue.

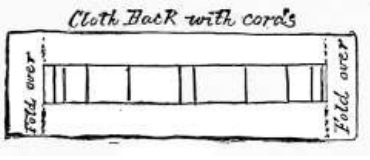


FIG. 3.

After this the covers may be finished as elaborately as you may choose; we bind the edges of most of ours with cloth, and then trim off the edges of some of the front covers of the magazines and paste them on. We make a pretty inside finish by laying in a double leaf of manilla paper, one half pasted to the inside of the cover the other being left as fly-leaf. [168]

The freshly bound books should be piled with plenty of paper between them to absorb the moisture, with weights atop, until they are wholly dry. Shabby books may be made almost as good as new by smoothing the leaves, rebinding and recovering; and it is surprising to see how pretty bits of wrapping paper, and bits of brown, black, or gray cloth can be made to serve in this work; bits of leather may be used on the corners of covers. Sabbath-school papers, Lesson Quarterlies, etc., may thus be made into pretty volumes very easily. Five cents' worth of glue will bind a great many volumes, and the gluing is a much easier and better way than sewing.

XX.—HOW TO PHOTOGRAPH. [169]

NEARLY ten years ago I took lessons in landscape photography, and since then have made hundreds of photographs of places rarely visited, of strange people and wonderful vegetation, which have delighted the eyes of many friends. Assuming that many members of the Reading Union will wish to retain more permanent pictures of vacation scenes this summer than can be carried in memory alone, I propose to show how they can do this with little trouble and expense.

First, I must congratulate you upon your good fortune in being able to enter upon the study of photography in the year 1882, rather than twenty, or even ten, years earlier. In no other department of science, except perhaps in electricity, has such an advance been made. It was only in 1839 that Daguerre published his success in obtaining an image on a silver plate, and in 1851 [170] that the collodion process—that most in use at the present day—was given to the world. But within the past few years improvements have been made, by means of which the art is not confined to professional workmen, but can be enjoyed by all the young folks in the land.

I well remember the disadvantages attending outdoor photography, even no longer ago than when I made my first attempts. By the collodion or wet process it was absolutely necessary to carry a large trunk full of chemicals and bulky apparatus. Among other things there was the "dark tent;" in its most compact form it was a box, about two feet and a half square, with curtains and aprons arranged so as to exclude all *actinic* or chemical light. After setting your camera in position and focusing the picture, you had to retire into the dark tent, arrange the curtains about you to exclude all outside light, and consequently air, and then you coated the glass plate with collodion and dipped it into the "silver bath" to make it sensitive to light. This operation required several minutes, and if the day was hot and sultry, the operator in the dark box was nearly [171] suffocated before he emerged with the prepared plate ready for the camera. After exposing this he was obliged to hide himself again in that hot box full of chemical fumes, and there "develop" the picture supposed to be upon the glass.

With the discovery that plates could be prepared ready for use at any time, and that would remain sensitive to the action of light for months, a new field was opened, in which any one could wander who had the inclination. By this discovery all the bottles of chemicals, with the dark tent and the clumsy apparatus, were done away with. Materials for a hundred photographs can now be carried in a small valise or in an ordinary trunk amongst clothes and books.

Though an amateur, and having no greater interest in photography than arose from a desire to secure pictures of the spots I visited, I hailed the appearance of the "dry plates" and their simpler mode of use, for I was heartily tired of the old way. My fingers were always black with silver stains, and my clothes streaked and stained with salts of iron and soda. My accidents, from the tipping over of chemicals, and in struggling over mountain roads and the beds of mountain [172] torrents, were more than I could count on my fingers. In Florida, whenever I crawled into the dark tent—pitched, perhaps, on the border of a swamp or in the deep woods—the mosquitoes and sand-flies would make furious attacks upon my legs and nearly drive me wild, and I would be haunted by fear of the snakes and alligators that might attack me in that defenseless position—with my head in a sack and my hands employed. One day an enormous old billy-goat, taking offence at the outlandish appearance of my tent, as I was at work in it, half concealed from his view, charged on it with such force as to knock us all in a heap. When I had crawled out from the ruins, expecting to learn that an earthquake had passed by, I saw that billy-goat standing calmly by, chewing his cud, and shaking his head sidewise, as much as to say, "Get into that box again, and I'll knock you over a second time!" In the West Indies it was always necessary to hire two negroes to carry my trunk, and as they invariably bore their burdens on their heads, the silver solution would sometimes leave a black streak down their faces, even darker than their ebony [173] countenances!

The new discovery did away with all this trouble. I was quick to see this, and in one of my trips to the tropics carried a camera and a stock of "dry plates." Alas! I had too hastily adopted a crude invention. I climbed mountains, descended into craters of volcanoes, threaded tangled thickets, and penetrated to secluded valleys to photograph new scenes with my new instrument. Having perfect faith in the new invention, I did not test my plates with chemicals on the spot, but kept them till I returned, and then gave them to the photographer to manipulate. My carelessness was well rewarded, for of the nearly one hundred plates, *not one* contained a perfect picture. I was in a condition then to sympathize with the great Audubon, who had a trunk full of drawings, the result of a year's labor, destroyed by mice.

Unlike him, I had not a sufficiently powerful incentive to repeat my travels, and the anticipated pictures were gone forever. Nothing daunted, I next year procured another machine and tried again, this time in Mexico. In that year the inventor had not been idle, and I informed myself upon the merits of his invention so that my results at the end of the journey were such as greatly [174] pleased me and my friends; for from the plates of glass exposed to light in the camera flashed out fac-similes of strange idols of stone, grand old ruins, snow-capped volcanoes, valleys almost hid in dense vegetation, palms, tropical plants, and the picturesque features of that strange country.

But, without further preface, let me tell you how you may take pictures this summer without any of the hindrances that I had to encounter in my first attempts.

The first thing needed is a camera, which in its simplest form is a darkened box, with a lens in

front, through which the scene is focused upon a plate in its back—a plate of glass prepared with chemicals so that its surface is sensitive to the light admitted through the lens.

A few seconds of time is generally sufficient for the transmission of an impression to this plate, and before and after that “exposure” it must be kept away from all light until the “latent image”—the picture we cannot yet see—has been brought out and “fixed” by means of chemicals. This forms the “negative,” which is to the finished photograph what an engraved block is to the [175] engraving on paper. To obtain this negative is your first object; having got this, you may produce from it as many prints as you like, at very little cost, either by taking it to a photographer, or by continuing the process and printing them yourself.

While there are several instruments in the market with which the negative can be taken, most of them are so costly as to be beyond the reach of a boy or a girl with a limited supply of pocket money for a vacation trip; hence I shall choose one that is not only very cheap, but which I know by experiment will perform the work for which it is intended. It is the invention of a young man who has a practical knowledge of photography, and is called the “tourograph.”

At first sight it is a small mahogany box, eight by ten inches broad, with a strap by which one can carry it. But by pulling out a slide in front a lens is revealed; and by drawing out another slide on the top an inner box is shown full of negative plates. This smaller box is fitted in position on top of the larger one, so that the plates, one at a time, can be dropped into a carrying-rack turned by [176] a screw, in the dark chamber below. This plate having been placed in focus, the lens is uncapped for a few seconds, then recapped, and the glass is returned to the box above, where it is kept till evening, or until a favorable time for development. In this way all the plates—eight or ten—in the box may be exposed, and their places filled with fresh ones later on.

The camera is supported upon a tripod, or three-legged stick, which can be closed up until not much larger than an alpenstock.

This is the outline of the mechanical operation necessary to secure the negative. The plates, being ready prepared and packed in little boxes of a dozen each, are transferred to the camera at night, or in a dark room by day, by the aid of a *red* light. This is obtained by placing a roll of red or orange-colored paper—made expressly for this purpose—around a lamp or candle, as the light that shines through a medium of this color is *non-actinic*, or without the power to produce chemical change in the very sensitive plates. You now have a plate with a latent image of the [177] picture you desire to retain; this plate must pass through a chemical operation before that image will appear.

Imagine yourself in a darkened room illuminated only by the *red* light, with a plate in your hand on which you fondly hope there is a duplicate of the scene before which you had set up the instrument. To all appearances it is a plate of plain glass, one side covered with a film of gelatine, and if you hold it to the light nothing appears to indicate the change that has taken place in that film since it was exposed to the light. The question is, how to bring that picture out from its hiding-place. First, you must have a shallow pan at hand, and place yourself near a good supply of water. Into the pan you pour the chemicals previously mixed, necessary for the *development* or bringing out of the hidden image. These chemicals are, oxalate of potash and protosulphate of iron. To simplify matters, the inventor of the tourograph puts up these chemicals in papers, so that you only have to put into four ounces, or a gill, of water[D] one paper of the potash and [178] another of iron; mix well, and the solution is ready for the plate. This must be placed in the tray with the film side up, and the solution flowed over it. When completely covered, let it remain, and carefully watch the development.

This is the period of greatest anxiety for the young operator, for it is the critical stage of the proceedings. A few seconds will determine whether you have a picture before you, or merely a square of plain glass. Gradually the details unfold themselves: the “high lights” or white portions first, then the “half tones” or grades of shadow, then the deeper shades of foliage or objects feebly lighted. When the view has come out distinct, seems to progress no farther and to gradually fade away to a deep brown, you have got out all it is possible to obtain from that exposure, and the plate must be removed from the solution, and chemical action arrested by washing in clear water.

Now you have before you tangible evidence of success, but your picture is not complete; it is dull, perhaps obscure, and if exposed to the light of day would quickly vanish. It must now *fixed* in another solution and in another dish. The “fixing solution” is made by dissolving half an ounce of [179] hyposulphite of soda in five or six ounces of water. Into this place the developed plate, and allow it to remain until all the whitish film is dissolved away. If both operations are faithfully performed you will have, on taking the plate from the solution and holding it to the light, a brilliant picture on glass—the *negative*—with all the lights and shadows reversed, the white portions quite opaque, and the dark parts almost transparent.

Now wash very thoroughly in clear water, beneath a tap if possible, or by pouring a gentle stream over the glass for a few minutes, in order to remove every trace of superfluous chemical substance that might work injury. As a precaution against the possible peeling of the film, it is well to dip the negative in a strong solution of alum and water, then wash again, and set up to dry in a slanting position, with the film side next the wall. When perfectly dry a coat of photographic varnish, furnished with the chemicals, is flowed over the coated side of the glass, and the impression is securely fixed, ready for use in printing. Having secured the negative, your object is [180] virtually attained: the possession of a souvenir of a vacation ramble, a favorite view, or of a picturesque camping-place. If it were my negative, I should take it to some good photographer,

and let him prepare from it the prints I wanted, as that expense is small, and involves a good deal of labor for the amateur. But I suppose my readers will wish—as I did years ago—to see the whole process, and to make their own prints or paper pictures.

PRINTING FROM THE NEGATIVE.

White paper coated with albumen is made sensitive to light by being floated upon a solution of chloride of silver in water; and this, when dry, is placed against the negative and exposed to the sun. In this way, by pressing the silvered surface of the paper against the film side of the negative, a duplicate impression of the picture on the glass is transferred to the paper. This may be repeated with other pieces of paper any number of times, until hundreds are obtained from the same negative. Instead of attempting to prepare the paper yourself, it would be better to [181] purchase it already *sensitized*, which you can do of any dealer in photographic goods. A printing-frame, or grooved block with a spring back, is used in printing. After having placed it with the negative and paper in the sun, watch carefully. By removing the frame and retiring to a dark corner, you can examine the paper by unspringing *one-half* the back at a time, and thus print to the degree desired. It is best to print a little darker than it is designed to have the print when finished, as it will bleach a little in the subsequent process of *toning*. This toning operation, as well as the cutting up of the paper, the placing of it on the negative and removing it, should be performed in a darkened room. When a sufficient number of prints are done, trim them the size they are to be when finished, wash in two or three changes of water, and then place in the "toning bath," made as follows: Chloride of gold one grain, water ten ounces, saturated solution of bread soda three or four drops. This will change them to a deep bluish or purple color, and gives them that lovely tint we admire in fine photographs.

The chloride of gold is sent in solution, as well as the soda, so that you have but to follow the [182] printed directions accompanying them, putting a certain quantity of each in the water, and your toning bath is at once prepared.

After toning for a few minutes, remove the prints, and place in another dish containing an ounce of hyposulphite of soda dissolved in a pint of water; allow them to remain ten minutes, and then remove and wash an hour or more in water—running water if possible—constantly changing the water and moving the prints about. Then dry your prints and the completed picture is before you, ready for mounting on a card, or pasting in an album.[E] If you wish to obtain merely a "proof," or a fair print, without the delicacy of shading and tone of the silver print, you can do this with "blue paper," by simply exposing this prepared paper beneath the negative, and washing and drying without any further toning or fixing.

These, in brief, are the various processes necessary for procuring a photographic print; but, as I [183] have already remarked, the negative being your main object, it would be much better to rest content with securing that, and depend upon some photographer to give you the paper impressions.

To recapitulate: For a short trip, fully equipped for taking photographs, we shall need the following:—

A "tourograph," for plates 4×5 inches, with alpenstock tripod and lens	$15.00
One dozen 4×5 plates	1.00
One graduate (or measuring glass)	.50
Two developing pans	.40
One pound oxalate potash, in papers ready for use, 60 cents, half pound protosulphate of iron, in papers, 10 cents	.70
One pound hypo' soda, in papers, 10 cents, six ounces varnish, 50 cents	.60
Sum total for apparatus and chemicals sufficient for development of fifty negatives	$18.20
If you will insist upon printing your own views, then you will need in addition—one printing frame	.60
One bottle chloride gold sufficient for a certain number of prints as stated in directions with it, 50 cents, one bottle bicarb, soda, 10 cents	.60
Sensitized paper for one dozen prints	.25
	$1.45

In round numbers, for $20.00 you can be fully prepared to set up for yourself as an amateur photographer, and after many trials, with diligence and perseverance, can hope to secure [184] photographs of scenery, interiors, and even portraits, that will compare favorably with the work of professional artists. The above is such an outfit—except that I had a larger camera and larger stock of plates—as I have carried to the West Indies and to Mexico.

Since my return, however, I find that my friend, the inventor, has produced yet another instrument, which he calls his "pocket camera," which folds up into a small package but one inch and a half in thickness, and weighs but *twenty-four ounces*. This is so constructed that double

plate-holders, each containing two dry plates, form the top, sides and back of the camera, and the entire outfit for the taking of eight negatives, sold for ten dollars.

It is only fair to state that other apparatus and outfits can be purchased at rates almost equally low, notably those of the Scovill Manufacturing Company, of New York, who furnish complete equipments from ten dollars up. While I recognize the excellence of these articles, I have selected the “tourograph,” as being something with which I have experimented, and likely, from its [185] simplicity, to meet the wants of beginners.

Since the expense is reduced to so reasonable a sum, and the road is made so easy that any one can travel it, what boy or girl will be deterred from entering this fascinating domain of photography?

If you can secure some old room in the garret, or in some unused corner, cover the window with yellow or orange paper, excluding all other light, and take to it such simple chemicals and apparatus as I have indicated, then what a delightful world for experiment and research is opened to you!

The mysteries of photography; how the subtle changes are wrought by the potent salts and acids, under the influence of the sun, I cannot explain now. But following the outline I have sketched, the rest will appear as you get interested, and you will gain an insight into wonders hitherto unrevealed, and enjoy sensations to which the boys and girls of past generations have been strangers.

XXI.—ARCHERY FOR BOYS.

[186]

MR. MAURICE THOMPSON has excited all the grown-up boys who loved in their younger days to draw the bow, by his graceful articles on archery for young men and women.

I want to tell the boys who are wide awake how they may, without too much labor and with but little expense, make their own bows and arrows and targets, having *their* fun, like their elders, in this health-giving and graceful recreation.

In the first place, after you have made your implements for the sport, you must never shoot at or towards anyone; nor must you ever shoot directly upwards. In the one case you may maim some one for life, and in the other you may put out your own eye as an acquaintance of the writer's once did in Virginia.

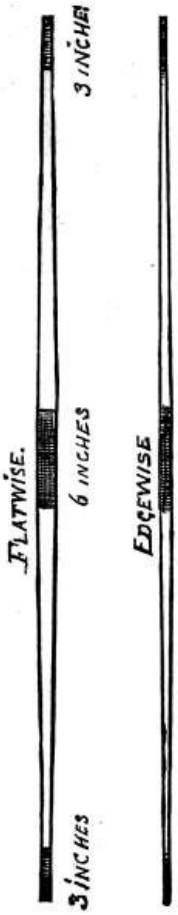


FIG. A.

[187]

To make a bow take a piece of any tough, elastic wood, as cedar, ash, sassafras or hickory, well-seasoned, about your own length. Trim it so as to taper gradually from the centre to the ends, keeping it flat, at first, until you have it as in this sketch-for a boy, say, five feet in height: (Fig. A)

This represents a bow five feet long, one and a quarter inches broad in the middle, three-fourths of an inch thick at the centre, and a half-inch scant at the ends in breadth and thickness.

Bend the bow across your knee, pulling back both ends, one in each hand, the centre against your knee, and see whether it is easily bent, and whether it springs readily back to its original position. If so your bow is about the right size. Cut near each end the notch for the string as in this figure: (Fig. B.)

FIG. B.

[188]

Bevel the side of the bow which is to be held towards you, so that a section of your bow will look like this figure: (Fig. C.)

The back or flat part is held from you in shooting, and the bevelled or rounded part towards you. Scrape the bow with glass and smooth it with sandpaper.

FIG. C.

To shape your bow lay it on a stout, flat piece of timber, and drive five ten-penny nails in the timber, one at the centre of your bow, and the others as in figure below, so as to bend the ends for about six inches in a direction contrary to the direction in which you draw the bow: (Fig. D.)

Your bow is now finished as far as the woodwork is concerned, and you may proceed to wrap it from end to end with silk or colored twine, increasing its elasticity and improving the appearance. The ends of the wrap must be concealed as in wrapping a fish-hook. Glue with Spaulding's glue a piece of velvet or even red flannel around the middle to mark your handhold. The ends may in like manner be ornamented by glueing colored pieces upon them.

[189]

A hempen string, whipped in the middle with colored silk, to mark the place for your arrow nock to be put, in shooting, will make a very good string.

For arrows any light, tough wood, which splits straight, will do. I use white pine, which may be gotten from an ordinary store-box, and for hunting-arrows seasoned hickory. These must be trimmed straight and true, until they are in thickness about the size of ordinary cedar pencils, from twenty-five to twenty-eight inches in length. They must be feathered and weighted either with lead or copper, or by fastening on sharp awl-points or steel arrow-points with wire.

I used to make six different kinds; a simple copper-wrap, a blunt leaden head, a sharp leaden head like a minie bullet, an awl-point wrapped with copper wire and soldered, and a broad-head hunting-arrow.

Fig. D. (A and B are six inches from the ends. The bow is bent slightly at C.)

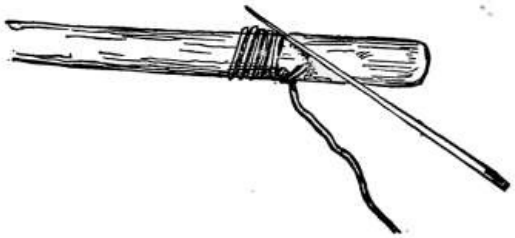


Fig. E.

To make a copper wrap, wrap with copper wire the last half-inch of the arrow until you get near the end, then lay a needle as large as your wire obliquely along the arrow as in this figure: (Fig. E.) Continue the wrapping until you have weighted the arrow sufficiently; draw out the needle and thrust the end of your wire through the little passage kept by the needle, and draw it tight thus: (Fig. F.) [190]

Fig. F.
(Before wrap was drawn through.)

Fig. G.
(After wire was drawn through.)

A blunt leaden head is made by pouring three or four melted buck-shot into a cylinder of paper, wrapped around the end of the arrow, slightly larger at the open end, and tied on by a piece of thread. The wood of the arrow must be cut thus: (Fig. H.)

Fig. H.

The paper is put on thus: (Fig. X.) [191]

Fig. X.

It should look like this after the metal has been poured in and the paper all stripped off. (Fig. I.)

It should look like this after being sharpened like a minie bullet: (Fig. J.)

Fig. I.

Fig. J.

An awl-point arrow is made by inserting the point in the end of the arrow, wrapping with copper wire, and getting a tinner to drop some solder at the end to fasten the wire and awl-point firmly together. The awl-point looks like this: (Fig. K.)

Fig. L.

The awls (like Fig. L) are filed like this into teeth-like notches on the part going into the wood, and roundly sharp on the other part thus: (Fig. M.) These may be shot into an oak-tree and extracted by a twist of the hand close to the arrow-point. [192]

Fig. K.

The broad-head hunting-point (Fig. N) is put on by slitting the arrow and inserting the flat handle of the arrow point, and wrapping it with silk, sinews, or copper wire. These points can be sharpened along the line A B on a whetstone, and will cut like knives. The hunting arrow looks like this: (Fig. O.)

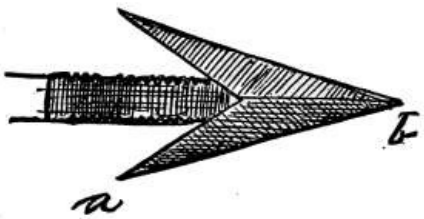


Fig. N.

Fig. M.

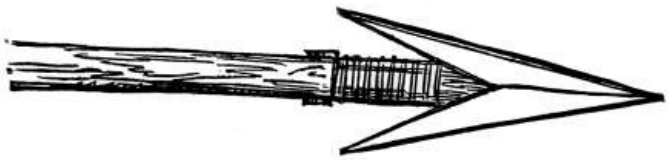


Fig. O.

To feather an arrow you strip a goose feather from the quill and, after clipping off the part near the quill-end, you mark a line down the arrow from a point one inch from the nock and, spreading some Spaulding's glue along that line apply the feather, lightly pressing it home with forefinger and thumb. After you have glued on one piece lay aside the arrow and fix another, and so on until the first is set, so that you may put on another piece. When you have fastened these feathers on each arrow lay them aside for ten or twelve hours. The three feathers will look like this: (Fig. P.) [193]

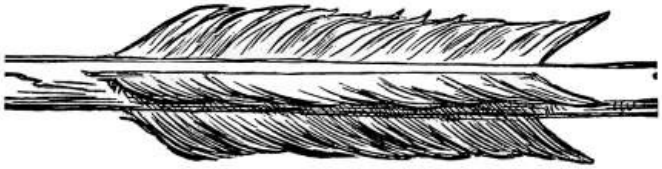
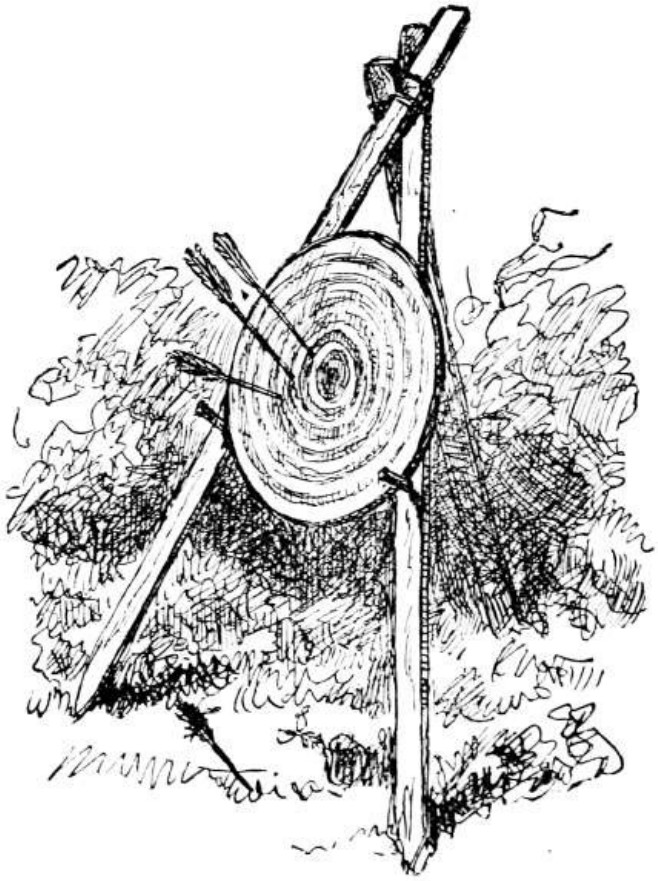


Fig. P.

A boy can hardly make a good quiver unless he were to kill some furred animal and make a cylindrical case such as the Indians have, out of its skin. I am afraid that he usually would have to get a harness-maker to make him a quiver out of leather, somewhat larger at the top than at the bottom. It should hold from eight to twelve arrows.



The Target.

A good target may be made of soft pine, circular or elliptical in shape. In the latter case a line-shot might count, even though it were farther from the centre. Pieces should be tacked to the [194]
back of this target at right angles to the grain of the wood. Differently-colored circles or rings, a little more than the width of an arrow, must be painted on this, with a centre twice the width of
an arrow. The outer ring counts one, the next two, three, four and so on to the centre, which of [195]
course counts highest. By this plan one's score could be told with perfect accuracy.

If an arrow struck on a line between number three and four it counts three and a half. Anything like this rarely happens. The target is fixed upon an easel formed of three pieces of wood fastened together by a string at the top, and it ought to lean back at the top slightly, away from the archer.

The three arrows count seven, nine, ten—twenty-six in all. In target-shooting you should use awl-pointed, wire-wrapped arrows, as they can be easily drawn out of even a wooden target.

XXII.—SIR WALTER SCOTT'S IDEA.

[196]

SOME years ago, while reading Lockhart's *Life of Sir Walter Scott*, I came across a passage, in the autobiographical part, which struck me as so suggestive that I copied it; and here I copy it again, after which I will say my little say on the subject (it was when he was a youth, you know):

> Wherever I went, I cut a piece of a branch from a tree—these constituted what I called my log-book; and I intended to have a set of chessmen out of them, each having reference to the place where it was cut—as the kings from Falkland and Holy Rood; the queens from Queen Mary's yew-tree at Crookston; the bishops from abbeys or Episcopal palaces; the knights from baronial residences; the rooks from royal fortresses; and the pawns generally from places worthy of historical note.

Do you suppose he ever did it?

Now I had had the "collecting craze" for years, just as most boys and girls have now; and wherever I had been, had secured something, till a most miscellaneous accumulation was packed [197] away in boxes and drawers about the house. Moreover, the rest of the children, as they grew up, had been possessed with the same idea. The boy who went South had obtained specimens of different kinds of woods; the one who was in the army had picked up relics; the girl who went to the White Mountains, and afterwards to Ticonderoga, had gathered mosses, leaves, and wild flowers.

Besides, all of us who had a duplicate or a bit to spare, had exchanged with some of our friends, just as you are all doing. The thing is in the air. Boys are boys, and girls are girls, everywhere; and fashions repeat themselves, and are passed on. You are doing what we did before you; and by and by, others will do as you are doing.

The result was that we had a little of everything, and a great deal, a very great deal all told; and when spring house-cleaning came around, and as in all proper households, every closet and drawer, bag and bundle was turned inside out, our mother would say: "Why don't you make something out of these things? Seems to me if I couldn't, I'd give them to somebody who would." [198]

There was the trouble—we meant to; forever meaning to do something; but that class, whether old or young, does not usually accomplish much.

But let me tell you of things that *have* been done—by whom it does not matter. One boy started up on Sir Walter's plan, and set the example for his comrades (besides correspondents); so that presently hand-books on chess made their appearance in the neighborhood; and there began to be a great deal of turning on lathes, and fine sawing, and whittling, and sand-papering. Pretty soon chess was all the talk; and as that game is one which requires in Wordsworth's line (written on an altogether different subject)

> Endurance, foresight, strength, and skill,

(the strength being strength of purpose) also a good head for planning, and a memory, it turned out that the chessmen fancy proved a good thing. Nothing outside of good, hard, school studies can better discipline some of the faculties than that game. It is indeed no light accomplishment to [199] play even tolerably well. Besides, when those boys were absorbed in chess, their fathers and mothers did not have to worry about them when they were away in the evening.

One set had historic associations almost the next best thing to Sir Walter's. Think of the king being made of a piece of wood from Mount Vernon; a castle (or rook) of a piece from Fort Ticonderoga (we have forts, or ruins of forts, enough); a knight from a piece of John Brown's scaffold; and the pawns from a peach-tree that grew from a stone a soldier had thrown away on a Virginia battlefield.

Chessmen can be made from specimens of wood of our native trees; solid oak for king or castle, delicate poplar or birch for the queen, and so on; or of any curious and rare woods; and almost all have some beauty of grain or markings. They can be turned on a lathe, and then finished in grooves and otherwise, or wholly done with the knife. Many, as you know, are in two pieces; and the king and queen in some sets can be taken apart in two places, making three.

There are great opportunities in pieces of wood. The boy who went to the war brought home [200] enough of Southern woods for several canes; and for convenience in packing, he cut it in sections about six inches long; purposing to fit them together on the same principle that a cap of rubber is fitted to the end of a pencil; by cutting away on one piece to slip into a hole made in the next, plug fashion, and there glued.

Relics in wood can be worked into a glove box or handkerchief box, skilfully joining the parts and as skilfully gluing them. Picture frames suggest another form. There is one here made by a clerk in a store while waiting for customers. It has over three hundred small strips, lapping in a fanciful way, and not a tack, or a brad is used in the work; but this is too complicated.

It is easier to turn out checker-men or napkin-rings, or make pen-holders, or paper-knives. Very elegant paper-knives can be fashioned, having one kind for the blade and two for the handle. But all this woodwork must be done with great care, accuracy and nicety, not only in the cutting and dovetailing or matching of the parts, but in the gluing and finishing off, including a delicate oiling [201]

to bring out the grain. It is nice work; to be sure it is. But if soldiers in prisons can do such things as some of our soldiers did, with not much besides a jack-knife to do with, pray cannot a smart Western or Eastern boy do as much?—between scroll saws and the variety of choice tools within his reach, he is not the boy I take him for if he cannot make himself a set of chessmen, or a work-box for his sister.

As for minerals, I lately saw at a State Fair a box on which broken-up specimens from that State were glued, crusting it all over with stone that sparkled in places like crystal. On each specimen was a mere speck of paper with a number on it, which corresponded to a number on a written list placed inside, telling what they were—beryl, tourmaline, quartz, etc., etc., and I thought it an admirable thing.

In a parlor, arranged in a border around the little iron fence in front of the coal grate I once saw a curious display of cobble-stones brought home from different beaches. The lady who put them there was artistic, and the effect was pretty. Sea-shells of delicate varieties can be used as necklaces or bracelets if pierced with a red-hot darning needle, or in some way bored to admit of [202] being strung; some of those lovely, iridescent, foreign shells, strung in such a way, are greatly to be desired. You can think of so many ways to put them to pretty use!

Mosses and lichens you can group on card-board or glue them to a wooden cross. With leaves and pressed flowers you can do no end of things. You can mount them on card-board, or make a wreath of them around a piece of wire or rattan; or ornament a fan with them—a round, Japanese fan, recovering it with silk or paper of a neutral color, for background. One girl made a transparency with three or four bright autumn leaves (from a woodbine), which were gathered from among some that had fallen at Longfellow’s gate—just where the poet’s feet had passed in and out hundreds of times. She cut two pieces of coarse lace to fit the window-pane, glued her cluster of leaves in the centre between them, then overcast the outer edges and put on a deep binding of crimson velvet. As the light streamed through they were gorgeous as old stained glass.

If you collect relics, souvenirs, momentos, curiosities, they are worth arranging. If you get tired [203] of them, give them to somebody else.

All these articles require much painstaking. They will be spoiled for any person of good taste if they are daubed, out of proportion, or awry. Don’t let them have a home-made look either. They need not. No reason why a boy of average skill should not do as well, after some experience, as those sailors in the light-ships; or why a girl should not, with care and all her trying, make as pretty things as the gypsy women or the nuns, of whom people like so well to buy.

XXIII.—KNOTS, HITCHES AND SPLICES.

[204]

WHEN I was a boy (which was not so very long ago), it was my fortune, one time, to make a trip from Bristol, Rhode Island, to New York, as a sort of working passenger in the sloop *Resolution*, Captain Israel Northup. One morning the captain called out to me from the wheel to bring aft a bucket of water, at the same time pointing to a wooden pail that stood on the deck near me. I therefore made fast (as I thought) to the handle of the pail the end of the peak halliards and dropped it over the side. It filled readily enough, and I was carelessly pulling it up again, when suddenly, to my great chagrin, the knot that I had made untied itself, and away went the pail drifting rapidly astern.

Captain Israel, although he had witnessed the whole of this performance, said nothing at the time. But a little later, chancing to walk past where I was sitting, he picked up the end of a rope, and, running it through a ringbolt near by, showed me the knot which you see in Fig. 1.

[205]

FIG. 1.—ANCHOR-BEND.

"The next time you throw a bucket overboard," said he, "you'd better make it fast with an Anchor-bend." Then in the kindness of his heart he sat down on the rail beside me and gave me a practical lesson (afterwards several times renewed) in the matter of rope-tying.

"There is some things about ropes that a boy *must* know to be wuth anything at all," observed he. "An' there mought be times when a man would give all Cuby ter know how ter tie two ropes together so't they'd *stay*."

Believing that these words of Captain Israel are worth heeding, and wishing, so far as is possible in an article like this, to do for other boys what the worthy old sailor did for me, I shall ask the readers—both boys and girls, mind you—to take a rope and practise, according to the following directions, some few of the most important knots, hitches and splices.

[206]

FIG. 2.—THE WRONG WAY.

The first thing to be sure of is the right way to fasten together two pieces of string or rope. That is a thing that some of us have to do twenty times a day; and it is quite probable that twenty times a day we do it wrong. Suppose that you wish to lengthen your fish-line, or add another ball to your kite-string: how will you do it? Shall you lay the two ends side by side and then twist them together into a knot just such as your sister would make in the end of her thread, as is seen in Fig. 2?

If you do, you may fairly expect that your fish (if you hook him) will get away with the main part of your line, or that presently your kite will go skurrying off to northward far out of your sight, until you find it again, half an hour later, after a hot chase, hanging tangled and torn in one of the trees of farmer Applewood's orchard. Such a knot is at least as likely to slip as to hold, and, if tied in a rope, is liable sooner or later to cut the rope, because the strain is at right angles. What is really wanted is a Square-knot (Fig. 3, *a*).

[207]

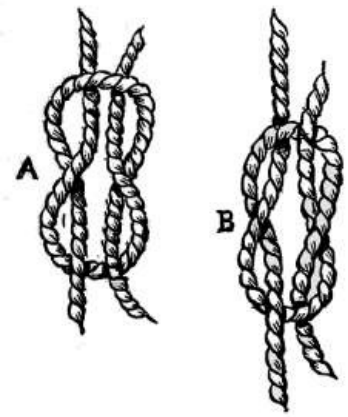


FIG. 3.
A SQUARE OR REEF-KNOT.
A GRANNY.

Take the two ends and tie them together exactly as you would tie a "hard-knot" in your shoe-string. Only you must be careful and not tie a Granny (Fig. 3, *b*).

One *may* slip, the other won't.

Fig. 4 is a Becket-hitch, the proper knot for joining a large and a smaller rope. It will be useful, for example, when the keleg-line of your boat is too short, and the only line at hand to bend on to it is a stout piece of hemp twine.

A loop at the end of a rope—that is, a loop that will not draw up—is another knot that has frequently to be made. And yet few people know how to make it. I know a very bright young fellow living out at the Highlands, who the other day made a loop in the end of a rope which he *knew* would not slip, and then, squeezing it over his dog's head, tied him to the kennel and went off to school by himself. But the loop did slip, and poor Don almost choked to death before his plight was discovered. What is wanted in such a case is a Bowline.

[208]

FIG. 4.—A

Make a bight near the end of your rope, as in the first cut of Fig. 5. Seize this with the left hand at *a*, and then with the right hand pass the end *b* up through the bight, around behind the main part of the rope at *c* and down in front of it through the bight again as in *d*. Draw this tight and you have the much-talked-of Bowline. It is a very simple matter, as you see; but with it you

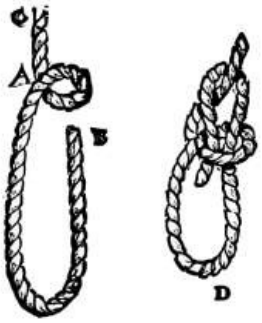


FIG. 5.—THE BOWLINE.

BECKET-HITCH.

can make a slip-noose that will give you no trouble in lacing up your box, or you can put your dog's head in it without fear of coming home and finding him "dead at his post;" or the farmer's daughter can safely tether a pet pony or the bleating calf out to feed upon the fresh grass. [209]

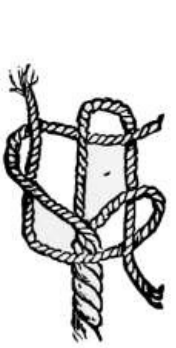


FIG. 6.

FIG. 7.

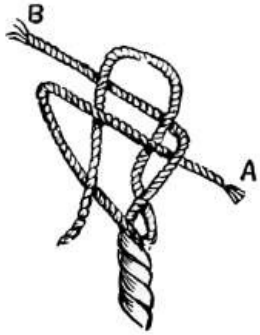


FIG. 8.

FIG. 9.

While speaking still of the ends of ropes, let us stop and learn to "fasten them off" properly to prevent their untwisting or fraying out. The painter or main-sheet of your boat, Bridget's clothes-line, your little sister's jump-rope, and indeed *any* rope whose end is not (like the Irishman's) cut off altogether, may need such treatment. The simplest method is to "serve" or wind the end with small twine. A Single-wall (Fig. 6), or a Double-wall (Fig. 7), is better. But better still is the Boatswain's-whipping, formed by making an inverted single-wall and then splicing the ends back over the rope itself (Fig. 8 and Fig. 9).

The most elegant of all such, however, is the Stopper-knot, seen complete in Fig. 14. [210]

Place the end *a* as in Fig. 10, holding it with the thumb at *d*; pass *b* around under it, *c* around under *b* and through the bight of *a*, and pull tight; this forms a Single-wall (Fig. 11). Now lay *a* over *d*, *b* over *e*, *c* over *b* and through the bight of *a*, and draw tight (Fig 12).

Next pass *b* down around *f* and up through the bight *g*, and do the same with *a* and *c*, forming Fig. 13.

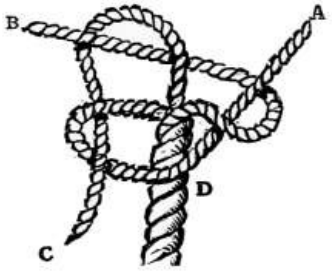


FIG. 10.

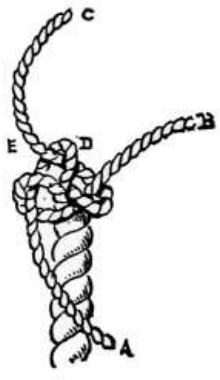


FIG. 11.

FIG. 12.

FIG. 13.

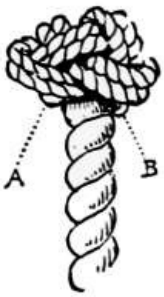


FIG. 14.

THE FIVE STEPS OF THE STOPPER-KNOT.

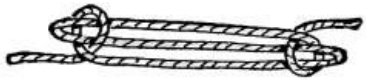


FIG. 15.—A SHEEPSHANK, BEFORE IT IS DRAWN TIGHT.

Then pass each strand by the side of the strands in the crown down through the walling to form the “double-crown,” and cut close the ends *a*, *b* (and *c*), producing Fig. 14. [211]

A Sheepshank (Fig. 15) is a knot by which a rope may be made shorter, or (as a young yacht-woman of my acquaintance recently expressed it) “a tuck taken in it.” If the tide has come in and you wish to shorten the mooring-line of your boat, or if the line by which your campaign flag is suspended across the street is too loose, or your clothesline, or your swing, has sagged frightfully, the Sheepshank will gather up the slack for you and hold it firmly.

When one wants to make an artificial handle for an old jug or some other vessel, the True-Lover’s knot is used, as seen in Fig 16.

Tie two loose knots, *a*, *b*, as in the first cut of Fig. 17; pass the bight *a* through the opening *f*, the bight *b* through *g*, pull the loops equal, and, to complete the knot as in second cut of Fig. 17, join the ends *c*, *d*, by a long splice at *e*. [212]

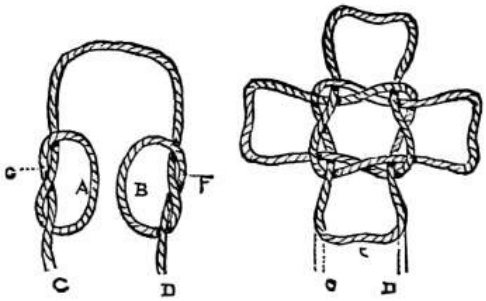


FIG. 17.

FIG. 16.—THE TRUE-LOVER’S KNOT.

The Jar-sling, seen in Fig. 20, serves a similar purpose. You are out picnicking, perhaps, and you suddenly find it desirable to convert an empty gherkin bottle into a swing-vessel in which to take home alive some tadpoles or minnows. In a long piece of cord make a large loop as in Fig. 18, and hold the bight against the standing parts, *a, a*; pass the thumb and forefinger of the other hand down through *c*, lay hold of *b* where the crook of the imaginary wire is seen, and draw it through *c* down a little below *a, a*, as in Fig 19, *d*, and hold it there. Now pass the thumb and forefinger down through the opening *e* (in the way the wire goes), lay hold of *g*, and draw it up through *e*, forming the complete knot as in Fig. 20. [213]

One more knot, the Turk’s-head (Fig. 23), remains to be described before we pass to the briefer subject of hitches. Take a long piece of fishing-cord, place the end *a* against the forefinger, wind the cord around the two fingers and hold it with the thumb, as in Fig. 21.

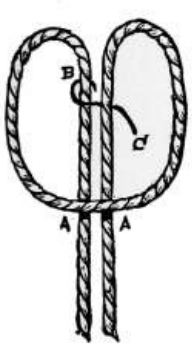


FIG. 18.

FIG. 19.

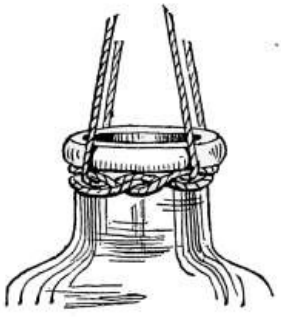


FIG. 20.

Now with the other hand lay the part *b over* part *c*, and while in that position pass the end *a* down between them, over the first crossing, under left strand, up between, over second crossing, under right strand, up between; take the hitch off your fingers, and it will be as in Fig. 22.

Next pass the loose end through the opening *d*, laying it against the cord *a*; then with it follow that strand (*a*) over and under, over and under, until you have a complete plait of three cords. Pass the knot over a stick to make it taut, and cut the ends close. [214]

The Turk's-head knot, like the two preceding it, will tax your precision, deftness and patience, and is an ornamental rather than a useful knot. You may weave one from wire or cord about the handle of your cane or riding-whip, or you may pull a few hairs from old Dobbin's tail and make them into a very pretty horsehair ring for your cousin Fanny when you two are out driving together along the forest road.

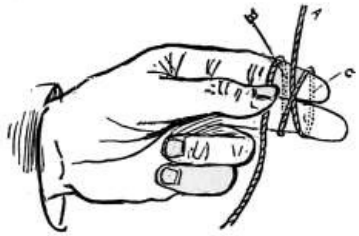


FIG. 21.

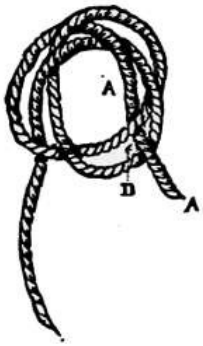


FIG. 22.

FIG. 23.

The knots in Figs. 24, 25 and 26 explain themselves; they are often useful to picnickers and campers-out. *Hitches* are no less *knots* than any of the foregoing; but they are knots used to fasten the end of a rope to any object in such manner as to be easily cast off when no longer needed. They are few in number, and all very simple and easily described. [215]

A Blackwall hitch is merely a loop thrown about a hook, as in Fig. 27, in such a way that the main part of the rope, *c*, being pulled downward, the part a jams the part *b* against the hook so firmly that while the strain is kept up the knot cannot possibly slip. Sailors use this hitch very frequently, but it can be used on land as well as at sea. If you have retreated, in a game of "Chase," to the topmost branch of the oak-tree on the lawn, and have a rope in your hand just long enough to reach the ground and no longer, just make, in a single instant of time, a Blackwall hitch in the crotch of the limb, and, if you dare trust yourself to it, it will take you to the ground in perfect safety, long before your pursuer can climb down again by the way he came up; and you can carry off your rope with you.

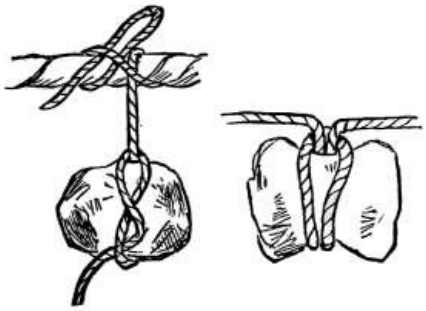
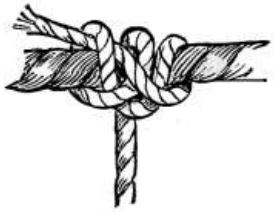


FIG. 24.—TWO WAYS OF FASTENING A WEIGHT TO A LINE.



[216]

FIG. 25.—TO TIE A SHORT LINE, TO WHICH A HOOK IS ATTACHED, TO A LONGER OR GROUND LINE.

FIG. 26.—TO FASTEN A LINE TO A FISHHOOK.

Or possibly you might be "up a tree" in a different way. Old Tibbetts, your father's gardener, not daring to trust himself away from mother earth, has sent you up into the elm tree to saw off for him the limb that is growing too near the house. But that limb must not be allowed to come crashing down; and so, with the rope you have taken up with you, you cast about it, while you saw, a Timber hitch, shown in Fig. 28.

[217]

FIG. 27.—BLACKWALL HITCH.

Of all hitches, however, the one which any man or boy can least afford not to know is the Clove hitch. Make two bights or loops, as in Fig. 29; hold them between the thumbs and forefingers at *a*, *b*; slide the left loop over the right loop; then slip the double loop thus formed over the table-leg, or your brother Willie's finger, or anything that will represent a post, and draw tight by the end (Fig. 30). Practise this until your fingers can do it swiftly and *of themselves*, just as your tongue can say the alphabet; for a Clove hitch, when it is used, needs to be made quickly and handsomely. I once saw a young cadet from Annapolis, who had been out on a sailing party with some ladies and had jumped ashore with a rope, hesitate at least half a minute before he could think how to make the proper knot, while a number of old sea captains sitting by were watching him and laughing among themselves. A Clove hitch may be used, too, when, while out fishing, you extemporize an anchor by tying a rope to a stone. And in Fig. 31 you see again how this knot, *e* (with a half-hitch, *f* in front of it), is used

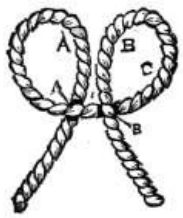


FIG. 28—TIMBER HITCH.

to tow a floating spar or drag a piece of timber across the field. **FIG. 29.** [218]

Two other hitches, a Rolling hitch and a Cat's-paw, are shown in Fig. 32.

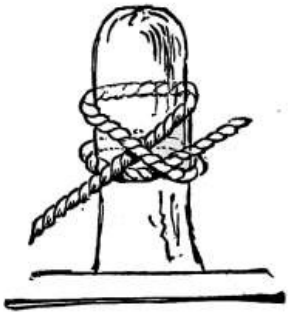


FIG. 30.—THE CLOVE HITCH.

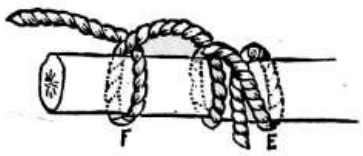


FIG. 31.—FLOATING SPAR.

Splicing is a process by which ropes are joined together so as to leave no knot. I appreciated its importance the other morning when I saw an intelligent man of fifty work for an hour to splice a hammock rope. Where it is specially important that the joining be a very nice and smooth one, the "short" splice is used. It is made by passing the strands of one piece in and out between those of the other. The short splice always leaves the spliced part thicker and clumsier than the rest of the rope. If it is desirable that the joining be a very neat one, so as to admit of the rope's running readily through the sheave-hole of a block, the "long" splice is necessary. This is made by unwinding each end about two inches, placing the strands as in the short splice, then unwinding [219] one strand further back, and winding the corresponding strand of the other piece in its place; proceeding in the same way with the other strands, and then fastening the ends in such a way that it is almost impossible to detect the splice. We have not space to describe here the exact mode of procedure; but there is scarcely a town or village anywhere but has its "old sailor," and there is no old sailor anywhere but will be glad to come and give you all a lesson in splicing.

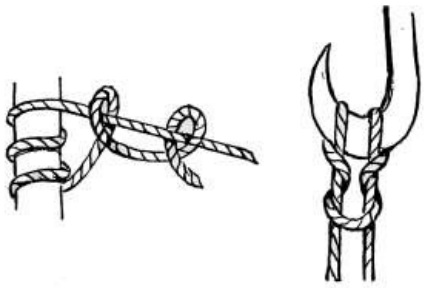


FIG. 32. A ROLLING HITCH. A CAT'S-PAW.

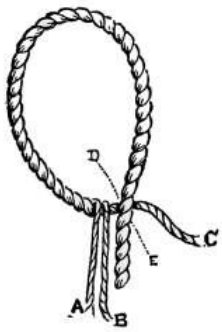


FIG. 33.

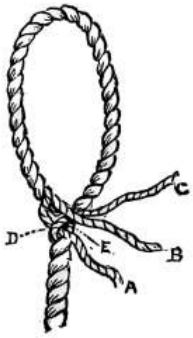


FIG. 34.

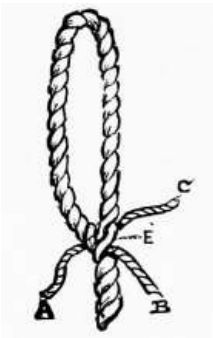


FIG. 35.

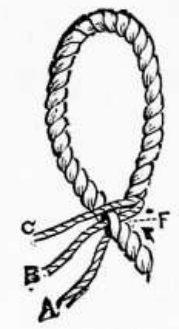


FIG. 36.

FIG. 37.

A splice that you can very easily learn for yourselves, however, is the Eye-splice. First make [220] yourself a marling-spike—if you have not the genuine article by whittling down to a point a piece of hard wood. I have found that the half of a clothes-pin, so treated, answered the purpose exceedingly well. Then take a piece of good three-strand rope, unwind the strands, and place them as you see *a*, *b*, *c*, in Fig. 33. Open the strand *d* and pass *a* through it, as in Fig. 34; then open *e* and pass *b over d* and *under e*, as in Fig. 35. Turn the eye over, Fig. 36, open *f* and pass *c* through it, as in Fig. 37, and pull the strands tight. Now pass *a over* the strand next it, *under* the next one, and so on with the others. Proceed in the same way until the splice is about an inch long. Then stretch the eye (holding by the rope) to tighten everything, and cut the ends close. If you will make a neat Eye-splice all by yourself and take it to the old sailor aforementioned, he will [221] be sure to think it worth while to teach you all he knows, and he will be likely to tell you many things about knots, hitches and splices which are of necessity omitted here.

FOOTNOTES:

[A] I do not explain again how to use a chalk line and a splitting-saw, for you ought to thoroughly understand that if you have read the other papers and made the sawhorse and workbench yourself.

[B] Where accuracy is required always allow one eighth inch for waste in sawing; draw line and saw *on* the line and plane off any thickness over and above the measure required.

[C] Always remember to square and plane edges *before* measuring from them.

[D] The operator should bear in mind that old saying, “A pint’s a pound, the world around,” then he will remember that it contains sixteen fluid ounces, four ounces to the gill, &c.

[E] Many preparations are advertised for sticking the prints to the cards, but common starch paste is about as good as anything. Mix the starch in cold water, very thin, and then boil it, constantly stirring it to break up lumps, and remove from the fire soon as it reaches the boiling point. The prints should be wet and pasted on while quite moist, rubbing them down beneath a sheet of blotting-paper from the centre to the margin, in order to expel all air, that would otherwise cause lumps or wrinkles.

Transcriber’s Notes

Minor punctuation errors have been corrected.

Some inconsistencies in hyphenation have been left as printed.

In the text version underscores have been used to indicate _italics_, and equals signs to show =bold= text.

Figure numbering is not consistent through the book.
p 79. The figure here is mislabelled as Fig 2 and has been corrected to Fig. 1.
p 107. Fig14 is out of order and repeated further on, left as printed.
p. 58. “Half the length of brass piece” has been corrected to “Half the length of the brass piece”.
p. 106. “50 feet, ⅞ inch pien” changed to “50 feet, ⅞ inch pine”.
p. 144. Fig. 3 appears to be upside down. It has been left as printed.
p. 166. “No we have a pile of books” changed to “Now we have a pile of books”.
p. 167. “The back cloth is always at beast an inch longer” changed to “The back cloth is always at best an inch longer”.
p. 174. “hindrances that I had to encouter” changed to “hindrances that I had to encounter”.

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