A Fish-tail Propeller Fitted to a Scow.—(See page 234.)

THE SCIENTIFIC AMERICAN BOY AT SCHOOL

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By

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NEW YORK

MUNN & CO., Inc., *Publishers*

1910

MACGOWAN & SLIPPER, Printers
30 Beekman St.
New York, U. S. A.

PREFACE

TO those who have read "The Scientific American Boy," Bill needs no introduction. But his new acquaintances may be interested to know that Bill and several companions established a camp on an island in the Delaware, where for two summers they spent their time in various engineering undertakings, such as building bridges, huts, boats, windmills, etc. Their work was suddenly interrupted by the sale of the land on which they were encamped. However, this did not mark the end of Bill's activities. A boy of his stamp could not be content to remain idle very long. The present volume finds him at boarding school, where his ingenuity and creative instinct were an inspiration to another club of boys. It needs but the proper initiative to cause in the average American boy with a mechanical turn of mind, a remarkable display of originality and resourcefulness, and Bill's companions on several occasions even outdid their leader in ingenuity.

Bill has grown in years and experience since we first met him, and, as would be expected, his work described in the following pages is of a more advanced character.

The author desires to acknowledge his indebtedness to Mr. J. B. Walker for assistance in designing the Howe truss bridge; to Mr. Henry Thorpe for details of the camp refrigerator and fireless cooker; to Mr. Thomas Fagan, who invented the "fish-tail propeller"; and to Mr. A. A. Hopkins, whose excellent book on Magic has been freely drawn upon. Several of the devices described have been taken from the Scientific American and modified to suit the requirements or abilities of a boy, The seismograph, for instance, is very similar to one described and built by Prof. Henry H. Riggs, President of the Euphrates

College at Harpoot, Turkey. The ornithologist's blind will be recognized as one originally designed by Mr. Frank M. Chapman.

Some of the material has received advanced publication in the Woman's Home Companion and Suburban Life.

A. RUSSELL BOND

NEW YORK, *October*, 1909

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CHAPTER I.

INITIATION

It was the first moonless night of the school year. The time had been chosen only after carefully consulting a patent medicine almanac on the chances for a dark, cloudy night. Strange to say, the almanac struck it right that time. We couldn't have wished for wilder weather. The wind was blowing a gale. No rain fell, but occasionally there was a brilliant flash of lightning, revealing weird cloud forms against the jet-black sky.

We were all ready for the initiation. Announcements had been sent to the favored three, who were to be admitted into the fold of the Big Bug Club, summoning them to be ready for their guides on the stroke of midnight.

"This shall be your sign," so the summons read; "your guide will utter the word 'doom,' at which you must give the countersign 'devotion.' Remember the countersign!"

At ten minutes of 12 four Big Bugs, the only survivors of the last year's famous club, assembled in the lobby of the school, and each donned his white cap, and rolled a pebble under his tongue to disguise his voice. Bill staid down stairs on guard, while the rest of us wrapped in sheets stole up to our positions in the dormitory, and on the last stroke of 12, three bedroom doors opened simultaneously.

"Jig" Nelson was my victim—an awfully nervous fellow. As I opened the door there was a tremendous clap of thunder, and a blue-green flash lighted up the room. "Jig" started up in bed, staring at me with terrified eyes. He did not stir as I glided toward him and leaned over to utter the mysterious signal in his very ear.

"Doom!" The word boomed out with an unearthly, hollow sound. No answer from the spellbound "Jig."

"Doom-m!" I said again, but "Jig" was struck speechless.

"Doom-m-m!" I said a third time, but the spell was broken, for in this supreme effort the pebble suddenly shot out of my mouth and down my victim's neck.

"Wow!" cried "Jig" with a yell that should have brought out the police.

"Shut up, you fool!" I said in a hoarse whisper; "don't be an ass! This is one of the Big Bugs. Have you forgotten your countersign?"

"Devotion," came the trembling response.

"Now, brace up!" as I blindfolded him; "we don't want any mollycoddles in our club. Get your duds on, man! You should have been all dressed and waiting for me. I hope you haven't waked up the whole house."

A few minutes later I led him out into the hall. On the way down we had to pass the "old man's" room. This was decidedly a misnomer, because the new principal of our academy was far from being an elderly man. On the contrary, Professor James looked strangely young for his age. His short, slight figure, fair hair, light blue eyes, and smooth-shaven face were a marked contrast to the rugged features of his predecessor, Professor Clark.

The Principal's Door

At the foot of the stairs, right in front of the principal's door, was a squeaky board. This board had been my undoing once before, when I was sneaking to a midnight club meeting, and I didn't mean to be betrayed by it a second time. Now, as we approached the telltale spot, I cautioned "Jig" to take a long step over it, but as luck

Fig. 1—Stumbled and struck heavily against the door

would have it, he stumbled and struck heavily against the door. I was sure the game was all up; for fully two minutes we stood quaking with bated breath, but nothing happened. Presently we made out the measured breathing of the sleeper, and much relieved groped our way noiselessly down to the lobby.

Bill and "Doc" Williams had already gone out with "Sneezer" Tracy, the first neophyte (new member), and Roy Bowers was waiting for me with "Jumbo" Harris, the second candidate. As it took two guides to initiate each victim properly, "Jig" had to be left behind until the other two had been put through their paces. Stripping off our sheets and white caps we plunged out into the wild night with "Jumbo," the fattest boy in school.

Quite a programme of foolish tricks was provided for his entertainment. The tricks were all harmless, because our object was to be funny rather than to cause pain. To start with, we held his legs and made him walk on his hands, down the steep terrace toward the barn. Then we led him up to the hay loft and made him do the "dip of death," which was a slide down the slippery mound. He had to shin up a slippery pole, and walk the plank. The plank was laid across a saw horse, seesaw fashion, and he had to walk up one side, teeter the board over, and then walk down the other with no assistance from us, though we stood by at each side to catch him in case he made a false step.

The Bottomless Pit

Next we led him into the shed. A six-inch beam was laid on the floor, and supported one end of a long plank. "Jumbo" was led up this inclined path, but the slope was so gradual that he thought he was walking on the level. Suddenly we stopped him at the very end of the plank with his toes over the edge.

"Before you lies the bottomless pit," said Bill in sepulchral tones. "Leap down into the depths to meet the 'A-awful Presence.' "

But "Jumbo" rebelled; he did not care to take a leap in the dark. Only after the direst threats and dares could we induce him to make the venture. He gathered himself up

Fig. 2—He passed for a pretty good goat in the dark

for a long jump; imagine his surprise at bringing up short after a drop of but six inches. We howled with laughter, in which even "Sneezer," who had just been through the same trick, joined.

The next "stunt" on the programme was the goat ride. We had no goat, but Bill agreed to act as a substitute. He had tied upon him a sheepskin rug, purloined from the library, and he had a pair of horns whittled out of a gnarled root and nailed to a leather strap, by which he fastened them on his head. He passed for a pretty good goat in the dark, and "Doc" told me that the antics he went through while "Sneezer" tried to hang on his back were better than those of a real live goat. However, when it came to putting "Jumbo" through the same performance, he demurred. He wasn't going to prance around with an elephant on his back, so we reversed the proceedings, and "Jumbo" had to be the goat, while we all took turns riding on him.

"Jig's" Initiation

The two neophytes, still blindfolded, were now stood up in a corner of the shed, while Bill and I hurried back after "Jig" Nelson. "Jig" appeared to have regained his nerve, and went through the ordeal without flinching. He seemed actually to enjoy the scramble down the steep terrace, the seesaw board didn't alarm him, and he shinned up the slippery pole with an alacrity that evoked our admiration. The oyster, which we told him was the "evil eye," he ate with evident relish, and even the leap into the bottomless pit did not appear to phase him. Whether he was startled at being brought up short we could not tell, as the large handkerchief I had tied over his eyes completely covered his face.

The final act of the initiation was now performed. Bill, who was to pose as the "A-awful Presence," took his seat on a soap box, attired in his goat costume, while the two neophytes were made to kneel before him. Roy, "Doc," and I took up our positions behind them. Each member was sworn to secrecy and loyalty to the club. By the light of a barn lantern, Bill then read the constitution—not a very long document; but it dealt mainly with our pledge to meet at least once a month for a midnight banquet. Then, with a cheer, the neophytes were suddenly unblindfolded and made to look on the "A-a-awful Presence."

An Unexpected Member

I will never forget that moment. The Awful Presence fell over backward from his throne and started like a shot for the door. "Jig" ran after him and stopped him. But no; was it "Jig"? Sure as I live, there stood Professor

Fig. 3—The "Awful Presence" fell over backward

James wearing the broadest of broad smiles, while we simply stared with fear frozen on our faces.

"Don't be alarmed, boys," said Professor James. "Did I not just swear absolute secrecy and loyalty to the club? I want to tell you right here that I will be just as loyal to you as you are to me." Oh, pshaw, we were in for it now. A lecture on loyalty and such. But the next sentence surprised me. "I have no objection to your continuing this club in all secrecy to the rest of the school." Did he mean it? "But, now that I have been duly initiated and sworn in as a member, you must let me into your plans and recognize my vote. I will try to be a boy with you, and I think I can help you in lots of ways which will make up for my forcible entry into the Big Bugs' Club."

"Three cheers for Professor James!" cried someone, and the cheers were given with a vim.

"Now, Mr. President," he said, addressing Bill, "I believe the constitution limits the membership to seven, but I move you that the article be amended to allow one more member, for poor Nelson is still waiting in the lobby, where I traded coats with him."

The motion was unanimously carried, and I hurried off to fetch "Jig." To make up for his long wait, we swore him in without putting him through any initiation pranks. The society then adjourned after passing a motion made by Professor James that we meet in his own room immediately after school hours the next day.

"I am asking you to come to my own room, and not to the office. In the office I shall always be Professor James, principal of the Academy, and as such I shall demand that you treat me with all respect due to my office. But in my own room I can be a boy with you, a loyal member of the Big Bugs' Club."

"Say, he's a slick one, isn't he?" said Bill, as we were getting back to bed; "but he seems to be the right sort."

CHAPTER II.

BUILDING A DAM

THE next day we assembled in the principal's room, where Professor James greeted us cordially with the secret handshake and the countersign of the month and then escorted Bill to the seat of honor. A meeting was called at once, and Professor James was given the floor.

"Fellow members," he said, "I want to apologize for taking an unfair advantage of you last night. But there is quite a little to be said on my side. When Professor Clark handed over the school to me, he told me of a mysterious club which some of the boys were conducting on the sly. Just what sort of a club it was, he could not tell. He knew that the members had held secret meetings at night, but their purpose was a mystery to him. The fact that the club was secret was conclusive evidence to him that it must be 'crooked.' Consequently, he was strongly of the opinion that the organization should be broken up. That is why he had your cave destroyed, and his urgent advice to me was that I check any attempts at reorganizing the club this fall. But I could not do such a thing without giving you a trial. Now, I hate a 'squealer' just as much as you do; and though I knew one or two members of the club, I could not call them up to tell on the rest. Last night, as luck would have it, I heard you creep out to your rendezvous, and I had to take some action. As I have just said, I took an unfair advantage of you; but, come now, don't you think you took an unfair advantage of me in trying to steal off to the barn while I was asleep?

"Now, I haven't seen any harm in the club, except for the loss of sleep at the midnight banquets, but there is one thing that every one despises, and that is a 'sneak.' Don't *sneak* off to those banquets. You can be secretive, and need not let anyone else in the school know when and where you are going to meet. But, why not have something better than midnight feasts for the chief aim of the society? Why not make it a club worth while? Bill, your uncle told me the other day, about the things you did in camp last summer. Why not continue the good work here? You may rely on me for considerably more than my share of the funds necessary to carry out any ideas that are worth while."

Cheers!

The Scarabeus

"Hold on, boys. I am not through yet. Among the relics of your cave house that Professor Clark turned over to me was a drawing of a huge bettle bearing the letters G.I.B. Now that I have been initiated, of course I know that G.I.B. must be read backward and with the beetle signifies Big Bug; but when I first saw it I thought it was meant to represent the Egyptian sacred beetle, or scarabeus, and that your club was patterned after one of the mysterious ancient societies. I am sorry my guess was wrong, because you could do much worse than to copy those old-time scientists and engineers. They were pretty smart, those people of Bible days. Do you know that the first subway under a river was built by the Assyrians, ages ago? Yes; one of their old kings wanted to have a private passage run under the Euphrates, and he told his engineers to build it. They must have been a pretty blue lot of engineers when they got those orders. It would not have been so bad if they were going through rock, but the bed of the Euphrates is sandy, and there were no tunnel shields in those days to keep the tunnel from caving in while it was being built. They had to build the tunnel though, or have their heads chopped off. A pretty strong incentive, that! Well, they didn't lose their heads; some one hit upon a scheme. It meant a lot of labor, but there were no unions then, and labor cost nothing. What do you suppose they did? The simplest thing in the world. They dug a new channel for the Euphrates, diverted the waters into it, and then proceeded to build their tunnel in perfect safety in the dry bed of the river. When all was completed, the new channel was stopped, and the waters flowed through the old channel over the tunnel."

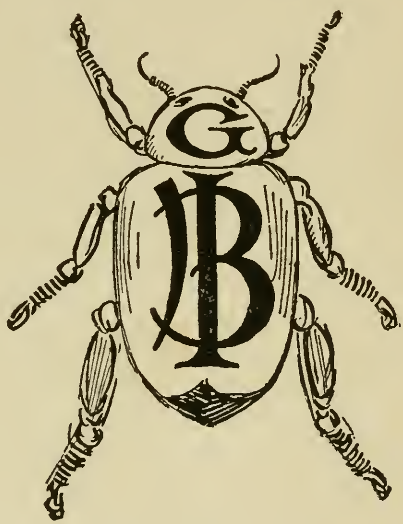


Fig. 4—A beetle bearing the letters G I B

"Gee! that was clever, wasn't it?" interjected Bill.

"It certainly was. Why, you have no idea how smart those people were! The old Egyptians used to hatch their eggs in incubators. The Egyptian priests had nickel-in-the-slot machines for selling holy water in their temples, and when it came to great engineering works they were simply wonderful. They didn't have steam engines, or much in the way of machines to help them, but yet they managed somehow. That's a good motto for the Big Bug Club—'Manage

Somehow.' You cannot afford to buy a steam engine or a gasoline motor, and you cannot put much money into the things you want to do, but with a little headwork I believe you can get up some schemes that would make even the clever old Egyptians sit up and take notice."

"Hooray for the old Egyptian engineers! Give them three cheers!" And they were given with a vim.

"Let's make it an Egyptian club," said Roy.

"How will this do?" put in "Doc;" "The Modern Order or Ancient Engineers." The motion was carried with a storm of applause.

"This means that we've got to study ancient history," said Bill, "and I appoint Jim and 'Doc' as a committee of two to look up the subject and work out the details of our organization."

A New Club House

Next we discussed the question of building a new home for our club, to take the place of the cave we had dug the year before. Caves, huts, log cabins, and tree houses were in turn proposed and rejected. But finally someone suggested that we construct a lake house on Fithian's Pond. The proposition seemed a good one, and the entire club, Professor James included, walked down to the pond to make a preliminary survey.

Fithian's Pond was a boggy, half-submerged tract, near the Academy grounds, that had once been a mill pond, but the dam had been completely destroyed, and a large stream flowed through it to a much larger pond beyond called Jenkin's Lake. We planned first to reconstruct the dam, and then to build our lake house on a bank which would be covered to a comparatively shallow depth when the dam was completed.

The Bramble Path

The shores of the pond, particularly on the western side, were clothed with a thick, almost impenetrable, mass of undergrowth and briars. The year before, Bill had chanced on an old forgotten trail through the matted growth, which led to the water's edge. Here there were splendid opportunities for concealing a boat. By the judicious use of a hatchet, Bill had trimmed a clear path which, however, was completely hidden at each end by a large bush that had to be parted before we could enter the trail. We planned to use this path as our main approach to the lake.

Pile Driving

On the following afternoon we commenced operations on the dam. The gap we had to fill was about ten feet wide, and we meant to build the dam to a height of five or six feet. First we chopped down three young trees, trimmed off the branches, and made three posts or piles, each ten feet long. The posts were pointed at one end, and the branches which had been chopped off were piled away for future use. Bill and "Sneezer" had worked out a method of construction. They proposed to drive these posts into the bed of the stream and then pile logs and brush against them. Just how we were to drive the posts without a pile driver puzzled me, but Bill said he had seen a "human pile driver" on the Harlem River, and was sure we could drive our piles in the same way, particularly as the stream had a soft, mud bottom. Back of the barn we found a long two-inch plank, which was put into service. The end of this plank was sawed out to a V shape, as shown in Fig. 5, so that it would fit partly around the pile or post. A ten-foot pile was set upright in the stream, with its pointed end sticking in the mud, and the plank was laid with one end resting on the shore and the other on a cleat, *A*, nailed to the pile at the proper height. To prevent the plank from slipping off the cleat, blocks, *B*, were nailed to the points of the V on the under side, and

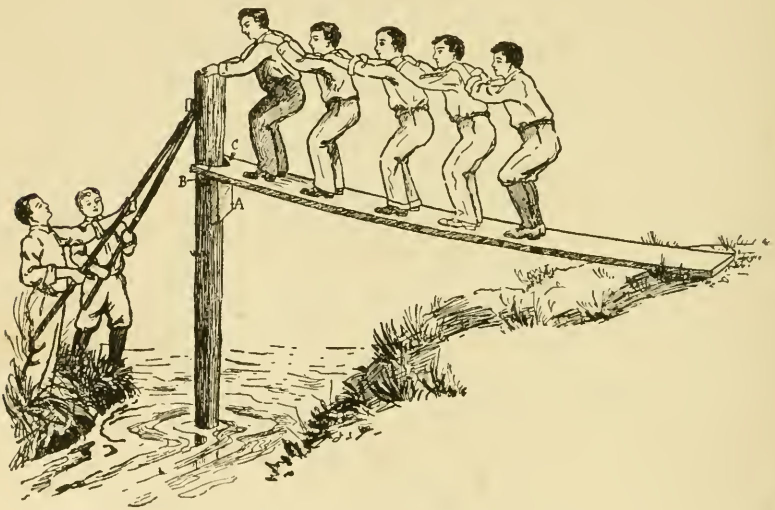


Fig. 5—When Bill counted three we all jumped

they fitted over the cleat. As a further precaution, nails, *C*, were driven through the plank into the cleat, but with the heads sticking up so that they could easily be withdrawn whenever desired. "Jig" and "Sneezer," who were the lightest members of the club, steadied the pile to start with by means of a pair of laths nailed to it, while the rest of us lined up on the plank, "Jumbo" Harris in the lead, for in this game avoirdupois was everything. Then when Bill counted three, we all jumped up and landed as one on the plank with a total weight of nearly six hundred pounds. The post dropped fully fifteen inches, and we had to knock off the cleat and nail it higher up, and then repeat the jumping operation. It took three jumps to drive the post the next fifteen inches, and before we had driven it to a depth of four feet we lost count of the number of jumps we had to make.

After the center pile was driven we drove the other two piles in line near the opposite banks, but with the ends sticking up about six inches higher than the center pile. The

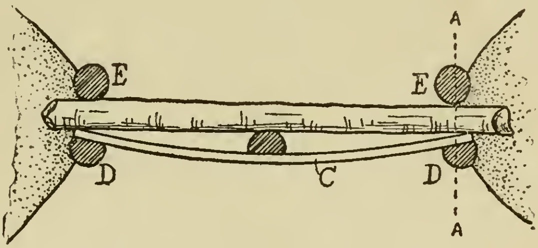


Fig. 6—Looking down on the top of the dam

piles were connected at the top by a board, *C*, which was bent around the front of the center pile and back of the other piles (see Fig. 6). This helped to stiffen the upper end of the central pile. To the rear or upstream side of each of the side piles, *D*, and six or eight inches from them, two lighter posts, *E*, were driven into the mud. These sticks were driven with an ax, as it was not necessary to sink them to any great depth.

A Log Wall

Our next task was to cut a number of light logs, which we wedged down between the piles *D* and *E;* thus a log wall was built across the stream. To stop up the cracks between the logs, we lowered a mass of brush and branches against the upstream side of the dam, sinking it with loads of earth and stone. The water forced this mass against the logs, pretty effectually stopping the leaks. The main trick in building a dam is to prevent the water from washing out the banks at each side, so Professor James told us, and we over-

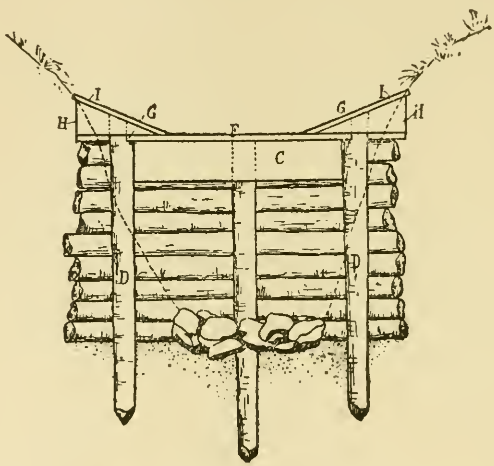


Fig. 7—A log wall across the stream

came the difficulty by building up the sides of the dam higher than the center so that the water would flow over the center only. Fig. 7, which is a front view of the dam, shows how this was done. A board, *F,* was nailed onto the top of the dam, forming a sort of sill. The two end piles, which extended through the sill, were notched to provide a bearing for this board. (See *G,* Fig. 7.) Four wedge-shaped boards, *H,* were then sawed out, and nailed onto the sill and to the piles at each side, and finally two boards, *I,* were nailed onto the wedge-shaped pieces.

Nearly two weeks elapsed before the dam was entirely completed. The pond filled as rapidly as we built, and was

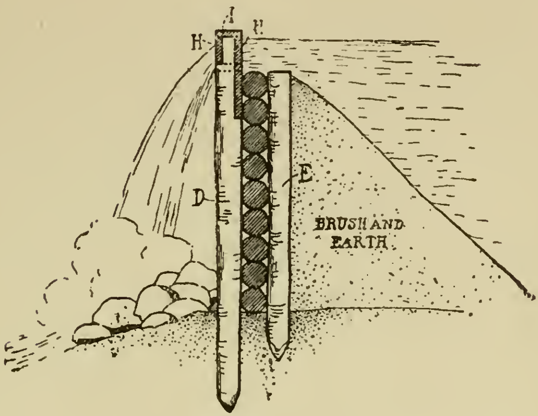


Fig. 8—The filling behind the log wall

pouring over the top of the dam before we had finished dumping rock and earth on the upstream side. A pile of stones was dumped on the downstream side of the dam to break the fall of the water and prevent it from washing out a deep hole and undermining the central pile.

CHAPTER III.

BOAT BUILDING

It was not until after our dam had been completed that we realized how foolish we were not to have built the lake house before flooding the site with water. We did not even have a boat to navigate our lake. There was nothing to do but to build one, and we determined that as lake dwellers we should have something pretty nice, not a common scow such as most boys build. Roy Bowers designed the skiff and superintended its construction. His home was somewhere on Chesapeake Bay, and he knew more about boats than all the rest of us put together.

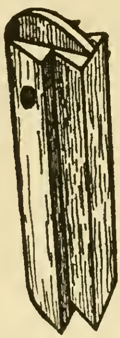


Fig. 9—The stem piece

First we bought four ¾-inch boards, each 14 feet long. These were planed on a taper, so that they measured 10 inches wide at the bow of our boat and but 9 inches at the stern. Out of a piece of oak 3 x 4 x 22 inches long we cut a stem piece like that shown in Fig. 9. Then we sawed out a mold or form such as shown in Fig. 10. The two lower side planks of the boat, or "strakes" as they are called, were now nailed to the stem.

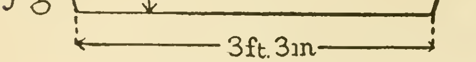


Fig. 10—The mold board

Galvanized iron nails were used, so as to prevent rusting. The form was placed between the strakes about 5 feet from the stem, and the opposite ends of the boards were then drawn together by means of a rope, which was tightened by winding it up like a tourniquet with a stick *A*,

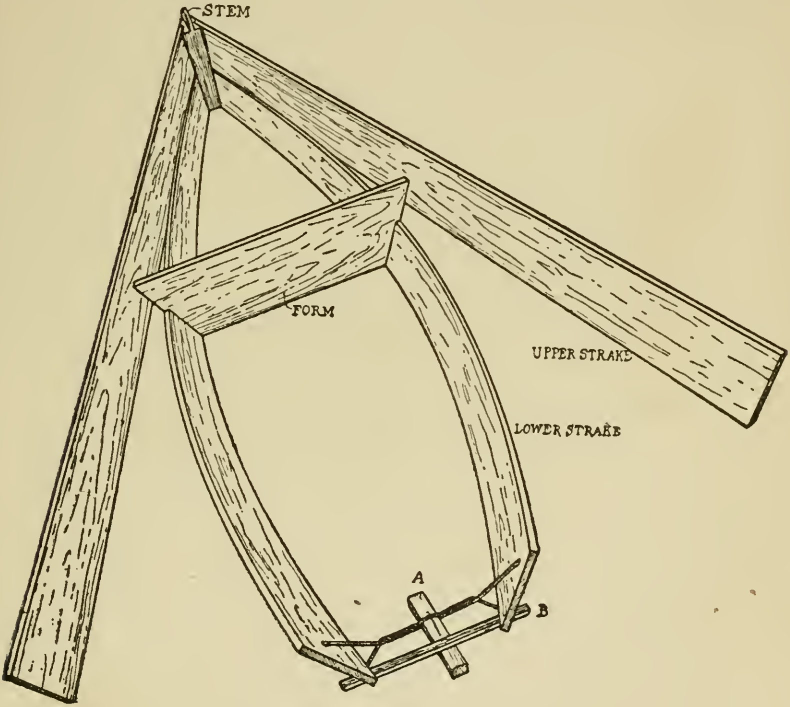


Fig. 11—Bending the side planks

as shown in Fig. 11. When we had drawn the ends of the strakes within about 28 inches of each other, the lever *A* was held in place by a bar *B* placed over it and under the ends of the boards. The upper strakes were now nailed to the stem piece with their lower edges overlapping the lower boards about an inch, and the boards were drawn together in the same way as the lower ones by means of a rope. It will be noticed that at the bow the lapping of the two boards is concealed, and they come together at the stem as if one were directly above the other. To accomplish such a joint, we had to bevel the meeting edges of the upper and lower strakes for a distance of about 40 inches

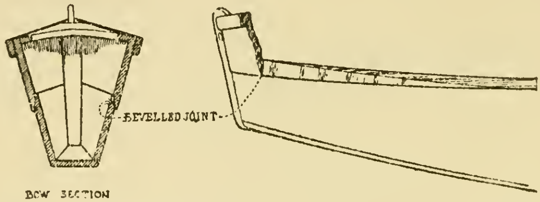


Fig. 12—The beveled joints of the upper and lower strakes

from the stern, as indicated in Fig. 12. The upper and lower strakes were now nailed to the transom, 34 inches wide at the top and 29 at the bottom. (See Figs. 13 and 15.) This done, the strakes were nailed together along their overlapping edges. The gunwales *C* were then nailed to the upper boards. They were strips 2½ inches wide and ⅞ inch thick.

Nailing on the Bottom

The boat was then turned upside down, and the side edges were planed flat to receive the bottom boards, which were nailed on as shown in Fig. 13. The boards were not jammed up close to each other, but were separated by a very narrow crack, to allow for swelling of the wood when in the water. After enough of the bottom was nailed on to hold the sides of the boat in place without the rope, they were sawed off at an angle, starting at about 30 inches from the stern, as shown at *D*, Fig. 13. Then we continued nailing on the bottom boards over the incline and up to the transom. After the bottom boards were nailed on, their projecting ends were sawed off. A keel board 6 inches wide (*E*, Figs. 14 and 15)

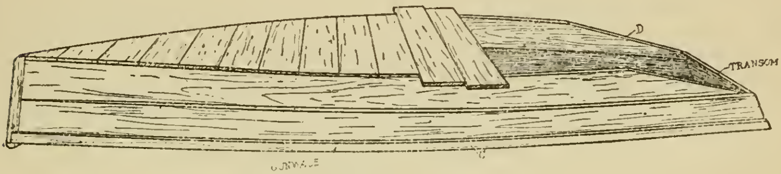


Fig. 13—Nailing on the bottom

was fastened to the bottom of the boat. This extended up the slanting stern to the transom. A triangular piece, *F*, called the "dead wood" or "skag" (see Fig. 20), was now nailed to the slanting part of the keel, and to it a sternpost, *G*, was secured.

The boat was now turned right side up, and ten ribs, which had been sawed out of an oak board to the form shown in Fig. 16, were nailed against the sides so as to bind the strakes firmly together. Two corner braces of oak, like that shown in Fig. 17, served to stiffen the joints between the sternboard and the upper strakes. Before the corner braces were nailed in place the stern seat was built in. This was made with

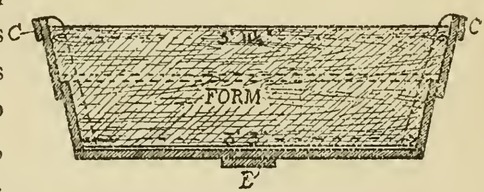


Fig. 14—A section through the center of the boat

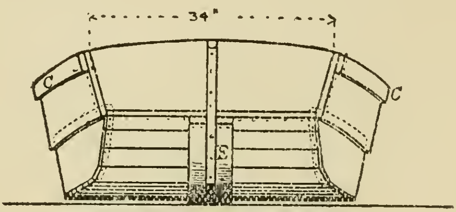


Fig. 15—Stern view of the boat

a removable section *H*, consisting of three boards fastened together with cleats, as shown in Fig. 18. A board *I* supported the front of the seat, and a strip *J* the rear, and

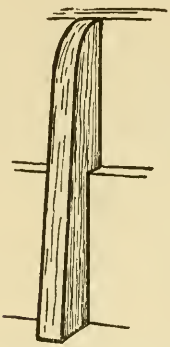


Fig. 16—One of the oak ribs

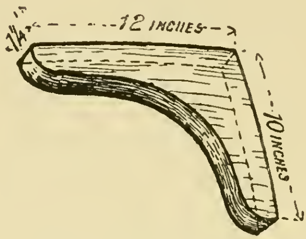


Fig. 17—Oak corner brace

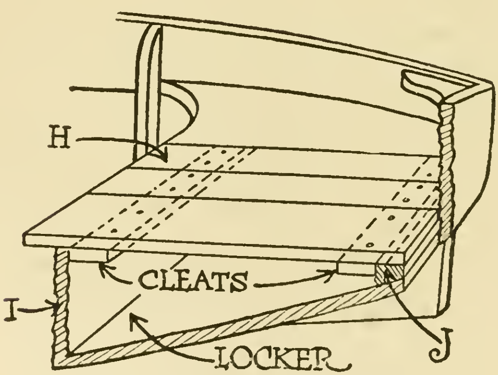
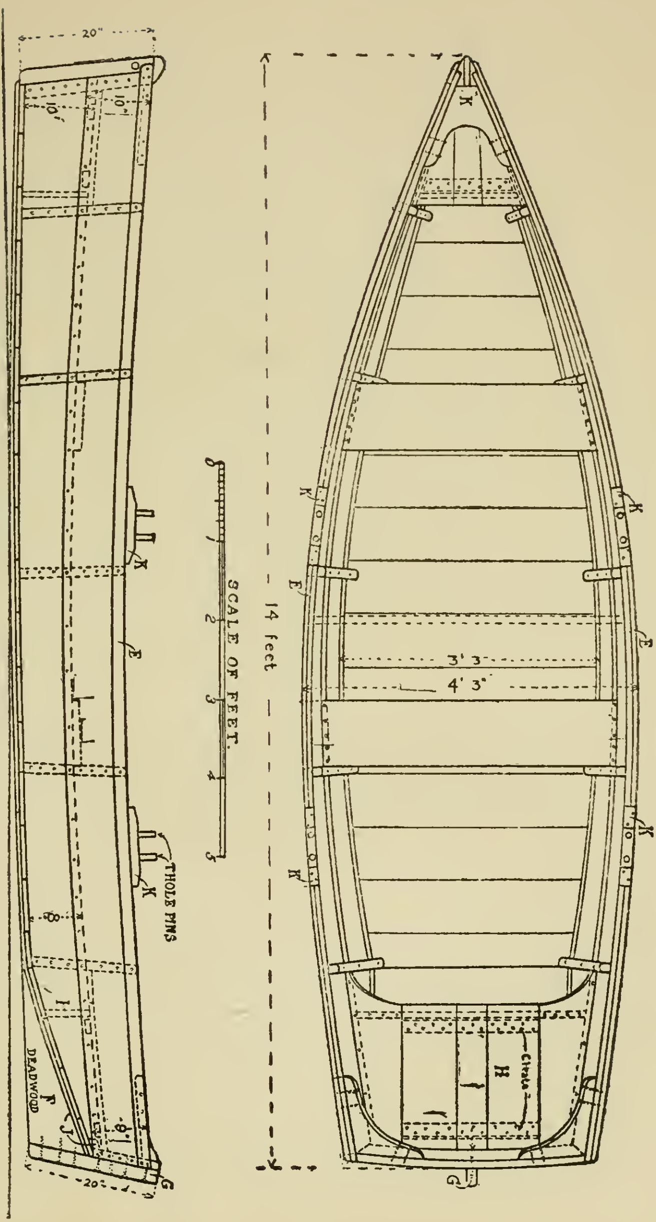


Fig. 18—The locker under the stern seat

the cleats fitted snugly between them. In this way a shallow locker was formed which was opened by lifting out the removable section. A locker was also built in the bow, the top of it forming the bow seat. A brace of oak was then nailed to the bow, as shown in Fig. 19. Two more seats were



Figs. 19 and 20—Plan and side views of the boat fitted into the boat, one 3 feet from the stern seat, and the other 27 inches from the bow seat. These two seats were 10 inches wide. They were supported on and nailed to the upper edge of the lower strake. There was but one more detail necessary to complete the building of the boat, viz., the oar locks. We cut four oak blocks, *K* (Figs. 19 and 20), each 12 inches long and 2 inches thick. In each block two holes were drilled, 2 inches apart, to receive the thole pins, which were driven tightly into place. The blocks were then nailed to the gunwales, so that the thole pins were about a foot abaft of each of the two seats. We did not attempt to make the oars for the boat, because they could be bought very cheaply.

Calking and Painting

Our boat was now done except for the calking and painting. We used all sorts of scrap materials to stop up the cracks—old rope, bits of cotton waste, and pieces of felt. In each case the calking was coated with white lead paint

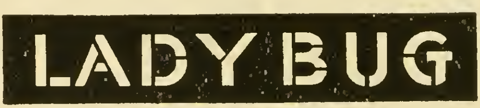


Fig. 21—A cardboard stencil

before wedging it into the crack. The nail heads were driven well into the wood, all over the boat, and covered over with putty. Then we painted the boat with two coats of white-lead paint, and trimmed it with red on the gunwales and stem and stern posts.

We settled on the name "Lady Bug" as the most suitable for the Big Bugs' boat. "Jig" painted the name on in red letters by means of a stencil which he cut out of a piece of cardboard, as shown in Fig. 21.

Launching the "Lady Bug"

When the boat was ready to be launched and put into commission, it occurred to us that we should have an appropriate launching ceremony. A programme was prepared and we issued cards of invitation, each card bearing the emblem of the Scarab in one corner drawn by "Jig," who was quite an artist.

The launching ceremony was a great success. The whole school came down, as well as some guests from the town. Altogether there was quite a crowd. Roy's sister, Nell, was the guest of honor, and had come all the way from Maryland for the christening. First of all, Professor James delivered an address, and while he was talking Bill and I stationed ourselves on opposite sides of the boat, which was mounted on several round sticks or rollers, resting on a couple of planks that were laid on the slanting bank near the dam.

After the address, Nell came forward and shattered a bottle of soda water on the bow of the boat, exclaiming at the same time, "I christen thee 'Lady Bug.' " At that instant Bill and I on opposite sides of the boat pulled out the chocks from under the rollers, gave the boat a shove, and the "Lady Bug" rolled majestically into the water, while Captain Roy waved aloft, not an Egyptian flag, but the dear old Stars and Stripes, for after all we were loyal Americans, despite our Egyptian name.

. . . . . .

"Say, did you see Pat Mulligan back of the crowd?" said "Sneezer" after the launching was over. Pat Mulligan was

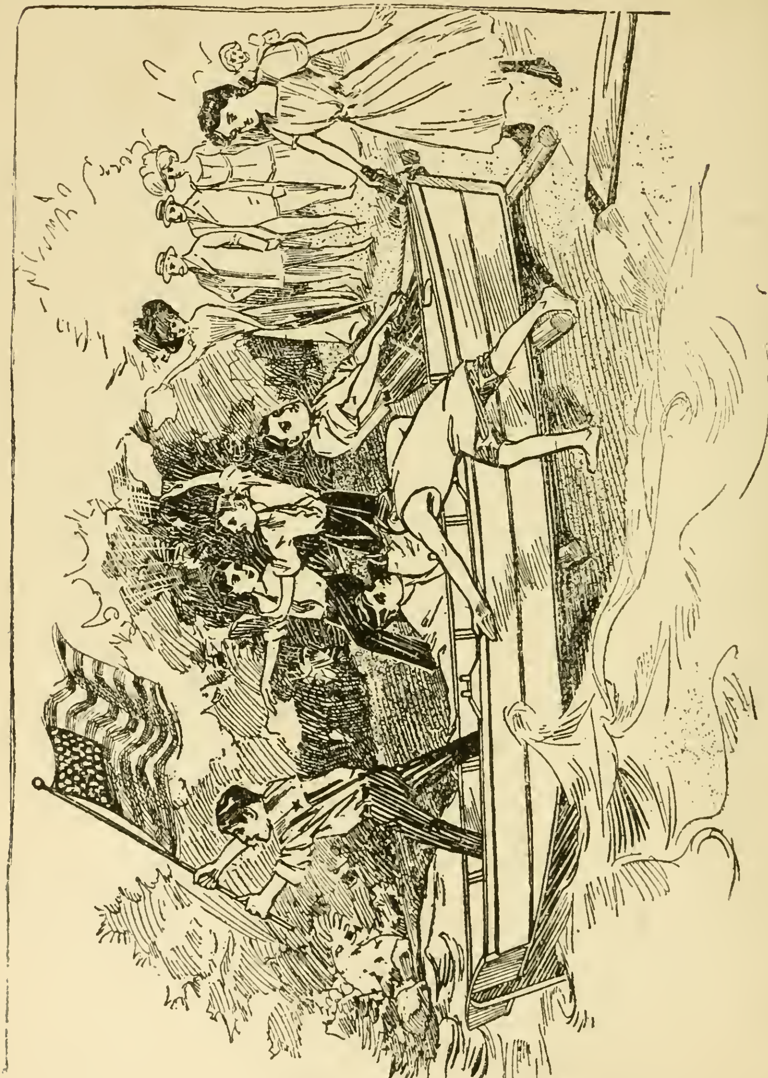


Fig. 22—Launching the "Lady Bug"

one of the toughest young rascals in town. He was the leader of a gang of hoodlums that were the terror of the East Side section.

"Well, he wasn't there for any good," I responded. "We had better hide our boat to-night or there will be trouble."

CHAPTER IV.

THE CLUB HOUSE ON THE LAKE

When we first started building the boat, all seven of us took part in the work, with the result that we were always in each other's way; so finally the boat building was left in the hands of Roy Bowers, "Jumbo," and myself, while Bill with the rest of the boys started work on a dock for the boat. The dock was built out from the end of our bramble path for a distance of 10 or 12 feet. The task was a simple one, for the water was quite shallow here. Into the bed of the pond, posts were driven in two rows, 3 feet apart. Each row was connected by a stringer, 1 inch thick by 4 inches

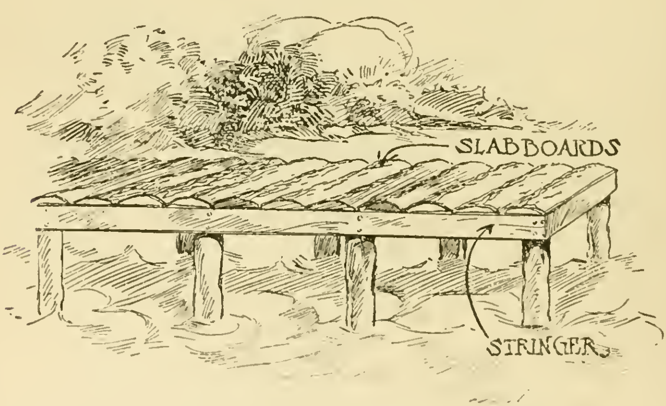


Fig. 23—A dock built out from the end of the bramble path

wide (Fig. 23), and on these stringers the flooring was laid. For the flooring we used slab boards, which we managed to get from a sawmill in the vicinity. (Slab boards are the worthless first cuts obtained in squaring timber. For this reason one side of the board is usually round and may have more or less bark on it, while the other side is flat.)

The dock was completed before the boat was done, but that did not prevent Bill from starting work on the lake house. It was evident that a number of piles would be needed for the foundations; according to Bill's estimate, sixteen. Fortunately, at the site chosen the water was but 2 or 3 feet deep, and we figured that 6- or 8-foot piles would be long enough, because the floor of the house was to be only a foot above water level. So, while Roy and I were putting on the finishing touches to the boat, Bill headed the rest of the club into Fithian's Woods near by, and proceeded to chop down the necessary timber.

Farmer Fithian

Farmer Fithian was a good old soul, who took a great interest in the Academy boys because he had attended school there fully fifty years before; although, judging by his grammar, he had not profited much by his schooling. He strolled over while Bill was hacking at the trees, and watched him for a while in silence. Finally he spoke up.

How to Chop Down a Tree

"Here; hand me that there ax, and I'll give ye a lesson in tree fellin'. Of course, ye ain't cuttin' down no sixty-foot trees, but ye might as well l'arn how it's done. First of all pick out the place where ye want it to fall at. Of course, if yer tree leans over a good bit, or if it has most of its branches on one side like this here," pointing to a tree which had a decided overhanging in one direction, "then it's sure to fall over that way, and ye can't help it. But if the tree is anywhere near straight, you can make it fall where ye want to. Now suppose ye was to cut down that big tree there and make it fall over toward the left. Ye'd start chopping on the left side; but first ye'd clear away the bushes all 'round, so they wouldn't ketch your ax when you was a-swingin' it. Now that's a pretty big tree. It must be two foot through. So ye'd have to start with two notches, two foot apart (Fig. 24) and split away the wood between 'em, and keep on a-cuttin' until ye're a little more'n half way through. Then chop away on the right side until she falls. Get off to one side when she begins to crack (Fig. 25) and don't think of standing behind the tree, because the butt end might kick out backward and land ye one in the stomach. That's what ye've always got to look out fur. That and the bushes as might ketch yer ax."

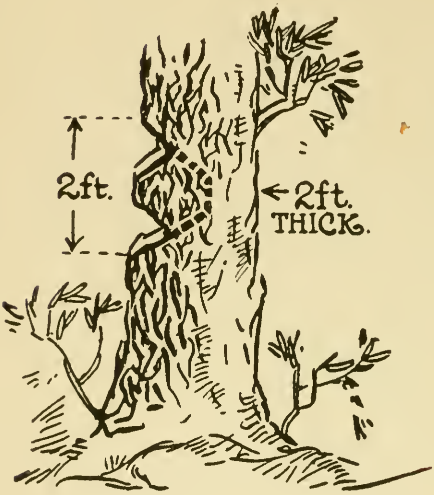


Fig. 24—"Two notches two foot apart"

Fig. 25 —"Get off to one side when she begins to crack"

Several days elapsed before we had cut and trimmed sixteen 8-foot piles each from 4 to 6 inches in diameter. The end of each pile was cut to a point, so that it could be driven into the bed of the pond more easily. Farmer Fithian happened along just as we were about to float the logs to the site of our club-house.

"Look a-here, boys. Don't try no fool games with them sticks. I ain't sayin' as there's much danger with small timbers, but ye might as well know, if ye're going to play lumbermen, that it's risky walking about on a lot of loose floating logs. They're liable to spread apart any minute, and leave ye drop in the water. Then they'll close over your head and ye've got to swim out from under the hull batch or drown. Ye've got to be mighty sure-footed running around on floatin' timber. But, shucks! Them sticks is too light fur to hold ye up anyhow."

The Working Platform

We explained to Farmer Fithian that we were going to tie the majority of our piles together in a raft and use it as a working platform, from which we could drive the other piles. But Farmer Fithian strongly advised against this, pointing out that if we started dancing on the plank, the raft would rock and maybe tip over, and we would be sure to get wet. At his advice then we procured a large packing box, weighted it with stone, and sank it at the spot where the lake house was to be built. The open top of the box projected 6 or 8 inches above the surface of the water, and a few boards nailed across it provided us with a fairly solid working platform. We proceeded as with the piles in our dam, driving the sticks into the bed of the lake by dancing on the planks. The boat was anchored securely near the box, and one of us standing in this held the pile while the rest of us did the driving.

Laying Out a Rectangle

Our house was to measure 12 feet wide and 8 feet deep, with a front porch 4 feet wide. Bill had figured out the "ground" plan as in Fig. 26, showing the position of each

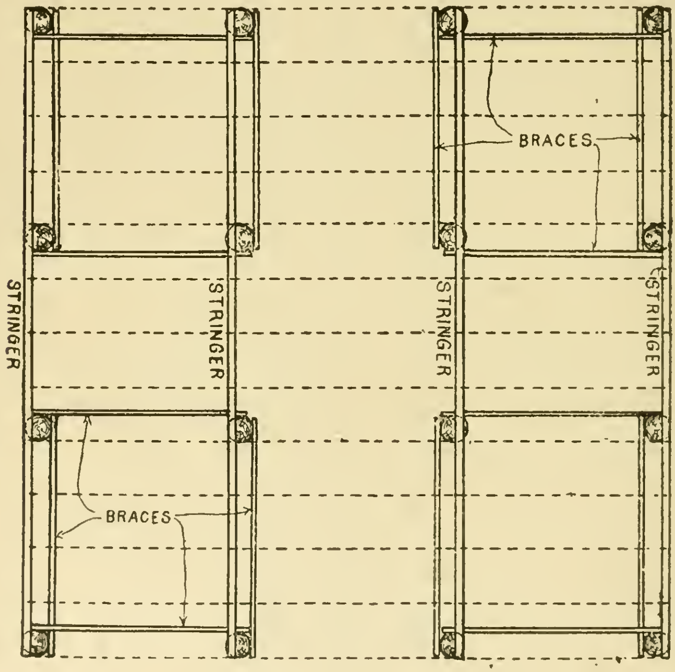


Fig. 26—The "ground" plan showing the position of each pile

pile. The first task then was to stake out a rectangle 12 feet square. Two stakes, *A* and *B*, Fig. 27, were first driven into the bed of the pond 12 feet apart, and a cord was stretched between them. This gave us a base line for the first row of piles. But how to get our side lines at right angles to the base line was a puzzle. Here Professor James came to our rescue.

"If a rectangular figure is 3 feet wide and 4 feet long, it will always measure 5 feet across corners," he said. "Remember that: 3, 4, 5. Or, if you want to double the dimensions, 6, 8, 10, or, to triple them, 9, 12, 15. It makes no difference how large the figure; the proportions will always be the same."

Under his directions then we drove a stake along our base line just 9 feet from the stake *B*, as indicated at *C* in the diagram. Then we tied a string to it, and also to the end stake *B*. The two strings were knotted together, one at a distance of 12 feet from stake *B*, and the other at a distance of 15 feet from stake *C*. Then holding the knot in his hand, Professor James backed away to such a position that both cords were drawn equally taut. The 12-foot side was then at right angles to the base line, and we drove a stake *D* at the end of this side. The fourth corner *E* was found by measuring 12 feet from the stake *A* and stake *D*.

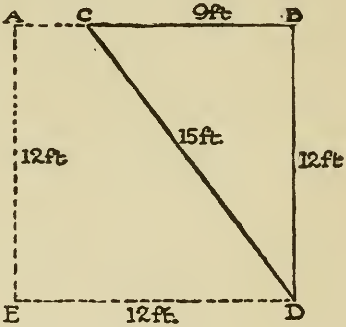


Fig. 27—Staking out a rectangle

From our packing box as a working platform we drove four piles in a square at one corner of the rectangle. The piles were about 4 feet apart. They were temporarily connected by means of stringers, and boards were laid across them to form a new working base from which to drive the other piles. The packing box was then knocked to pieces, and hauled away.

Triangles

The platform did not prove to be as solid as we expected. It swayed when we jumped our pile driver, and threatened to collapse. Professor James showed us very graphically

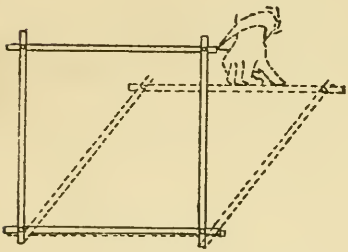


Fig. 28—Bore it down to a diamond shape

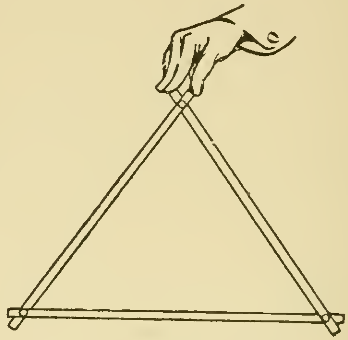


Fig. 29—It stood firm

what was the trouble. He took four light sticks and made a square frame, fastening them with a single nail in each corner. Then he stood the frame on end, and with a slight pressure of the hand on the top bore it down to a diamond shape, as shown by dotted lines in Fig. 28. Then he took three sticks and made a triangle in the same way, but when he tried to distort this it stood firm, no matter whether he pressed the sides or the corners.

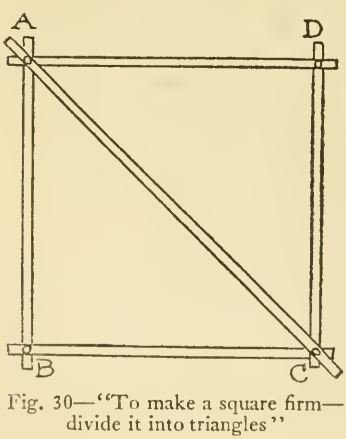


Fig. 30—"To make a square firm—divide it into triangles"

"The triangle is the only figure that cannot be distorted without bending or breaking one or more of the sides. You saw how weak the square was. A five-sided figure would be even worse. The only way to make a square firm, is to divide it into triangles. If you fasten a piece diagonally from one corner to the other, you will have two triangles, *A B C* and *A D C* (Fig. 30). If you put in two diagonals, your square will be made up of four triangles and will be stronger yet, because the smaller the triangles the stronger they are. Now if you are going to make your working platform solid, you will have to connect each pair of piles with a diagonal brace, so as to get the triangular construction that I have been talking about."

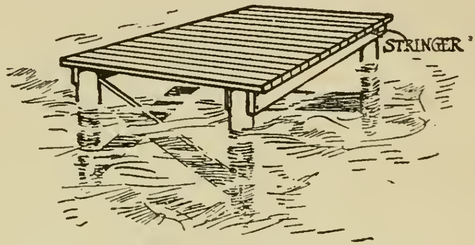


Fig. 31—"Connect each pair of piles with a diagonal brace"

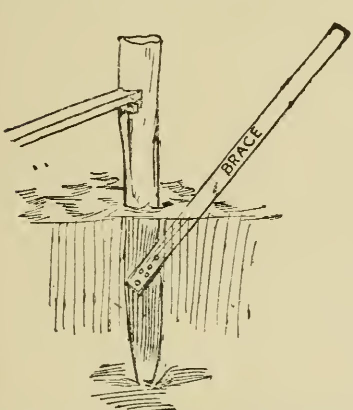


Fig. 32—Nailed a brace to each pile before it was driven

This proved to be a very troublesome task, because the lower end of the braces had to be nailed fast under water. It was then getting late in the year and the water was too cold for comfort, so we drew straws for the one who should do the under-water hammering. "Sneezer" was the unlucky chap, and he had to wade in and nail the lower ends of the braces to the piles underneath the surface. This done, our platform was as solid as could be desired.

From the platform as a base we drove as many piles as we could conveniently reach. Then we extended the platform over the piles just driven, and from this new base drove more piles. Thus the platform was extended until the entire foundation of piles had been driven. Profiting

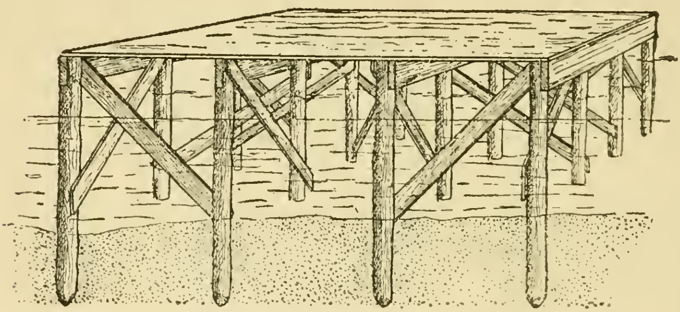


Fig. 33—Four separate piers supporting the floor

by our experience with the first set of diagonal braces, we nailed a brace to each pile before it was driven (see Fig. 32), and after the pile was down in place the upper end of this brace was nailed to the next pile. The four piles at each corner were then braced, making four separate piers. (See Figs. 26 and 33.) By consulting Fig. 26, it will be observed that certain of the braces had to be fastened to the inner side of the piles, so as not to be in the way of the stringers.

The Floor of the Lake House

The working platform, which had so far been built on the piles, was only of a temporary character. When all the piles had been driven, this platform was removed and a permanent floor was laid. First we nailed the stringers or floor beams to the sides of the piles. These floor beams were 2-inch planks, 6 inches wide and 12 feet long, which we bought especially for the purpose. The piles were cut to a depth of an inch or more at the side, to provide a flat bearing surface for the planks. After the planks had been nailed on, we sawed off the ends of such piles as projected above the floor beams, after which we proceeded to nail down the flooring. Instead of slab boards, 1-inch planks were used here, because we wanted to have a solid foundation for our house.

The Frame of the House

The floor done, we started immediately to work on the house proper. For the corner posts 2 x 4-inch scantlings were used. These were cut to a length of 7 feet. We set them up in place, with their lower ends nailed to the floor, as shown in Fig. 34, while near the top they were temporarily fastened together with slab boards. The two front posts, *A,* were now connected at the upper end by means of a board, *B,* 6 inches wide by 1 inch thick. The bottom of the board was just 6 feet from the floor. The two rear posts were similarly connected, and at exactly the same height. To make the frame more substantial, corner pieces (*C,* Fig. 34) were nailed to the foot of each post, and diagonal braces were temporarily fastened from one post to the other.

Then we made four triangular frames for the roof, like that shown in Fig. 35. The horizontal beam or chord, *D,* was 14 feet long over all, and the two inclined rafters, *E,* were 8½ feet long. They were fastened together so that the peak of the triangle was just 4 feet above the chord *D*. After we had made sure that all the frames were exactly alike, the projecting points, which are shown in dotted lines in the illustration, were sawed off. Two roof frames were now set up on the wall plates, *B*, one at each end, and nailed to the projecting corner posts, *A*. At each end of the house two more posts, *F* and *G*, were set up, but these were over 9 feet long, so that they would reach up to the slanting rafters, to which they were nailed as well as to the chords. (See Fig. 36.) The two posts G marked the front corners of the house, and they were connected by a wall plate *H* to help support the rafters. Two other 9-foot posts were set up along the front of the house about 4 feet apart, and the plate *H* was nailed to them,

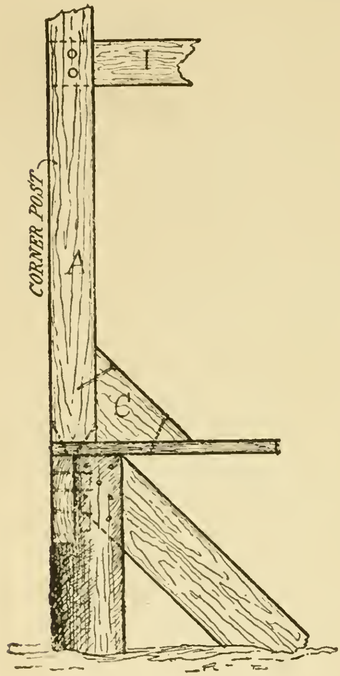


Fig. 34—A corner post

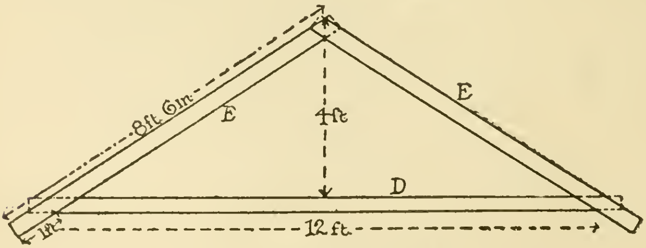


Fig. 35—One of the roof frames

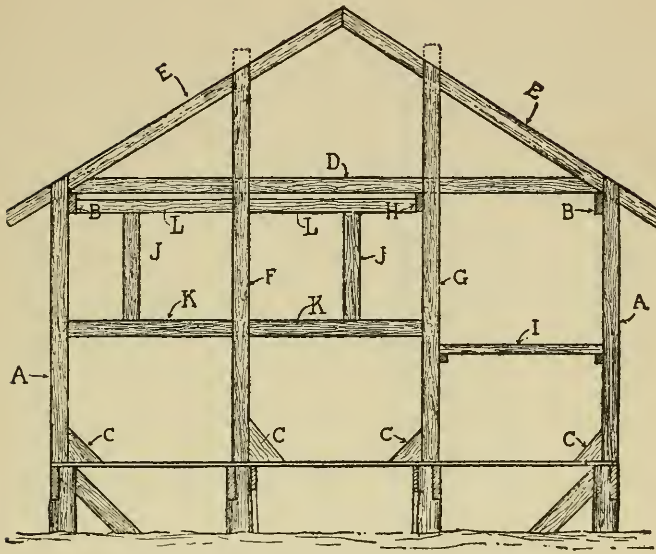


Fig. 36—Side elevation of the frame work

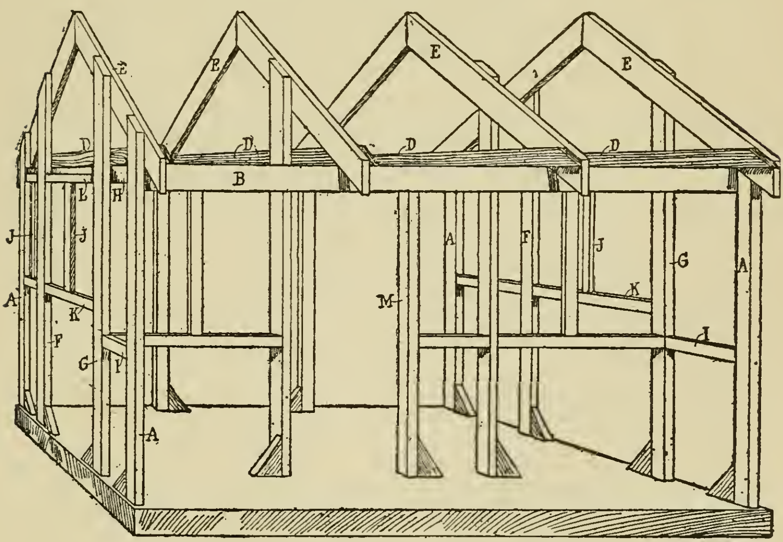


Fig. 37—A front view of the frame work

and then opposite them at the rear of the house two 6½-foot posts were erected and secured to the rear wall plate *B*. We were now ready to set up the remaining roof frames, which were fastened as shown in Fig. 37.

At each end of the house a 2-inch square strip, *K*, was nailed from post *G* to post *F*, and another from there to the rear post *A* to form the bottom of the window frames. They were then connected to similar strips, *L*, above, by two studs, *J*, which formed the sides of the windows. At the front of the house two similar window frames were built on each side of the door, and for the door frame one more upright post, *M*, was required.

Putting on the Clapboards

We were now ready to put on the sheathing. Slab-boards were used for this purpose, and they were laid on like clapboards, beginning with the bottom one and running on up to the eaves with each board overlapping the board below. At the door and window frames the clapboards were, of course, cut away.

The roof was covered in the same way, but with a better class of board to insure a dry house. We started at the eaves, lapping the boards one over the other up to the peak. A strip of tar paper was laid over the ridge of the roof to keep it from leaking, and for the sake of appearances we covered the paper with a pair of clapboards. Our window sashes and casings we managed to pick up from a builder for a

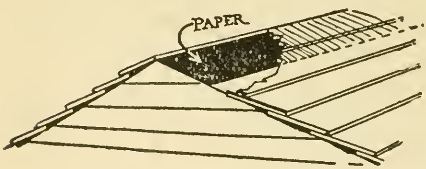


Fig. 38—Tar paper was laid over the ridge of the roof

mere song. The door of our house was of the simplest type, and needs no special description. We lined the walls on the inside with burlap, over which building paper was tacked. This made a cheap but efficient wall covering that kept the house cosy and warm.

The Chimney Opening

We managed to get hold of an old sheet-iron wood stove, which was set up in the house with the stovepipe running out through the roof. We had a good deal of difficulty in keeping the round opening through the roof for the stovepipe from leaking. The difficulty was finally overcome by getting a small square box, which was fitted into a square opening in the roof. Through this the stovepipe was passed, and then the box was packed with asbestos around the stovepipe, so as to prevent danger of fire in case the stove became too hot.

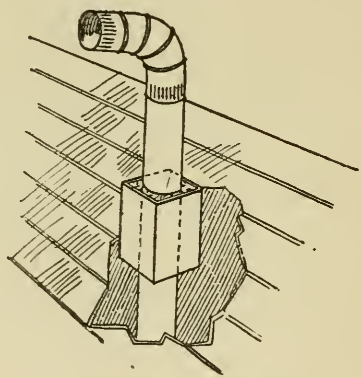


Fig. 39—The box was packed with asbestos

CHAPTER V.

A CHAPTER OF SURPRISES

OUR club house was done at last, and so important an event could not pass without some sort of a celebration. "Let's have a midnight banquet," suggested "Doc," and dedicate the house to the Sacred Scarabeus.

"Professor James won't stand for that!" cried Bill.

"Oh, bother Professor James! Let's sneak out just this once. It will be lots more fun than anything we've done yet, and he won't know anything about it."

The plan seemed very alluring. There is such a delightful mystery about midnight feasts. Some of us favored telling Professor James, feeling sure that he would enter into the plan, but then, as "Doc" pointed out, "there ain't any fun in it if there ain't any danger of getting found out." Bill put the question to a vote, and it was decided against Professor James.

"Jumbo," who was on the best side of the cook, managed to wheedle some provisions from her, and Roy sneaked down town for the rest of our eatables. We laid in a fine supply, because this was to be no ordinary banquet. There were as yet no furnishings in the lake house, and it took some pretty clever maneuvering to make off with seven chairs and a table from the school after dark without being detected by the other boys or by any of the teachers.

Midnight

Just as the clock struck twelve that night, seven boys, fully dressed, except for the shoes they had in their hands,

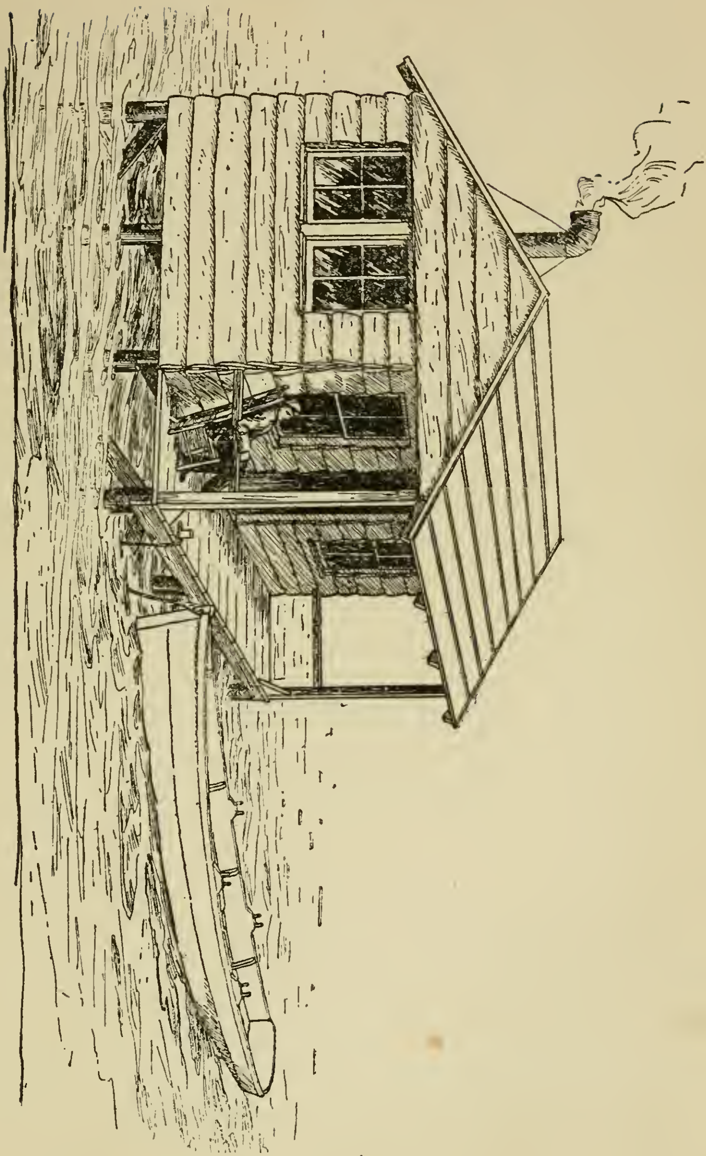


Fig. 40—Our club house was done at last

cautiously opened their doors and stole down the hall. With the recollection of our first night's experience, we did not propose to risk the creaky board in front of Professor James's room. Bill had discovered in a corner of the barn the rope ladder which we had used on our midnight expeditions of the previous years, and with the aid of this ladder we climbed down from the roof of the annex to the ground. It was a raw night, and a fine drizzle filled the air. So black was it, that we had to feel our way like blind men through the woods back of the Academy grounds. When we emerged from them, we could scarcely make out where we were. Our course among the trees had been a very circuitous one, and landed us some distance from the point we were aiming for. But soon we caught the faint glow of the corner street light struggling through the thick fog, and we groped our way toward it.

"Did you hear that?" whispered Bill suddenly. "Somebody's coming after us."

There was a sound of footsteps and the murmur of voices. We ran panic stricken for the bushes that lined the sidewalk. The footsteps came nearer and the talking grew louder. Soon a group of figures loomed out the fog and passed close by us.

The Mulligans

"Now, what the dickens do you suppose they're up to this time of night?" I whispered. "Who are they?" asked Bill. "Why, didn't you recognize Pat Mulligan and his gang? They're bent on mischief, I'll have you know." We were in no mood to attack the Mulligans if a fight could be avoided, and so lay quiet until they had passed out of hearing.

Anticipating some difficulty in finding our way through the thicket at night, we had anchored our boat at the dam instead of at our secret dock. Toward the dam then we wended our way. As we neared the water, we heard the Mulligans ahead of us.

"Stop them, fellows!" cried Bill. "They're stealing our boat." And we charged upon them at double quick. But we were too late. The Mulligans had already launched the boat, and were well out on the water. They were carrying on like mad, too, splashing around and making a terrible noise. Apparently they hadn't heard us, or they would have stood off and taunted us.

What were we to do now? and how in the world had they found our boat? It was a breathless and excited group that discussed these questions. We had anchored it behind a bush, so that it could not be seen from the road. They must have been spying on us, and no doubt they saw us laying in our provisions. Else, why would they have picked out this of all nights for their raid?

"If it weren't so blamed cold, I'd swim out and get that boat after they land at the lake house," said "Sneezer"; and then we could take them by storm and chuck them into the pond."

"Oh, I'm not afraid of the cold," declared Roy. "I'll bring back the boat." But he changed his mind when he had thrust his bare foot into the water to test its temperature. Besides, a swim in the dark, when the fog was so thick that you could not see your hand before your face, required a little more nerve than even Roy possessed.

Meanwhile the boat was not making much progress toward the lake house. They must have lost their bearings, because the racket seemed to grow nearer. We could hear them fighting over the oars, which they were using to splash water on each other rather than to make progress toward the house. Presently we heard a fellow cry out that one of the oars was lost. Then suddenly all the noise was smothered in one tremendous splash, followed a moment later by a chorus of spitting and spluttering curses. They had upset the boat, and it was now our inning.

An Ambush

"Keep quiet," Bill whispered, "and we'll give them such a dose as will teach them never to monkey with our property again." We could hear Pat Mulligan swimming off toward the left, calling to the rest to follow him. "He's heading for the brambles," whispered "Jumbo." "He'll have the dickens of a time getting through that thicket. All they can do is to wade along the edge of the pond until they come back here."

"That's right," said Bill. "We'll lie in ambush at the edge of the thicket. Don't stir until I give you the word. Then whoop it up for all you're worth, and give them the fight of their lives. We'll know the enemy by their wet clothes." Three of us hid along the edge of the thicket, and the rest crouched down along the shore a little way off, so that we could head off the Mulligans and attack them from both sides.

Put to Rout

A few minutes later we heard them wading toward us, shivering with the cold, and each one blaming the other for upsetting the boat. As they cleared the thicket and came to shore, Bill and I closed in behind them. Then with a yell that would have sent the shivers through an Apache

Indian we swooped in upon them. We had them on the run from the start. There was no fight left in that gang. They just "piked" for home as fast as they could make it. We chased them as far as the Academy grounds, pitching and falling over each other and them in the darkness. Suddenly I heard "Jumbo" yelling, "Help, quick! I've got Pat Mulligan!" We hurried back to find him sitting on his victim's head, struggling desperately to hold him down.

"You blamed chump!" came a smothered voice from beneath. "Get off, I tell you, I'm no Mulligan."

Almost helpless from laughter I dragged "Jumbo" off our illustrious president. My! but wasn't he mad!

"I told you fellows to go for the wet clothes, and here this 'Jumbo' elephant tripped me up and fell on me before I could get my feet again."

"Jumbo" may have been stupid, but the joke was on Bill after all, and our laughter didn't improve his frame of mind.

With our boat lost the banquet was out of the question, but we had had about enough fun for one night, and it was with no regret that we groped our way up the rope ladder to the roof of the annex and took off our shoes and then crept stealthily into the hall window.

The Light in the Hall

Suddenly a light flashed up in the hall, and there under the lamp was Professor James. Not a word did he say as we passed in shame-faced review before him to our rooms.

The next day we waited all day for an invitation, not to Professor James's own room, but to his office.

When school was over we went down to our lake, and found the boat stranded bottom up against the dam. One of the oars was close by, but the other had been washed over the dam, and after a long hunt we discovered it quite a way down stream. The boat was pretty well battered up, and many scars bore testimony to the ill-treatment which

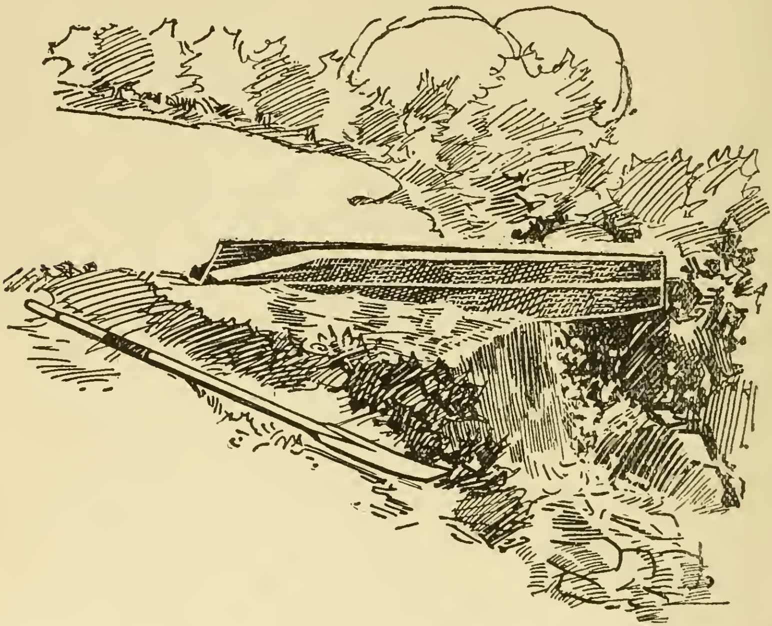


Fig. 41—Stranded bottom up against the dam

it had received. But we were delighted to find that it was perfectly sound and did not leak a drop.

We rowed across to the club house, and talked over our experiences. Not a word had been said to us by Professor James, and this surprising attitude was the chief topic of conversation. We would have felt better if he had given us a lecture, but his silence, and above all his very evident sense of disappointment in us, was more than we could stand.

"We didn't treat him square," was the consensus of the club; "and it's up to us to make good." A resolution was drawn up in which we clearly stated what we had done and our reasons, and in which we begged Professor James to pardon us.

A Daylight Banquet

The victuals which we had gathered for our feast were untouched, and such of them as were not liable to grow stale we planned to use at a feast on the following afternoon. As a postscript we asked Professor James to come to this feast in token of reconciliation. Professor James accepted our invitation in a formal note to our president, but he did not mention our spree of the night before, nor was any reference made to it thereafter. And so it happened that there was no midnight dedication feast, but a well-ordered daylight banquet at which we had no end of fun, for Professor James was at his best and soon broke down the strained relations which had existed between us.

CHAPTER VI.

THE MODERN ORDER OF ANCIENT ENGINEERS

In the meantime "Doc" and I were putting in all our spare moments on ancient history. It seemed best to model our club after the Egyptians, because we had already adopted the Egyptian scarabeus, or sacred beetle, as our club emblem.

There were seven offices to be provided, Professor James having declined a title because he did not take a very active part in the club. The highest office was that of Pharaoh, whose power extended over every other office, and naturally Bill was the one to occupy this responsible position. I was chosen to fill the office of Visier, a sort of secretary and right-hand man to Pharaoh, with supervisory power over all the other offices except that of the Chief Priest. Of course, we had to have an Arch Priest and Astrologer, and there was no question as to who should fill this position. "Doc" was the slickest sleight-of-hand performer I had ever seen

Fig. 42—Rameses Amenophis Amenhotep

off the stage, and a pretty good ventriloquist too. He was always up to tricks of one sort or another, and all these qualifications were most essential to one who was to be the priest of the Sacred Scarabeus. The old Egyptians often found it necessary to perform miracles, and they had to resort to all sorts of tricks to hoodwink the public. The priests were the first scientists. Science was their stock in trade. It helped them mystify the people. Hence, "Doc" would have to represent the scientific end of our club, particularly experimental physics.

The other four nobles in our society were the Chief Admiral and Naval Architect, the Chief Engineer, the Chief Craftsman, and the Chief Artist. Each one of us took an Egyptian name, and so the roll call of the club with the official titles was as follows:

Bill Rameses..........Pharaoh.
Jim Amenhotep........Vizier.
"Doc" Amenophis.....Arch Priest and Astrologer.
Roy Ahmosis..........Chief Admiral.
"Sneezer" Menes......Chief Engineer.
"Jumbo" Unis........Chief Craftsman.
"Jig" Sonches.........Chief Artist.

Unis Ahmosis Menes Sonches

Each officer had his official seal, consisting of hieroglyphics that we had picked out of a book on Egypt. Of course, we did not know what they meant, but they were chosen for their artistic effect.

The Rogues' Gallery

"Jig," whose task it was to ornament the lake house, made a portrait of each member of the club, and arranged them in sort of a "rogues' gallery" along the rear wall of the

Fig. 43—Drew an outline of the shadow

room. He drew them all in Egyptian style, with the shoulders squared as if in a front view and the rest of the body in profile. In order to have the pictures really look like us, he made a "shadowgraph" of each face. The subject stood in the lake house close to one of the front windows. A lamp was placed before him, so as to throw a shadow of his profile on the window pane. "Jig" stood out on the porch, and holding a sheet of thin paper against the glass pane drew an outline of the shadow.

The Pantagraph

The silhouettes that "Jig" made in this way were larger than life size, and they had to be reduced to convenient

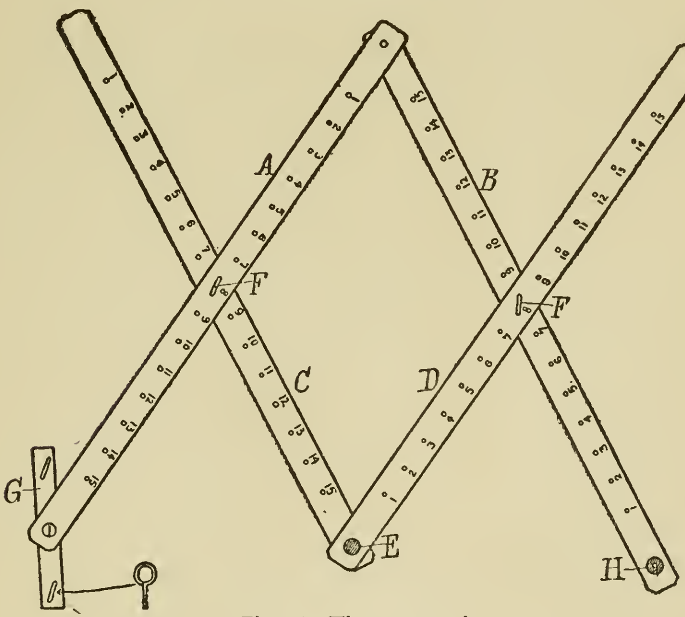


Fig. 44—The pantagraph

proportions by means of a pantagraph. This was constructed out of four sticks, each 20 inches long, as shown in Fig. 44.

The sticks *A* and *B* were pivoted together with a screw.

The sticks *C* and *D* were also pivoted together, but instead of using a screw they were provided with a hole through which a pencil *E* was passed, forming the pivot. At intervals of an inch along the four sticks holes were drilled and numbered, as shown in the illustration. The numbers on stick *A* started from the pivot, while on stick *B* they ran toward the pivot. On stick *C* the numbers ran toward the pencil *E,* while on stick *D* they started from the pencil. The two pairs of sticks were connected by means of screw eyes *F,* which were passed through the holes of the same number. At the end of stick *A* a piece of wood, *G*, was fastened with a screw, and was provided with screw eyes, as shown, which could be screwed into the drawing board to make this end fast. At the end of stick *B* there was a hole to receive a tracing point *H*. When this was run over the lines of the silhouette, the pencil *E* traced a similar outline, but on a much smaller scale than the original. If the connections of the pantagraph were made at holes of a larger number the reduction was greater, and if at holes of a smaller number the reduction was less. By connecting, for instance, hole 4 with hole 12, or some other odd combination, the resulting outline drawn by the pencil at *E* would be a distorted reproduction or caricature of the original traced at *H*. By putting the tracing point at *E* and the pencil at *H,* enlargements could be made.

Drawing One's Own Silhouette

"Jig" made out all right with our shadows, but when it came to drawing his own silhouette, he found it a decidedly different task. We offered to make the tracing for him, but no, he wouldn't let us meddle with his work. He pinned a piece of paper to the wall, placed a lamp on the table directly before it, and seated himself close to the wall, so that his head cast a strong shadow on the paper. Then, with a mirror in his left hand and a pencil in the other, he started to outline his shadow. I say "started," but he could not even do that at first, because his pencil seemed to wander everywhere but in the right direction. Of course, the mirror reversed everything, and made it look as though the pencil should be moved to the right when in reality it should have been moved to the left. In addition to this difficulty, the pencil kept getting in the way of his eyes, so that he could not see the line he was trying to follow. It was a pretty confusing performance, and we had lots of sport watching him, but "Jig" was persevering, and finally succeeded fairly well. Then we all had to try the trick, and found it very puzzling indeed. Not a bad entertainment, by the way, for an evening party.

Official Seals

The silhouettes all drawn, and reduced with the pantagraph, the next task was to draw the rest of each figure in Egyptian costume. Pharaoh, of course, was pictured as seated on a throne, but the rest of us were shown standing. The profiles were so true to life that it was easy enough to recognize the different members without reading their names and titles below. The official seal of each officer was placed in the right-hand upper corner of each portrait. The principal figures on Pharaoh's seal were the lion, which signified strength, and a fly to indicate his persistence. The Vizier's seal contained a hawk, denoting boldness, and a dog, for devotion to Pharaoh. In "Doc's" seal there was an owl, representing wisdom, and a bat to show his connection with the black art. A fox and a snake represented the skill and ingenuity of our Chief Craftsman. Our Chief Admiral had a duck in his seal, also a crocodile, to show that he was the king of the water. The Chief Engineer had a pyramid, representing his skill in constructional work, and a goat to show his ability to overcome obstacles; while the Chief Artist had a dove, representing works of peace, and a turtle to signify his perseverance.

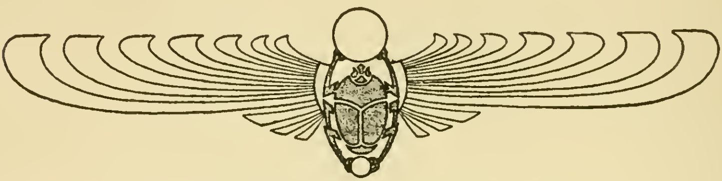


Fig. 45—He had drawn an immense scarabeus

Outside of the lake house over the doorway "Jig" nailed a board on which he had drawn an immense scarabeus in true Egyptian style, with wings spread out and standing on a globe and holding the sun with his forelegs.

The Workbench

In the meantime our Chief Craftsman was at work fitting up a workbench in one corner of the lake house. He had quite a complete workshop there before he got through. First he made a frame like that shown in Fig. 46. One of the uprights or posts was a 2 x 4-inch scantling, while the other was cut from a 2 x 8-inch plank. The posts were connected at the top and bottom, and braced with diagonal strips. The wide post was to serve as the stationary jaw of the bench vise, as indicated at *A*, Fig. 47. For the other end of the bench another frame was made exactly like the first, with the exception of the wide post. The two frames were

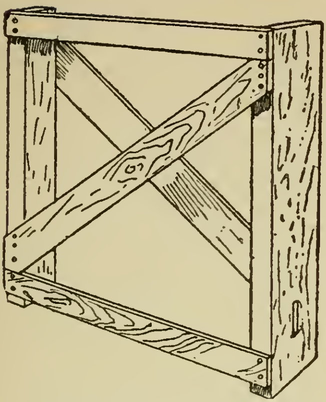


Fig. 46—Frame for the left end of the workbench

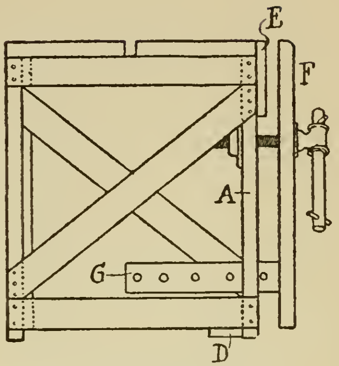


Fig. 47—The left end of the workbench

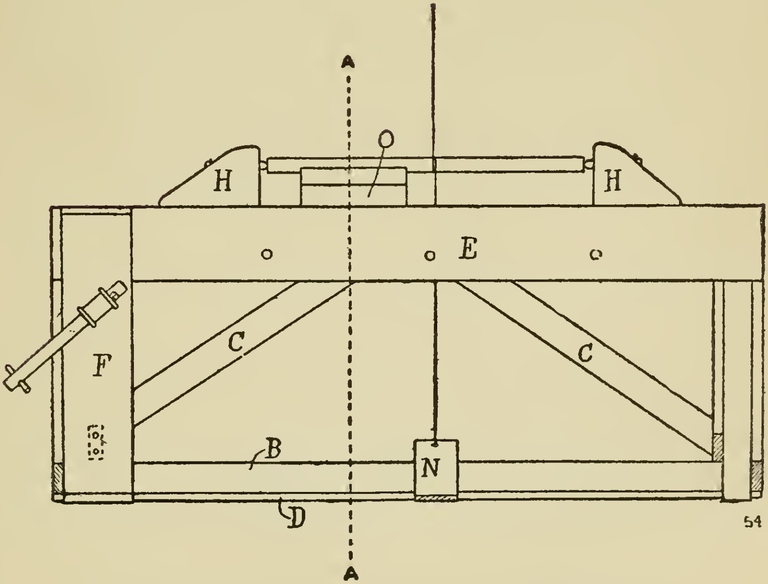


Fig. 48—Front view of the workbench with the lathe attached

connected at the rear by means of boards *B* about 6 feet long, and they were braced with diagonal strips *C* (Figs. 48 and 49). At the front a board *D* was used to connect the frames. "Jumbo" expected to rig up a lathe on this bench, and therefore the board *D* was nailed to the bottom of the lower horizontal frame pieces, so as to be out of the way of the treadle of the lathe. The top planks of the bench were now nailed to the frames. They were spaced apart at the center, leaving a slot an inch wide, the purpose of which will be explained presently. A plank *E,* 12 inches wide, was secured to the side of the bench overlapping the edge of the forward top plank, to which it was nailed. This gave us a very substantial construction.

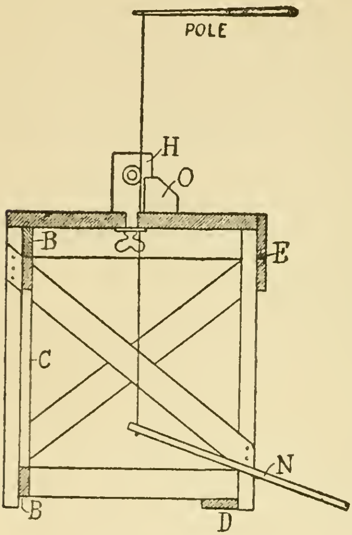


Fig. 49—A section through the bench and lathe

The Bench Vise

For the movable jaw *F* of the vise we took a 1½-inch plank 8 inches wide. Near the bottom we nailed a wooden piece *G,* which was to serve as the heel. The heel was made fast by what is called toe nailing, that is, the nails were driven through the end of the heel diagonally into the face of the jaw. Before the bench had been put together, a slot was cut in the front post *A* to receive this heel. The slot was made by boring two holes in the post and then cutting out the wood between them. Holes were bored into the heel for a peg, which kept the heel from being forced into the slot when the vise was screwed up. The vise screw and nut were bought at the hardware store, and were fastened in place about 9 inches below the top of the bench.

An Egyptian Lathe

The primitive lathe which "Jumbo" rigged up on the bench was made as follows: Out of a heavy stick of oak he cut two blocks, *H*, like those shown in Fig. 50. These were to be the head and tail stocks of the lathe. In the bottom of each block he bored a hole and chiseled it out square, so that he could just drive the head of a bolt in it. The shank of the bolt he passed through a stick *J*, which he nailed to the bottom of the block. This stick was just wide enough to fit in the slot between the top planks of the bench. The blocks were locked at any point along the bench top by means of thumb nuts *K* and broad washers *L* on the bolts. A long bolt was fitted into each block, with the end projecting from the front face of the block. A nut *M* was screwed onto the projecting end, and the latter was filed to a point to form a center on which the work was to be revolved. "Jumbo" was careful to have the centers both in line with each other, so that the points would meet when the blocks were brought together.

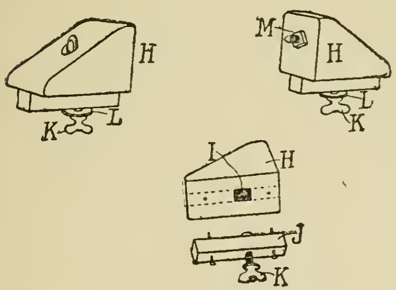


Fig. 50—The head and tail stocks of the lathe

To the ceiling above the bench he fastened a slender pole or sapling, with one end free. A light rope tied to this free end passed down through a notch in the bench to a board *N*, which served as a treadle.

When he desired to use the lathe, he would take a turn of the rope about a piece of wood and center the piece between the pins in the blocks, as shown in Fig. 51, after which the blocks were locked in place. The rope was run along

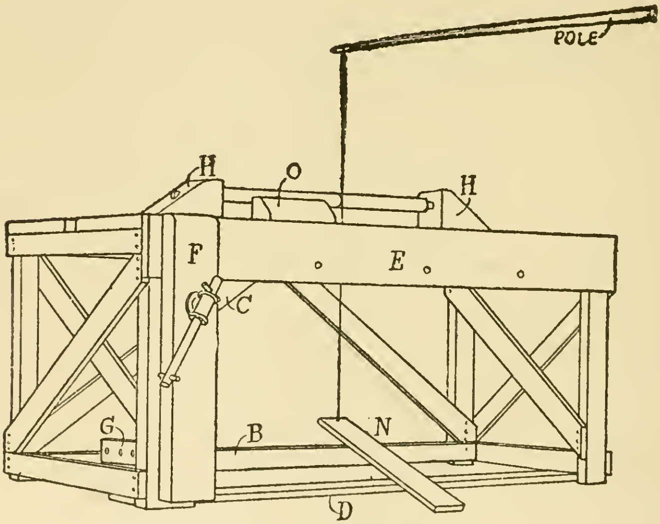


Fig. 51—A general view of the Egyptian lathe

the piece in such a way that when "Jumbo" pressed his foot on the treadle, the piece would turn toward him. Whenever he released the treadle, the sapling would pull up the rope and turn the work in the opposite direction. He used a block of wood *O* as a rest for his chisel. At each down stroke of the treadle the chisel would cut the wood, but on the recover it would slide over without cutting it. With this primitive lathe, copied from an old Egyptian tablet, "Jumbo" managed to turn out some pretty clever work.

A Bow Drill

In addition to the lathe, "Jumbo" made a couple of drills also of primitive pattern. One was the well-known bow drill, such as shown in Fig. 52. For the spindle of the drill he used ⅝-inch gas pipe about 12 inches long. First he made a socket in the lower end of the pipe to receive the square shank of the bit. This was done as shown in Fig. 53. The pipe *P* was strapped to a board after a plug *Q* had been driven into it to a depth of about an inch below the end. A bit *R* was then fastened to the board, with its shank centered in the end of the pipe *P*. The shank was coated with lampblack mixed

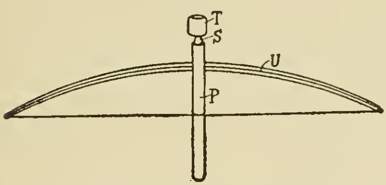


Fig. 52—The well-known bow drill

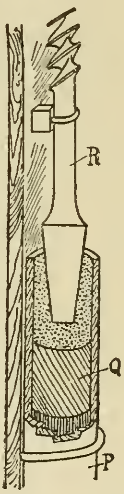


Fig. 53—Making a square socket in the pipe

with oil. Graphite would have been better, but "Jumbo" did not have it at hand. When everything was ready, as shown, he melted some Babbitt metal in the stove and poured it into the end of the pipe *E,* filling the pipe up to the top. When this had cooled, the bit *R* was knocked out, leaving a square socket in the Babbitt metal. At the opposite end of the pipe *P* he fastened the cone point, *S*, made by whittling a top to fit. A block of wood *T*, with a depression in it to receive the point of the cone, was used to steady the upper end of the spindle while it was being operated. The spindle was revolved by means of a bow *U*, the string of which was wrapped around the pipe, as shown in Fig. 52. By holding the block *T* with one hand, and moving the bow *U* back and forth, the spindle was made to revolve first in one direction and then in the other. Unfortunately, an ordinary auger bit could not be used with this type of drill, because on the return stroke of the bow the screw would be unscrewed from the wood. However, twist drills worked to perfection because they are not drawn into the wood by a screw tip at the end, but are fed merely by the pressure on the block T.

Twisted Cord Drill

Another form of drill was made, as shown in Fig. 54. This required a flywheel on the spindle. "Jumbo" managed to get hold of a large valve wheel *W*, which was made fast to the spindle by means of Babbitt metal, as shown in Fig. 55. A hole was drilled through a board *V* to fit the pipe snugly. The pipe was battered just above the board, so that it would hold the Babbitt metal. The wheel was now placed over the pipe and centered, after which the Babbitt metal was poured into the hub around the pipe *P*, as shown. A plug of wood was driven into the upper end of the pipe *P*, and a screw eye was threaded into it. A crosspiece *X* was provided with a hole in the center, so that it could be slipped over the pipe *P*. A cord tied to the screw eye was fastened at opposite ends to the ends of the crosspiece *X*. The crosspiece was first twisted around, coiling the cord around the spindle, as shown in Fig. 54. Then, when the crosspiece *X* was pressed down, the spindle would be spun around by the unwinding cord. The flywheel *W* would keep the drill spinning until the cord was wound up

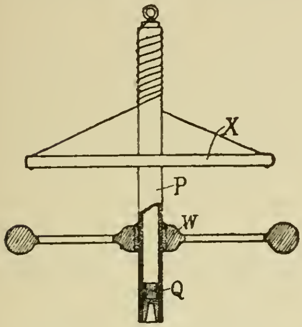


Fig. 54—A twisted cord drill

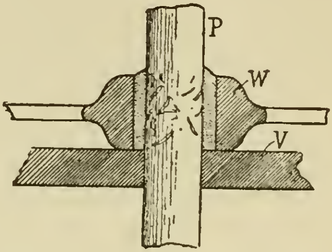


Fig. 55—Fastening the flywheel to the drill spindle

in the opposite direction, raising the crosspiece *X* again, so that when it was pressed down a second time, the spindle would be revolved again, but in the reverse direction. So, by intermittently pressing the crosspiece *X* downward, the spindle was kept spinning first one way and then the other.

CHAPTER VII.

A "PEDAL-PADDLE-BOAT"

ONE of the first things we did after getting our lake house built was to fit up the "Lady Bug" with a pair of paddle wheels arranged so that they could be operated by a bicycle. The plan as originally figured out by Roy Ahmosis, Chief Admiral and Naval Architect, was to fasten the bicycle in the boat with the rear wheel raised off the floor, so that it would turn freely, and to run a belt from this wheel to a pulley on the shaft of the paddle wheel. Of course, the rear tire would have to be removed and the belt would run on the concave rim of the wheel. It seemed like a very good scheme, but there was one serious objection to it. The bicycle once mounted in the boat could not readily be removed, and not only would it soon get badly rusted, if thus exposed night and day, but the owner would be deprived of its use.

Friction Drive

We had already built the paddle wheels for the boat before the question of sacrificing the bicycle came up. No one volunteered his wheel for this purpose, and it seemed as if the elaborate plans we had made for a power-driven boat were about to fall through. Then Bill worked out an ingenious arrangement by which not only the bicycle but the paddle wheels as well could be removed from the boat or set in place at a moment's notice. This left the boat free for the use of oars instead of pedal power whenever desired, but best of all it was not necessary to take off the rear tire of the bicycle, because a friction drive was used in place of the belt. It made it possible for any one of us to set his wheel in the boat and pedal about over the water, and on coming to shore lift the wheel out of the boat and ride off.

How the Rollers Were Made

The rear wheel of the bicycle rested on two rollers, *A* and *B*, mounted in brackets secured to a plank, as shown

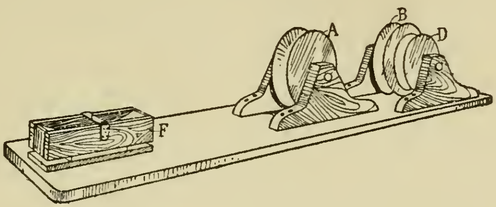


Fig. 56—The friction rollers mounted on a plank

in Fig. 56, which was laid in the bottom of the boat. Each roller was made as follows: From a plank 1¼ inch thick we cut four pieces, each 10 inches square. Then we sawed off the four corners, making the piece octagonal (Fig. 57). After that we cut off the eight corners, which

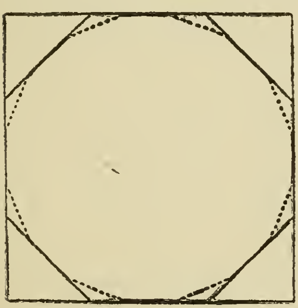


Fig. 57—We sawed off the four corners

made the piece sixteen-sided. Then with a draw knife the angles were trimmed down so as to true the edge to a perfect circle 10 inches in diameter. The rim of each disk was now beveled off to a diameter about 7½ inches, so that when two disks were put together they would form a roller with a V-shaped groove in it. The two disks were firmly fastened together with screws, and a ¾-inch hole was drilled through the roller exactly at the center of the axle. A smaller V-grooved roller, *D,* was made in the same way as the roller *B,* to which it was fastened, making a double roller as shown in Fig. 58. Four brackets were then cut out of hard wood, shaped as shown in Fig. 56. Each roller was journaled between a pair of these brackets on a ¾-inch bolt, and the brackets in turn were nailed to the plank with the combined roller and pulley at the rear. The distance from center to center of the rollers was fully 22 inches, and the rear wheel of the bicycle was supported by them.

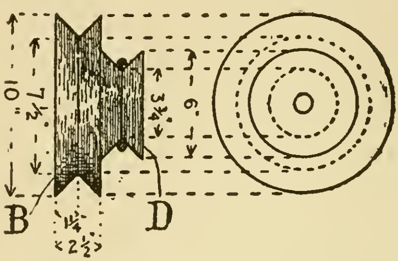


Fig. 58—The roller and pulley

A Swivel Bearing

For the forward wheel of the bicycle a swivel bearing was made. We cut out of a 2 x 4-inch scantling a piece about 12 inches long. One edge of this piece was hollowed out to fit against the tire of the wheel and then a board, *F,* was nailed against each side, making a shallow trough, as shown in Fig. 59. A hole was drilled through the center of the trough, and a bolt was fitted into it with the head sunk below the surface and the shank projecting through. A block of wood, *G,* Fig. 61, about 6 inches square

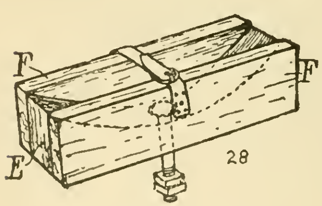
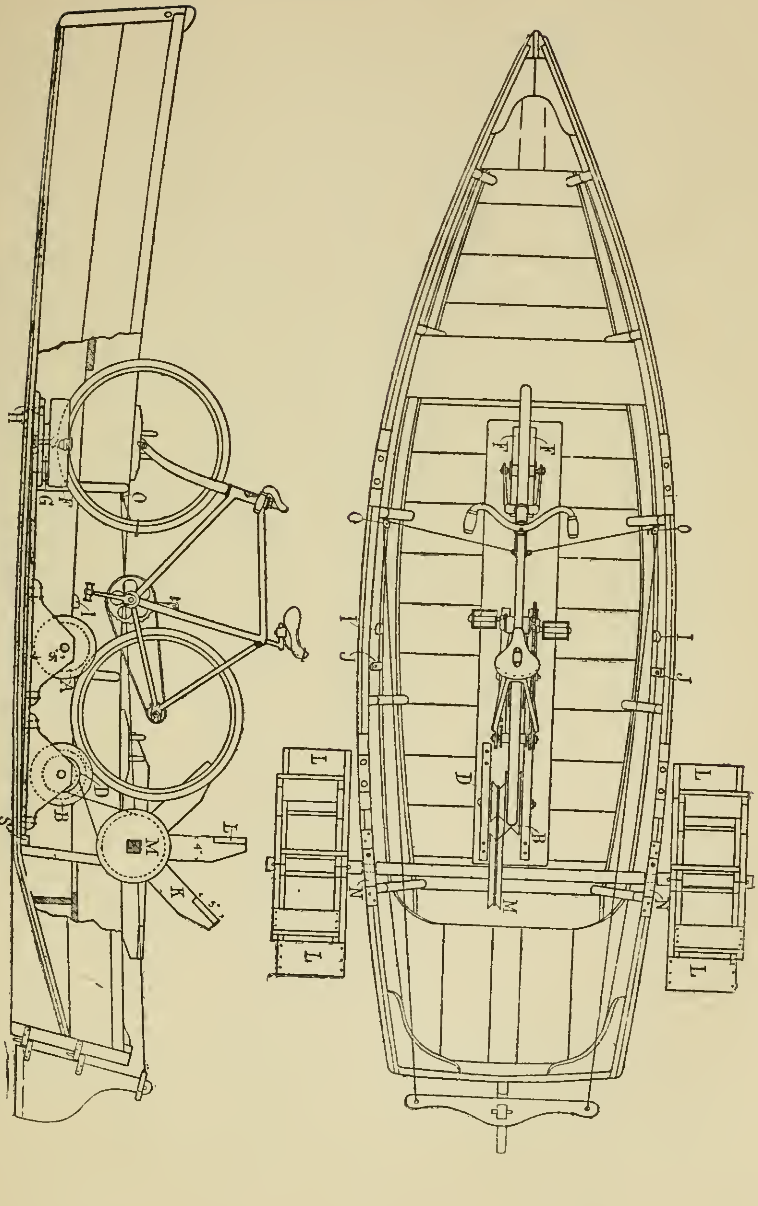


Fig. 59—A shallow trough



Figs. 60 and 61—Plan and side views of the pedal-paddle-boat and an inch thick, was nailed to the bottom of the trough and the bolt passed through this and a larger 20-inch board, *H*. The nut on the bolt was screwed up until the board fitted snugly against the block but yet was free to swivel without too much play. Then a second nut was screwed onto the bolt and jammed against the first one, to prevent it from working loose.

The trough was now fitted to the front wheel of the bicycle, and made fast with a strap that was nailed to the side of the trough. The bicycle was then lifted bodily and placed on the plank (Fig. 56) with the rear wheel resting on the two rollers, and a mark was made at the point where the bolt touched the plank. Here a large hole was cut through the plank to receive the bolt and nuts, and then the board *H* was nailed down. In order to get the plank into the boat and make room for the bicycle, we had to take out one of the seats. The aft rower's seat was accordingly made removable. The seat was fitted at each end between one of the ribs and a block *I*. Two buttons, *J*, one at each side of the boat, held the seatboard down (Fig. 62), but they could be turned up to let the seat be drawn out over the blocks.

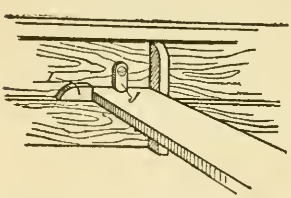


Fig. 62—Two buttons J held the seat board down

The Paddle Wheels

Our paddle wheels were 3 feet in diameter; each wheel required eight 1-inch boards, 4 inches wide and 3 feet long. The boards were fitted together in pairs to form four crosses. The two boards of each cross were halved

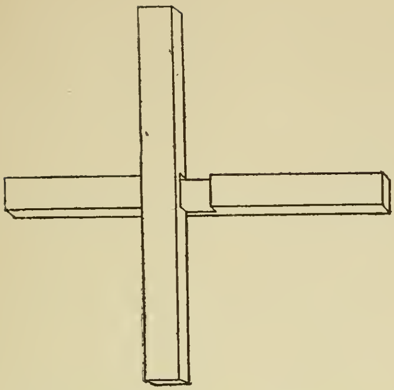


Fig. 63—The boards were halved together

together (Fig. 63). Two crosses were now nailed together, with the arms of one halving the angles between the others. The other two crosses were similarly fastened together, so that we had two 8-spoked wheels but without rims. The two sets of spokes were laid one over the other, and a hole was drilled through both for the paddle shaft. The holes were cut 2 inches square with a chisel. The two wheels were now connected by means of paddle blades *K*, 5 inches wide and 12 inches

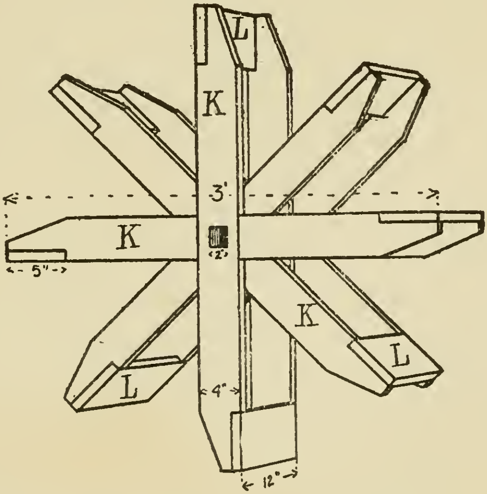


Fig. 64—One of the paddle wheels

long (Fig. 64). The paddle wheels were mounted on a wooden shaft 2 inches square, and held in place by means of two wooden pins one at each side of the wheel, driven into

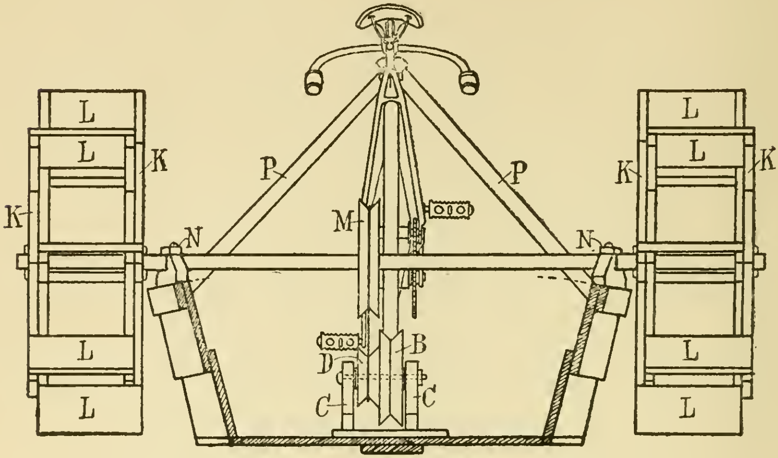


Fig. 65—A section taken through the rear of the boat

holes in the shaft. At the center of the shaft there was a pulley *M* (Fig. 65), with a V-groove, made like the rollers of two disks of wood nailed together. This pulley also had

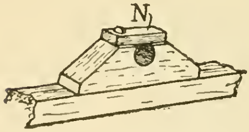


Fig. 66—A journal block

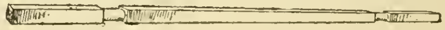


Fig. 67—Where the shaft was journaled it was cut round

a square hole at the center to fit the square shaft. A rope belt connected the pulley *M* with the pulley *D;* but this belt had to be crossed as shown in Fig. 61 so that when the pedals were operated in the usual way the paddle wheels would revolve in the right direction. The shaft was journaled to the boat in a pair of blocks such as indicated in Fig. 66, which were fastened to the gunwales. At the points where the shaft was journaled it was cut round (Fig. 67), in "Jumbo's" lathe, but the lathe bed had to be extended to take so long a piece. To hold the shaft in the notches in the blocks a button *N* was pivoted to each block. When we wanted to take the paddle wheels out of the boat, the buttons were merely turned to one side, permitting us to lift the shaft out bodily.

The Rudder

The "Lady Bug" was fitted with a rudder cut out of a 12-inch board to the shape shown in Fig. 68, and hinged to the sternpost. A tiller or yoke was fastened to the top of the rudder. This consisted of a cross piece in which three holes were drilled as indicated by dotted lines and then cut to form a slot in which the upper end of the rudder blade was snugly fitted. A pin held the yoke in place, as shown in Fig. 69. The tiller ropes ran through pulleys *O* at each side of the boat, and were fastened to the front

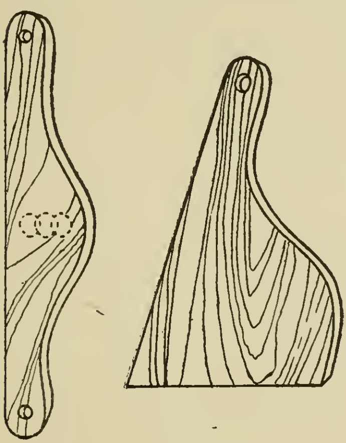


Fig. 68—The rudder blade and yoke

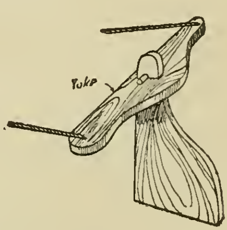


Fig. 69—A pin held the yoke in place

bicycle wheel, as shown in Fig. 60. As the trough in which the wheel was secured was mounted so that it could swivel, the bicycle rider could swing the rudder whichever way he pleased by turning the wheel this way or that.

The Bicycle Support

To hold the bicycle erect in the boat we provided two braces *P* (Fig. 70), which were hinged to the sides of the boat, and at their upper ends were formed with hooks which could be caught over the bicycle frame just under the

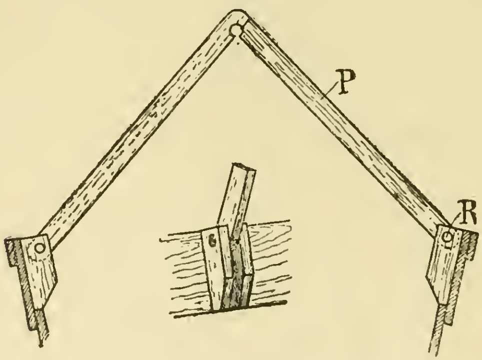


Fig. 70—The bicycle support

seat. The pins *R*, with which these braces were hinged to the boat, could be drawn out, enabling us to remove the braces whenever we wanted to convert the "pedal-paddle-boat" as we called it, into a common, ordinary, everyday rowboat. When the plank was placed in the boat a block *S* (Fig. 61) kept it from working toward the stern and easing the necessary tension on the driving belt.

CHAPTER VIII.

SURVEYING THE LAKE

"We ought to rig up some sort of a scheme to keep the Mulligan gang out of here," said Chief Admiral Roy Ahmosis, at one of our daily meetings in the new lake house. "They're likely to find our bramble path any day, and steal the 'Lady Bug.' I've been thinking over this a lot, and it seems to me that the only scheme is to make a secret channel to the landing at the house. We could build a sort of stockade under water, and have only one clear path through it, and that a crooked one, so that it would take an experienced pilot to bring the boat through."

"Just the thing! Capital!" we all cried.

"Yes; and we ought to have a chart of the lake with soundings all over it," put in Bill.

"Now that we have our craft rigged with paddle wheels," continued Roy, "we can maneuver it through a narrower channel than we could if we had to row it through. We will have to use one or two buoys to mark the channel, and several range posts on shore by which we can lay our course."

The Under-Water Stockade

Admiral Roy produced a sketch of the proposed stockade, which with one or two minor changes was adopted by the club. It called for a row of stakes all around the porch of our lake house, sawed off just below the surface of the water. The sticks were set about 3 feet apart, so that a boat could not pass between them, and the line was set 7 feet from the edge of the porch, with a wide sweep around

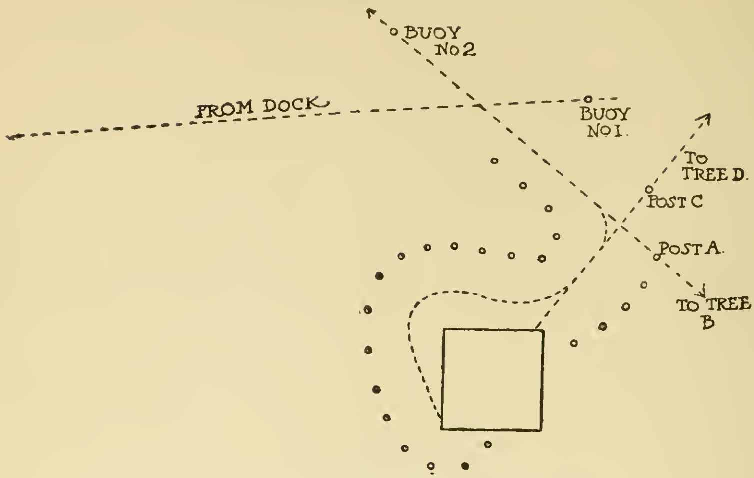


Fig. 71—Chart showing the underground stockade

the northwestern corner, so that the boat could take the curve, and a tortuous entrance to the channel. Fig. 71 shows the arrangement, together with the positions of the range posts and buoys, which were placed under Admiral Roy's directions to guide him into the channel. We had to chop down quite a little timber and do a lot of jumping on the pile driver before the stockade was completed, but the satisfaction it gave us, and the sense of security from the inroads of the Mulligans, was worth all the labor expended on it.

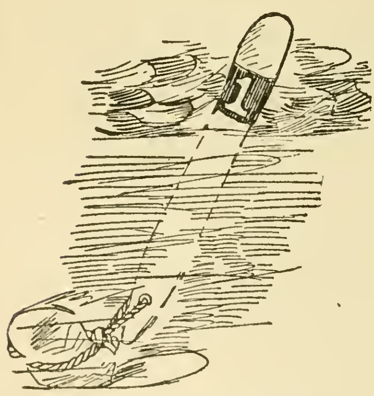


Fig. 72—Its lower end anchored to a stone

Starting from the dock, we laid our course first toward spar buoy No. 1. The buoy was a stick of wood painted with a band of red and with its lower end anchored to a stone (Fig. 72). When the boat reached the point where post *A* was in line with a tree *B* back on shore, it was turned sharply about and kept on this line. The next turn came when post *C* was in range with a convenient tree *D*. Then we skirted the building until we came to the boat landing in front. On the return trip we had to back out, skirting the building till we found the range *C D*, and keeping to this till we came to the range *A B*. Then we headed for buoy No. 2 until we were out in the open water.

Tricks of Surveying

The secret channel completed, we began our chart of the pond. The task devolved upon our Chief Engineer, "Sneezer" Menes. He was not awfully sure that he knew how to do it, and so, very wisely, went to Professor James for help. Now, as I have said before, Professor James used to be a civil engineer, and he knew all the little tricks of the surveyor by which distances can be roughly estimated without instruments. He was only too delighted to teach them to "Sneezer," and of course the rest of us gathered around too and took in all he had to say.

Sighting Over the Thumb

"Let us imagine that this road is a river or an impassable gorge," said Professor James. "One of the simplest methods of measuring it is this. Pick out some object on the opposite bank, say that stone over there. Hold your arm out straight before you, with your thumb sticking up like this. (See Fig. 73.) Shut one eye and move your thumb up or down until it comes in line with the stone.

Then keeping your arm perfectly rigid, with your eye on your thumb, swing bodily around until you sight a stone or any other object on your own side of the river. This way—see?" and he turned slowly on his right heel. "There;

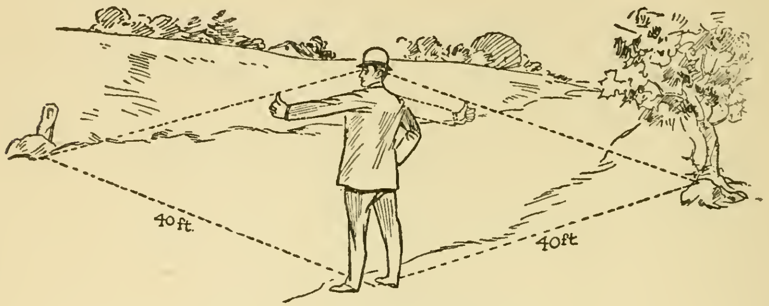


Fig. 73—"Swing bodily around"

my thumb comes right in line with that clump of grass."

Then he paced off the distance to the clump.

"Sixteen paces exactly," he said. "The road must be sixteen paces wide. At 2½ feet for each pace, that makes 40 feet for the width of the road. You can measure it with a tape measure if you want to see how nearly right I am."

Sighting Across a Ruler

"Here's another way: Roy, you must be about 5 feet tall."

"Five feet one inch and three-quarters," corrected Roy.

"Oh, well, we will call it 5 feet 2 inches, or 62 inches. Now run up the road a ways, and we will tell you how far off you are."

When Roy had taken his stand, Professor James held a ruler at arm's length before him, and announced that as nearly as he could make out, Roy appeared to be about 2 inches high.

"But, Roy says he is 62 inches tall, or 31 times as large as he appears to be at this distance. That means that he is 31 times as far away as the ruler is from my eyes. Now,

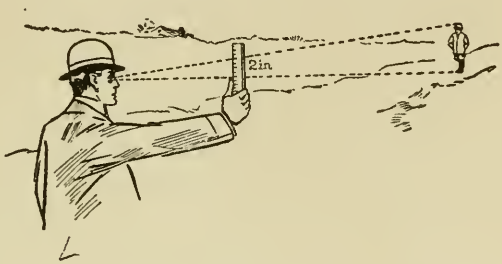


Fig. 74—Roy appeared to be about two inches high

I have often measured the length of my arm, and know when I hold it out like that, that the ruler is almost exactly 2 feet from my eyes. That shows that Roy is 31 times 2 feet or 62 feet away."

The Cane and Cardboard Scale

"Just notice this: Roy is 62 inches tall and just 62 feet away. Had he been 70 inches tall, he would have appeared 2 inches high at a distance of 70 feet. The reason is very

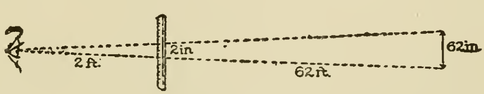


Fig. 75—"Two similar triangles, one over the other"

simple. It's a case of triangles. What we really have is two similar triangles, one over the other;" and he drew a diagram like Fig. 75. "This first runs from the eye to the ruler, and the other from the eye to Roy. In smaller triangle we have one side 2 inches high and the other 2 feet long, and so the sides of our larger triangle must bear the same relation, namely, 62 inches and 62 feet. Now, if Roy should move away until he appeared an inch high, the long sides of the small triangle would be twice as many feet long as the height in inches of the small side; that is, twice 62, or 124 feet. Suppose Roy appeared to be ⅛ inch high. Then the ratio would be 1 to 16, because there are 16 eighths in 2 inches, and you would have to multiply 62 by 16 to find the distance. When I first learned this trick, I used to carry a small cardboard scale with me, like this;" and he drew a small strip of cardboard from his pocket, graduated as shown in Fig. 76, with a 2-inch space marked 1, a 1-inch space

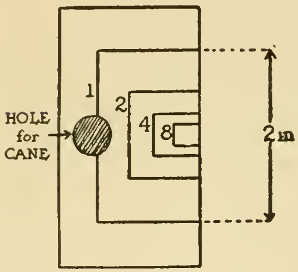


Fig. 76—The cardboard scale

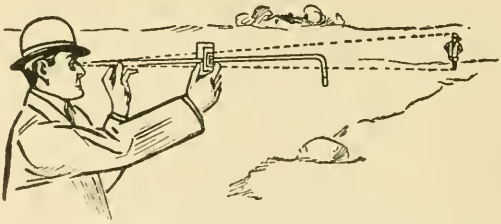


Fig. 77—"Squinting at him along the cane"

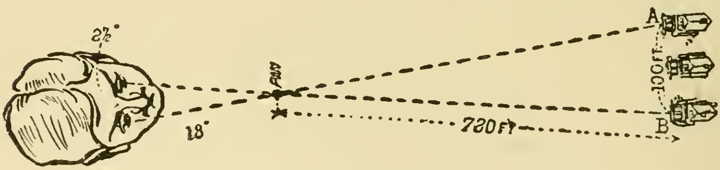
marked 2, a ½-inch space marked 4, a ¼-inch space marked 8, and so on. "I used to slip my cane through the hole in the scale, setting the cardboard at a scratch just 2 feet from the ferrule of the cane. I used to calculate the distance of every man I saw by squinting at him along the cane with the ferrule to my eye, and noting his apparent height on the scale (Fig. 77). The ordinary height of a man is from 68 to 70 inches, and this I would multiply by 2 if the man appeared to be as high as the space marked 2 on the card, or by 8 if he appeared to fill the space marked 8, and so on. The distance I got would be the number of feet between the man and myself."

Surveying with a Pin

"How far off do you suppose that row of houses is on the hill there? City lots have a frontage of 25 feet, but in the suburbs the lots are usually 50 feet wide. If the lots there are full width, the houses must be 50 feet apart from center to center. That gives us a clue to the distance, and with our cane we can tell how far off we are. But here is another method: The eyes of most people are 2½ inches apart from pupil to pupil. We will let that form one side of our triangle."

Then he stuck a pin through the 18-inch mark of a tape measure, and with one end against the bridge of his nose, he stretched the tape in front of him, holding the pin upright. First he squinted the right eye and sighted with the left over the pin to the center of one of the houses, after which without moving his arm or body he sighted with the right eye, and noted that the pin seemed to have moved toward the left across to the third house. Figuring 50 feet for each lot, that made 100 feet or 1200 inches for the apparent travel of the pin. Then he showed us that by dividing 1200 by 2½, or the distance between the eyes, we got the figure 480, which meant that the large triangle between the pin and the houses was 480 times as large as the small triangle between the pin and the eyes, so that if the distance between the eye and the pin was 18 inches, or 1½ feet, the distance between the pin and the houses would be 480 times this, or 720 feet.

The system was made perfectly clear by a diagram which Professor James drew, like that in Fig. 78, showing that what we had was a pair of triangles lying point to point at the pin. The eyes were at the other end of one triangle, and the houses *A* and *B* lay at opposite corners of the other triangle. He showed us that the two triangles were exactly alike in every particular except size, and, as has just been



F g. 78—A pair of triangles lying point to point

stated, that one was 480 times the size of the other. In our diagram the smaller triangle is much exaggerated, of course.

"You can use this scheme whenever you get a clue to the base of the larger triangle," continued Professor James. "Keep your eyes open for average distances. Telegraph poles along a railroad are usually set a certain distance apart, though the interval varies with different railroads; but if you should happen to know the interval of a certain telegraph line, you could measure across a river or lake to a railroad on the opposite shore, and by counting the telegraph poles across which the pin appears to move, when you sight first with one eye and then with the other, it will be an easy matter to figure out their distance from you. As a clue for shorter distance, the number of bricks per yard in the wall, or the average width or size of windows, and a great variety of different average measurements, will help you out in making rough surveys."

The Two-Foot Rule Method

"These methods are all very good if you have some clue to the size of the object you are sighting to. If you have no such clue, here is a method that will do for rough calculation. It will require two persons and a pair of carpenter's folding 2-foot rules. If one of you will run up to my office, you will find in the upper right-hand pigeon hole of my desk just the kind of rule I mean, and I guess the janitor will let you have another one like it." When the two rules had been procured, Professor James opened them to a V-shape, and stuck two pins in the face of each leg, so that he could sight along them.

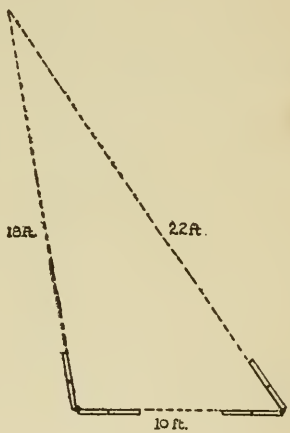


Fig. 79—Sighting to the flagpole

"Now, let us measure the distance to that flagpole."

He handed "Sneezer" one of the rules, with instructions to aim one leg of the ruler at the flagpole, and then without disturbing the position of the ruler to sight the other leg on him. Professor James paced off a distance of 10 feet along the ground, and then sighted toward "Sneezer" with one leg of the rule, and toward the flagpole with the other. (See Fig. 79.) Then, holding the rule carefully, so as not to disturb the angle of the two legs, he placed it on "Sneezer's" rule with the apex of the angle just 5 inches from the apex of "Sneezer's" rule. (See Fig. 80.) Then the place where the legs of the triangle crossed each other was 11 inches from the apex on Professor James's rule and 9 inches on "Sneezer's." Professor James pointed out

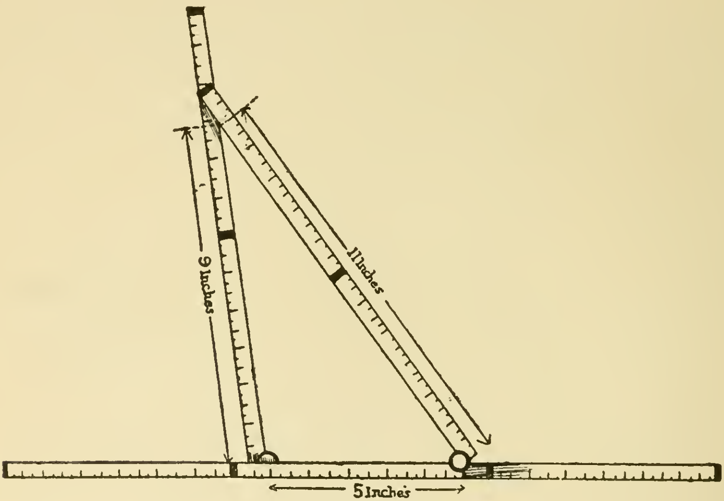


Fig. 80—He placed it on "Sneezer's" rule

that we had two similar triangles, one made with the 2-foot rules with sides 5, 9, and 11 inches long, and the other formed between his position, the tree, and "Sneezer's" position; also that we knew that the shortest side of the larger triangle was 10 feet long instead of 5 inches, so that the other two sides of the big triangle must be 2 times 11 and 2 times 9 feet respectively. The tree was therefore 22 feet from Professor James's station and 18 feet from "Sneezer's."

The Shadow of a Tree

"The easiest way of finding the height of a tree or steeple is to measure the shadow. Here is a good example: Suppose the shadow stretches out 50 feet from the foot of the tree. Drive a stake in the ground 5 feet from the

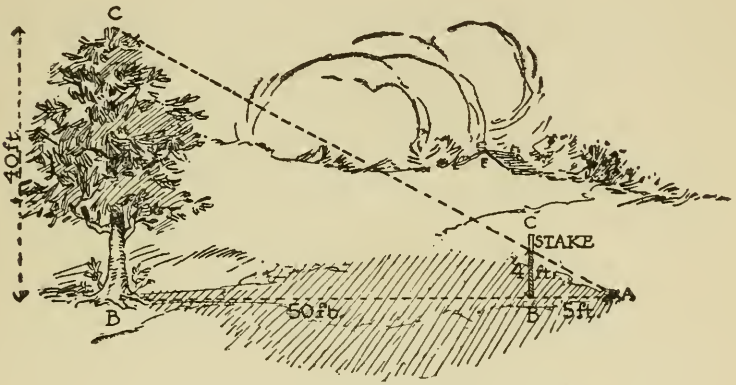


Fig. 81—Measuring the height by the shadow

edge of the shadow, and if the stake is shaded for a height of 4 feet above the ground, we will know that the tree must be 40 feet high, because we have two triangles *A B C* (Fig. 81), one with a base 50 feet long and the other with a base 5 feet long, and so the larger triangle is 10 times the size of the smaller one."

Measuring a Height by Reflection

"If there happens to be a puddle of water near the steeple or tree whose height you wish to measure, stand off from it just far enough to enable you to see the top of the steeple reflected in the water. Then you will have two similar triangles again meeting point to point in the puddle (at *A*, Fig. 82). Suppose your eyes are 5 feet above the water, and that you are standing 2 feet away from the image in the puddle. Then, if the distance from the puddle to the base of the steeple is 50 feet, your larger triangle must be 25 times the size of the smaller one, and so the steeple must be 5 x 25 or 125 feet high.

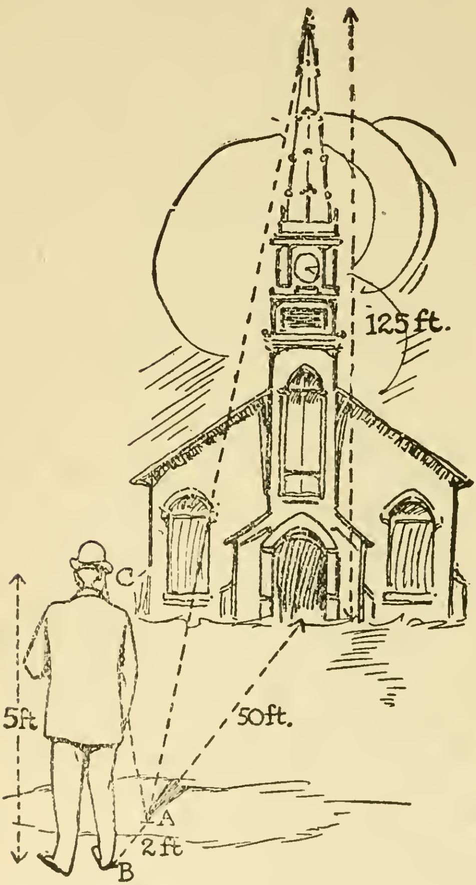


Fig. 82—"Meeting point to point in the puddle"

"Of course, all these schemes are rough, very rough. You will need something better if you are going to make a survey of your lake. 'Sneezer,' you and Bill come up to my room to-morrow afternoon, and I will tell you all about plane table surveying as done by Uncle Sam's surveyors. After that I will leave it to you to make an instrument for surveying the lake. I want to see how clever this Modern Order of Ancient Engineers is."

The Plane Table

The next afternoon Bill and "Sneezer" emerged from

Professor James's room looking very important indeed. They called "Jumbo," the Chief Craftsman, and then went off by themselves to talk things over. It did not take them long to lay their plans. "Jumbo" went over to his work-bench, and made a drawing table about 2 feet square by fastening two wide boards together with a pair of cleats. "Sneezer" borrowed my tripod, which was a pretty substantial one, and took it down to the nearest hardware

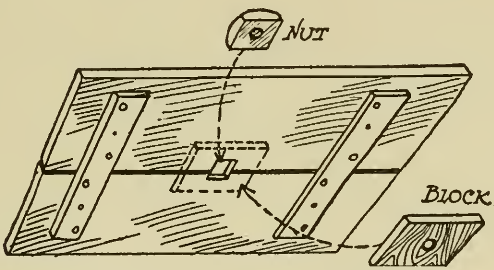


Fig. 83—The underside of the plane table

store to get a nut that would fit the thumbscrew in the tripod head. This nut "Jumbo" seated snugly in a square depression which he had cut with a chisel in the under side of the drawing board. Then over the nut he nailed a block of wood with a hole in it just large enough to admit the thumbscrew (Fig. 83). The drawing board was fastened to the tripod by screwing the thumbscrew through the hole in the block and into the nut.

The Alidade

Meantime, Bill procured a piece of a yard stick. Two blocks of wood were nailed to it at each end, overhanging one edge. A screw eye was put into the top of one block to serve as an eye piece, and a pin was stuck upright in the other to serve as a sight. Both were placed directly over the edge of the yard stick. Near the pin sight a second block was hinged, as shown, and a sight pin was stuck in it. "Sneezer" then informed us that in the language of the surveyor the yard stick with eye piece and sight is known as an "alidade," and the board as a "plane table."

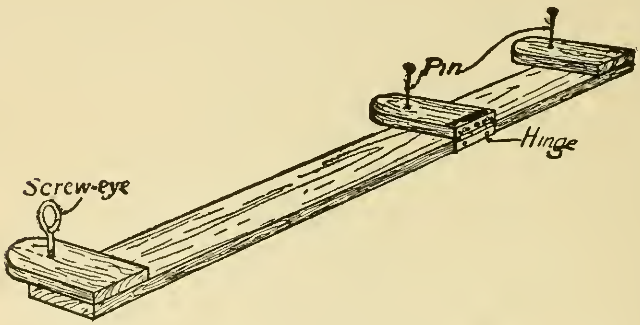


Fig. 84—The "alidade"

Bill sent "Doc" and "Jig" out to Fithian's Woods to cut a pole or rod about 5 feet long and a dozen small stakes. A piece of paper was tacked to each stake, so that we could mark it with a letter or numeral. This done, we were ready to make our survey.

Surveying the Lake

First, a base line was measured off on the northern shore of the lake. We made it just 300 feet long, and drove a stake at each end of the line, marking one stake Station A and the other Station B. The tripod was set up over stake *A*, and the plane table was made fast to it. A sheet of paper was fastened on the plane table with thumb tacks, and a pin was stuck in the board directly over the stake *A*. "Sneezer" then laid the alidade on the paper with the graduated edge against the pin, and sighted through the screw eye and over the two pins to the rod which "Jig" was holding at Station B. When he had moved the alidade so that the sight pin came in line with "Jig's" rod, Bill raised the hinged block out of the way and drew a line along the edge of the alidade. At 6 inches from the pin marking Station A a second pin was stuck in the board to indicate

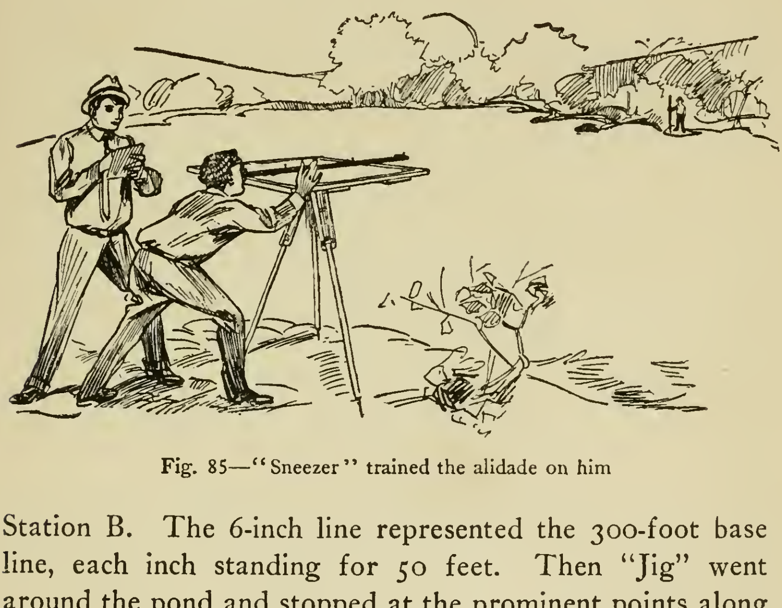


Fig. 85—"Sneezer" trained the alidade on him

Station B. The 6-inch line represented the 300-foot base line, each inch standing for 50 feet. Then "Jig" went around the pond and stopped at the prominent points along the shore, while "Sneezer" trained the alidade on him, and drew lines toward the different points. At each of these points "Jumbo," who accompanied "Jig," drove a stake in the ground, numbering the stakes, 1, 2, 3, etc., for future reference. At the same time Bill marked the lines he drew on the board, *A*1, *A*2, *A*3, etc.

When "Jig" had circled the entire pond, the plane table

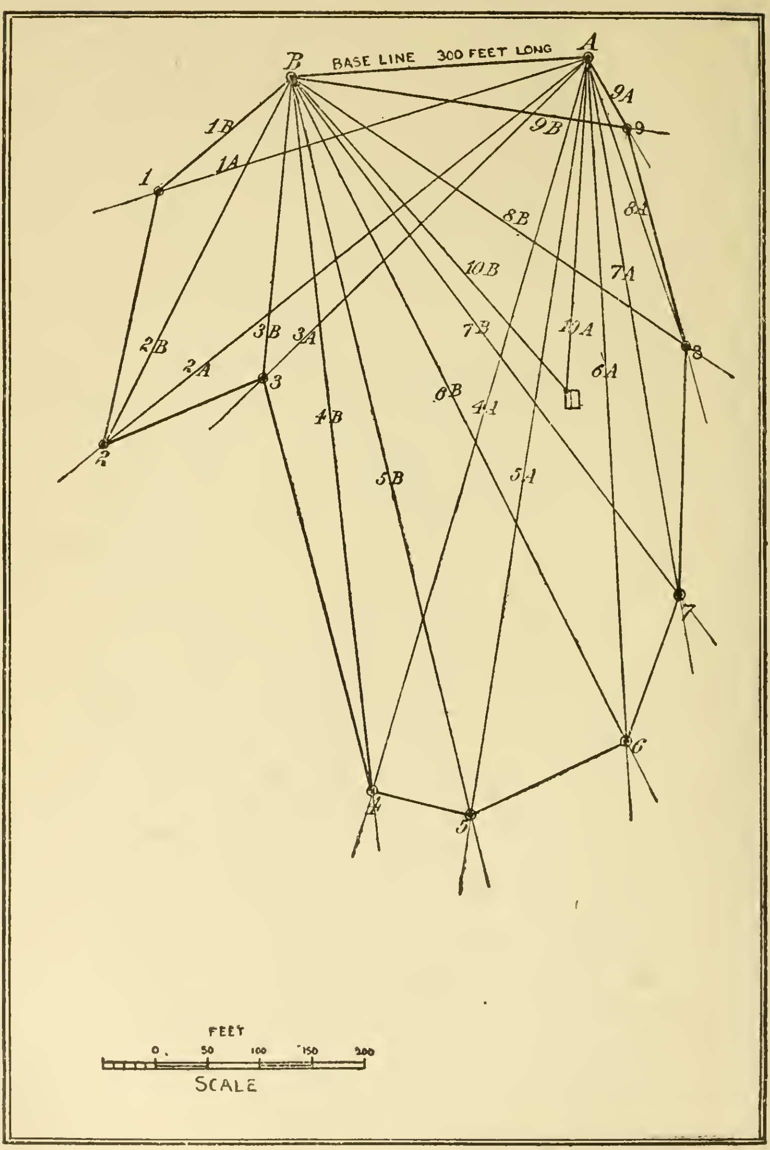


Fig. 86—This gave him a skeleton map of the pond

was moved over to Station B. Then the alidade was laid on the base line, and the table was swiveled around until the alidade pointed back toward Station A, with the pin *B* directly over stake *B*. Then the table was firmly secured in this position. "Jig" now retraced his steps around the pond, stopping at the stakes that "Jumbo" had driven, so that "Sneezer" could make a set of observations to them from Station B. Bill marked the lines *B*1, *B*2, *B*3, etc. Where each *B* line met an *A* line he drew a circle, and numbered these circles in order. Then he connected the circles with heavy lines, and this gave him a skeleton map of the pond, as shown in Fig. 86.

Sketching in the Shore Line

It was now an easy matter to sketch in the shore line over the skeleton with a fair degree of accuracy, for while on his tramp around the pond "Jumbo" had taken note of the various indentations of the shore line between each pair of stakes. During the observations "Sneezer" had turned his alidade on the lake house, so that the position of this on the map was also determined. The trail through the brambles and the road beyond the dam were put in largely by guesswork. This done, the lines were gone over in ink, and the observation lines were erased. At the bottom of the map "Sneezer" put in the scale, 50 feet per inch, and an arrow pointing north. The direction was found by means of a compass laid on the map while the paper was still on the base line. The complete map is shown in Fig. 87.

"Traversing"

We found surveying such a fascinating game that we decided to survey the road leading from the pond to the

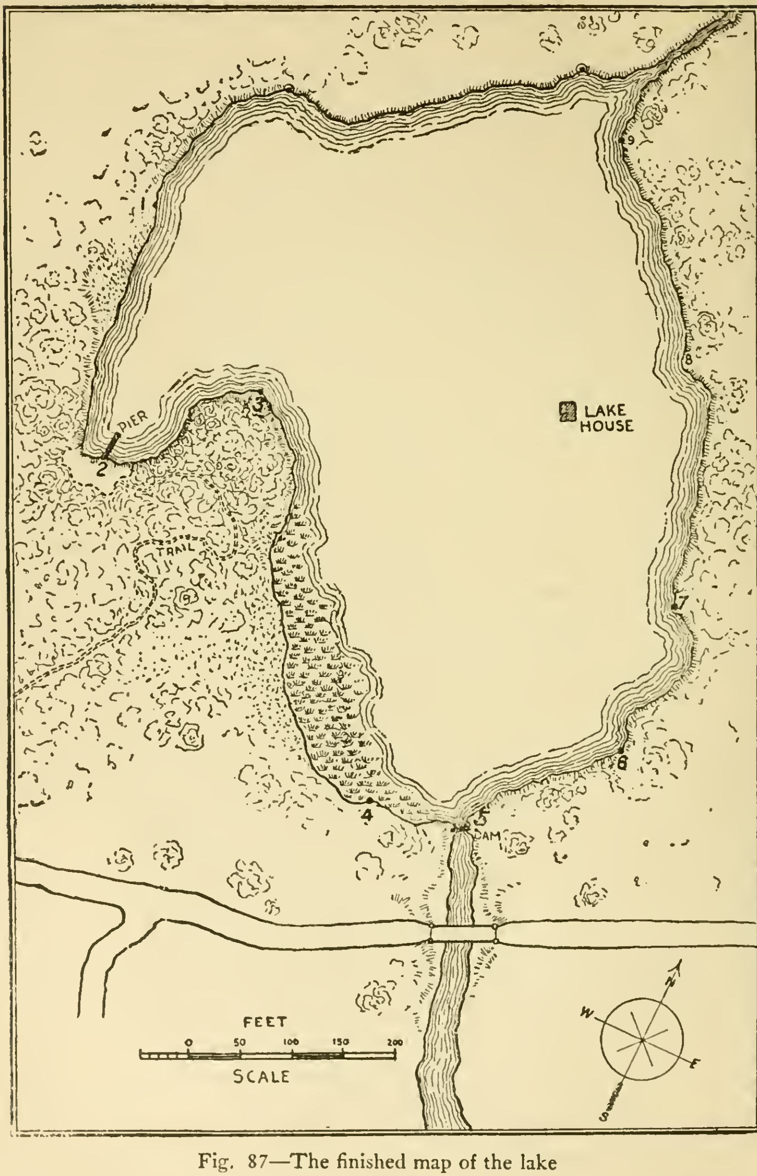


Fig. 87—The finished map of the lake

Academy. This called for a somewhat different system, not unlike Professor James's cane and paper scale trick. This "Sneezer" told us was known as "traversing," while the other was intersection. Another yard stick was procured and cut to a length of just 31 inches, and two blocks were fastened to it at each end, but set back rather than overhanging the edge. Instead of the pin and screw eye we

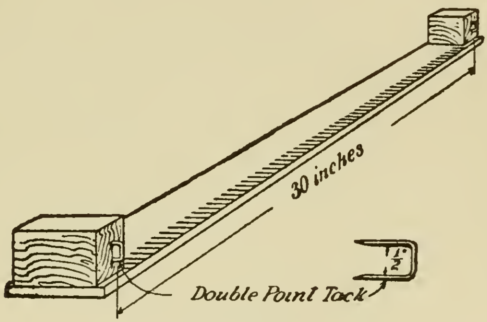


Fig. 88—The carpet tack alidade

used two double-point carpet tacks and placed them in the side of each block, just 30 inches apart. The carpet tacks measured just ½ inch between the legs. "Jumbo" filed them out to exactly that width because Bill had figured it out that with these proportions an object 4 inches high and 20 feet away would just fill this ½-inch space when viewed through the carpet tacks.

The Stadia Rod.

With this instrument we had to use a "stadia" rod. The stadia rod was a light board, 4 inches wide and 6 feet long, and it was divided off into black and white squares 4 inches high. Before painting the rod Bill proved that his calculation was correct by training the instrument on a piece of

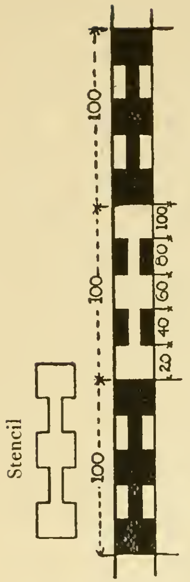


Fig. 89—The stadia rod

paper just 4 inches square and 20 feet away from the instrument. Then "Jig" proceeded to paint the rod. The squares were arranged in groups of five, as shown in Fig. 89, each group representing a distance of 100 feet. One group was connected by a central band of black, and the next by a central band of white. "Jig" began by painting the first group of blocks solid black and the next solid white. Then from a piece of cardboard he cut a stencil like that shown in Fig. 89. Placing this on the black group, he was able to paint in the white parts at each side of the central band, and then by placing the stencil on a white group to paint in the black. "Jig" found it difficult to paint a solid white over the black until the man from whom he bought the paint taught him the trick of putting on a coat of blue first and then the white.

Surveying the Road to the Academy

The survey started from the dam. "Sneezer" set up his plane table with the new alidade on it, while "Jig" went up the road a piece with the stadia rod. Sighting through the double-point tacks, "Sneezer" was able to see seven blocks between the legs of the tack, so he drew a line along the alidade 3½ inches (7 half inches) long and drove a pin in the table at the end of this line, marking it *B*. Each block represented a distance of 20 feet, so he put down the distance, 140 feet. The tripod was then moved to where "Jig" had stood, and was adjusted so that the pin was exactly over the spot where the butt of "Jig's" stadia rod

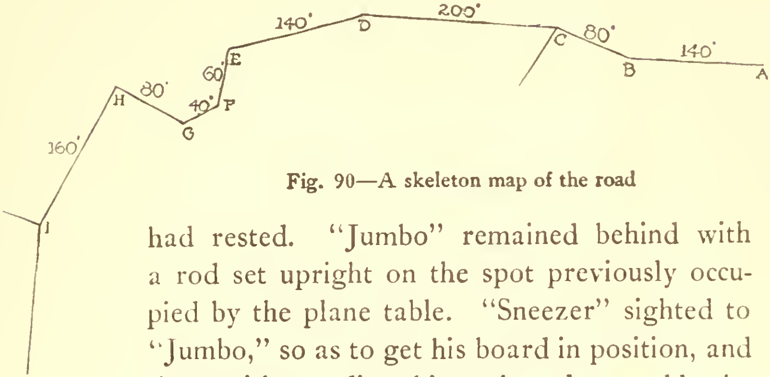


Fig. 90—A skeleton map of the road

had rested. "Jumbo" remained behind with a rod set upright on the spot previously occupied by the plane table. "Sneezer" sighted to "Jumbo," so as to get his board in position, and then without disturbing the plane table he trained his alidade on the stadia rod at the next position taken by "Jig." This time he saw four squares, so he drew

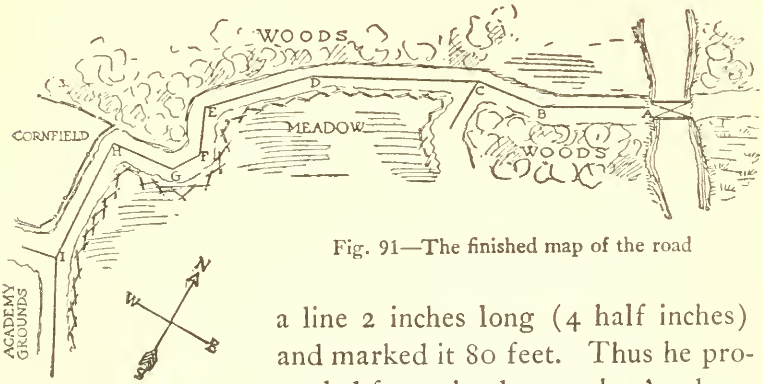


Fig. 91—The finished map of the road

a line 2 inches long (4 half inches) and marked it 80 feet. Thus he proceeded from the dam to the Academy without a tape measure, and obtained a skeleton like that shown in Fig. 90. While the observations were being made, Bill was taking notes of the country at each side of the road, so that he could work them into his finished map, as shown in Fig. 91.

CHAPTER IX.

SOUNDING THE LAKE

AFTER we had made a survey of the pond and its surroundings, the next task was to make a chart showing the depth of water, etc. This was quite a problem. It was easy enough to make the soundings, but how in the world would we know where to put them on the chart? To be sure, we could take observations from the shore with the alidade and the stadia rod, but that would hardly do, because our measurements were far from accurate, particularly on long distances. Finally we hit upon a plan that worked out fairly well except that it called for another plane table. My tripod was the only one in the club, but it was not a very difficult matter to rig up a home-made duplicate.

A Home-Made Tripod

The bottom of a peach basket served for the tripod head. We divided the head into three parts in the following way: A string was fastened to one edge with a tack, and was stretched across the disk to the opposite edge, where it was wrapped around the lead of a pencil. Then seizing the string by the center, it was pulled over to the edge of the disk, drawing the pencil back along the circumference to the desired point, where a mark was made. Then the

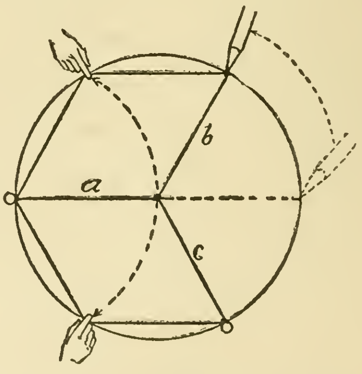


Fig. 92—Dividing the head into three parts

string was pulled over to the opposite edge, and a second point was marked with the pencil. Lines were drawn from the center of the disk to these points, and also to the point

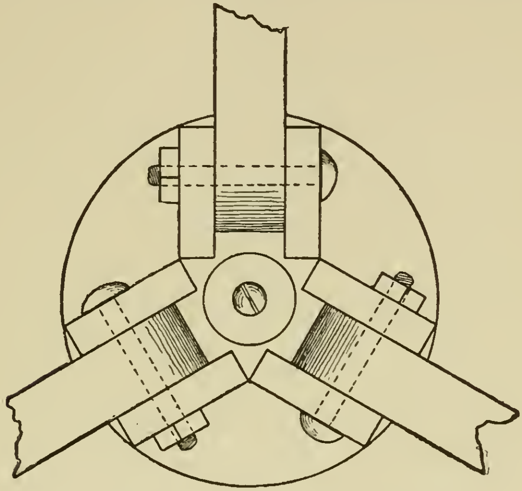


Fig. 93—The bottom of the tripod head

where the string was tacked fast, and this gave us three equal divisions of the head.

On opposite sides of each line wooden blocks were fastened, ¾ inch apart. The legs of the tripod were fitted between these blocks, and hinged by means of bolts which

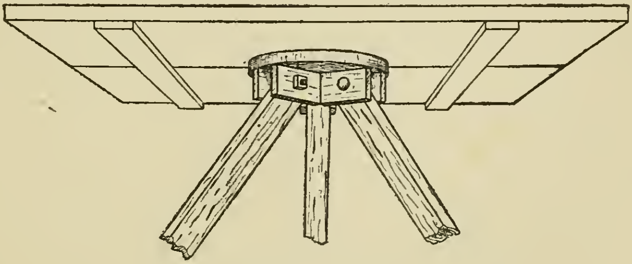


Fig. 94—The plane table on the tripod

passed through them and the blocks. (See Figs. 93 and 94.) As we required a very substantial tripod, we did not attempt to make folding legs. Instead, each leg was made of a single stick 3 feet 6 inches long, and tapering from a width of 3 inches at the top to an inch at the bottom. A nail was driven into the bottom of each leg and left projecting slightly. The head of the nail was then filed off, leaving a sharp point to stick in the ground and keep the tripod from slipping. The alidade and table were made in the same way as before.

The Sounding Parties

Under Bill Rameses's directions our sounding parties were organized as follows: In the boat Chief Admiral Roy Ahmosis, recorder; "Jig" Sonches, leadsman; and "Jumbo" Unis, boatman. On land, at plane table Station A, "Sneezer" Menes, chief observer, and "Doc" Amenophis, assistant; plane table Station B, Bill Rameses, chief observer, and Jim Amenhotep, assistant.

The Land Stations

Two tracings of the map of our lake were made, one for each plane table. The stakes that had been driven to mark the points of observation for the first survey were still in place. The plane table parties first set their tables over the stakes *A* and *B* on the base line. "Sneezer" at stake *A* swung his alidade against a pin driven into the spot marked *A* in the map, while Bill at the other station swung his alidade against the pin stuck in the map at *B*.

The Boat Party

The boat was fitted with a mast from which the signals were hung, telling us on shore what the soundings were. We used the cone and ball signals, which will be explained later on. "Jig" sat in the bow of the boat, straddling the stem. He carried a sounding pole about 10 feet long, which was divided off into feet, and the numbers were marked with white paint. Roy had the responsible duty of signaling the soundings as they were called out by "Jig," and then jotting down the figures, so as to check up the work of the observers on shore. "Jumbo" in the meantime rowed the boat to the various positions indicated by Roy.

Recording the Soundings

The soundings were taken first from a point a little below the lake house. "Jumbo" rowed the boat slowly back and forth across the lake, coming about 20 or 30 feet nearer to us at each trip. Every once in a while "Jig" would make a sounding. He plunged the pole into the water on the forward slant, so that the moving boat would bring it up straight just as the pole touched bottom. Before each sounding "Jig" would call "Ready," and "Jumbo" would raise his oars to indicate to us on shore that the sounding was about to be made. We would then train our alidades on "Jig." At the moment the pole touched bottom "Jig" would say "Now," and "Jumbo" would drop his oars. At the same time we on shore, following the boat with our instruments, would draw a line along the alidade. In the meantime "Jig" would call out the depth of water to Roy, who would hang up the proper signal from the mast and record the figure in his notebook.

The assistant of each party on shore read the signal, and jotted down the number on the range line just drawn. These range lines were lettered *A, B, C*, etc., so that we could identify them. First, the northern half of the lake was sounded and surveyed from the original surveying stations

A and B (Fig. 87), and then the lower half from stakes 4 and 6.

Locating the Soundings

When the sounding was done, we had two charts, each covered with a mass of lines marked *A* 3, *B* 5, *C* 7, etc. One chart was laid over the other, and being of tracing paper, the lines of the under chart showed through the upper chart, as indicated by dotted lines in Fig. 97. At the points where the lines of the same letter intersected, that is, where *C* on

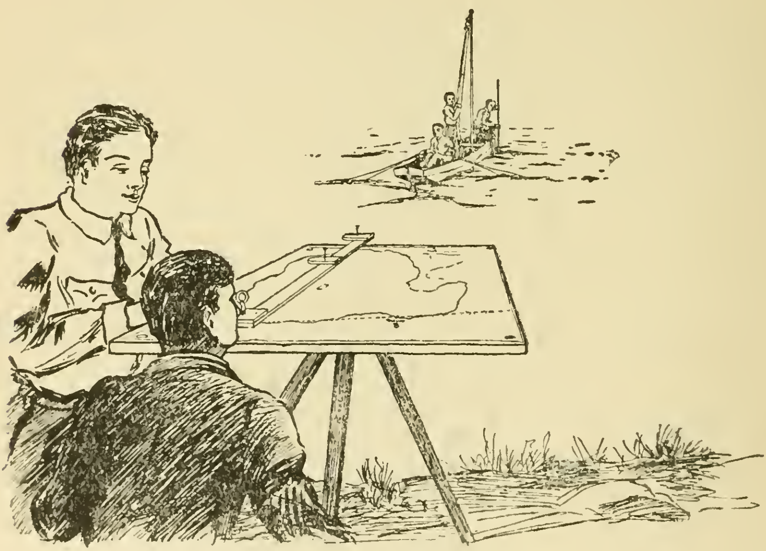


Fig. 95—Sighting from station A

one chart met *C* on the other, a small circle was made, and the depth of the water, in this case 7 feet, was written in the circle. There were some places near the observation station where the range lines made so sharp an angle or else so wide an angle with each other that we could not be very sure of the position of our soundings. However, it did not matter very much, as most of the lake was properly charted. While marking the observations of the soundings, we also located the range poles and buoys of our secret channel. These were marked down on the chart. Fig. 98 represents the chart after it was completed. Of course, the original was made on a larger scale than is possible on these pages, and it contained more soundings than can be shown here. The secret channel has also been omitted from the illustration because of its reduced scale.

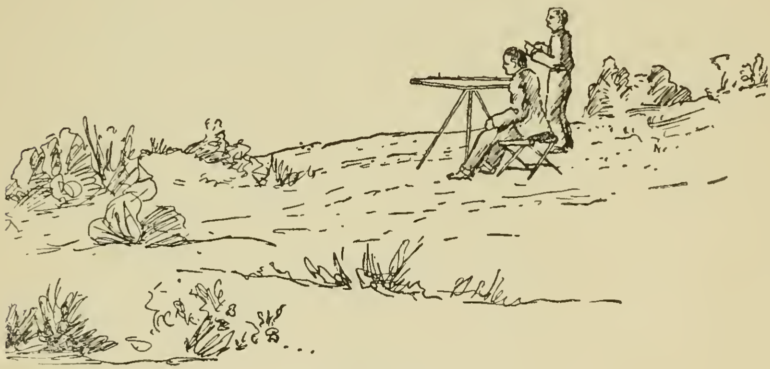


Fig. 96—Station B

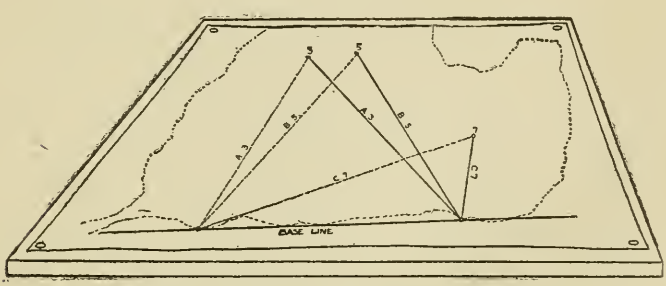


Fig. 97—One chart was laid over the other

Prof. James's Comment

It was a triumphant crowd of boys that visited Professor James when the three maps had been completed. He commended us highly on our ingenuity, and said we had done

Fig. 98—The finished chart of the lake

ourselves credit. But when we showed him our instruments, he did not seem quite so pleased. They were entirely too rough to suit him.

"Why didn't you use a telescope on your alidade?" inquired Professor James. "A telescope?" said Bill, rather crestfallen at this criticism. "Why, we couldn't afford to buy a telescope."

"But why did you not make one?"

"Make one? How could we?"

"Look here," said Professor James; "don't you know how a telescope is made? Oh, I don't mean how the lenses are ground, but how they are arranged. Go and get me your camera, Jim, and I'll show you."

A Camera as a Telescope

When I had brought the camera, he set it up on the tripod and focused on the scene out of the window. Then from his pocket he took a magnifying glass.

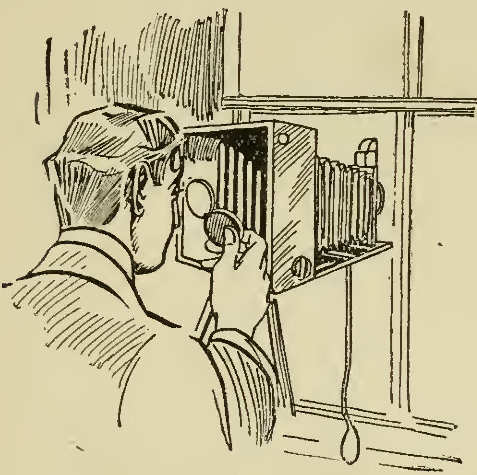


Fig. 99—Using the camera as a telescope

"Now, Jim, it's your camera, and you can have first peek. Look at the picture on the ground glass through the microscope."

I did, but could not see much because of the grain of the ground glass. But he told me to hold the lens right there and keep on looking for a moment. With a sudden whisk he pulled the glass out of the way, and there was the lawn tennis court and the old Academy fence, the whole scene as clear as day and sharper than it would appear to the naked eye, except that everything was upside down.

"That's a telescope," said Professor James. "You see the idea, don't you? One lens makes a picture, and the other magnifies it. It doesn't magnify much. Let's see; it is about 12 inches from your camera lens to the ground glass, and 3 inches from there to the magnifying glass. An optician would say your object glass had a 12-inch focus and your eye piece a 3-inch focus, so the power of your telescope is 4 diameters; that is, the things you see through the telescope are three times as large as they appear to the naked eye. The power of a telescope is always found by dividing the focus of the object glass by the focus of the eye piece. The longer the focus of the object glass, and the shorter the focus of the eye piece, the more powerful the telescope. Now this telescope shows things upside down, just like an astronomical telescope. For daylight telescopes two more glasses are needed in the eye piece, to turn the picture right side up, but it won't make any difference in surveying whether the view is inverted or not. Now you ought to know enough about telescopes to make a good alidade with fine stadia hairs in place of staples. You can buy the lenses for 25 cents apiece."

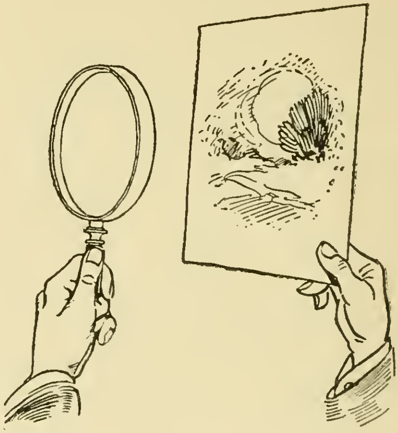


Fig. 100—"It throws a distant image on the paper"

"But how will we know what kind of lenses to get?" asked Bill.

"Why, any magnifying lens will do," said Professor James. "Get one with as long a focus as you can for the object glass, and a smaller one with as short a focus as possible for the eye piece. You can test the focus of each glass by holding it in front of a sheet of paper, and moving it back or forward until it throws a distinct image on the paper of the scene before us (Fig. 100). A small reading glass makes a very good object glass, and a pocket magnifying glass can be used for the eye piece" (Fig. 101).

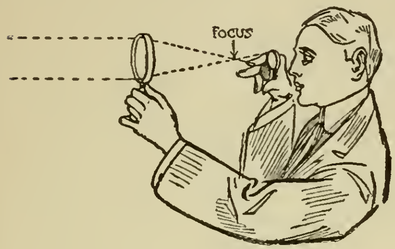


Fig. 101—A simple telescope

"But where shall we put the stadia hairs?" asked Bill.

"Now look here, Bill; I am not going to tell you everything. Just figure it out for yourself."

Testing the Lenses

At the very first opportunity we made a trip to Louis

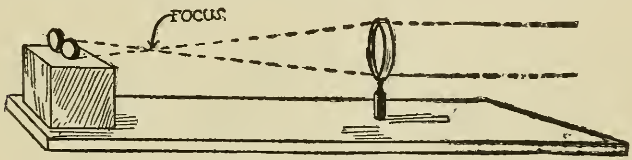


Fig. 102—Testing the focus

Goldberg, the oculist and jeweler, and succeeded in getting a small reading glass of 12-inch focus and a magnifying glass of about 2-inch focus. These we set up on a base board, as shown in Fig. 102, so as to test them, and to find out how big our telescope would be and where to set the stadia hairs. The handle of the reading glass was jammed into a hole in the base board, and the pocket glass was set on a block which raised it so that the centers of the two glasses were at the same level. The block was free to move along the board, so as to give us the necessary focus.

Where to Set the Stadia Hairs

Bill had an idea that the stadia hairs should be placed on the object glass. So he drew two lines of black ink on the glass, but strange to say they disappeared entirely when he looked through the telescope. Then he wiped off these lines, and drew them on the eye piece instead. But all he could see was two blurs that had a way of appearing and disappearing as he moved his eye, and were worse than useless for observation on the stadia rods. Then it suddenly dawned upon Bill that he had been very stupid. If he was to see the hairs through the eye piece, they would have to be set at the focus of the eye piece, so he cut a hole in a piece of cardboard and wrapped fine black thread around the card across the hole. The card was held at the focus of the eye piece, and then when he looked through the telescope, the view was cut by two sharp black lines. When he looked at things near by, the focus of the object glass was lengthened, and he had to move the eye piece back correspondingly, but the stadia hairs had to be moved back with the eye piece.

Making a Telescope

Having thoroughly tested our lenses, we were ready to make a telescope that would look like a telescope. First of all, we took the lenses out of their frames. We found that when the handle of the reading glass was unscrewed, the frame spread open and let the glass fall out. The pocket glass was mounted in a bone frame, and it was a simple matter to saw this in two and get the glass out. The tubes of our telescope were paper mailing tubes. The main tube was over 3 inches in diameter and 12 inches long. Several layers of paper were pasted to the inside of the tube, so that the lens would fit closely, but not too tightly. Then a ring or collar *A* (Fig. 103) of pasteboard was glued to the inside of the tube, about ½ inch from the edge, forming a shoulder for the lens to rest against. The lens was held to the shoulder by means of a piece of spring brass wire that was bent into a ring *B*. This was sprung into the tube, and pressed against the edge of the glass. The inside of the tube was painted a dull black, so as to prevent reflection of the light from dimming the image.

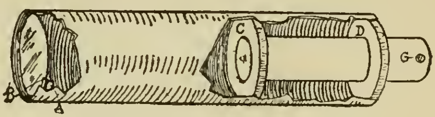


Fig. 103—Details of the telescope

The Eye Piece

For the eye piece we got a piece of 1-inch tubing about 5 inches long. To fit this into the main tube we needed two disks or flat rings. "Jumbo" cut them with his scroll saw out of the cover of a cigar box. The rings were just large enough to fit into the 3-inch tube, and a 1-inch hole was cut exactly in the center of each. One ring *C* was glued to the inner end of the 1-inch tube, and the other ring *D*, after the tube had been fitted into it, was tacked and glued to the end of the large tube, as shown in Fig. 103. The small lens was fastened by means of tacks to a plug

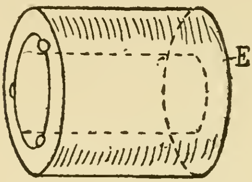


Fig. 104—The plug in the eye piece

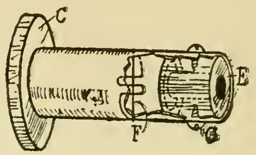


Fig. 105—The eye piece of the telescope

of wood *E* (Figs. 104 and 105) which just fitted the inside of the smaller tube. A hole was drilled through the plug about ½ inch in diameter.

Sewing-in the Stadia Hairs

The stadia hairs *F*, which consisted of black thread, were sewed with a long needle right through the paper tube. There were three parallel horizontal hairs, the middle one of which ran through the center of the tube. A fourth hair ran vertically through the center at right angles to the others. In order to get the lines perfectly true, Bill drew a large circle on a piece of white cardboard, and laid out the horizontal and vertical lines on it. Then the telescope was focused on this card at such a distance that the circle just filled the field of vision, and when the needle was pushed through one side of the tube, it was trued up to the lines of the chart before it was pushed through the opposite side. After the hairs were fastened in place, the plug containing the small lens was adjusted to bring it to a sharp focus, and then it was fastened into place with two screws *G*.

We used round-headed screws, so that the projecting heads would serve as stops to prevent the eye piece from being pushed into the main tube too far.

We did not know how to figure out beforehand what distance to use between the stadia hairs so that they would fit the stadia rods already made, and so we set them ⅛ of an inch apart, as explained above, and then sighting through

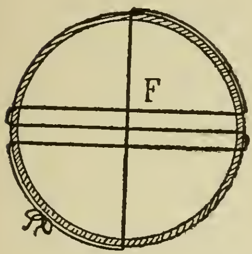


Fig. 106—The stadia hairs

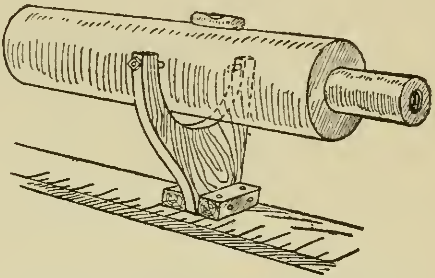


Fig. 107—The telescope mounted on the yard stick

the telescope at a 2-foot rule placed at a distance of 10 feet, we noted the number of inches between the outside two horizontal hairs, and made the blocks of our new stadia rod of this size. Of course, the hairs passing through the center of the field were not used on the stadia rod, but only when we were using the intersection method of surveying.

The telescope was mounted in a bracket such as shown in Fig. 107, and the bracket was made fast to a yard stick, so that the axis of the telescope was parallel with and directly over the graduated edge of the yard stick. The pivots used were small bolts, which could be tightened to hold the telescope at any angle in the bracket. A small spirit level fastened on the main barrel showed us when the telescope was level.

CHAPTER X.

SIGNALING SYSTEMS

THE signals which Roy ran up the mast to indicate the depth of the soundings were patterned after the ball and cone system, which we found in the manual of the United States Signal Corps. The signals were made up of two balls, two cones, and a drum. For the balls we used croquet balls, each with a screw hook at the top and bottom (Fig. 108). The drum and cones we had to make.

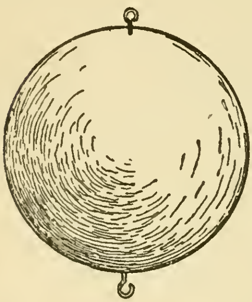


Fig. 108—A screw hook at the top and bottom

Making the Cones

For the cone we took a disk of wood about 4 inches in diameter, and fastened a stick upright in the center of it (Fig. 109). The stick was 4 inches long. Out of a piece of cardboard we cut a circle about 12 inches in diameter. The thin cardboard was slit at one side from the center to the circumference (Fig. 110). Then we lapped one edge over the other, drawing the cardboard up into a cone, which was fitted over the upright stick and tacked at the base to the wooden disk. A screw hook was secured to the apex of the cone by threading it through the paper into the stick, and another hook was screwed into the center of the disk at the bottom (Fig. 111).

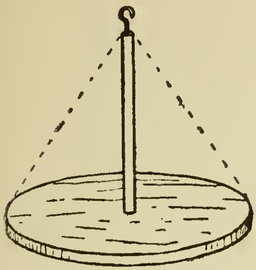


Fig. 109—Frame of the cone

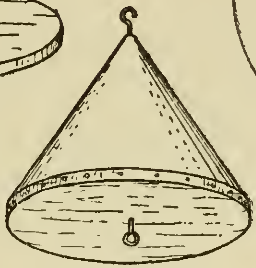


Fig. 111—The cone

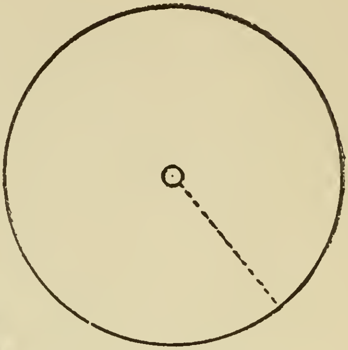


Fig. 110—Slit from center to circumference

The lapping edges of the cardboard were glued together, and the whole was coated with shellac.

Making the Drum

The drum was made in a similar way of two wooden disks, 4 inches in diameter, which were connected by a strip of

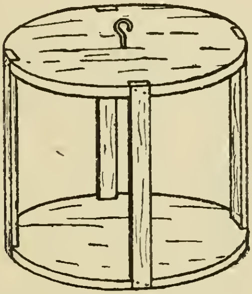


Fig. 112—Frame of the drum

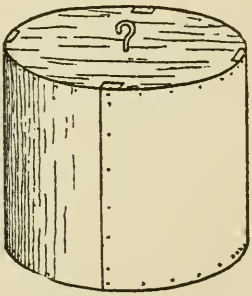


Fig. 113—The drum

cardboard, 4 inches wide. Before applying the cardboard, the disks were connected by two or three sticks, as shown in Fig. 112, forming a substantial framework for the cardboard. The cardboard was tacked on and glued fast, after which it was painted with shellac to protect it from the weather. The drum was also provided with a screw hook at the top and bottom (Fig. 113).

The Ball, Cone, and Drum Code

According to the manual, the cone was numbered 1, the ball 2, the inverted cone 3, and the drum 4. The alphabet was made up as follows, using the numbers to represent the cones, balls, and drum:

A	112	H	211	O	231		
B	121	I	212	P	232	V	312
C	122	J	213	Q	233	W	321
D	123	K	214	R	234	X	322
E	124	L	221	S	241	Y	323
F	132	M	223	T	242	Z	324
G	142	N	224	U	243		

End of word.............	432
End of signal.............	1
Numeral signal...........	423
Alphabetical signal........	422
Annul signal.............	22

It will be noticed that the first seven letters began with number 1, and the next fourteen with the number 2, and the last five letters with the number 3. When signaling the

Fig. 114—The two cones, ball and drum

soundings we did not need to use the alphabet, but only the numbers to represent the depth in feet. We did not have any special code for numerals, but let A (112) represent 1 foot, B (121) 2 feet, and so on up to J (213), which was 10. So as not to mix up the numerals with the alphabet at other times, we would run up the signal 423 to show that every signal after that would mean numerals until we ran up the signal 422, which signified a change back to the alphabet. When we were spelling we used the signal 432 at the end of each word, then 1 at the end of each sentence. When we made a mistake 22 was used, meaning cancel the sentence and begin over again.

Of course, Roy did not have to bother with the period or word sign, or even with the alphabet sign, when he was signaling the soundings, because we knew that all he had to signal to us was numerals; and as the depths did not exceed 8 feet, except for one hole near the dam, there were not

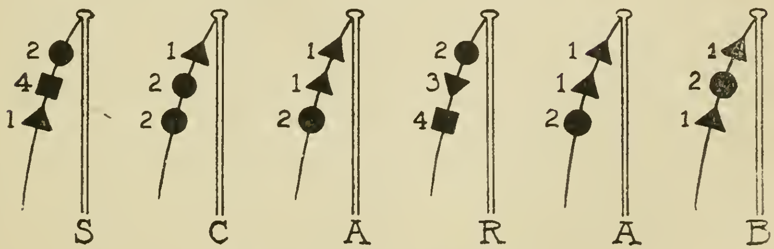


Fig. 115—A sample set of signals

many signals he had to memorize. However, to guard against confusion, the sounding rod was marked not with numbers, but with the corresponding letters of the alphabet to indicate the depth in feet, and Roy put the letters rather than the numbers in his notebook, while we at the shore stations read the signals as numerals, and afterward checked up our notes with Roy's.

The Semaphore System

The ball and cone system was pretty slow for ordinary conversation, so we hunted through the manual for something better, which would enable us to carry on a conversation from the lake house to the dock. Bill hit on a combination of the wigwagging and semaphore systems. A post about 10 feet high was erected on shore, just back of the dock. Out of a board we cut two semaphore arms, each 3 feet long and about 4 inches wide. The arms were slightly tapered, so that they would look like the semaphore arms of railroad block signals. At the narrower end the corners of the arms were cut off, and the arm was rounded, as shown in Fig. 116. A groove was cut in the rounded end to receive the operating cord, which was tacked fast to the upper edge of the semaphore arm. The two arms were hinged to the post near the upper end by means of a long bolt *A* (Fig. 117), which we picked up in the hardware store—a chair bolt they called it. A couple of large washers were placed on the bolt between the post and the semaphore arms, so that they would not stick when we operated them. Then the nut on the bolt was screwed up until it held the

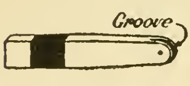


Fig. 116—A groove was cut in the rounded end

semaphore arms without much, if any, play; and then a second nut was screwed on and jammed tightly against the first, so as to keep it from working loose.

At a convenient point above the ground we nailed a block

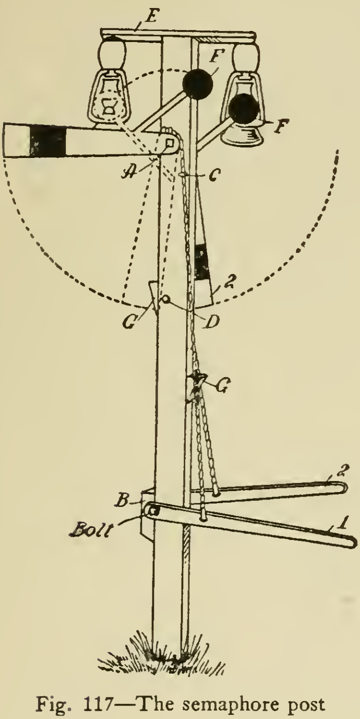


Fig. 117—The semaphore post

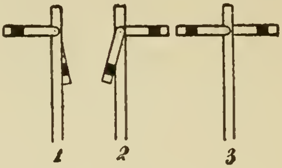


Fig. 118—The semaphore signals

B to the side of the post, and pivoted on it two levers, to which the lower ends of the cords were fastened. One arm was to be swung to the right, and the other to the left, and so one cord had to run up the left side to one arm and the other up the right side to the other arm. Screw eyes *C* were used to guide these cords. Now, when one lever was pushed down, the corresponding arm would spring up. The arm that swung to the right of the operator stood for No. 1, and the one that swung to the left No. 2, and when both were swung up at the same time, they gave the signal No. 3. (See Fig. 118.) A stop pin *D* prevented the semaphore arm from swinging too far where it dropped.

One thing we had to be careful about—the arm that was swung to the right by the sender of the message appeared to the receiver of the message to be going toward the left, because he was facing the sender.

The Wig-Wag Alphabet

We used the wig-wag alphabet which is as follows:

A	22	H	122	O	21	V	1222
B	2112	I	1	P	1212	W	1121
C	121	J	1122	Q	1211	X	2122
D	222	K	2121	R	211	Y	111
E	12	L	221	S	212	Z	2222
F	2221	M	1221	T	2	tion	1112
G	2211	N	11	U	112		

Numerals.

1	1111	4	2221	7	1222	9	1221
2	2222	5	1122	8	2111	0	2112
3	1112	6	2211				

For instance, A was made by two pulls on lever 2, and B by one pull on lever 2, two pulls on lever 1, and one pull on lever 2. The end of each word was indicated by 3, the end of a sentence by 331 and the end of the message by 333. So if we wanted to signal the message "lie low," we would do it as follows: Two pulls on lever 2 and one on lever 1, pause, one pull on lever 1, pause, one pull on lever 1, one on lever 2, and a pull on both levers, to signify the end of the first word (221 1 123); then two pulls on lever 2 and one on lever 1, pause, one on lever 2 and one on lever 1, pause, two on lever 1, one on lever 2, one on lever 1, and three pulls on both levers, to signify that the message was ended (221 21 1121333).

Some of the commoner words were not spelled out, but instead we used the abbreviations found in the manual. A stood for after, B for before, C for can, H for have, N for not, R for are, T for the, U for you, U R for your, W for word, W I for with, and Y for yes.

Night Semaphore Signals

The semaphore stations were rigged up for night use in a very simple way. A board *E* was nailed across the top of the semaphore posts, and from it a couple of barn lanterns were suspended. A stick with a tin disk *F* on it was fastened to each semaphore arm in such a position that it would cover the lantern when the arm was down, but uncover it when the arm was raised, as shown in Fig. 117.

One lantern was covered with ruby tissue paper, so that it would give a red light, while the other was left white. The white light was hung at the right and stood for number 1, while the red was used for number 2, and both together for number 3. We did not have much chance to use this system except for a little while in the early evening, as the days were getting short. Several blocks *G* were nailed to each post, so that we could climb up to the lanterns to light them.

Electric Night Signals

Although we were not very strong on electrical apparatus, "Jumbo," who had dabbled in the science a trifle, rigged up an electric signal, which did away with lighting the lanterns. He had several small electric lamps of about one candle-power each, which had been used for decorating a Christmas tree the year before. He put one at each end of the porch of the lake house, and connected the two to a battery and two keys placed on the side rail of the porch. The keys were strips of wood *H* cut to about the shape shown in Fig. 119. A screw *I* was driven into the porch rail through a hole in the center of each key. (See Fig. 120.) The hole was large enough to permit the key to be rocked up and down. At one end of each key there was a knob *J* consisting of half a spool. This was fastened to the key by means of a bolt and nut. The two keys were electrically connected by a bit of bell wire *L*, wrapped around the bolt between the knob and the key and passed around screw *I* to the opposite key, where it was similarly coiled around

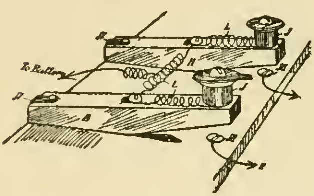


Fig. 119—Two keys placed on the side rail

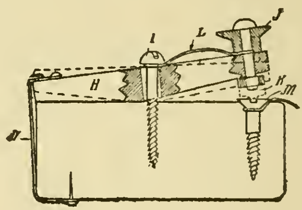


Fig. 120—Details of one of the keys

the screw and twisted about the bolt. Of course, we took off the cotton covering of the wire, and scraped the copper clean where it came in contact with the bolt, and wherever any electrical connections were made. Directly under each bolt a brass screw was screwed into the porch rail, so that when the key was pressed down, the end of the bolt would strike the screw head. One of these screw heads was connected to lamp No. 1, and the other to lamp No. 2. Then each lamp was connected by a wire to one end of the battery, while the other end of the battery was connected with the wire *L*, that ran from one key to the other. Fig. 121 shows just how the connections were made, so that when key No. 1

(R. K.) was pressed down, bringing the bolt into contact with the screw head, the current would flow from the battery *B* through the key to lamp No. 1 (R. L.) and back again. And when key No. 2 (L. K.) was pressed down, the current would pass through lamp No. 2 (L. L.) and light it.

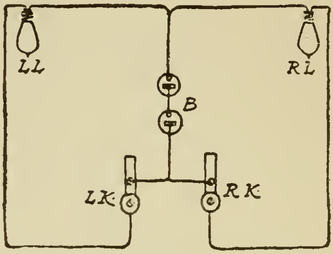


Fig. 121—Diagram of the lamp circuits

Each key was held open by a rubber band *N*, hooked to a nail at the bottom of the porch rail. Our battery consisted of two dry cells, which were connected, as indicated in the diagram, with a wire running from the zinc of each cell to the carbon of the next.

Of course, one of the lights had to be colored, so as to distinguish it from the other. This was done by dipping the lamp globe in a thin solution of white shellac, and then while the shellac was still sticky, dipping the globe into red ink.

The same kind of signaling apparatus was installed at the dock, the lamps being mounted on a couple of posts ten to twelve feet apart, and the operating keys on a narrow shelf on one of the posts. It was a most convenient system of signaling, because the operator could seat himself comfortably in a chair, and operate the two keys with the left hand by pressing one key with the first finger and the other with the second. That left the right hand free to take down the other fellow's message. The rubber bands which held the keys open were so light that scarcely any pressure was required to close the keys. Many an evening we begged off half an hour after supper to carry on a signal talk across the lake. Of course, in the day time we had to use our semaphore system.

One day, while a brisk semaphore talk was being carried on between the lake house and shore stations, I happened upon one of the Academy boys who was not a member of our club, taking notes of the signals. "Hello!" I exclaimed. "What are you doing?"

"Oh, you needn't think that you're the only ones who know how to wigwag," he replied, waving before me a copy of the conversation that had just been signaled.

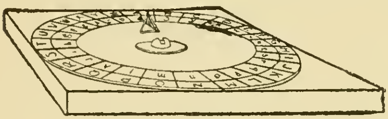


Fig. 122—The cipher disk

"What! Have you been spying on us? Here, give me that copy. You have no right to it." I snatched it out of his hand, but he only laughed.

"Oh, I don't need to write it down," he responded, with a taunting laugh. "I can read off the message just as well without writing the signals."

"Well, you won't read any more messages. Now, clear out before the whole club sets after you."

It had just occurred to me that a cipher system of signaling was described in the manual, and that we must use it by all means. It called for a little device similar to that shown in Fig. 122.

The Cipher Disk

Out of a piece of thin cardboard we cut two disks, one 4 inches in diameter and the other 3 inches. The larger disk was glued to a wooden base, and a smaller one was pivoted centrally on the larger disk by means of a screw and broad washer. Now, each disk was divided off into twenty-six equal parts. The spaces in the larger circle were a shade less than half an inch wide. Each space was marked with a letter of the alphabet, capitals being used on the large circle and small letters on the inner circle. The alphabet read toward the right in the outer circle and toward the left in the inner one. (See Fig. 123.) A small handle was fastened on the smaller disk to help in turning it. The handle consisted of a corner of a well-made pasteboard box, glued to the disk, just under the letter *a*.

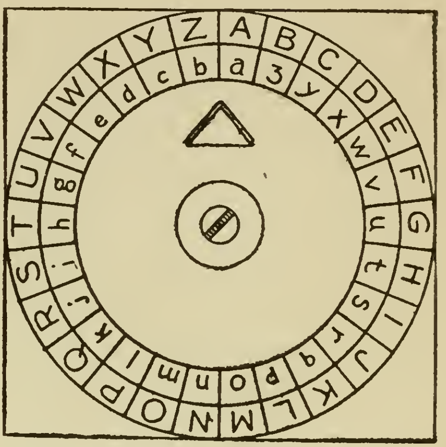


Fig. 123—The lettering on the cipher disks

Making Up the Cipher

Our cipher message was sent as follows: First, we selected a key word, say "Lady Bug"; then we wrote down our message, for instance, "Lie low, the Mulligans are about." Over it we would write a string of "Lady Bugs," and below it the cipher as follows:

LADYBUGLADYBUGLADYBUGLADYB (Key)
BEWARETHEMULLIGANSAREABOUT (Message)
k w h y k q n e w r e q j y f a q g b d c l z p e i (Cipher)

The cipher was obtained as follows: The smaller disk was turned so as to bring the letter *a* opposite L, the first letter of the key. Then B, the first letter of the message, was opposite the letter *k* on the smaller disk, and this letter was the first of the cipher. Then the disk was turned until the letter *a* came opposite A, the second letter of the key word, and the letter E lay opposite *w* on the movable disk, giving us the second letter of our cipher. And so we reduced the whole message to a cipher, and then the cipher message was signaled in the usual way. At the opposite station the letters were taken down in the order in which they were received, and then deciphered by turning the disk to bring letter *a* opposite L, and then setting down the letter which came opposite *k*, viz., B. Then *a* would be set opposite A, and reading opposite *w* we would have E, and so on until the whole message was deciphered.

CHAPTER XI.

THE "HOWE" TRUSS BRIDGE

WHILE we had lots of fun building our submerged stockade, we might have saved ourselves all the trouble as far as the Mulligans were concerned. When weeks had passed and they made no attempt to attack our property we began to boast loudly about the surprise that had apparently knocked all the fight out of them. But, as winter drew near, a new danger cropped up. We had been having quite a little cold weather, enough to form a thin skin of ice along the edges of the pond, but one night there was a sudden cold snap, and in the morning we found the lake covered with quite a thick sheet of ice. We managed to get our boat over to the house by breaking open the channel. We would all gather at the stern of the boat, so as to lift the bow out of the water, and when the boat rode on the ice, we would run forward and crush it down. But the next day the ice was so thick that we could skate on it, and it was out of the question to try to get the boat over. That was the beginning of the long skating season, which would have been very enjoyable had it not left our lake house defenseless and exposed to attack when we were not about to guard it. The inevitable happened.

An Afternoon Call

One afternoon while we were at school the Mulligans paid us a call, and finding us not at home, proceeded to make themselves at home. They kicked in the door, smashed our windows, took out our stove, fire and all, and dumped it on the ice, through which it soon melted a hole and dropped into the water. They tore down our rogues' gallery, hacked our scarabeus to pieces, demolished our chairs and table, and left us nothing but the bare walls of our building, and then lest we mistake the identity of our visitors they scribbled on the wreck of the door: "Compliments of the Mulligans."

We were wild, especially when we saw the stovepipe sticking up through the ice; and when "Jumbo" found that his lathe had been wrecked and his tools all stolen, he actually wept. He was for having the police after them; but what boy would ever get a policeman to help him in a "scrap" with other boys. There was nothing we could do but grit our teeth, and threaten to "fix" them if they should ever fall into our clutches again. So disheartened were we that we would have abandoned the old lake house then and there had we not been too proud to do so.

"We've got to rig up some scheme to keep them off," said Bill.

"How the dickens are you going to do it? We can't stay on guard here day and night."

"But we've got to do something, I tell you."

"Well, do something then! For Heaven's sake, do something," replied Roy, rather testily. That evening, as we went to bed, I heard Bill muttering to himself, "We've got to do something."

The Moat

I had a furious fight with Pat Mulligan that night. The whole gang swooped down on us, and Pat singled me out for his fist work. The battle was so fierce that all the rest stood by and watched Pat and myself. I had the best of him, and was giving him a terrific punishing when the rascal tripped me, and then began to pound me as I struggled to get up. Gradually it dawned upon me that it was Bill who was punching me in the side and trying to shake the slumber out of me. "Wake up, Jim. For Heaven's sake, wake up, can't you? I've got a dandy scheme."

"Oh, leave me alone."

"Come, wake up, won't you?"

"Fade away, Bill. If your scheme won't keep till morning it isn't worth telling."

"But I've got to tell you now."

"Well, go ahead, why don't you? You aren't waiting for me to get up and put on my best Sunday meeting clothes with a rosebud in my buttonhole before you tell me your wonderful scheme?"

"Well, if you're really awake, I'll tell you. We'll break the ice all round our house as far as the stockade, or farther, and that will make a sort of moat around our fort. Then we'll have a drawbridge that we can let down over the moat whenever we want to cross it, and raise it up at other times, so that the enemy cannot reach the house. Of course, we will have to break up the ice every morning. But that's easy."

"Well, the scheme isn't so bad," I said; "but now that you have unloaded your mind, get to sleep. It must be most morning."

The Plank Bridge

Bill was still enthusiastic over his scheme the next day. Under his direction we got a long plank, and fastened it with barn-door hinges to the porch floor of our lake house. A rope was fastened to the center of the plank and passed over a pulley on the porch roof, so that we could pull it up whenever we wished. The board was rather thin and sagged in the center, so we strung wire from end to end of the plank near each edge at the bottom, and slipping a brace which consisted of a board a foot square between the wire and the plank, we turned the board on edge, bowing the

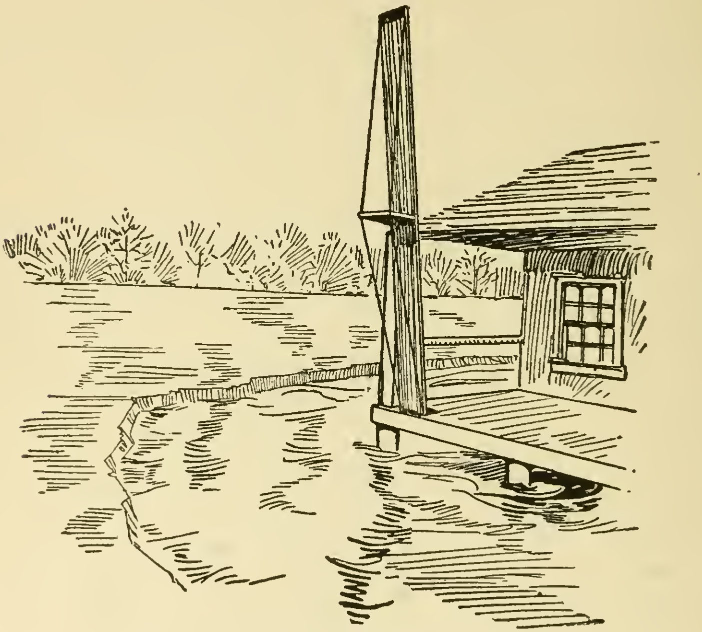


Fig. 124—The drawbridge over the moat

plank slightly in the center. (See Fig. 124.) A catch or button *C* (Fig. 125) on the porch post held the plank when it was raised.

It then occurred to us that we must have some way of raising and lowering the plank from the ice which the Mulligans could not discover, otherwise the drawbridge was of no value. No way seemed to offer. Evidently Bill's scheme was not just the thing after all. What we needed was some sort of a light rig that we could carry around with us, and hide in the barn at night or when school was in session. We could do that with the plank, but Bill had suddenly made up his mind to have something better, and appealed to Professor James for help. Could he suggest some construction that would give us a footbridge light enough to carry around, and yet strong enough to hold the entire club if need be?

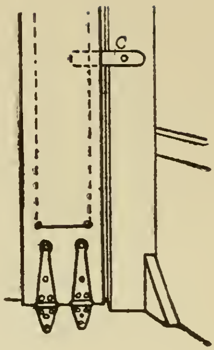


Fig. 125—A button held the draw open

A Lesson in Bridge Building

"Triangles again," said Professor James. "I tell you there is something magic about them. Suppose we used an ordinary plank for the bridge. When you stood in the center the plank would sag down. One way to prevent this you have already adopted in your drawbridge, but it puts an

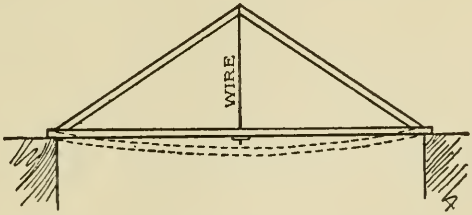


Fig. 126—"Tying it with wire to the apex"

awful strain on the wire. Another way is to use two inclined beams, like this (see Fig. 126), making a triangle. Then draw up the sagging plank by tying it with wire to the apex of the triangle. A truss bridge is made just like that, but

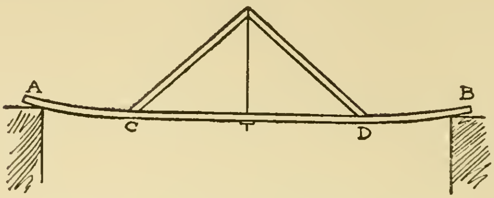


Fig. 127—Sagging despite the braced center

with a lot of triangles, one connected to the other. Suppose, for instance, that you wished to extend your truss on

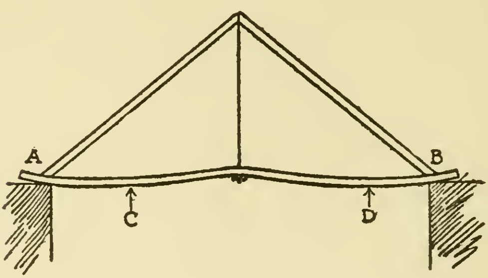


Fig. 128—Another illustration of inadequate bracing

each side to *A* and *B* (Figs. 127 and 128), then your bridge floor might sag despite the braced center, unless

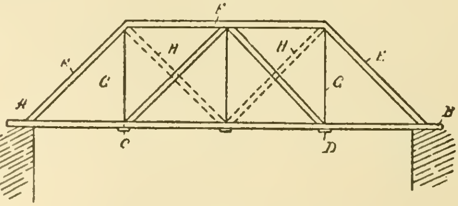


Fig. 129—A four-panel bridge

you tied it up at the point *C* and *D*. To do this, set a couple of inclined beams as at *E* (Fig. 129), and brace them apart with a horizontal stick *F* at the top. Then tie the flooring to it with wires *G*. That will give you a four-panel bridge. It can be made stronger yet by putting in the counter braces *H*. Now you want a bridge to span a gap 10 feet wide. Better make it 12 feet long with eight panels, each 18 inches square."

Construction of the "Howe" Truss

This time Professor James did not leave it to us to figure out a suitable construction, but sat right down himself and drew up a design for us. He was not going to risk any accident by faulty construction.

First, we got four 2 x 3 scantlings, two of them 10 feet long, for the top chords of the bridge, and the others 13 feet long for the bottom chords. Also a piece of 3 x 3 scantling 4 feet long, and two ⅞-inch boards, 10 inches wide and 10 feet long, which we had cut at the sawmill into strips 2½ inches wide.

First, we cut nine notches in the larger chords and seven in the shorter chords. These notches were 3½ inches wide and ½ inch deep. In order to get them all just alike and the same distance apart, we cut a notch at the center of one of the scantlings in the 3-inch space and then laid the scantlings edge to edge, wide face up, with their centers in line. Measuring from the right edge of the notch, we drew lines across all four of the scantlings, 18 inches apart, using a

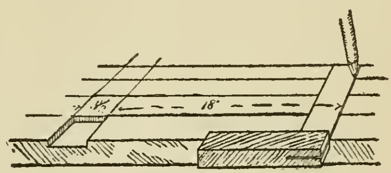


Fig. 130—Drew lines across all four scantlings

carpenter's square to get them true. (See Fig. 130.) That gave us one side of each notch, and it was easy enough to find the other by measuring 3½ inches to the left. Then with saw and chisel we soon cut out the notches.

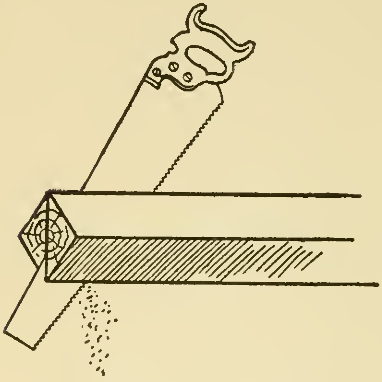


Fig. 131—Sawing across corners

There were thirty-two notches in all, and we had to cut a block to fit each notch. Taking the 3-inch square scantling, we cut it in two lengthwise, sawing across corners (Fig. 131) so as to give us two triangular strips 3 x 3 x 4¼ inches. By planing the two edges the 4¼-inch side was reduced to about 3½ inches. Then we cut each strip into blocks 3 inches long (Fig. 132) and drove and nailed one in each notch of the top and bottom chords. A pair of holes was drilled into the V of each block through the chord.

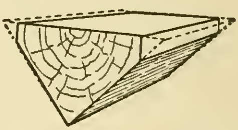


Fig. 132—One of the blocks

From the 2½-inch strips we cut forty-four braces just 26 inches long. In order to get them all exactly the same length, we cut one and used it as a template for cutting the others. We were very careful to saw the ends off square. Then we got about 6 feet of No. 15 steel wire, and everything was ready for assembling the bridge.

Assembling the Truss

A top chord *A* and a bottom chord *B* were laid on the ground 18 inches apart, and after two braces running diagonally in opposite directions from the block *C* at the center of the upper chord had been set in place the chords were temporarily tied together with rope. The rest of the braces *D* were then put in place in pairs, between which the counter braces *E* were fitted. When all the braces had been assembled between the top and bottom chords, as shown in Fig. 133, we fastened the chords together permanently with the steel wire. A loop in the wire was fitted over the end of the top chord. Then it was threaded into the holes in the chords, passing down through the bottom chord and back again, then on to the next pair of holes, and down and back again, as shown in Fig. 134, and so on to the end of the bridge, where the wire was made fast by wrapping it around the top chord a couple of times and driving a stout nail through a loop that had been twisted in the end of the wire. The wire was drawn as taut as possible while we threaded it through the holes, but the twists and kinks in it showed that it was not nearly tight enough. So we cut a number of wedges *G* of oak, and drove them between the wire and the bottom of the lower chord, as indi-

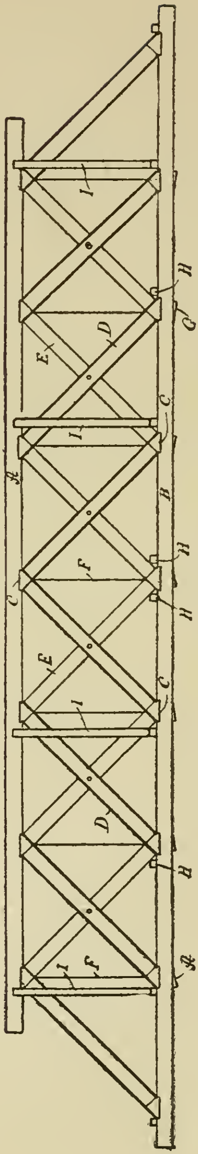


Fig. 133—Side view of the "Howe" truss bridge

cated in Fig. 135. Each wedge was driven in part way at first, and then when all were in place we tapped them

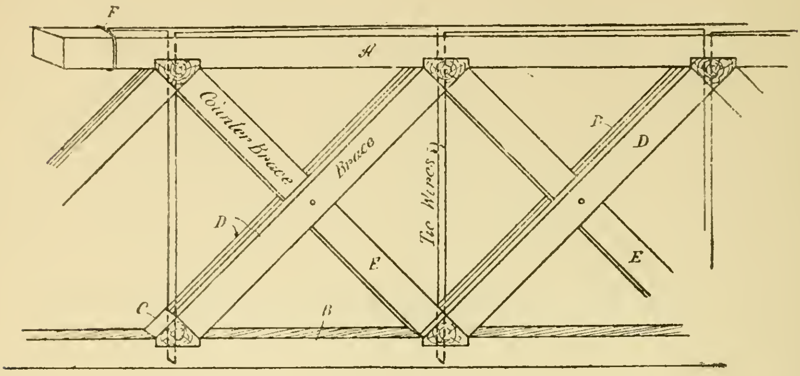


Fig. 134—How the wire was strung through the chords

successively with a hammer until the wire was tight enough to sing like a banjo string when we thrummed it. We could

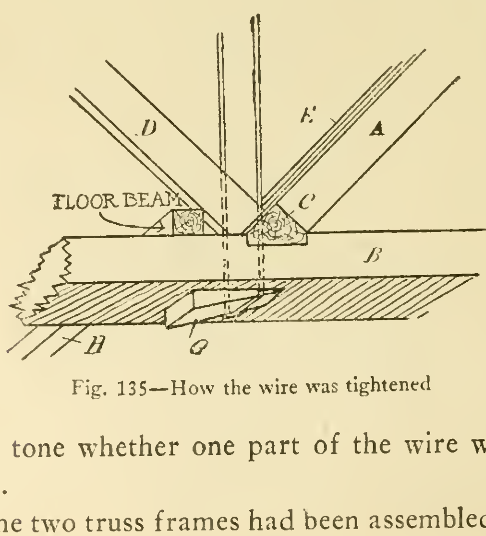


Fig. 135—How the wire was tightened

tell by the tone whether one part of the wire was as tight as another.

When the two truss frames had been assembled and wired we set them on edge two feet apart and laid our floor beams *H* across the bottom chords, to which they were nailed. The beams were 1-inch square sticks, and every second one extended about a foot beyond the chord at each side, and braces *I* were fitted between the ends of the beam and the top chord, so as to hold the two trusses upright. On our floor beams we laid three narrow ¾-inch boards for the floor of the bridge.

Mounting the Bridge on Runners

The bridge weighed about 120 pounds, which was considerably more than we had anticipated, and it was quite a nuisance to carry it down to the ice whenever we wanted to go to our lake house. Furthermore, it was no easy task to

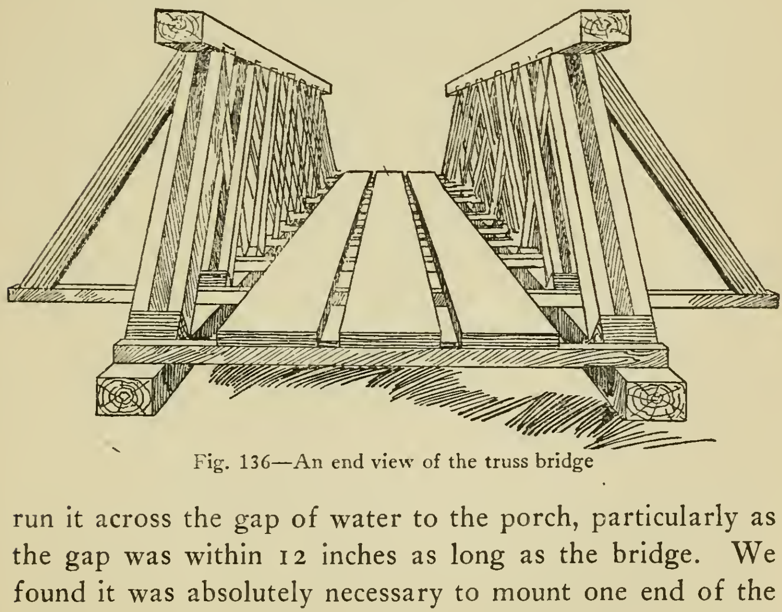


Fig. 136—An end view of the truss bridge

run it across the gap of water to the porch, particularly as the gap was within 12 inches as long as the bridge. We found it was absolutely necessary to mount one end of the bridge on a box, which had been rendered watertight by nailing felt-lined strips of wood over the cracks. This box was sufficient to float one end of the bridge, so that all we

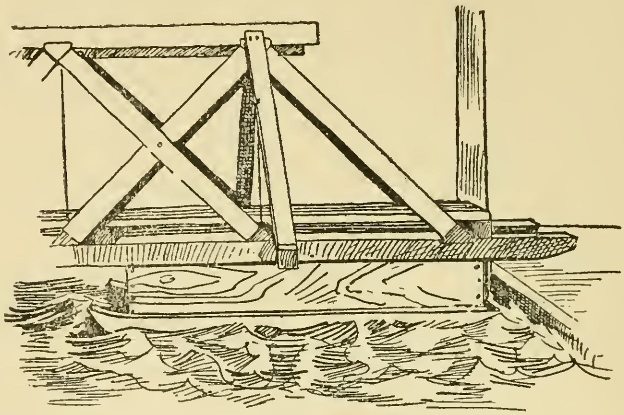


Fig. 137—The bottom chords resting on the edge of the porch

needed to do was to push it across and let the bottom chords rest on the edge of the porch. A couple of piles were driven

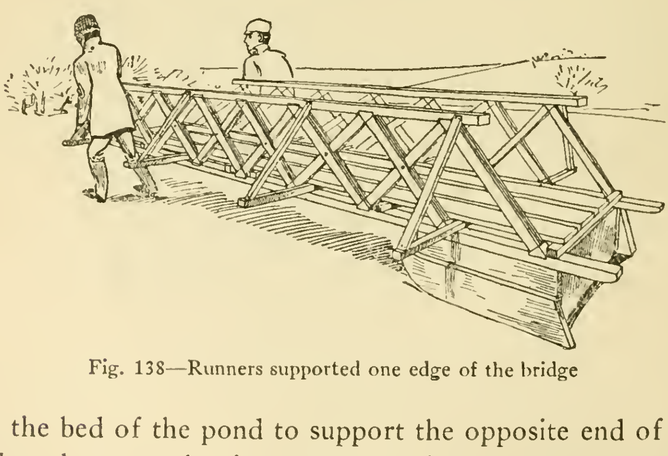


Fig. 138—Runners supported one edge of the bridge

into the bed of the pond to support the opposite end of the bridge, because the ice was not always strong enough.

To assist us in getting the soap box out of water when we were moving the bridge we nailed a couple of sled runners to it, letting them curve up toward the center of the bridge, as shown in Fig. 138. The runners supported one end of the bridge when we were dragging it to the barn or to the house.

Snowball Catapult

As a further protection to the lake house, "Jumbo" got up a sort of catapult for throwing snowballs. It consisted

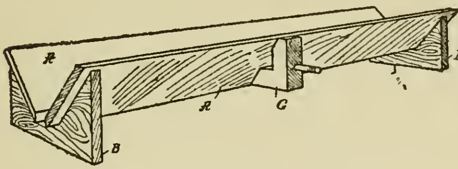


Fig. 139—TheV-shaped trough

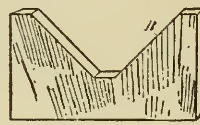


Fig. 140—One of the crosspieces

of a V-shaped trough in which the snowball was placed, and a spring board arranged to shoot the snowball out of the trough. The trough was 3 feet long, and made of

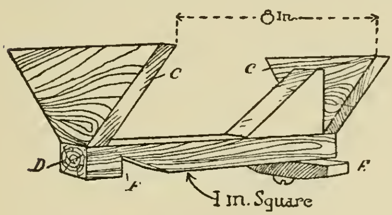


Fig. 141—The slide for the trough

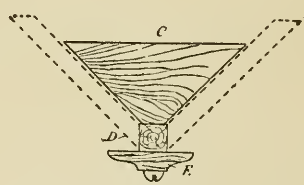


Fig. 142—End view of the slide

a pair of light boards *A* nailed at each end to a cross piece *B*, in which a V-shaped notch was cut, as shown in Fig. 140. The boards did not come together at the bottom of the V, but were separated by a space 1 inch wide. A slide for the trough was made from a pair of V-shaped pieces *C*, to which a stick *D* 1 inch square and about 8 inches long was nailed. The stick was planed down to slide freely in the slot at the bottom of the trough, and to the under side of the stick a button *E* of wood was fastened with a screw, so that it could be turned crosswise to hold the slide in place. A notch *F* was cut in the stick for the trigger.

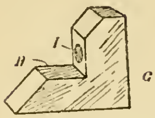


Fig. 143—A block for the trough

Two triangular blocks *G* were attached to the outside of the trough on opposite sides, but before nailing them fast a bolt hole *H* was drilled edgewise through each block, and a notch *I* was cut in the block to receive the head of the bolt. These bolts connected the trough to the catapult stand.

The Catapult Stand

The stand was made of two A-shaped frames *J* and *K* about 4½ feet high, which were inclined toward each other and connected with strips, making a sort of pyramid 4 feet high. The spring board was hinged to a central board *M* that ran from one frame to the other. Two blocks *N* (Fig. 145) were nailed to the board *M* between which the spring board *O* was mounted. The spring board was a piece of seasoned hickory, ½ inch thick, 6 inches wide and 3½ feet long. A piece of a broom handle *P* was nailed to the spring board above the center and then the spring board was fitted between the blocks *N* with the broom handle resting in notches

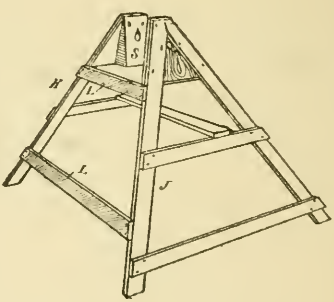


Fig. 144—The catapult stand

in the blocks. Two plates *R* were nailed over the broom stick to the board *M* and blocks *N*. The trough was now mounted on the stand, as shown in Fig. 146, with the bolts passing extending from the blocks *G* through the A-frames at each side. Wedge-shaped pieces *S* were nailed to the A-frames to provide suitable bearing surfaces that would

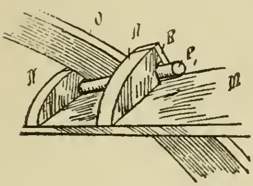


Fig. 145—Mounting of the spring board

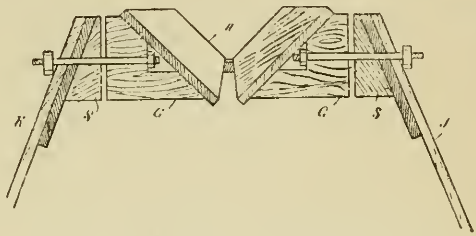


Fig. 146—Method of mounting the trough

press against the blocks *G* when the nuts on the bolts were screwed up and hold the trough at any angle at which it was set. The slide was connected to the upper end of the spring board by a stout cord. A rope was passed around the lower end of the spring board and tied fast to the rear of the frame. A handle *T* was nailed to the trough to help us to aim the catapult.

The Trigger of the Catapult

The trigger of the gun was cut from a piece of oak to the shape shown in Fig. 147, and was pivoted on a bolt which ran through a slot. A cord was attached to the trigger, and its other end was fastened to the handle.

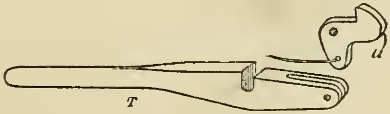


Fig. 147—The handle and trigger

To fire the catapult, the slide was drawn back and caught on the trigger U. Then with a stick we twisted the rope until the spring board was bowed. The end of the stick

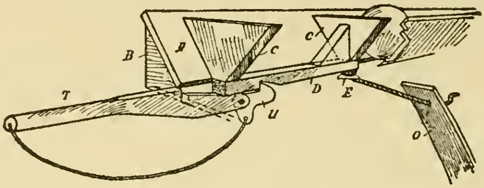


Fig. 148—The slide was caught on the trigger

was caught in a loop of the string to keep the rope from unwinding. Then the catapult was ready to be fired. We could swing the trough up and down as far as we pleased, but when we wanted to aim to one side, we had to turn the whole stand around. When the trigger cord was pulled, the slide would shoot along the trough until brought up short at the end, and the snowball would be hurled out at tremendous speed.

The Gunners' Shield

At the front of the stand we built a shield to protect the gunners while in battle. The shield was constructed, as shown in Fig. 149, of a number of boards fastened together with cleats and with an opening wide enough to let the trough through.

The catapult was such a success that Bill Rameses made out a written order for a second one just like it, sealing the order with Pharaoh's official seal. We set the two catapults on the porch of the lake house, one at each end, and laid in a supply of snowballs. Two boxes filled with snowballs were kept over in the bramble patch as reserve ammunition for an emergency. With the two snowball cannon to guard

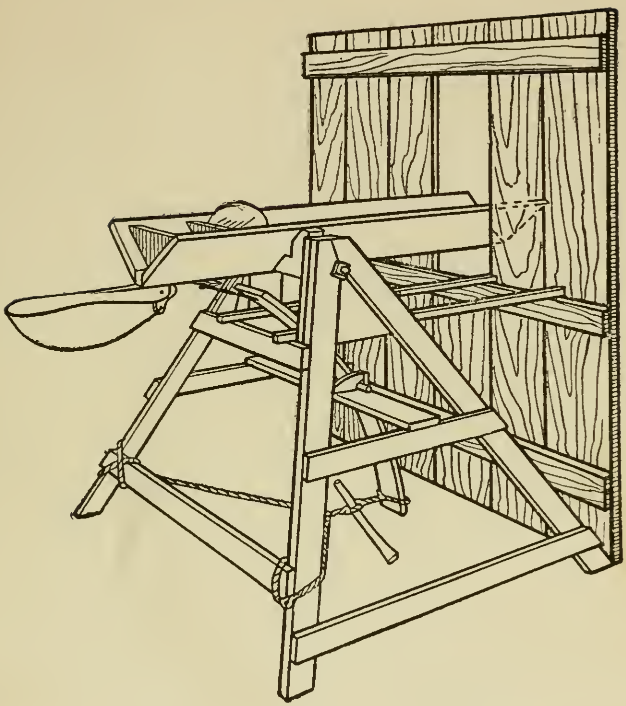


Fig. 149—The catapult ready for action

the moat, and a stretch of open water between the house and the ice, we felt pretty safe from attack.

A Warning

One afternoon, just after our truss bridge had been completed, as the time for the afternoon school session to end was drawing near, "Doc" asked to be excused. As he passed rather hastily down the aisle, he dropped a note on my desk. "Come at once. The Mulligans are about. Leave word for the rest." The other Scarabs were all at recitation, but I penned a note to "Jumbo" to hurry along with reinforcements, passed it over to his desk, and then obtained permission to leave the room. "Doc" was outside, fairly frantic with impatience.

"For Heaven's sake hurry, can't you?" he said as he started on a wild rush to the barn for the truss bridge. We dragged the thing down to the ice and over to the lake house, hurled it across the gap of clear water, and then ran back for our loads of extra snowballs, drew them quickly across to the house, and pulled in the truss bridge. While I drew in the bridge "Doc" loaded both of the catapults.

All this while we hadn't seen anything of the Mulligans, and "Doc" had kept me so on the run that I had not had a chance to ask him how he knew the Mulligans were coming. When I did put the question to him, he tapped his forehead, looked wise, and told me not to question Amenophis, the great magician and astrologer, arch priest of the scarabeus. Then he pointed to the dam. "Behold, doubting sire, thine eyes are opened that thou mayest acknowledge the power of the high priest of the Sacred Scarabeus."

There were the Mulligans, sure enough, putting on their skates!

"Lie low, Jim Amenhotep, and I will tell you the very workings of their minds. They did not see us come, and do not know that we are here. They planned to take possession of our house while we were still in school, and surprise us when we came around with a volley from our own catapults. But we have stolen a march on them. Do you see those poles they have with them? They are going to use them to vault our moat."

"Now, how in the world did you find this all out?"

"Don't bother me with foolish questions. We have serious business ahead. Train your gun on them, but do not fire until I give you the word."

The Attack

Not until the Mulligans had about reached the edge of our moat did "Doc" give me the signal, and then suddenly two snowballs were hurled as if from a cannon right in the midst of the gang. We did not see at first what havoc had been wrought, we were too busy reloading. But a yell from the Mulligans told us that we had hit something, and when we looked up, we saw them scrambling off in all directions. However, they were only surprised, not licked, and came back at us right away. After our first volley we did not waste our ammunition by firing both catapults at once, but while "Doc" aimed and fired one I loaded the other. The catapults could hardly work fast enough. The Mulligans spread out in a fan, so that we had harder work aiming at them, and they could dodge our shots better. Then they made a rush for us. We dropped the catapults, and ran to the edge of the moat to fight them off. But what could two of us do against half a dozen? I knocked Pat Mulligan into the water the moment he touched the landing, but before I could turn around the rest of the Mulligans had vaulted across, and were struggling to throw "Doc" and me into the water. We each picked out an assailant, and despite the pounding we received clung to him so desperately that he could not shake us off, and if one was thrown overboard the other would have to go too.

Reinforcements

Just then I caught a glimpse of Bill and the rest of the Scarabs coming to the rescue. The plank bridge was still in place in front of the house, and while I fought I managed to make my way over to it, and with my elbow knocked the retaining button loose. The plank fell with a crash, but fortunately the ice was thick and held. Immediately Bill and the rest swarmed across. Then the fight was on in earnest. First one side and then the other seemed to have the mastery. Once in a while a fellow would be knocked over into the ice-cold water, but he would scramble out again to renew the battle. Luckily the water was not deep, else the consequences might have been serious. The Mulligans were gradually getting the worst of it. At one time we had half of them overboard, and succeeded in keeping them from scrambling out onto the porch. They managed to get up on the plank bridge, but as they had to come single file it was an easy matter to keep them off. The porch was soon cleared of the other three, and the day was won. The Mulligans turned and fled. We ran after them, not so much with the idea of putting them to rout as to get back to the school as soon as possible and dry our clothes.

It is a wonder that none of us came down with pneumonia. All but "Jumbo" and myself had had a ducking. The next day our club boasted of four beautiful black eyes and a various assortment of battered noses, bruises, etc.

CHAPTER XII.

THE SEISMOGRAPH

I SAW the postman coming up to the Academy one day, grinning and chuckling to himself. "Hello, boy!" he cried. "Who's this come to boardin' school? Is it a heathen institution you're running? Look at this, now. Nobody but a Chink would stand a name like that. The first one isn't so bad—'William Rameses.' We've got Ramseys next door to us; but say, if anybody dared to call me by this here name, I'd smash his face for him." He handed me a letter bearing an Egyptian postage stamp and addressed to Messrs. William Rameses and James Amenhotep.

"Oh, I know those two fellows," I said. "I'll give them the letter."

"What are they—Turks or Persians?"

"Neither," I replied; "pseudonyms."

"Soudanums? Oh, I know. They come from Africa, don't they?"

I didn't disillusion him, but chased off to find Bill. "How in the world did any one discover our names?" I wondered.

"It must be Uncle Ed," said Bill, tearing open the envelope. "He's somewhere in the Orient, and in my last letter I told him I was Pharaoh of our club, and you the Grand Vizier. I didn't see any harm in it, because he is really one of us, you know."

Uncle Ed's Letter

Bill was right. Uncle Ed's letter was brief, but as usual to the point. He was glad that we were a *modern* order of ancient engineers. He wanted us, above all, to be up to date, not only in science and engineering, but in every other branch of learning as well. The ancients, he told us, were very smart—wonderfully smart, considering the tools they had to work with; but he wished us to copy only their resourcefulness and their dogged perseverance. In everything else he wanted us to be very modern, and he urged us to subscribe to a first-class New York daily paper, and read it from cover to cover every day, so that we could keep up with the times.

A Daily Paper

Of course, he could just as well have bought the paper for us himself, but he knew that we would think more of it if we paid for it out of our own pocketbooks. Instead of having the paper come to the club, Bill suggested that he and I buy it for ourselves, because one paper divided between seven fellows would mean that some would get nothing but the "ad" pages. I readily fell in with the proposition, and went halves with him on the subscription. It arrived every morning just before noon addressed to Messrs. Rameses and Amenhotep, and right after dinner as regularly as clockwork we betook ourselves to a sequestered spot, divided the journal in two, and pored over its pages. Every item was of intense interest, and the reading was almost invariably followed by a discussion. Strange and original doctrines were propounded at these noonday meetings. We were studying the world's doings, and planning wonderful remedies for its many shortcomings.

A Report from Bokhara

While reading the paper one day, Bill came across a small cable dispatch that I had read but hadn't taken in. "Say, what do you think of this, Jim? A traveler from Central Asia reports a disastrous earthquake in the Khanate of Bokhara. Four villages were destroyed and over five hundred lives were lost."

"Terrible loss of life," I replied perfunctorily, and went on reading.

"Yes; but that isn't what I mean. Don't you remember not long ago, we read about an earthquake record made by an instrument in Washington. They said the earthquake must have been about 8,000 miles away, and probably in the heart of Asia. This must have been it. But how the dickens could that instrument record a quake so far off?"

"Give it up, Bill. Better ask Prof."

The Seismograph Explained

"Well, boys, what is it now?" said Professor James. "Triangles?"

"I suppose so," assented Bill doubtedfully. "What we would like to know is how a man in America can tell that there has been an earthquake in Asia before word can come by mail or telegraph."

"Well, there are no triangles in that question," laughed Professor James. "You know when you drop a stone in a pond how it will start a set of waves that spread round in circles which grow larger and larger though weaker and weaker until they cover the entire surface of the water. In the same way, when the earth starts to quaking, a wavelike motion spreads out in every direction and travels over the whole world. By the time the waves have travelled all the way from Asia to America, they are so weak that it takes an exceedingly delicate instrument, called a 'seismograph,' to feel them. Delicate as it is, this instrument is very simple—

merely a big weight hung so that it will not move or tremble when the earth does. Then a lever which moves with the earth has one end connected to the weight in such a way as to exaggerate or multiply the slightest motion of the earth, and a pen on the lever traces an outline of the earth waves on a sheet of paper." He drew a diagram like Fig. 150. "The lever is pivoted on a post driven in the ground close to the stationary weight. The short arm of the lever is connected by a link to the weight, and the longer arm is provided with the pen. Now, if the earth should jog the post slightly to one side, the pen would be swung much farther because it is much farther from the weight *W*. It is just like this: When you hold one end of a pencil and move the middle of it an inch, the outer end moves two inches. (See Fig. 151.) This is what we call a multiplying lever.

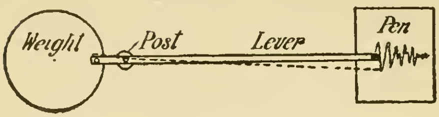


Fig. 150—Diagram of a seismograph

"Any sort of pendulum will do to support the weight, provided the weight is very heavy and on a long string. But there is a special kind of pendulum that swings horizontally and is better in many respects than any other. Sometimes you will find a door that persists in swinging open unless you latch it, merely because the frame is warped and one hinge is not directly over the other. That is the way the

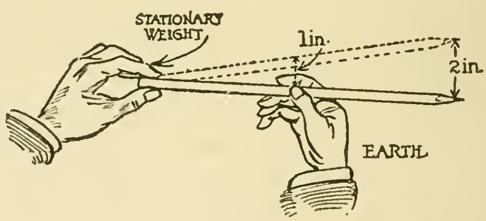


Fig. 151—A multiplying lever

horizontal pendulum works. The weight instead of hanging vertically is held out to one side by a horizontal rod, which is pivoted to a solid foundation. The pivot of the pendulum rod is not directly below the pivot of the pendulum wire. (See Fig. 152.) This makes the pendulum always swing back slowly to the same position after it has been moved one

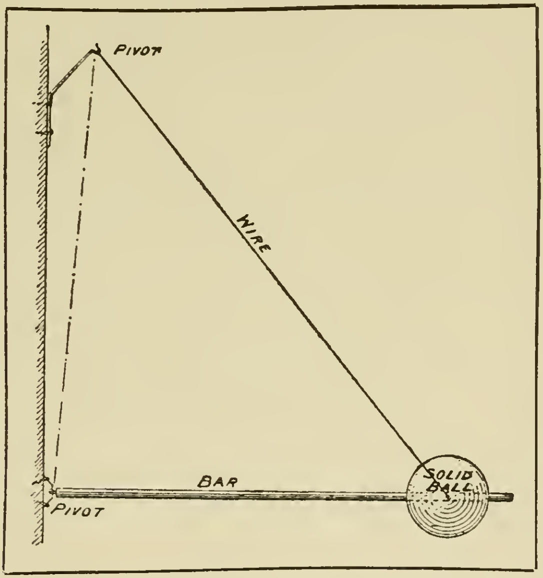


Fig. 152—The weight is held to one side by a horizontal bar

side. The more nearly the two pivots are in line the more slowly will the pendulum swing, and the heavier the weight the less it will be disturbed by the trembling of the earth.

"There now, Bill. I suppose you will invite me around to-morrow to see a seismograph built *á la* Bill Rameses by the Modern Order of Ancient Engineers."

Locating the Earthquake

"But, Professor James, we wanted to know how they can tell where the earthquake is."

"Well, I declare! So you did; so you did." He reached for an encyclopedia, and turned to a page on which there were a number of earthquake records made by a seismograph. "Do you notice that every one of them starts out with a set of small tremors? (*P′*, Fig. 153). Then a set of larger tremors (*P″*), and finally the big waves (*P‴*).

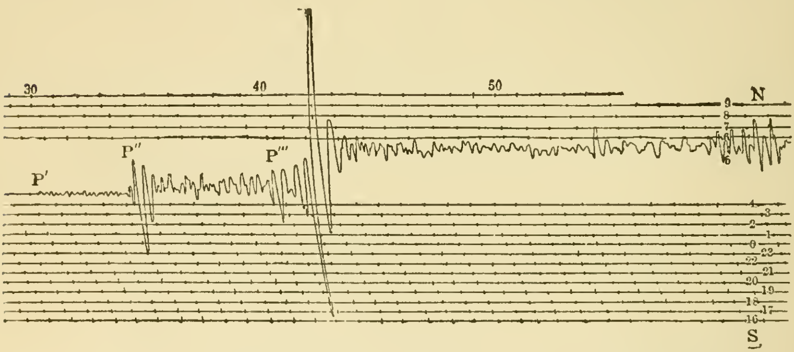


Fig. 153—An earthquake record. P′ small tremors, P″ larger tremors, P‴ big waves

All these waves are produced at about the same time, but the smaller tremors travel much faster than the bigger waves. Usually they gain a minute over them every two hundred miles. So all you have to do is to count the minutes that elapse between the first tremor and the first of the big waves, and multiply this by 200 to find out how far the waves have come. The direction of the waves, however, is more of a problem, and a little too complicated for me to explain. Sometimes two seismographs are used, one set at right angles to the other. One pendulum will tell you how many miles east or west to measure, and the other how many north and south, and in this way you can tell that the earthquake is in one of four places. Then usually the swing of the pendulum is a little more pronounced in the direction in which the waves are traveling, and this can be detected by a careful examination of the earthquake record. Any more questions?"

"Yes," answered Bill. "Do you think we could build one?"

"It's a pretty delicate job," said Professor James; "but the Modern Order of Ancient Engineers hasn't failed at anything yet. If you like, I will help you."

The Horizontal Pendulum

Of course we "liked," and with Professor James's help built a very good seismograph as follows: The instrument was set up in the cellar, where it would have a good foundation and would be free from local disturbances. For our heavy weight we took a large galvanized-iron pail and filled it with stones. The horizontal rod of the pendulum was a wooden pole, 8 feet long, on which the pail was nailed about 10 inches from one end. At the other end of the pole a block *A* (Fig. 154) was nailed fast, and a

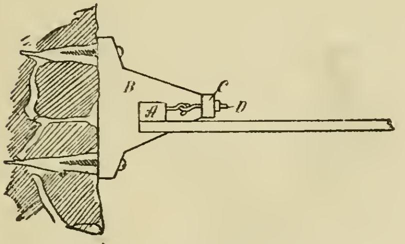


Fig. 154—The lower pendulum pivot

screw hook was threaded into it. On the wall of the cellar we fastened two brackets of wood, nailing them to plugs of wood driven into chinks in the masonry. The brackets were made very solid, and across their projecting ends we nailed a wooden strip *C*. An eyebolt *D* was slipped through a hole in this crosspiece, and was held by a nut. When we were ready to mount the pendulum the screw hook was caught in the eye of the bolt.

For the upper pivot we fastened two brackets *E* (Fig. 155) at the top of the cellar wall directly above the other pair. The projecting ends of this bracket were beveled off, as shown. Two crosspieces *F* were nailed to this beveled surface just far enough apart to receive the tongue *G* of a slide block *H* (Fig. 156). An eyebolt *I* passed

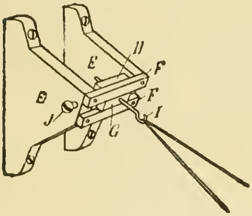


Fig. 155—The upper pivot

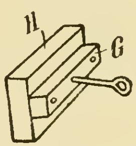


Fig. 156—The slide block

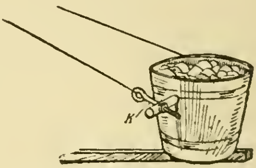


Fig. 157—The pendulum weight

through a hole in this block, and was held from slipping through the hole by a nut. The eye of the bolt was hammered open to form a hook, as in Fig. 155. Two screws *J* were threaded through the brackets *E* and their ends, which were filed blunt, pressed against opposite sides of the block *G* to hold it fast anywhere we wished in the slot between the crosspieces *F*.

A piece of a broomstick was passed through two holes in the pail at right angles to the pendulum bar. Two eye-bolts *K* (Fig. 157) were fastened to the ends of the stick. A wire was then attached at its center to a hook which was caught in the eye-bolt of the upper pivot. The ends of the wire were attached to the eye-bolts on the broomstick, and after the pendulum bar was hooked to its pivot *I* the wires were tightened up until the bar was horizontal, by screwing up the nuts on the bolts *K*. The upper and lower pivot bolts *I* and *D* were then adjusted until the pendulum, if disturbed, would take half a minute or more to swing from one side to the other. To make the motion slower the pivot bolts were let out and to quicken the motion they were drawn up. By shifting the block *H* along the cross-pieces we could make the pendulum bar come to rest where we wished it to.

The Multiplying Lever

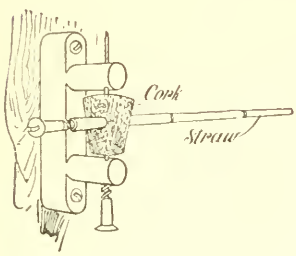


Fig. 158—The straw was threaded through a cork

A post was now driven into the cellar floor near the outer end of the pendulum bar and a very light lever was pivoted on this stake. The lever was a straw about 15 inches long with a heavy screw fitted tightly into one end of it. The screw was made fast to the straw with sealing wax. The straw was threaded through a hole in a large cork. For the pivot pin we used a sewing needle which was passed through the cork at right angles to the lever.

Casting the Lever Bearing

The pivot bearing was made out of Babbitt metal which we cast in a block of wood. Two 1-inch holes were drilled in the block of wood to a depth of about half an inch, then a channel was cut in the block connecting the two holes, as indicated by dotted lines in Fig. 160. Two ½-inch holes were then bored into the bottom of the channel about as far apart as the height of our cork and an inch deep. The block of wood was cut away at one end L (Fig. 160) so that there was only a thin wall of wood at the side of one

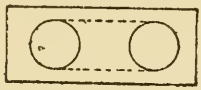


Fig. 159—A channel connecting two holes

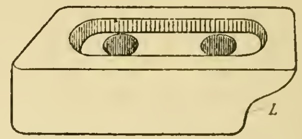


Fig. 160—The block was cut away at one side

of the ¼-inch holes. A large needle was then driven through this hole and half way through the other. A brass screw was threaded through the other end of the block until its blunted end touched the point of the needle. Two nails were now driven into the wood at the bottom of the channel. The nails, needle, and screw were coated with a mixture of oil and lampblack and then the Babbitt metal was melted in a tin can in the cellar furnace and poured into the block, filling the holes and the channel to the brim. When the metal was cool the block was split open and the nail and needle were drawn out, leaving us a casting like that shown in Fig. 158. This casting was fastened to the post with two screws which were passed through the nail holes, and when we were ready to mount the lever the pivot pin was fitted into the needle hole with the point resting on the end of the brass screw. For our pivot pin we selected a needle that

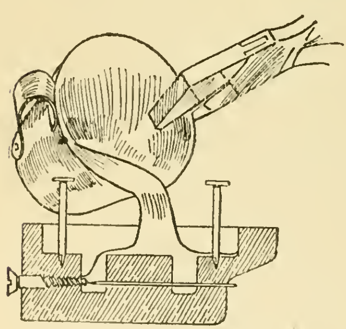


Fig. 161—Filling the channel to the brim

was a trifle smaller than the one that was used in making the casting, so that it would fit freely but not loosely in the hole.

The Stylus

At the end of the straw lever a light stick of hard wood *M* was fitted and glued fast. The ends of this stick were capped with a drop of solder. A piece of fine piano wire was bent into a yoke. (See Fig. 162.) The ends of this yoke were sharpened with a file and stuck into pin pricks in the solder at each end of the stick *M*. The wire at the center of the yoke was doubled to form a stylus *N*, which was sharpened with a file.

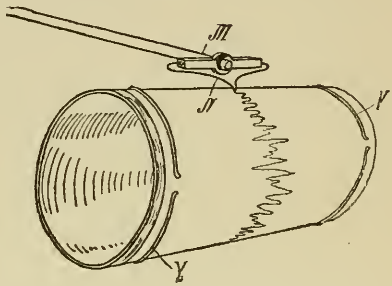


Fig. 162—The stylus at the end of the straw

Connecting the Lever to the Pendulum

At the other end of the lever the screw was punched with an awl to form a slight dent and at the end of the pendulum bar we placed a drop of solder with a small hole pricked in the surface. Then the bar and the nail were connected by a light wire link bent to the shape shown in Fig. 163, with the ends resting in the pin pricks in the solder and nail. To balance the lever as nearly as possible we added a drop or two of solder to the nail.


Fig. 163—The wire link

The Recording Drum

The next task was to make the recording drum. We took a mailing tube *O* (Fig. 164), about 3 inches in diameter, and cut off about 5 inches of it. Two disks of wood, *P,* were fitted and glued in the ends. For the drum shaft, *R,* a wooden rod was threaded through the two disks at the exact center and glued fast. The rod projected about 4 inches from each disk. A piece of wire, *S,* was coiled in a tight spiral around the rod. After 25 turns had been put on, one end of the wire was made fast with a staple close to the drum. The coil was then pulled out and the other end of the wire was tacked fast to the outer end of the rod. A nail *V* (Fig. 165) was driven into the shaft at the other side of the drum.

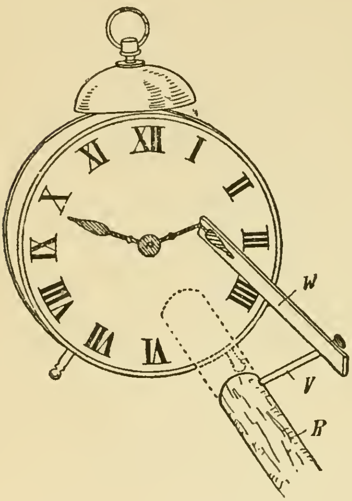


Fig. 165—The clock made the drum turn

The drum shaft was supported on two notched brackets nailed to a baseboard. One bracket, *T*, was of wood, as indicated in Fig. 166, while the other, *U*, was a piece of tin bent to an L shape with a V-shaped notch in the upper

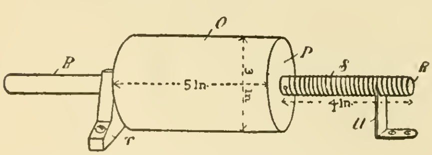


Fig. 164—The recording drum

Fig. 166—The wooden bracket

end. The tin fitted between the coils of the wire and as the drum was turned the coils made the drum move slowly endwise. To turn the shaft *R* we used an ordinary alarm clock. The minute hand was bent out at right angles, as shown in Fig. 165, and on this projecting end we got a tinsmith to solder a piece of tin, *W*, a little over four inches long. The clock was then set on the baseboard so that the tin strip would bear against the nail on the rod and make the drum turn around once every hour. At the end of 25 hours the end of the coil would be reached, stopping the drum, unless an attendant came to reset it. To do this the drum was lifted bodily out of the brackets and set back in its original position.

On the drum we wrapped a strip of paper coated with lampblack and fastened it with a couple of wire rings, *Y* (Fig. 162), at each end. These rings were split open at one side and had to be sprung apart before they could be slipped on to the drum. The baseboard of the instrument was mounted on a stout box in such a position that the stylus of the latter rested lightly on the blackened paper near one edge. As the drum turned around the stylus traced a straight line in the soot.

The Time Recorder

We had to have some way to measure the minutes along this line and so we got an electric bell, took off the gong and mounted it so that the clapper would hit the post on which the straw lever was supported. (See Fig. 167.) The little adjusting screw of the bell was screwed up against the contact spring so that the clapper would hit only one stroke when the current passed through the electro-magnets of the bell. Then we connected up the bell to a good timepiece, as shown in Fig. 168. One wire, *a,* ran from the battery directly to the bell, and the other battery wire, *b,* was connected to the metal frame of the clock. A third wire, *c*, then ran from the bell to the face of the clock, where it was fastened in the path of the second hand. At the end of each minute, when the second hand came around and touched this wire, the current would run from the battery

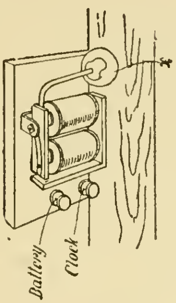


Fig. 167—Mounted so that the clapper would hit the post

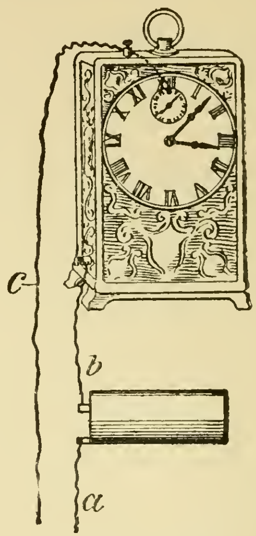


Fig. 168—Electrical connections of the bell and clock

through the bell magnets, causing the clapper to hit the post. The slight tremor of the post at each blow of the clapper was recorded by the stylus *N*, just as if it were a tiny earthquake, and thus every minute a jog was made in the line traced on the drum. These jogs may be clearly seen in the diagram, Fig. 153.

Coating the Paper

Our Chief Astrologer took charge of the seismograph and saw to it that the instrument was attended to every morning right after breakfast. The attendant would lift the drum off its bearings and put a new sheet of glazed paper on the drum, smoothing it down under the wire clips at each end. Then he would coat the paper with soot over a smoky whale-oil lamp. The paper that he took off was carefully scrutinized to see whether any waves were recorded on it and if not it was thrown away.

A Record from the West Indies

One morning "Doc" came running up full of excitement. There was a record on the drum, and he did not dare to take off the paper for fear of losing it. The whole school went down to see it. Professor James carefully removed the paper and then dipped it in alcohol. That "fixed" the soot so that there was no danger of its rubbing off.

The record showed that the disturbance had taken place about six o'clock in the morning and must have been about 1,500 miles away. A couple of days later our paper told us of a severe earthquake in the West Indies which had occurred before daybreak and routed the natives out of bed. We had other records once in a while which "Doc" carefully dated and preserved, but our first record was about the best of the lot, and it was presented to Professor James, who had it framed and hung in his office.

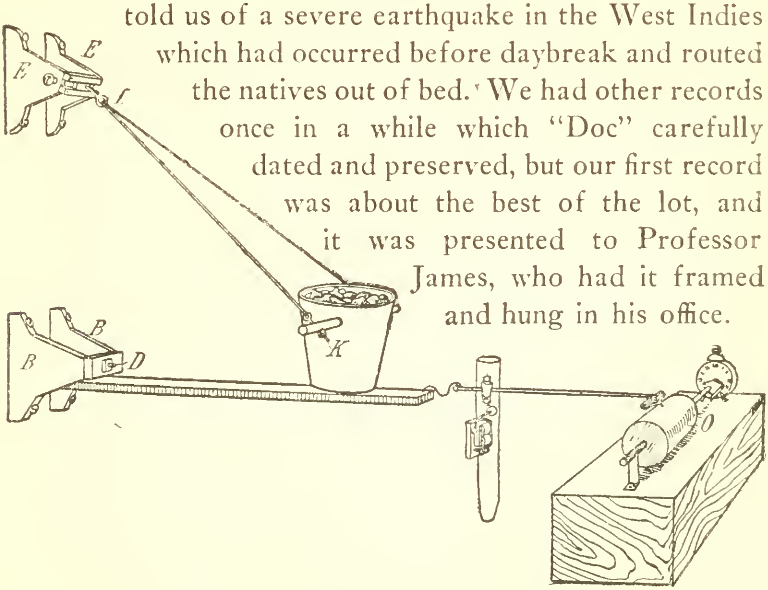


Fig. 169—General view of the seismograph

CHAPTER XIII.

THE CANAL LOCK

WITH the first signs of spring we hauled the "Lady Bug" down from the barn and placed her in the water to soak. The seams were all sprung and she leaked like a sieve, but after soaking for several days we bailed her out and found her as tight as any one could wish.

We had made great plans that winter as we sat around our little wood stove, and we were anxious to be at them. In the first place we wanted to establish some sort of communication between our pond and Jenkin's Lake. This lake was a quarter of a mile long and was connected by means of a wide mill race a full mile in length with Silver Lake, which was three-quarters of a mile long. While we could have lots of fun on our own little pond, we liked to get away once in a while for a good long row. It was no small task to get the "Lady Bug" over the dam into the stream below, and then we could not row far before striking a shallow rapids around which we had to guide the boat to get her into the lake. If we attempted to deepen this part of the stream we would have to dredge all the way back to the dam, which would have been a pretty difficult piece of work for us.

An Engineering Problem

Pharaoh summoned his Vizier, Chief Engineer, and Chief Admiral, and presented this engineering problem before them. After due deliberation we arrived at the following decision: We would build a slideway over the bank of our lake to the stream below and use the block and tackle to draw the boat up the slideway. Then we would build a canal around the rapids with a lock in it to raise or lower the boat between the stream level and that of Jenkin's Lake.

The Inclined Slideways

As we wished to use the same tackle for hauling the boat out of our pond as was used for hauling it up out of the stream we selected a level spot on the bank from which we built two inclined slideways running to the pond on one side and the river on the other. The lake incline was easily made by digging away a part of the bank, but the other incline to the stream was a more difficult proposition. A

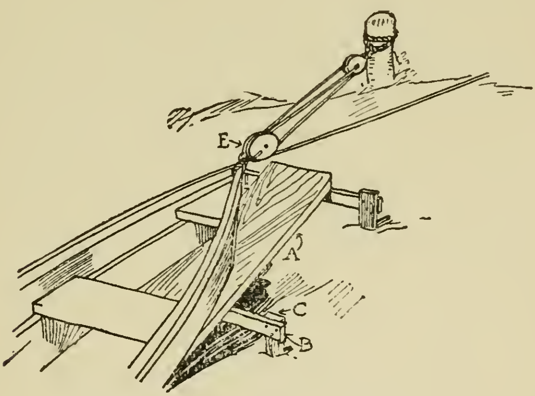


Fig. 170—A plank for the keel to slide on

part had to be filled in and another part cut away. A plank *A* (Fig. 170) was laid on the incline for the keel of the boat to slide on. The plank was nailed to cross-ties *B*, which in turn were nailed to stakes *C*. Then we bought one single and one double pulley block, fastened the single one to the stake and the other block *E* to the boat. The rope which ran around the pulleys, as indicated in Fig. 170, increased our power four fold, so that it was an easy matter for two of us to pull the boat up one slide and lower it down the other, whereas it would have taken the entire club to do the work without the tackle.

Surveying for the Lock

The canal and lock were a very different proposition, but we profited by the example of the ancient Assyrians and built the lock in dry ground to one side of the stream. Then when it was entirely complete the canal was dug and connected first to Jenkin's Lake and then to the stream. To start with, a careful survey was made of the lock site to find out how much of a drop there was between the stream above the rapids and the lake below. The tripod was set up in the lake itself and adjusted to make the plane table as nearly level as possible. A rodman was stationed just above the rapids with the rod at the very edge of the water and "Sneezer" then sighted to the rod. After he had aimed it in the proper direction the telescope was trued up absolutely level. This done, "Sneezer" noted the spot on the rod that was cut by the cross hairs of the telescope. The height of this spot above the river was compared with the height of the telescope above the lake and the difference in level was found to be 17½ inches. Our boat, when heavily loaded, drew as much as 8 inches. That meant that the bottom of our lock must be at least 25½ inches below the level of the river and preferably 30 inches to allow plenty of clearance.

The Canal Lock

As our boat was 14 feet long and 4 feet wide we made the lock 5 feet wide and 20 feet long, because one of the gates of the lock had to swing inward. The course of the canal was staked out and at a suitable point near the lake a ditch was dug in the ground 6 feet wide and over 20 feet long. The surveying instrument was used to give us the desired depth of the ditch, viz., 30 inches below the level of the stream. At the upper end of the ditch a pair of 2 x 4 scantlings were firmly driven into the ground with clearance of 5 feet between them. These were to form the up-stream gate posts, *A*, of the lock. Two more scantlings, *B*, 5 feet apart, were driven into the ditch 20 feet away for the

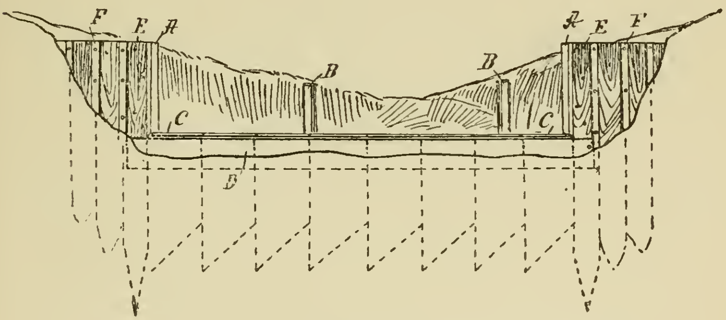


Fig. 171—A line of sheet piling was driven into the ground

down-stream gate. Between each pair a line of sheet piling was driven into the ground across the ditch to make a continuous wall. The sheet piling consisted of short boards, *C*, each cut with a sharpened end which slanted toward the board already driven so that it would crowd against this board when hammered into place with an ax. (See Fig. 171.) At the downstream end of the lock the boards were sawed off about 3 inches above the floor of the ditch, while at the other end they were cut off at 20 inches above the bottom of the ditch. Each row was faced with a board, *D*, on the upstream side, which served as the sill of the gate, while other strips, *E,* were nailed to the sides of the posts for the jambs. The gaps between the gate posts and the sides of the ditch were closed with boards driven end-first into the ground. The cracks between the boards were covered with strips of lath, *F*. Then the earth was filled in behind these boards and also back of each sill board until it was partly buried. The earth was well tamped all around the boards.

The Upper Gate

The upper gate of our lock was a single board, *G,* a foot wide and 5 feet long which was hinged to one of the posts with barn door hinges. A notch 6 inches deep and over a foot wide was cut in the bottom of the gate near the outer

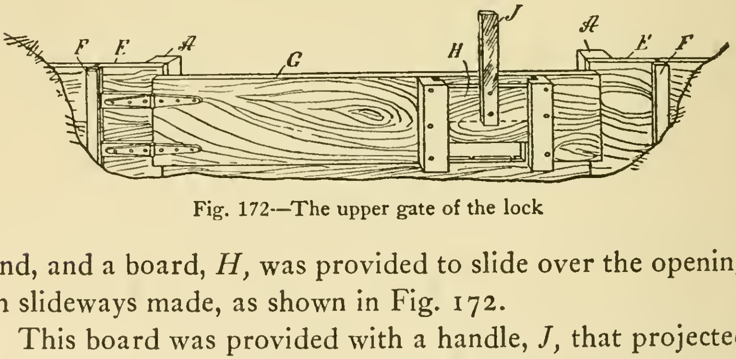


Fig. 172—The upper gate of the lock

end, and a board, *H,* was provided to slide over the opening in slideways made, as shown in Fig. 172.

This board was provided with a handle, *J,* that projected above the top of the gate, so that it could be raised whenever we wanted the water to flow through the ditch into the lock.

The Lower Gate

The lower gate was more elaborate. It was 30 inches high and was made of a row of boards fastened to a pair of 2 x 4 sticks, *K* (Fig. 173), 5 feet long. The cracks between the boards were covered with laths. A 12-inch wide opening

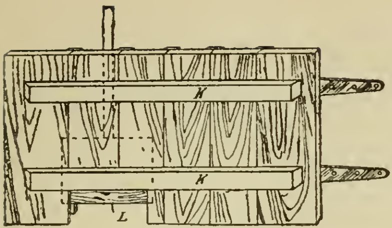


Fig. 173—The lower gate

was cut in the bottom of this gate and a slide, *L*, was provided to cover it like that in the upper gate. To prevent leakage, strips of felt were nailed to the sills and jambs for the gates to close on. The gates were pulled open or shut with a rope fastened to the outer end of each one.

Digging the Canal

Our lock was now complete, and so we dug first the canal to Jenkin's Lake, 30 inches deep below river level. The lower gate of the lock was left open, and when our canal broke through into the lake the water backed up in it and filled the lock to a depth of about a foot. The upper

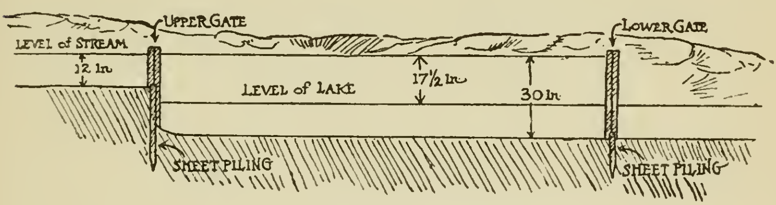


Fig. 174—A longitudinal section of the lock

part of the canal was then dug to a depth of about a foot below the water level in the stream. When we were not using the lock the upper gate remained closed and the lower one opened, because the water pressure against the upper gate was less than that against the lower one.

The paddle wheels of the "Lady Bug" were always shipped when taking her over the incline and through the locks. The canal was too narrow for us to row through it, so we either had to pole the boat along or draw it with a towline. The towline was not fastened to the bow, but a little way back, so that the boat would not be pulled toward shore as it was being towed.

Passing Through the Locks

When going through the locks toward the lake the lower gate was closed, and then the slide, *H*, in the upper gate was pulled open to let the water pour through. When the lock was filled to the brim the upper gate was pulled open, and the "Lady Bug" towed in. Then the upper gate was closed behind the boat, and the slide, *L*, in the lower gate was opened to let the water out of the lock. When it had fallen to the level in the lower canal the lower gate was opened, and the "Lady Bug" was towed out into the lake. On the return trip the process was reversed. After the boat had been towed into the lock the lower gate was shut, and water was let in through the upper gate until the lock was filled, when the upper gate was opened to let the boat be towed through the upper canal into the stream.

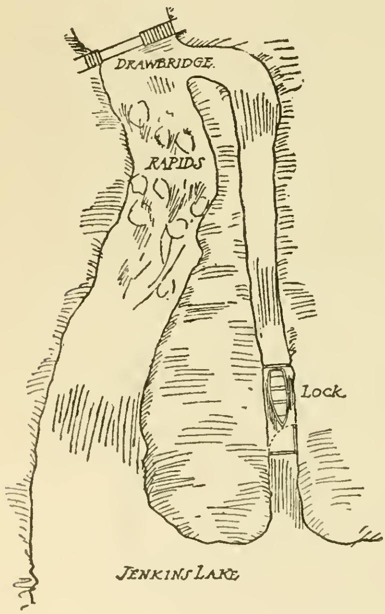


Fig. 175—Map of the canal and vicinity

The inclined slideway was built on the west side of the dam because the banks sloped to better advantage there, and we had to put the lock on the east side of the rapids because there were too many trees in the way on the west side. In order to cross from the towpath along the river to the path along the canal, we had to use a bridge. The banks of the river were quite low, and we would have to build the bridge and its approaches quite high to let the "Lady Bug" pass under, particularly when she carried a load such as the paddle mechanism. But our Chief Engineer proposed a scheme that was immediately indorsed by Pharaoh and his Council; namely, to build a drawbridge across the stream just above the head of the canal.

The Drawbridge Above the Canal

A spot was chosen where the branches of a large tree conveniently overhung the water. Piles were driven into the bed of the stream to support the stationary part of the bridge, which was built exactly like the dock in our pond, but with the posts well braced by means of diagonal strips. A gap of about 10 feet was left near the west bank for the draw span of the bridge. The draw was made of two planks a foot wide nailed near the ends to a pair of 2 x 4 beams. The bridge was prevented from sagging at the center in the same way as our plank bridge over the moat around the lake house. Four holes were bored in the draw span just inside of each floor beam. Then heavy galvanized iron wire was strung from end to end of the span through the holes,

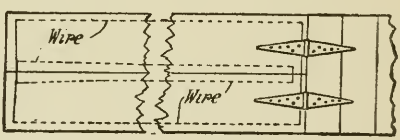


Fig. 176—Four strands of wire on the under side

so that there were four stands of wire on the under side of the bridge, as indicated by dotted lines in Fig. 176. Then

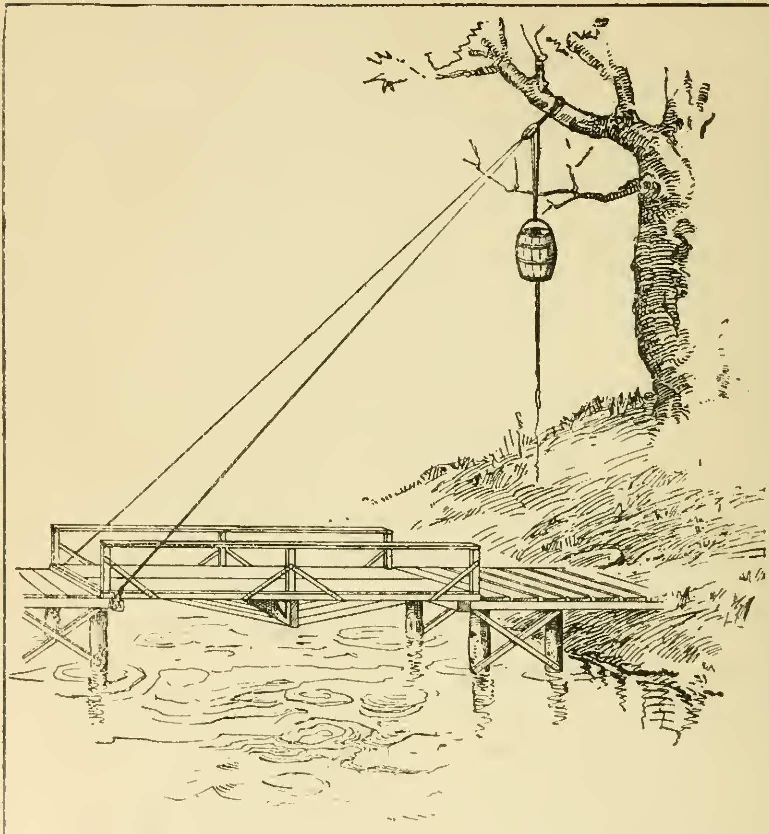


Fig. 177—The drawbridge above the rapids

a board—as wide a board as we could find—was slipped between the wires and the planks and turned up on edge, drawing the wires so taut that the bridge bowed up slightly at the center. The board was fastened in place with nails driven through the bridge floor and staples nailed over the wires. As a further precaution to prevent the board from slipping over one side or the other, several corner blocks were nailed to it and the planks of the bridge, as shown in Fig. 177. Three light posts were fastened to each side of the draw span and braced with inclined pieces. On these posts two light hand rails were secured.

The draw span was then floated down to the bridge and hoisted up, so that it reached across the gap and rested on the stationary part of the bridge. Then the span was hinged to the pier at one side with a pair of barn-door hinges. Two ropes were fastened to the opposite end of the draw span. A double pulley block was suspended from a branch of an overhanging tree, and the ropes were run through this block and tied to a counterweight consisting of a stout keg filled with stones. The counterweight partly balanced the weight of the draw and made it easier to lift. A hand rope was fastened to the bottom of the keg, and hung down within convenient reach when the draw was down. When the draw was raised it rested against the ends of the hand rail. The keg did not completely counterbalance the weight of the bridge, but merely assisted us at the start. When the draw was a little over half open the keg touched the ground and the rest of the lifting had to be done without the assistance of the counterweight.

Mighty proud we were of our waterway between the pond and Jenkin's Lake, and we used it constantly. After getting the "Lady Bug" down to Jenkin's Lake we would rig up the paddle mechanism and pedal through the long narrow raceway up to Silver Lake, much to the astonishment and amusement of people who were out boating on these waters and knew nothing of our own private pond and the things we were doing there.

Collecting Tolls

One day we met a boatload of persons at the lower end of our canal, who begged us to take them through the lock and on up to our lake. "Doc," who had an eye to business, charged them ten cents each way and made the two men in the boat get out and walk, but the ladies were allowed to ride as far as the incline, where they too had to get out and walk. We did not let them in to our lake house, as that was sacred property, but they were free to explore the rest of the pond and pole their boat as far as they wished up the stream which flowed into the upper end of the pond. The trip through the lock came to be quite popular, and every afternoon one or more boats would make the trip, while on Saturdays we were kept really quite busy, but we didn't mind because each trip meant twenty cents in the treasury of the club.

Lake Moeris and the Nile

We painted a sign which was nailed to a tree at the mouth of the lower canal giving our terms for the trip up the Nile and into the sacred Lake Moeris. As our time was too precious to be spent in attending the lock, and as the occupants of the boats which made the trips through it could haul their own boats up the incline, we left the matter largely in the hands of Tommy Fithian, a grandson of old Farmer Fithian, who had been so kind to us. We allowed him a quarter of the profits.

CHAPTER XIV.

HUNTING WITH A CAMERA

PROFESSOR JAMES had an older brother, Elliott, who might have been a twin brother, they looked so much alike, but there was this difference in them: Professor James was a crackerjack at mathematics and civil engineering and such things, but his brother did not know or care to know about anything but birds. He traveled all over the world to study them. He would go off on an all-day tramp, forgetting all about meals in his eager search for a rare species or with the object of studying the habits of well-known varieties. He never killed a bird in his life, but hunted them with a camera, and the pictures he had of them were simply great. He showed me one that it took him weeks to get. I thought I knew something about birds, but say, he could find a nest in two minutes where I might have looked an hour.

A Man Up a Tree

And where do you suppose we first met him? Shinning up a tree. Funny part of it was that we didn't know anything about him, and thought it must be Professor James. We had heard that Professor James was expecting a visit from his brother soon, but none of us supposed that he would come all the way from Philadelphia on foot. Bill and I were together when we saw a man skulking along the thicket that bordered our pond.

"Hello! What's up now?" I cried. "What's Professor James trying to do?"

"Looks funny, doesn't it?" replied Bill. "I believe he is spying on the gang." The rest of the boys were on the other side of the thicket, seated on the dock.

"What do you think of that?" The man was on his hands and knees, peering into the thicket. "That's how he caught us those two times. He must think there's another midnight meeting on foot. Never thought he was such a sneak. Guess we can play that game, too."

"Oh, look, look!" The boys were coming back through the bramble path, and the man jumped up suddenly and made for a tall persimmon tree. In a moment he was running up that tree like a monkey.

"Hello there, Prof!" we cried. "What's up?"

"I am," he answered facetiously.

The rest of the boys gathered around, wondering what Professor James could be doing up a tree. "He was spying on you!" I exclaimed. "And when he heard you coming, he thought he would hide up that tree."

"Come now! You don't think Professor James would be as small as that?" said a voice behind me. I turned around to see the real Professor James smiling at me.

"Well, I'll be—" Words failed me. I know I blushed furiously.

"Then who is the other fellow?"

"Why, that must be my brother, Doctor Elliott James. It's just like him to walk all the way from Philadelphia instead of taking a train, so as not to miss a moment of bird study. You'll find that he is looking for a bird's nest or taking a general survey of the surroundings, so as to lay his plans for to-morrow and the next day. He's a wonderful hunter.

"Hello there, Elliott! What have you found now?" called Professor James.

"Oh, hello, Bob! I have just discovered the nest of a *Buteo latissimus*. Must take a shot at the birds to-morrow. Need them for my book on the birds of New Jersey. They are a pretty scarce bird in these parts, you know."

"No, I don't know," said Professor James; "but I'll take your word for it. Let's stop talking of birds for five minutes. I want to introduce you to Mr. William Rameses, Mr. James Amenhotep, Mr. 'Doc' Amenophis, Mr. Edward, *alias* 'Jumbo,' Unis, Mr. Roy Ahmosis, Mr. Raymond, *alias* 'Sneezer,' Menes, Mr. John, *alias* 'Jig,' Sonches."

"Look here, Bob. What are you trying to spring on me this time?"

"Oh, nothing at all. You are being introduced to the Modern Order of Ancient Engineers, whose emblem is the Sacred Scarabeus and whose aim is to emulate the engineers and craftsmen of ancient times in resourcefulness. That is all I dare tell you about this club, of which I am a member, for fear of breaking my vow of secrecy. If you can spare an hour to-morrow, the club will take you over to the sacred Lake Moeris and show you the abode of the Sacred Scarabeus, and then they will pilot you down the Nile and around the rapids to the blue Mediterranean beyond."

"Ah! an Egyptian club," said Doctor James. "How interesting! I sailed down the real Nile only last winter, studying the water birds of that region. I have some wonderful photographs of the *Ibis aethiopica*, which was sacred to the ancient Egyptians."

"Now come on, Elliott. What do you suppose these boys know about the Latin names of ornithology?" taking his brother by the arm and leading him toward the Academy. "Do forget birds for a minute and talk business. Aren't you at all tired? Where did you last have a square meal? Where's your trunk?" And as their voices died away in the distance Bill muttered, "He's a queer Dick. Clean nutty on birds, I guess."

"Yes," I answered. "Not at all like Professor James. Funny they should look so much alike and be so different."

An Early Morning Hunt

Doctor James was not at the breakfast table the next morning. The chambermaid reported that his room was empty. "I expected as much," said Professor James. "He probably got up before daylight to hunt birds."

Fig. 178—He made an odd-looking hunter

It must have been after 10 o'clock when "Doc" signaled to me to look out the window. There was Doctor James trekking homeward with the queerest hunting outfit you can imagine. A camera was swung over one shoulder, and a big green bag over the other. In one hand was a huge umbrella, grasped by the middle after the fashion of Uncle Josh Hayseed in the comic supplements. He had his tree climbers strapped to his legs, and several note books were jammed in his pockets. Altogether he made an odd-looking hunter. I supposed that the green bag was full of birds he had shot, because Professor James told us that he was a wonderful bird hunter; but I did not see any gun.

As soon as the morning session of school ended we sought out Doctor Elliott James. He was in the library with a pile of books at his elbow, copying off his field notes and elaborating on them. When we asked to see his morning's bag, he pointed to a roll of films hanging up to dry. "Is that all you got?" I asked.

"All?" he exclaimed. "Why, that's a fine morning's work;" getting up to show us the negatives. "That one alone is worth a month's work;" and as Doctor Elliott James told us all about the birds, using the long Latin names to designate them, we were much impressed.

"But didn't you shoot any birds?" asked "Doc."

"Shoot them?" ejaculated Doctor James. "Shoot them? What would I want to shoot them for? I'm studying live birds, not dead ones."

"Don't you trap them either?"

"No; I wouldn't learn much about the life and habits of a bird that is locked up in a cage. I go to the bird in its own native haunts, and study the wild, free life it leads, where there is nothing to disturb it."

"But the green bag?" I put in.

"Oh, that is my shelter from which I take photographs without disturbing the timid creatures."

The Ornithologist's Blind

He explained to us just how the shelter was made, and how he used it for photographing birds that build their nests on the grounds or in low bushes. The shelter would be put up near the nest in full view of the birds. Then Doctor James would get his companion, if he had one, otherwise any person he happened to pick up, and both of them would enter the shelter, but only one of them would leave it. Most birds are stupid enough to be fooled by such a ruse. They would forget the presence of the other party in the tent, and after a while when everything remained quiet would fly back to the nest to feed their young, when "click!" would go the camera shutter.

A Guest of Honor

Doctor James was the guest of the Scarabeans that afternoon. We took him on board the "Lady Bug" at the dam instead of the dock, because we wished to keep the pathway through the brambles secret to all who were not members of our club. We showed him all over Lake Moeris, and took him up our secret channel to the lake house, though we did not let him land on this sacred spot. Then we took him over the incline and down the river Nile. While we were getting the "Lady Bug" through the locks, Doctor James suddenly jumped out of the boat and dove into the bushes. We were so surprised that he disappeared before we knew it. One or two of us started to run after him, but Professor James called us back. "The same old Elliott," he laughed. "When he sees a bird, he forgets his manners and everything else. He's on the trail of some odd species, and we would spoil it all if we tried to follow him."

On our way back to the Academy Professor James pointed out the tree where we had found his brother the day before. "Elliott is up to his old tricks again," he said. "He has a dummy camera up there pointed at that nest. It's merely a box with a hole in it for the lens of the camera to stick through when he takes a picture of the nest. The box is put there for the birds to get accustomed to it. In a day or two he will put the camera in it and hide behind a bush. Then when he sees a good chance he will spring the shutter by electricity or by air pressure with a bicycle pump through a long tube."

Photographing a Meadow Lark

That night after dark Doctor James went out with his green canvas bag and umbrella and set it up in a neighboring field at a spot he had selected in the morning. We begged to go along with him, but he told us this was a job for one man alone. He wanted to photograph a meadow lark—*Sturnella magna,* he called it—on its nest; and as the lark is an exceedingly shy bird, he had to set up his blind while the bird was abed and get into the shelter before daybreak. Then the lark would not be suspicious of the object, so long as it had not seen a human being rigging it up or loitering about it.

A Representative of the Scarabeans

Although Doctor James would not take us with him on this trip, he promised to take with him on the following afternoon, which was Saturday, any Scarab we elected. Bill was chosen for this honor, because it was quite probable that our club would want to copy Doctor James's methods, and Bill was the most observing of our number, except possibly "Doc"; but then "Doc" did not have quite so mechanical a head, and might not understand some important detail of the apparatus used by the great ornithologist. When Bill came back from the hunt, we all gathered around him to hear his report.

"It was great," said Bill. "Doctor James is a wonder. He would beat an Indian stalking game. He was up to all the bird tricks. They couldn't fool him. Why, he pointed out nest after nest over in Apgar's Swamp where we went egg hunting last month and found only three, and he didn't take a single egg either. Said he never did. What he was studying was birds, and every egg he took meant one less bird to study later on. He'd rather wait any day till the eggs hatched, and then he could photograph the youngsters as they were growing up. He found one nest where the eggs were just hatched. Didn't look anything out of the ordinary to me at all, but he wanted a picture of the birds that built it. We set up the blind; and say, that blind is nothing more than a big umbrella stuck in the ground with a green curtain hung over it. I didn't see the birds, but he told me that one was eying us suspiciously from the thicket over at the left. Doctor James told me he would leave me alone inside, and let me take a photograph myself while he went off to fool the birds. He put a camp stool in the blind and gave me a book on birds to read, because I might have to wait half an hour or so before the birds plucked up courage enough to come back to the nest. He broke away one or two branches that were in the way, but was very careful not to expose the young birds to the direct light of the sun. What he wanted was a picture of the parents. He had the camera focused, and told me that all I had to do was to touch the button when the *Pipilo erythrophthalmus* came back. 'The what?' I cried. 'Say, Doctor, I'd better put that down, or I won't recognize the bird when he comes around.' So he wrote it out for me. I sat there comfortably reading the book, and once in a while peeking out through one of the slits in the curtain to see if the birds had come back. I could hear the bees droning and the twittering of birds about me, and it was so hot in that tent that pretty soon I fell asleep. It seemed to me I had been asleep nearly an hour. Then I woke with a start. Doctor

James said he would be back in an hour, and I would have to hustle to get the photograph before he arrived. I peeked out of the blind just in time to see a bird perched on the edge of the nest, while a chorus of gaping mouths clamored for something to eat. And say, what do you suppose it was? Nothing but an ordinary chewink. But it was a dandy picture to take, and I squeezed the bulb right away. While I was changing the plates so as to get some more views, Doctor James came back and the game was over. Much as I hated to, I had to tell him that I had been asleep at the post. But when he found out what a dandy group I had snapped, he seemed perfectly satisfied. He told me he had been back to the Academy for another camera, and had set it in the dummy in the persimmon tree near our lake. So we packed up the blind and went over there to take the next shot. And say, fellows, we didn't have to be so cautious about our bramble path. He led me right through it to the dock, and then through another trail I had never seen before into a small clearing from which he could watch the nest. He said he had located this spot from the tree. We crept under a bush, and I noticed he had a couple of wires running from the camera to a battery alongside of him, and he held an electric push button in his hand. We had come in very stealthily by this roundabout way, so that the birds would not suspect us. Doctor James told me that it was a hawk's nest, and that the young hawks in the nest were almost full grown. He was going to wait until one of the parents came back to feed them. We didn't have long to wait, and, pretty soon, when they had taken just the right pose, 'click!' went the shutter of the camera. The hawks started up in alarm, but it was too late, the picture had been taken. Doctor James is developing the plates now."

An Electric Shutter

Bill had taken pains to examine the details of Doctor James's electric shutter, and although it was a little too elaborate for us to copy, he designed a simple construction that would do to set off my little snapshot camera. First he bought a pair of 5-ohm bell magnets. They cost about 35 cents nowadays, but at that time we had to pay considerably more. They were fastened to a light baseboard, *A*, with a leather strap, as shown in Fig. 179. Pivoted above the magnets was an armature, *B*, consisting of a light stick with a block, *C* (Fig. 180), nailed to one side, and a smaller block, *D*, nailed to the other side. The block, *C*, was set directly above the magnets, and a piece of flat soft iron, *E*, was fastened to its lower edge by means of L-shaped screw hooks. The iron, which we got at a hardware store, was ⅜ inch wide, 2 inches long, and ⅛ inch thick. The block, *D*, was notched to rest on the arm, *F*, of the shutter when the baseboard was fastened to the side of the camera, as shown in Fig. 179. Next we bought a battery of three good-sized dry cells and two hundred feet of bell wire, cut the wire in two, and twisted the two lengths together into a single cable. The two wires were

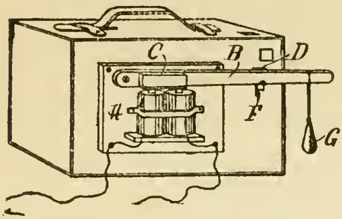


Fig. 179—The electric shutter on the camera

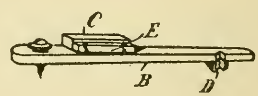


Fig. 180—The armature

Fig. 181—Touching the carbon to the zinc

connected to the ends of the magnet wire. At the opposite end of the cable one wire was connected to the carbon of one cell and the other to the carbon of the second cell. Then the carbon of the second cell was connected to the zinc of the third cell, as shown in Fig. 181. Now, when the carbon of the third cell touched the zinc of the first, a current of electricity flowed through the magnet, pulling down the iron

Fig. 182—Springing the shutter from a distance

armature, *E,* and springing the shutter. Of course, we had to raise or lower the magnets until they were just close enough to the armature to spring the shutter. As the shutter was a trifle stiff, we hung a weight, *G,* on the end of the lever to help out the magnet.

The Dummy Camera

Our dummy camera was a small box just large enough to receive the camera. The box was painted leaf green, so that it would not be very conspicuous, and when we used it we would place a few leaves over it, so as to conceal it to a certain extent. A hole was bored in one end of the box directly in front of the lens of the camera, and two smaller holes in front of the finders, so that we could focus on the nest with the camera in the box. Of course, my camera was not as good as Doctor James's, but we managed to take some fairly good pictures with it.

The Umbrella Blind

We also made a blind like that of Doctor James's. Bill found an old umbrella that had all its ribs intact. It was quite a large one, and just the thing for our blind. A hole was cut in the cover at the top for ventilation, and the wooden handle was broken off. A stout pole *H* was then procured, about five feet long. One side was flattened, and on this flattened part the umbrella rod was laid lengthwise. A number of staples or double point tacks *I* were driven over the rod into the wood (Fig. 183), but not so tightly that the rod could not be withdrawn from them lengthwise. In the other end of the pole we drove a large nail *J*. The head was filed off, leaving a sharp spike sticking out about an inch from the wood. The ferrule, *K*, which we procured from the hardware store, was driven over the end of pole to prevent splitting.

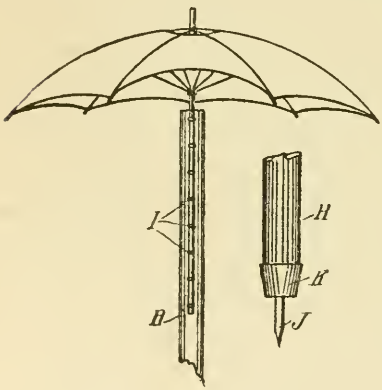


Fig. 183—Details of the pole and umbrella

The curtain was made of brown cloth, baize or denim, I've forgotten which. We bought enough to make a strip two yards wide and more than long enough to reach around the umbrella when it was open. A hem was sewed in the top and bottom of the curtain, and a shirring rope *L* was run through the upper hem.

To set up the blind, we drove the spike of the pole into the ground, opened the umbrella, and slipped the rod into the staples. Then we wrapped the curtain around the umbrella and shirred it on. The upper hem was cut away at four points to expose the shirring rope and permit four guy ropes *M* to be looped over it. (See Fig. 184.) These guy ropes were fastened to stakes driven into the ground. The edges of the curtain were held together with a hook or two. The bottom of the curtain was weighted by filling the hem with sand. This was done to prevent the curtain from blowing open. The umbrella and upper half of the curtain were painted a solid leaf green, and from there down the color was gradually shaded off into

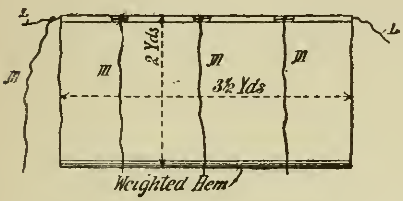


Fig. 184—A curtain of brown cloth

Fig. 185—The blind in use

the natural mud brown of the cloth. This was done to make the blind less conspicuous in the woods. Several slits were cut in the side of the curtain, through which the photographer could watch his quarry.

Climbers

Our bird-hunting outfit was now complete except for the climbers. Now there are mighty few trees a boy cannot climb, but we had to have some sort of apparatus for the purpose merely because Doctor James did. The climbers we used were not invented by us. Many readers of this book may know of them, but they are mentioned for the benefit of those who do not. A piece of heavy iron wire was bent around the tree we wished to climb, and its ends were joined; here it was twisted to form a figure 8, with large loop fitting loosely around the trunk, and the smaller loop serving as a sort of stirrup for the foot. When climbing a large trunk two climbers were necessary, one for each foot; but for a small tree a single climber would do because one could wrap his free leg around the tree trunk while raising the other to which the climber was attached. When the boy put his weight on the climber, the loop around the tree would be tipped down and would bind so that he could stand on it, without its sliding down the trunk, and take a fresh hold with the other leg. With two climbers the process was somewhat the same, but as the climbers could not pass each other, one foot had to be dragged behind the other.

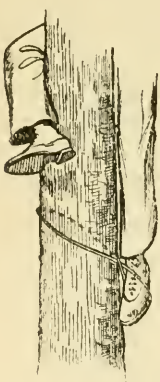


Fig. 186—A wire climber

An Honorary Member

Doctor James was with us a little over a week. Before he left us we elected him as an honorary member of our club because of his valuable suggestions on bird hunting. "Jig" Sonches, the Chief Artist, took a large bone (or may be it was celluloid) cuff stud, drew a picture of an Ibis on it and with infinite care went over the lines with a needle, scratching them deeply into the bone. Then the scratches were filled with red ink, making a very attractive little button. After Doctor James had been sworn in he was presented with one of our Scarab pins, and then Bill Rameses, Pharaoh of the Scarabs, decorated him with the Ibis button, and in an appropriate little speech informed him that the decoration was bestowed on him in view of his valuable services to the Scarabs. Doctor James was very much pleased with the red-veined button, and put it in the lapel of his coat. He made us a speech of thanks, but soon drifted into a talk on the sacred birds of Egypt which proved to be very interesting.

Photographing Wild Animals

The camera hunting craze which Doctor James started in our club was not confined to birds alone. Bill worked out a scheme by which he could photograph animals as well. He had located a rabbit hole, and meant to have a picture of Bunny. He rigged up a lever, like that shown in Fig. 187. It consisted of a broad, light strip of wood *A*, with a piece of rusty tin *B* tacked to one end, and a brass screw was driven through it at the other end, point upward. The lever was laid on the ground with the tin directly in front of the rabbit hole, so that the rabbit would have to step on it when he came out. Bill scooped away the dirt under the tin, so that it would move down ever so lightly, not more than a quarter of an inch, may be, under the weight of the

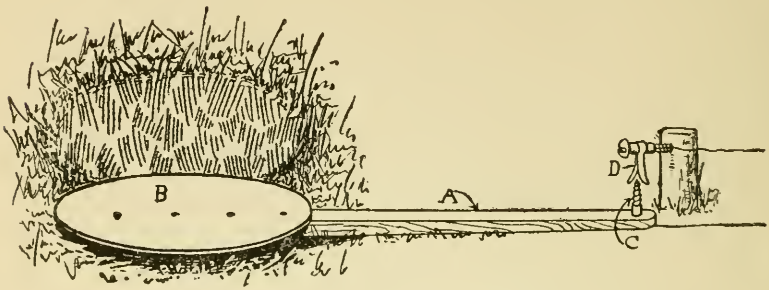


Fig. 187—The lever in front of the rabbit hole

rabbit. The opposite end of the lever would then be lifted up, wedging the screw *C* in a piece of thin brass, doubled as shown at *D* in Fig. 188, and fastened to a stake driven in the ground. A wire connected the screw *C* with the carbon of cell No. 3 of our battery, and another wire connected the brass *D* with the zinc of cell No. 1. The rest of the connections were exactly as they had been for taking the picture of the bird's nest in the tree; so that when the screw touched the brass, the electric circuit would be completed and the shutter would be sprung.

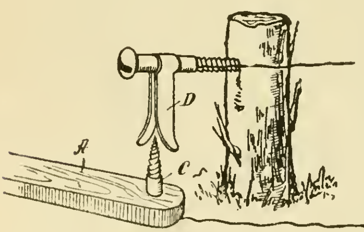


Fig. 188—The electrical contact points

An Unexpected Portrait

The camera was trained on the rabbit hole, and it, together with the lever and cam, was concealed as far as possible with leaves and dirt. Several hours later we returned to find our shutter sprung, and we hurried to the dark room to develop the plate. It came out beautifully, but instead of a rabbit we found a mud turtle in the act of creeping onto the tin. This was something of a disappointment, but we tried it again, and this time we were more successful. Bunny had taken his own picture while crawling out of his burrow.

Under-Water Photography

Having succeeded with bird, beast, and reptile, Chief Admiral Roy Ahmosis proposed that we try our luck with under-water photography. He explained that the main reason why it is difficult to see the bottom of a pond, even when the water is clear, is because the light reflected by the surface of the water, particularly when it is rippled, is too strong. His father, he said, had a water telescope which was just a tube with a glass at one end which he stuck into the water. When he looked through this he could see plainly if the water was not muddy, because he could avoid the surface glare. He proposed that we do the same thing with a camera—place it under water, and take pictures of the fishes. It sounded a little wild, but that did not prevent us from trying the scheme.

The Float Box

"Jumbo" made a box, which we coated with paraffine inside to close all seams. In the bottom of the box was a hole covered with glass. The glass was held in place by means of tack heads along the edges, and then it was sealed in with putty, which in turn was painted with shellac to keep the water out. The camera *B* was placed in the box, pointing downward, with the lens directly over the glass-covered opening. The box was quite a little larger than the camera, and there was plenty of room alongside of it for another glass-covered opening *C*, through which we could see what the camera was trained on.

We expected to float the box in the water, tipping it over on its side. The back of a fish is usually of such a color that it can hardly be distinguished from the mud bottom, and unless we tilted the camera so as to take a partial side view of the fish, it would probably be invisible or nearly so in the photograph. To prevent the water from entering the box when it was tipped, we nailed a narrow board *D* across the top, leaving only space enough for the camera to be taken out. A black cloth curtain *E* was fastened all around this opening and extended up to an oval board *F*, to which it was tacked. A piece of cardboard *G*, which was tacked to

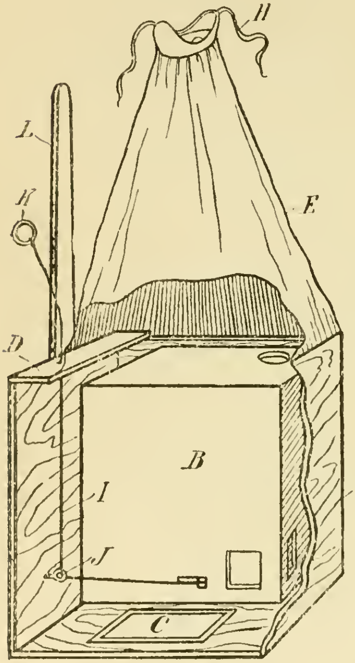


Fig. 189—The camera was placed in the box pointing downward

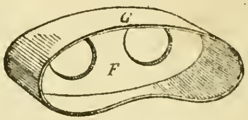


Fig. 190—Like the hood of a stereoscope

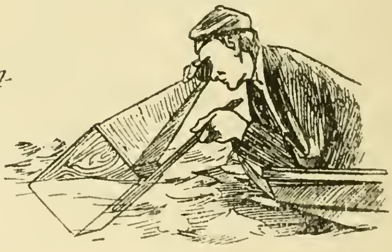


Fig. 191—He would point the box this way and that

the board over the cloth, was cut to fit against the face like the hood of a stereoscope, and two holes were bored into the board for the eyes to look through (Fig. 190). This was fastened to the head by means of a strap *H*. The shutter of the camera was sprung by pulling a string *I*, which was fastened to the shutter arm and ran through a screw eye *J* and thence through the board *D*, terminating in a ring *K*. A handle *L* was fastened to the box.

Taking Pictures of Fish

The apparatus was used chiefly on Silver Lake, where the water was very clear. Admiral Roy would float the box at the stern of the "Lady Bug," with the hood strapped over his head. Then he would drift slowly over the lake, taking care that his motion was toward the sun rather than away from it, so that he would be in advance of his shadow. Very quietly he would point the box this way and that until he could see through the glass-covered opening a view worth photographing. Then with a pull on the ring *K* the exposure would be made. Of course, he could only guess the direction to point the camera, and many photographs showed nothing because the fish that was in the field of the 4 x 4 opening was not in the field of the camera.

A Failure

Having met with some success with the apparatus, Roy thought he would try something more difficult. He was going to take the picture of a muskrat in much the same way as Bill got the rabbit photograph. There was a muskrat hole under a large tree at the upper end of the lake. In front of this hole he drove a stake, and fastened the box to it in such a way that the camera pointed directly at the hole.

Then he drove a stake in the ground at the water's edge, and pivoted a lever on it with a nail. To the bottom of the lever a fan-shaped branch was tied directly over the opening. A string connected the upper end of the lever with the shutter arm in such a way that when the muskrat came out of its hole it would push the branch away, swinging the lever on its pivot and snapping the shutter. But here a difficulty presented itself. The camera could be set only when the sun was shining directly on the hole, and the muskrat did not seem inclined to use this doorway while the sun was shining. When, one afternoon, the shutter was sprung, the picture was worthless, because the water was too dirty, and the mud-colored animal, if he were in the picture, was so nearly the color of his surroundings that it was impossible to make him out in the photograph.

CHAPTER XV.

THE GLIDING MACHINE

We made it a point to keep right up to date in our club. We were constantly hunting for something new to make. At one time we seriously considered building a tunnel under our stream after the manner of the old Assyrians. But Professor James forbade us to undertake anything so serious as that. Our next wild scheme was to build a hot-air balloon big enough to lift a boy, and a parachute so that we could come down just like the man in the circus. But this, too, was discouraged by Professor James. Then, one day Bill saw in an illustrated paper some pictures of a flying machine. Here was an inspiration. We would build a flying machine. But how were we to do it? We dared not consult Professor James, because he would quite surely turn down a scheme like that. Our machine was to be constructed on scientific principles, and we would launch it from the top of our lake house so that in case of a fall there would be no bones broken. But, how were we to build the machine? Bill and I pored over that magazine article and studied it with as much interest as if it had been a deep and mysterious detective story. True, the machine in the article had been smashed at the first attempt at flight, very nearly killing the inventor, but the inventor explained that the accident was due to a loose bolt and he was confident that the next venture would be successful. We went over the photographs with a magnifying glass, trying to ferret out the details of the construction. But the magnifying glass did not help us in the least. All we could see through the glass was a lot of big dots and no picture at all.

Professor James took us unawares while we were in the midst of our investigation.

"Aha! Studying aerial navigation? As your first lesson in this most modern sport I would recommend that you look up the experience of Darius Green. You know how he built a flying machine and jumped off the roof."

"But," interrupted Bill, "we are going to build our machine along scientific lines, and we are going to start from the roof of our lake house so that if we should fall we would drop into the water and no bones would be broken."

"Now, look here, Bill, why do you suppose Darius Green fell? It was not because his machine was not correctly built. He would have fallen with any machine no matter how scientifically it had been designed. The trouble was he did not know how to fly, and if he had made his first attempt over water as you intend to do the chances are that when he fell he'd have been struck by one of the spars or some other part of the machine and been rendered unconscious or have been so tangled in the wreckage that he could not swim out to save himself. You have to learn to ride a bicycle, don't you, and you can't do it without a few falls at least. Fortunately a fall from a wheel does not often cause broken bones or death, otherwise there would not be many bicycle riders in the world to-day. But with a flying machine the case is different. A fall is so serious that you must learn how to fly before you make your first venture in the machine. I know that sounds like learning to swim without going near the water. But there is a contrivance called a gliding machine, something like a huge box kite, with which the would-be aeronauts can practice flying without rising more than a foot or two off the ground. It teaches the novice to feel perfectly at home in the air so that he can balance his machine intuitively as a bicyclist balances his wheel, just by the 'feel' without stopping to give the matter a thought."

A Gliding Machine

Professor James did not know exactly how to build a glider, but he did not think it was beyond our abilities and he had a friend out West who had dabbled quite a bit in aeronautics and he promised to write to him for information on the subject. It seemed like an age before we got an answer and our interest in flying machines had almost died out when it was suddenly revived by a fat letter addressed to Messrs. William Rameses and James Amenhotep containing full directions for making a glider "youth's size." Thanks to the revenue from the canal lock our treasury was in a prosperous condition and we could well afford to buy the materials called for in the letter. For the frame of the machine we got the following sticks of spruce wood from a saw mill. Spruce is always the best material for spars, whether on a sailboat or a flying machine.

4 main bars	16 feet long	¾ inch thick and	1¼ inch wide
2 rudder bars	4 feet long	¼ inch thick and	1¼ inch wide
12 posts	3 feet long	¾ inch square	
12 crosspieces	3 feet long	¾ inch square	
38 ribs	45 inches long	½ inch wide and	¼ inch thick
4 rudder frame sticks	12 feet long	¾ inch square	

Making the Main Frame

First, we took two of the longest sticks and laid them on the floor. They were connected by six of the three-foot posts, one placed at each end, a pair at the center, two feet apart, and the other two three feet from the ends. The posts were glued fast and were also held in place by a single small brad at each joint. The other two 16-foot bars were similarly connected by crossbars glued fast. The two frames were set on edge and connected by the 32-inch crossbars which were glued and then clamped together by a piece

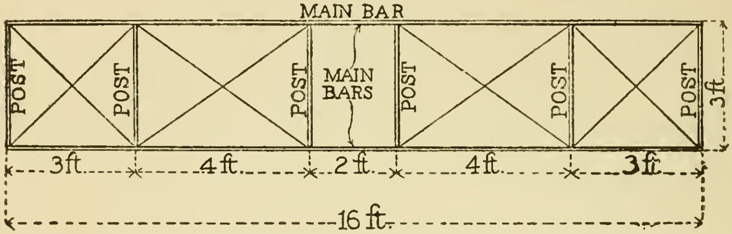


Fig. 192—One of the 16-foot frames

of wire bent over the crosspiece, under the main bar and around the post. Here the wire was tightened until it bit into the wood by twisting the ends with a pair of pliers. (See Fig. 193.) We had to be careful when twisting the

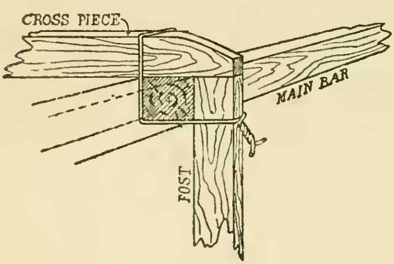


Fig. 193—Tightened until it bit into the wood

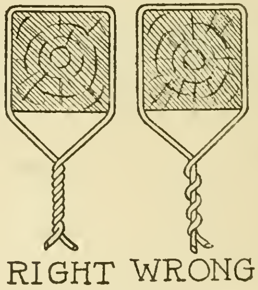


Fig. 194—The proper way to twist wire

wire to keep one from doing all the twisting while the other staid practically straight. (See Fig. 194.) Some one showed us that the best way to secure an even twist of both wires was to pull them both equally taut when starting the twist. Another thing we had to look out for was that the wire would break unless we stopped twisting it at the right moment.

Bracing the Frame

After the frame had been glued together we connected all opposite corners with guy wires, drawing them as tightly as possible and then tightening them by means of light bolts or machine screws. Each bolt was furnished with two washers in which we filed notches, *A* (Fig. 195), at opposite sides. The wires from four corners were looped over a single bolt and seated in the notches. Then when the nut was screwed up all four wires were tightened at once.

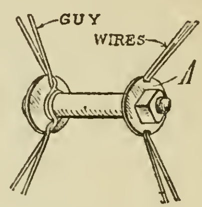


Fig. 195—Four wires tightened at once

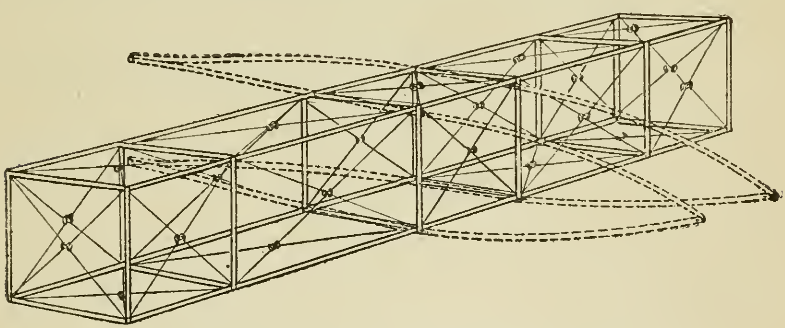


Fig. 196—The frame before the sail planes were put on

Fig. 196 shows how the frame looked after it was braced. The dotted lines indicate the rudder frame.

The Sail Planes

Next we bought 20 yards of unbleached muslin, a yard wide, for the sail planes of the glider. Of this we made three strips, one 16 feet long by 4 feet wide, and the other two 7 feet by 4 feet. The ribs, *B*, were laid on the three pieces of cloth, and spaced a foot apart. Narrow pieces of cloth, *C*, were placed over the ribs and stitched fast, forming pockets for the ribs to be slipped into. (Fig. 197.)

The larger plane was now laid on the upper deck of the frame, pocket side up, and each rib was lashed to the main bar by a criss-cross of wire twisted up tightly with the pliers. The wire passed through the cloth over the ribs and was twisted tightly enough to sink into the wood. The ribs were also fastened to the rear main bar with wire, but as each one was made fast it was pushed forward about an inch so as to make it bow up slightly. (See Fig. 198.) In this way we got a curved surface which was made uniform by pushing each rib forward exactly the same distance. The rear ends of the ribs which projected beyond the frame were connected with a piece of strong twine, and over this the muslin was lapped and glued. After this had set the cloth, which extended about an inch and a half over the front edge, was pulled taut over the front frame bar and glued and tacked to the under side of the bar. In the same way the other two cloth frames were lashed to the bottom of the frame, pocket side up, leaving a space two feet wide at the center for the operator of the machine.

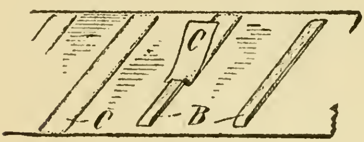


Fig. 197—Pockets for the ribs

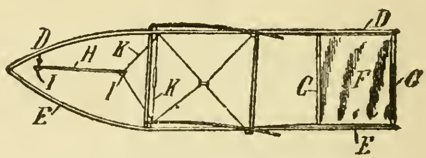


Fig. 198—Side view of the glider

The Rudder Frame

The four rudder frame bars were now glued and lashed to the main frame. They passed under the front main bars and through holes in the cloth over the rear main bars on each side of the two center posts, so that when the rudder frame was horizontal the sail frames tipped upward. The bars

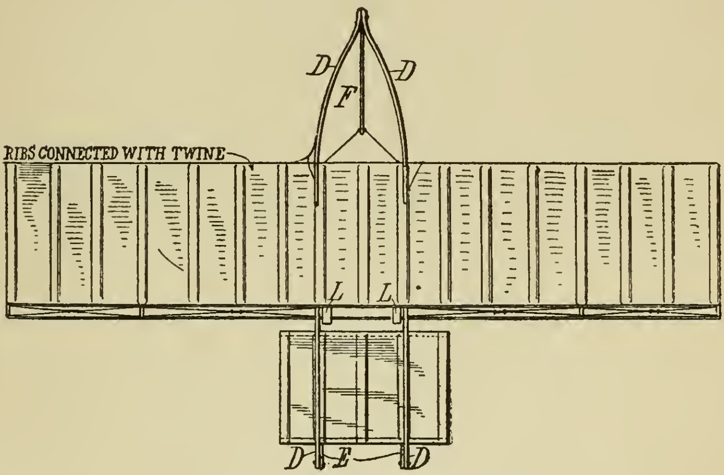


Fig. 199—Plan view of the gliding machine

projected forward about four and a half feet. At the rear, the two upper sticks, *D,* were bent inward and fastened together (see Fig. 198), and then the lower sticks, *E,* were fastened together, while at the forward end each of the upper sticks, D, was bent downward and fastened to lower stick, *E.* (See Fig. 200.)

The Rudders

For the rear rudder we used a strip of cloth, *F,* with a rib, *G,* at the forward and rear edges to stiffen it. This was stretched between the upper and lower sticks of the rudder frame, as shown in Fig. 198, and tied fast because we did not intend to use the rudder for steering.

The front rudder was horizontal, *H*, and it was four feet wide. It was stiffened like the main frames with ribs placed one foot apart and attached to two rudder bars, *I*. The rudder was hinged to the frame by means of two pairs of screw eyes, one pair threaded into the upper frame sticks, *D*, and the other into the rudder bars. The screw eyes on the rudder were pried open and linked through to the screw eyes on the frame, after which they were hammered shut. Two cords, *K* (Fig. 198), were attached to the rear end of the front rudder and passed over pulleys at the top of the machine and down under pulleys at the bottom of the machine and thence back to the rudder. The space at the center of the glider was narrowed to about 18 inches by laying a pair of 3-inch wooden strips, *L* (Fig. 199), across the lower deck for the aeronaut to rest his arms upon.

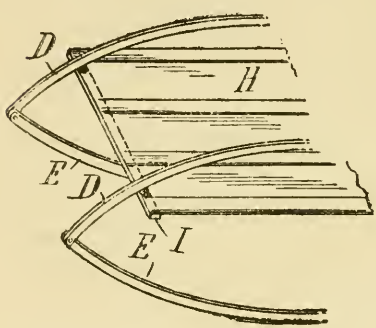


Fig. 200—How the front rudder was attached

The First Glide

Of course, we could not build a machine 16 feet long in our lake house, and though we disliked the publicity of it we had to use the barn for our workshop. The whole school found out what we were up to and when the machine was finally done, and we took it to a meadow near by to give it a trial a large crowd of boys trooped after us. Bill selected a

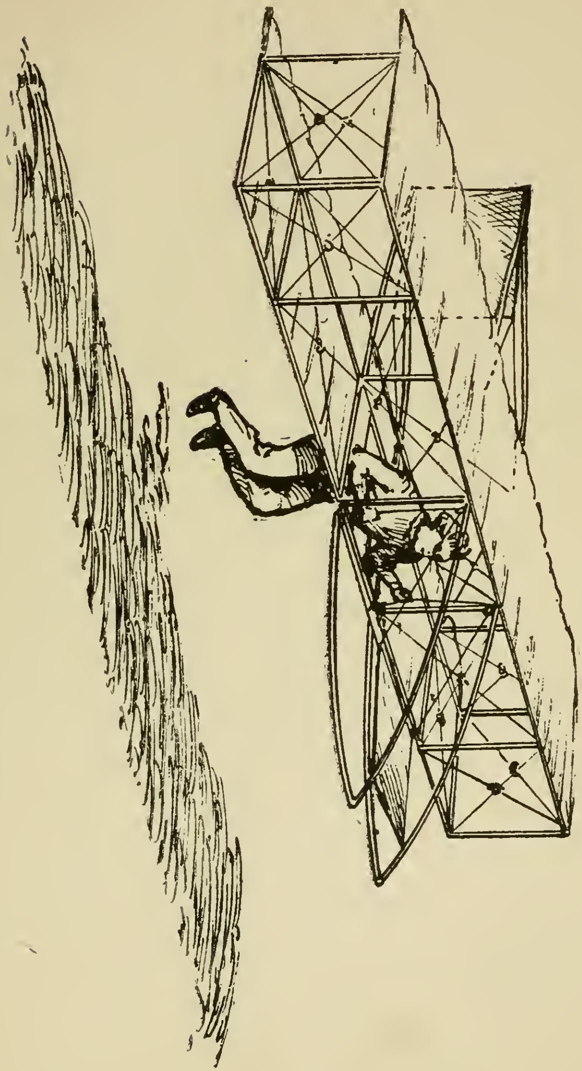


Fig. 201—The machine began to lift him

spot where the ground sloped down hill quite sharply. Slipping his shoulders through the opening in the lower deck of the glider he rested his arms on the two boards, *L*, and ran down hill until the machine began to lift him off his feet. It lifted him more suddenly than he expected. The first thing he knew the front of the machine shot into the air and down it fell backward.

Bill was not hurt. There was plenty of framework around him to break his fall. He was much more concerned about the machine than himself. The two lower rudder frame sticks were broken and the rear main bar of the lower deck and several of the ribs were smashed. We had to replace the rudder frame sticks and the ribs, but succeeded in splicing the main frame bar.

The next time Bill tried the gliding machine he was content to run it over level ground instead of trying a hill. It was so easy to smash the machine, and it took so long to repair the damage, that it paid to be careful. Besides, Bill realized that there was more to gliding than he had ever imagined. He found it hard enough to run the machine along the level. The head had a way of ducking up or down and he had to stop it by working the front rudder up and down. When he pulled down on the rudder ropes the rear of the rudder was tipped up and the machine shot downward, and when he pulled the ropes up the reverse took place and the machine shot upward. The slightest tilt of the rudder caused a decided dive up or down, and it took some very careful manipulating to run the machine properly.

Gliding Contests

Bill was not the only one who ran the machine. The rest of us all tried our hand at it and soon learned how difficult a matter it was to keep the thing on an even keel. When we did get the hang of it we had lots of fun skimming over the ground. We would run with the machine at top speed and then when we felt ourselves being lifted would raise our feet and glide as far as we could before touching ground again. We had quite a contest trying to discover which one of us could glide the farthest. A test was made in the meadow where Bill had his first fall, but we knew how to manage the horizontal rudder now and could easily negotiate the gentle incline when there was no wind blowing. We always sailed over level ground when there was a breeze and directed the machine against the wind and not with it. The rear rudder of the machine was never moved because we had our hands full controlling the front rudder and were content to fly in a straight line.

CHAPTER XVI.

CAMPING IDEAS

SUMMER vacation was upon us almost before we knew it. We realized that there was danger of having our lake house wrecked and our boat smashed or stolen by the Mulligans. But we meant to reduce the danger as much as possible, so we cleared it of the work bench, table, stove, etc., leaving nothing but the bare walls. Even the door was unhinged, and the windows removed from their frames and stored in the school barn. The boat, too, was hauled out of the water and dragged up to the barn, where it could not be meddled with. We drove a line of sheet piling across the mouth of the upper canal, and then drained the water out and unhinged the lock gates. Several stout stakes were driven in the entrance of the lower canal, to keep out boating parties.

Planning a Summer Outing

The Scarabs had a farewell banquet before leaving for their several homes. That did not mean that we would not meet again before fall. It happened that three of the Scarabs, "Jumbo," "Sneezer," and "Jig" lived within twenty miles of my home, and Bill was to spend part of his vacation with me, so we five decided to go camping for a couple of weeks in the hills near my home.

Bill had some great camping ideas that we wished to try out. He had been studying all the books he could get on the subject, but they soon disgusted him. What one book recommended, another ridiculed. One author sang the praises of the sleeping bag, and another said that no true woodsman would think of using one. The same fellow said that there was nothing like a head net to keep off the insects, while the first one made a slurring remark about those would-be woodsmen that wear a woman's veil to keep off a bug or two. And so it went with the building of fires, the cooking of meals, etc., and Bill finally came to the conclusion that we would have to try things out for ourselves.

Sleeping Bags

Fortunately we had a tent, the one we used on Willow Clump Island the summer before, and Bill and I each had a sleeping bag. Bill carefully instructed the others how to make their own sleeping bags. The design was his own, but it proved to be a very good one. The inside of the bag was merely a blanket folded lengthwise and sewed together at the bottom, leaving the sides and top open, so that one could get into and out of it quickly.

The covering for the bag was made of medium-weight canvas or heavy drill. About 6¾ yards of goods, 30 inches wide, were required. The cloth was cut as shown in Fig. 202. One strip, *A*, was 3½ yards long, and another strip, *B*, 2 yards long. A strip, *C*, was made from a single yard of goods cut in two with the ends sewed together, so that it would be 2 yards long and 18 inches wide. Out of

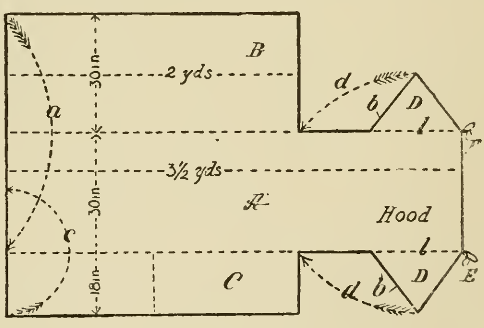


Fig. 202—Pattern for the canvas covering

the rest of the goods, a piece 18 inches square was cut. This square was then cut from corner to corner, to make two triangular pieces, *D*. The pieces *A*, *B*, and *C* were sewed together along their edges. Then the piece, *C*, was folded on piece *A*, as indicated by the arrow *c*, and the two were sewed together at the bottom. Next the piece *B* was folded on piece *A*, and the bottoms were sewed together. Snap fasteners were used instead of buttons to fasten the strip *B* to strip *C* when the bag was in use, because in case of an emergency they could be ripped open very quickly to let the sleeper out, while buttons would be more apt to prove troublesome, particularly if the buttonholes were at all stiff. Furthermore, none of us cared for the job of sewing buttonholes. Snap fasteners are sold by the yard on tape, and the tape was sewed to the canvas instead of sewing each fastener on separately.

At the upper end of the bag the piece *A* extended far enough to make a hood and the pieces *D* were used as the side flaps of the hood. Two sides of each triangle were sewed to the hood. Starting at the end of the strip *A* we sewed first alongside *l* of the triangle, then folding the hood over, as indicated by the arrow *d*, we sewed the side *b* to it. Then two loops *E* were sewed to the hood.

Waterproofing the Bags

The bag was made waterproof by painting it with paraffine. A good-sized cake of paraffine was grated or shaved into small pieces and dissolved in turpentine. Then with a large paint brush a good coat of paraffine was applied to the outside of the canvas covering.

The Sleeping Bags in Use

The sleeping bags were not used for sleeping out in the open except on one or two occasions, when we left camp on a trip of exploration. Then we took care to put the bags on the windward side of the camp fire, so that no sparks or embers would be blown on to them and set them afire. The bag was always laid head-on to the wind, so that in case of a storm the rain would not be blown in under the hood. Two stakes were driven into the ground at each side of the bag, and the loops *E* were caught on them, so as to hold up the hood as shown in Fig. 204. The blanket bag was then put inside the canvas bag. A pillow was stuffed into the hood, and the owner crawled in, pulled the blanket over him, snapped the fasteners together, and then went to sleep.

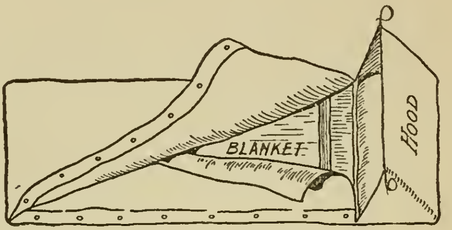


Fig. 203—The sleeping bag

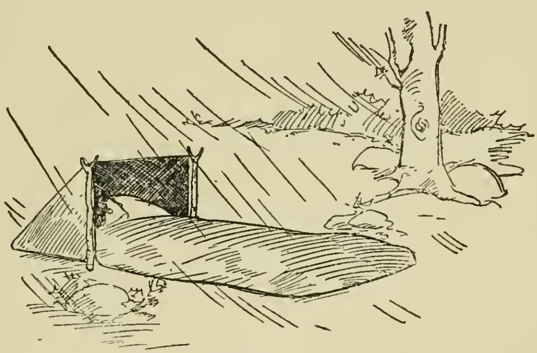


Fig. 204—Laid head-on to the wind

Pine Beds

The canvas bag kept the moisture out, so that we could lay it on the ground anywhere we chose, but it did not prevent the humps and bumps of the ground from wearing holes in us, making us very stiff and sore before morning. When we had the chance we would cover the ground with pine boughs, but usually on our camping trips we could do no more than pick out a fairly clear spot and brush away the pebbles, twigs, etc. In camp, however, we had a good pine bed under the tent. Bill tried to make one according to directions he had read in a book. He broke off the smaller branches or twigs of pine, and set them upright in the ground with the tops all leaning over in the same direction. They were arranged in rows about 6 inches apart, and were driven quite firmly into the ground, so as to make a nice springy bed that would not fall over when we lay upon it. The entire floor of the tent was covered except for a lane down the center and a space at the back where we kept our clothing. It took an endlessly long time to make this bed, and Bill vowed he'd never make another in that way. It was certainly a fine one while it lasted, the best pine bed I ever slept on; but it soon began to break down, and though it was repaired several times, we finally gave up in despair, tore it out, and thereafter made a fresh bed each night of pine boughs strewn on the ground. We were careful to lay the boughs convex side up, so that the ends would stick into the ground rather than into us.

A Fireless Cooker for the Camp

We had great times in camp those two weeks. "Jumbo" proved to be an exceptionally fine cook, but he did not have to stay at home while the rest of us were out enjoying ourselves, because Bill had rigged up a fireless cooker. "Jumbo" would cook the evening meal right after breakfast, while the rest of us were washing and drying the dishes or tidying up the camp. Then he would put the food in the fireless cooker before it was half done, and go off with the rest of us. "Sneezer" always prepared the cold lunch which we took with us. The food in the cooker would cook slowly all day, and at night it would be ready to serve. After supper "Jumbo" would prepare the oatmeal for breakfast, and let it cook over night in the fireless cooker. Of course, the cooker was used only for such foods as take a long time to cook, like boiled ham, potatoes, stews, etc. We did not use it for fried foods.

Construction of the Cooker

The fireless cooker was made as follows: Bill picked out a well-drained spot near the camp kitchen where there was a small mound. A hole was dug in the mound about 2 feet deep, and a trench was cut at the bottom of the hole to the edge of the mound to drain off any water that might collect in the hole. The hole and trench were then paved with a thick layer of stones and pebbles. Afterward the trench was filled with stones and covered over with dirt. Next we got some ashes from the camp fire, and put a layer 3 or 4 inches thick over the paving of the hole. On the ashes we placed a thick layer of newspapers, and a large galvanized iron pail *A* was set on the paper in the middle of the hole. Another thick layer of paper was wrapped around the pail, and the hole was then filled with ashes up to the top of the pail. A board *B* with a large hole cut in the center of it was fitted over the pail and ashes. As a lid for the fireless cooker Bill took another board of the same size and nailed a feather pillow to the under side.

The food, after being partly cooked, was put in a covered tin pail *C* (Fig. 205) and lowered, pail and all, into the fireless cooker. Then the lid was put on pillow side down.

The outside of any solid food cooks before the inside does, and the object of the fireless cooker was to cook the inside with the excess heat that was stored up in the outside. As the heat could not escape through the paper and the

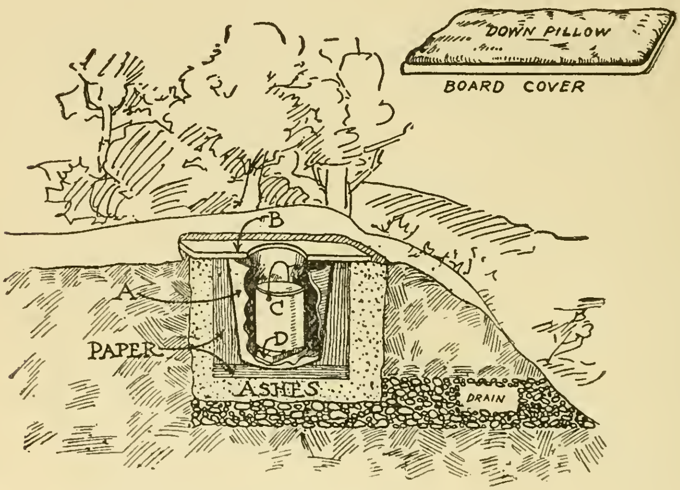


Fig. 205—Section through the fireless cooker

feather pillow, it worked its way through the raw parts of the food, and thoroughly cooked them through and through. Sometimes "Jumbo" would place a hot brick or stone in the fireless cooker, as shown at *D* in the illustration, so as to provide a little more heat.

An Iceless Refrigerator

Another useful device for camp cooking was designed by Bill. The year before we kept our drinking water in a canvas pail which was hung up in the wind, so that the moisture that oozed out of the pores of the canvas would rapidly evaporate, and thus cool the water inside. Bill suggested that we make an iceless refrigerator in the same way. A wooden disk *E* was cut just large enough to fit over the top of a galvanized-iron pail *F*, with an inch to spare all around. Three or four blocks *G* were nailed to the bottom of the disk to fit against the inside of the rim of the pail, as shown in Fig. 206. A curtain of cheese cloth *H* (Fig. 207) was tacked in a double layer to the edge of the disk. The curtain was long enough to hang over the pail, and extended an inch or two below it, so that it would dip into a pan *I* on

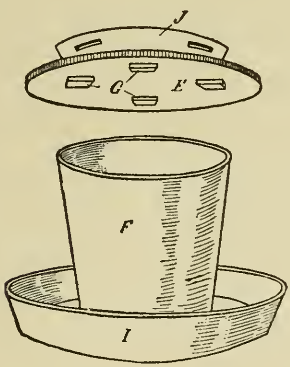


Fig. 206—Construction of the refrigerator

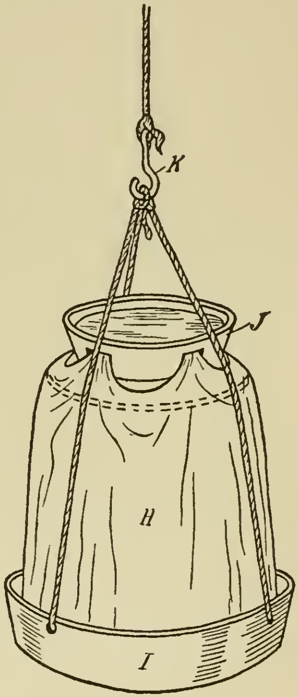


Fig. 207—The iceless refrigerator

which the pail rested. The upper end of the curtain extended above the wooden disk, and was stuffed into several holes in a deep tin pan *J*, which rested on the disk. The pan was filled with water and the cheese cloth was stuffed in so tightly that only enough water oozed out to keep the fabric wet. The pan below was designed to catch the drip of the curtain, if there were any, and it also supported the refrigerator. Three holes were punched through the sides of the pan *I*, and three cords were tied through the holes. These cords terminated in loops at the upper ends, which were caught on a heavy wire hook *K*. The hook was attached to a rope, which was slung over the branch of a tree. By pulling the opposite end of this rope we could raise the refrigerator up high, where it would get the full sweep of the wind and where the moisture in the wet cheese cloth would evaporate quickly. Whenever we wished to take something out of the refrigerator, all we had to do was to lower it, unhook the cords, and lift off the disk, curtain, pan, and all. The things we put in the pail, such as milk, butter, etc., were not kept ice cold, but yet they were much cooler than they would have been anywhere else.

Waterproof Matches

There was another useful little camping kink that Bill picked up somewhere. The heads of all the matches we had with us were dipped in melted paraffine. This kept them dry, even if they were left out in the rain. It made safety matches of them, too, because the paraffine kept them from igniting when they were shaken around in the box. When we scratched the matches they lighted about as readily as an ordinary match, but the flame was more persistent because of the paraffine.

CHAPTER XVII.

THE HAUNTED HOUSE

THERE was a big time at the old Academy when the Scarabs all went back in the fall. When Bill and I arrived we stopped at the school just long enough to leave our luggage and tore over at once to Lake Moeris. We were delighted to find the lake house intact. Apparently the Mulligans had not the ambition to drag a boat up over the dam and row across to it. They had found our path through the brambles and had tried to burn our dock. The land end was destroyed but the rest was only slightly charred, and it would not take long to repair it. The dam had been meddled with but not seriously injured, but the drawbridge above our canal was totally destroyed. After all, things might have been worse, and we were mighty glad our club house had not been destroyed.

When we got back to the dam we saw "Doc" sitting on the bank of the lake gazing pensively across the water.

"Why, hello, 'Doc'!" we both cried, rushing forward to greet him. "How's the boy?"

"Doc" remained motionless, staring into space.

"Why, what's the matter, old man?" I said. "Feeling homesick?"

A Message from the Sacred Scarabeus

"Disturb me not," he answered, without moving his head. "A spirit of prophecy has come over me. The Great Sacred Scarabeus is speaking to his humble servant."

"Oh, quit your fooling!" interrupted Bill.

"Amenophis has been studying the portents in the heavens," continued "Doc." "Last week, as the pale young moon sank into the bosom of the western plains, the dark evil-eyed planet Saturn, emissary of the lower regions, followed after her in close pursuit, but the young crescent has shaken off its antagonist. Watch the eastern sky this eve and behold the growing glory of this celestial body. Even so shall the sons of the Sacred Scarabeus increase in the wisdom and the knowledge of the mystic sciences and arts, while they laugh their enemies to scorn."

"Well done!" said Bill, entering into the spirit of the game. "But remember that Pharaoh is also a high priest of the Sacred Scarabeus, holding equal rank with Amenophis, and it behooves you to greet him with a little more respect."

"The words of Pharaoh are truth," answered "Doc," "but the mind of Pharaoh is occupied with temporal affairs. Therefore, the spirit of prophecy and the power of divination have been withheld from the mind of Pharaoh and given unto his servant Amenophis. The humble Amenophis can discern that which is hidden from the eyes of Pharaoh."

"Well, what do you know that I don't?" said Bill, somewhat nettled.

"Nay, nay, chide not thy servant for the Sacred Scarabeus has bidden the humble Amenophis to deliver this message into the ear of Pharaoh and his people: 'The evil star hath set; no longer shall thine enemy prevail against thee. The Hibernian horde, the people of Mulliganus, shall rise up against you out of the east land, but they shall not prevail. The spirit of death shall turn them back. At your very portals shall he check them, and never again shall they defile the house of the Sacred Scarabeus.' "

"Oh, stop this twiddle twaddle, 'Doc,'" cried Bill, impatiently. "After all, you know this is a *modern* order of ancient engineers, so if you've got anything to say, out with it in a modern tongue, but drop this blamed mystery business, I say, drop it."

Exciting News

"All right, Bill, if you prefer it in United States. What I mean to say is that there has been a murder in these woods."

"A murder!" we both exclaimed.

"Yes, a murder and a lynching."

"A lynching?"

"Yes, a lynching. Can't you even understand plain English? I thought you fellows read the papers regularly."

"We do," I answered. "When did it happen?"

"The first of last August."

"Oh, that accounts for it. We were camping then, and didn't see a paper for two weeks. How did it happen?"

"Well, there was a colored man working on a farm over near Salem, who got mad at the farmer there and got into a fight with him. The farmer licked him with a horsewhip and fired him off his lands. Then what did he do but lie in wait for him right there in the woods and shoot him as he was riding to town. Old Farmer Fithian was coming down the road and saw it all. He sounded the alarm, and pretty soon the whole town was up in arms scouring the country for the murderer. They couldn't find him anywhere. He had disappeared completely. Finally somebody thought of our lake house, so they dragged a boat over from Jenkin's Pond, and rowed over to it. He was in there sure enough, and opened fire on them. They backed off as fast as they could. Then they established a chain of guards all round so that he couldn't get away, and waited for him to be starved out. They waited a couple of days and then one night caught him trying to escape. Inside of an hour the whole countryside heard that he had been caught, and at two o'clock in the morning a mob stormed the jail, took the negro and lynched him right here where he had murdered the farmer."

This was exciting news indeed, and we plied "Doc" with questions. He seemed to know all about the details of the case, even though he had only just arrived in town.

"But what has that to do with all the tommy rot you were giving us a while ago?" demanded Bill.

"Simply this," said "Doc." "The woods are haunted. Our house is haunted and the Mulligans won't dare to come around after dark."

"Oh, that will soon wear off," replied Bill.

"I'll see that it doesn't," said "Doc" significantly. "They went over to the house the morning after the lynching in the boat which the guards had used. Tore a gap in the stockade, too. Then the constable got after them for stealing the boat. But they haven't been around this way after dark. Somebody started a ghost scare, and people are afraid to come down this road late at night."

"Doc" was pretty well informed for a fellow who had been in town for less than an hour. I was reminded of the time when he forestalled the Mulligans in their winter attack. In the excitement of the hour I had forgotten to question him about the source of his information. "Doc" always liked to be mysterious.

"Look here, 'Doc.' " I asked him, "how do you happen to know so much about the Mulligans and this murder?"

"Question not the word of Amenophis, Arch Priest and Astrologer of the Sacred Scarabeus," he replied.

"Oh, if you're going to put on the agony again, I give it up."

When we got back to the Academy we found that "Jumbo" and "Sneezer" had arrived, so together we dragged out the "Lady Bug" and launched her in Lake Moeris. She leaked quite badly, and so we had to give up our visit to the lake house until the water would swell the boards and close up the seams. This was a big disappointment because, with Professor James's permission this time, we had planned a great reunion that night. It was just as well that the banquet was postponed, because Roy and "Jig" did not show up until the next morning.

A Visit to the Lake House

When the afternoon session of school came to a close we rushed down to the lake to find the boat still very leaky, but we bailed her out dry and ventured across. The stakes and buoys which marked the channel had been yanked out by the Mulligans, but Admiral Roy knew the course so well that we had no difficulty on that score. There was nothing much to indicate the fact that the house had been occupied by the negro except for a few bullet holes in the walls and one or two rifle shells on the floor. All other evidence had been cleaned out by the constable, so "Doc" informed us. He also pointed out the place where the Mulligans had smashed through our stockade, and we made use of this gap on our way back.

Preparing for the Feast

We ferried our furniture over to the club house and made ready for the evening feast. It was not to be a midnight banquet. Professor James had put his foot down on that, but it was just as exciting as any spread we had had in Professor Clark's day, because it was to be held in a haunted house and we had to pass after dark along the very woods where the murder had been committed. We left a lighted barn lantern on the porch directly in front of the gap in the stockade so that we would not have to negotiate the secret channel after dark.

Old Farmer Fithian chanced upon us while we were putting in our provisions and was astonished to find us preparing for a banquet after dark in the haunted house. It was a brilliant move on Bill's part to invite the old man to our feast to tell us all about his part in the exciting events of the summer. He was not inclined to accept at first for fear of the "rheumatiz," but the prospect of an evening with the boys was not displeasing to him and finally we persuaded him to come to the dam at eight o'clock that evening, where the boat would be waiting for him. He insisted on doing his share toward the success of the banquet and took Roy up with him to the farm house, where "Mirandy," his daughter, stocked him with jam and cake.

The Trip to the Haunted House

There was something deliciously uncanny about our trip to the lake house that evening, particularly while we were passing through the haunted woods. All sorts of phantom monsters shaped themselves in the black shadows cast by the moon, and "Doc" did his best to work up our feelings to the highest pitch by pointing out the very spot where the tragedy occurred and the limb on which the murderer had been hanged. Now and then he would give a sigh or a groan which seemed to come from the depths of the woods and made the chills run up and down our backs.

Our boat was moored to the dam because we had not repaired the dock as yet and did not like to try the bramble path after dark anyway. We went over to the lake house in two loads. Bill and Roy remained behind to greet Farmer Fithian and bring him on the second trip. As the boat neared the house a hush fell over us. We spoke only in whispers. The mournful tremolo of a screech owl broke the stillness of the air. "Sneezer" was the first one to step out of the boat, and as he did so a bat flew past him so suddenly that he gave vent to his feelings with a yell of terror. That broke the tension and we all had a good laugh at "Sneezer." "Doc" was plainly delighted. He could not have planned it better had he tried.

Mysterious Sounds

"Jumbo" picked up a lantern and started for the door. As he pushed it open there was a low moan from within. Crash went the lantern on the floor, and the light went out.

"Now you've done it," I said.

"But did you hear that groan?" whispered "Jumbo."

"Oh, that was one of 'Doc's' tricks," I replied. But "Doc" was already well on his way back to the dam.

"Here, give me a match, someone"; and I stooped to light the lantern. "There's nothing in there. I'll show you."

Taking my courage between my teeth I strode boldly to the door and pushed it violently open. As I did, there was a fearful shriek from within that almost made my hair stand on end. I knew that "Doc" must be responsible for it in some way, so I marched right in and flashed the lantern round, but the room was empty. The rest trooped in behind me peering around for the source of the noise. Back of the door we found a small siren whistle attached to a large bicycle pump. The end of the pump had been unsoldered and in its place a disk *A* (Fig. 208) of wood was fitted. A slot was cut through the disk and the mouth of the whistle *B* was jammed in it. The pump was tied loosely to the floor with the end of the cylinder bearing against a block *C*, and the handle was attached to the door, so that when the door was opened the pump piston would be forced in, causing the siren whistle to be sounded.

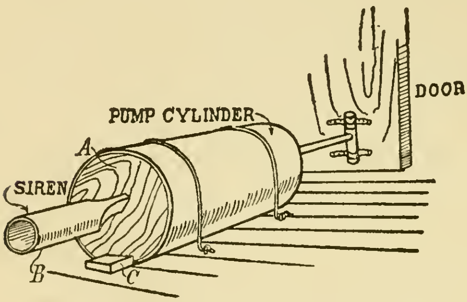


Fig. 208—A siren whistle attached to a bicycle pump

Over the water came a hoarse laugh. "Doc" was enjoying his joke. We vowed we'd punch him for playing such a trick on his own club fellows. But there was plenty of time for our feelings to cool down before he returned with Farmer Fithian aboard.

Farmer Fithian Enrolled with the Scarabs

In the meantime we busied ourselves with preparations for the spread. Our table consisted of two planks laid on a pair of wooden horses. We elected Farmer Fithian an honorary member of our club and gave him the title of Harmhab, Chief of Tilled Lands. Bill presented him with the emblem of an ox and plow on a bone stud. "Speech! Speech!" we all cried. Old Farmer Fithian arose.

"Boys and Fellow Sc'rabs," he began. "I made a speech onct thirty years ago and I got so flabbergasted that I vowed I'd never make another one. I hain't a-goin' to break my vow to-night."

"Oh, go on!" we cried. "You're doing splendidly."

Fig. 209—Harmhab, Chief of the Tilled Lands

But Farmer Fithian was obdurate. "I'll converse with you," he said, "but I won't do no speechifyin'."

"All right, converse with us!" responded Bill. "Tell us all about the murder."

Farmer Fithian gave us such a graphic account of the tragedy that it made our flesh creep. Then he entertained us with stories of his boyhood days. He kept us in roars of laughter at the ridiculous scrapes he had been in. At the close of the banquet he consented to have his shadowgraph drawn so that his likeness could be hung up in our rogues' gallery with the rest of us.

One of the Requirements

"There is one more requirement demanded of every honorary member when his name is entered in the roll of the Sacred Scarabeus," said Bill. "You must suggest something for the Scarabs to do. Preferably something quite Egyptian."

"If you fellers are lookin' for somethin' to do," said Farmer Fithian with a roguish look, "I've got plenty of work for ye over in the woodshed. I reckon the Egyptians had to chop kindlin' wood, didn't they?"

"There you're wrong," said Bill. "They didn't have much wood in that country and the weather was so warm they didn't needs fires anyway, except for cooking."

"Wal, I thought you'd have some excuse, if I offered you that kind of work. But how'll this do? My daughter, Mirandy, she's got a flower garden out in our front yard that she sets a mighty store by. There used to be a fine old elm tree right in the middle of that there garden, but I had to cut it down this summer because it shaded the garden too much. Then, land! if she didn't make our man Joe leave the stump, and what in Sam Hill d'ye suppose she wanted it fur? A sun dial! She got Joe to plane off the stump and sandpaper it down, smooth and even. Then we asked her how she was going to lay out her sun dial, and blamed if she knew. She come to me, but, law! I didn't know nothing about such things, though I do recollect seein' one when I was a boy. And Mirandy, she's still lookin' round for someone to tell her how to make one. Now, it just come to me that the old Egyptians used to tell time with a sun dial and there ought to be somethin' about it in some of your books up to the Academy."

"Bully for Farmer Fithian!" we cried. "You leave it to us. We will rig up the sun dial."

The Ghost at the Window

We left the lake house after ten o'clock, declaring this to be the very best banquet we had ever held. "Doc," "Sneezer," "Jumbo" and I were in the second boatload. The moon was getting lower in the west and long shadows swept across Lake Moeris. "Sneezer," who was at the oars and therefore faced the lake house, suddenly pointed to one of the windows. "Look!" he said. "There's a ghost in there." We turned to see a white skull staring at us from the front window. Despite the darkness we could see it very plainly because it seemed to shine with a light of its own—an unsteady, ghostly, blue-white light. I faced about and seized "Doc" by the coat collar.

"Now, tell us, you wily wizard, what game is this you're playing on us? You needn't think you can sting us twice in the same night."

"Touch not the spotless collar of Amenophis, Arch Priest of the Sacred——"

"Oh, cut it!" I cried. "Here, boys, let's duck him," and we soused his head in over the stern of the boat.

"Stop, stop!" he sputtered. "I'll 'fess up. That's just a board with some phosphorescent paint on it. Looks real, though, don't it?"

"Real enough. Yes, but what do you mean by trying to fool your fellow Scarabs? Souse him again, boys."

"Hold on there!" he protested. "I won't do it again. I just wanted to see how good those things were. I wanted to see how they would work. The Mulligans are scared of the place now. If they see a ghost in the window once in a while they won't dare to come near the house, and if they did the siren would scare them when they tried to push the door open."

Phosphorescent Paint

I took a look at the phosphorescent skull the next day. The paint was just chalky white. "Doc" had gotten it from a paint store in the city. He had painted the background white too, so that the picture of the skull scarcely showed by daylight. He had to leave the board in the bright sunlight so that the luminous paint would absorb the sun's rays only to give them back again at night with a sort of phosphorescent glow.

"Doc" left the siren whistle on the door and the first windy night left the door unlatched so that as the door swung back and forth it produced weird moans and wails. The ghostly sounds and the phosphorescent light in the window attracted so many people that we were afraid some bolder one of the crowd would investigate the mystery. That no one did was probably because the "Lady Bug" was the only boat available and we had taken the precaution to conceal it in the bushes. Although we had repaired the breach in our stockade, we could not depend upon it as an impassable barrier after the Mulligans had gotten through it, even though they had accidentally struck the weakest pile. So we cautioned "Doc" not to leave the door unlatched again.

CHAPTER XVIII.

SUN DIALS AND CLEPSYDRAS

THE morning after the banquet, Pharaoh wrote out an order directing that a sun dial of elaborate design be built with all possible haste by the Chief Craftsman and decorated and embellished by the Chief Artist and Sculptor under the direction of the Arch Priest and Astrologer. He sealed the document and placed it in the hands of Amenhotep, his Vizier, to give into the hand of the great Astrologer "Doc" Amenophis, Arch Priest of the Sacred Scarabeus. "Doc," as I have said, was fond of astronomical matters, but he knew little or nothing about sun dials, so he straightway betook himself to the library and studied up the subject in the encyclopedia. I saw him leave the library even more puzzled than when he had entered.

It seemed to me that the problem was not a very difficult one. "Just set up a post in the center of the tree stump," I said, "and then every hour exactly on the minute by your watch, put a mark at the end of the shadow."

"That's all right," answered "Doc," "only in winter your shadows will be longer than they are in summer. And then, too, the sun doesn't keep good time, so the cyclopedia says; some days it's fast and others it's slow."

"Why don't you find out when the sun is on time, and then mark your dial?"

"There may be something in that," admitted "Doc." "Guess I'd better ask Professor James about it."

"Your scheme is not bad," said Professor James, "only you must not mark the end of the shadow, but the edge of it. The post or gnomon, as it is called, that casts the shadow must be parallel with the axis of the earth so that the shadow will be the same all the year round. Now we are in latitude 39 degrees 30 minutes north, and that means that the post must point north and be tipped up at an angle of 39½ degrees because the angle of the gnomon must always be the same as the latitude. If we were at the equator the gnomon would have to lie horizontally, because the latitude is 0 degree, and south of the equator it would be tipped up toward the south. At the North and South Poles the gnomon would stand straight up and down. If you haven't a protractor to measure the angles you can point the gnomon toward the North Star and you won't be much more than a degree out. Now, let me see. There are four days in the year when the sun is on time—April 15, June 15, September 1, and December 25. You are just too late for the September date and will have to wait until Christmas Day before you can lay out your dial."

"But, I can't wait until Christmas," said "Doc." "I have orders from Pharaoh to build a dial at once. Isn't there some other day that we can mark the shadows?"

"Why, yes, you can do it any day, if you know how fast or slow the sun is. Get everything done, but the marking, and then come to me when you are ready to lay out the dial and I will give you the correct solar time."

The Square-Face Dial

The Chief Craftsman and the Chief Artist and Sculptor were then summoned. Together with "Doc" they went over to Aunt Mirandy's and consulted with her about the type of sun dial she would like to have. A plain square face with Latin numerals and some quaint motto on it, was what she wanted. "Jumbo" made the face of the dial out of two solid oak boards 10 inches wide and about 2 feet long. They were secured edge to edge on a pair of oak cleats 2 inches wide that projected about 4 inches beyond each side of the face. A tinsmith cut out the gnomon from a sheet of copper to the shape shown in Fig. 210 after "Doc" had laid off the angle with a protractor (see Fig. 211), and scratched the outline of the gnomon with a needle. First one of the boards was fastened to the cleats with countersunk screws put in from the under side. Then the gnomon was nailed to the edge of the board, as shown in Fig. 212, and the other board was jammed against it and fastened in place with screws which ran through the cleats. "Jig" then drew

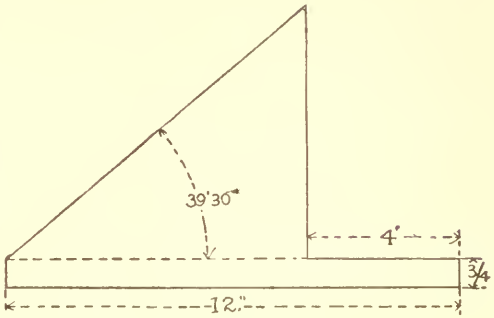


Fig. 210—Dimensions of the gnomon

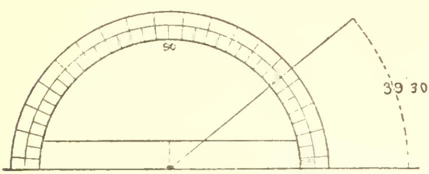


Fig. 211—Laid off the angle with a protractor

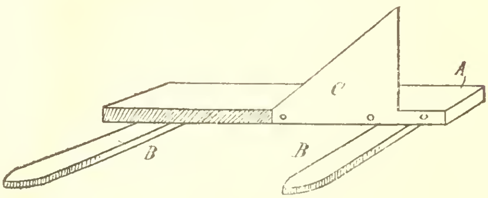


Fig. 212—The gnomon was nailed to the edge of the board

a square border on the dial face and traced the legend "I count the bright hours only."

The Sun as a Timekeeper

Then we told Professor James we were all ready for the marking. He took down an almanac and found that on the next day, which was Saturday, October 2, the sun would reach the meridian at 11:49:36, which meant that it would be 10 minutes and 24 seconds fast at noon that day.

"Now, let me see," said Professor James pointing to a map of New Jersey, "we are almost exactly on longitude 75 degrees west. That makes it much easier for us, because

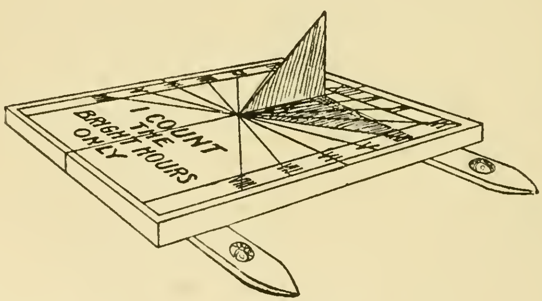


Fig. 213—The dial ready to be set in place

Eastern time is reckoned from this meridian. When the sun is exactly south of us or, as an astronomer would put it, when the sun is on the 75th meridian, all the cities east of Pittsburg set their watches and clocks to 12 o'clock noon. An hour later when the sun is due south at the 90th meridian all clocks between Pittsburg and the center of Nebraska must point to 12 o'clock noon. It is noon in the Rocky Mountains when the sun is due south at longitude 105 west and along the Pacific coast when it arrives at the 120th meridian. There is one hour's difference for every 15 degrees or 4 minutes for each degree. Of course, as I told you before, the sun is a pretty poor timekeeper. It may be as much as a quarter of an hour fast or slow, and if we used the sun as our standard of time some of our days would be a trifle more and others a trifle less than 24 hours long; so we have to base our reckoning on an imaginary sun that comes to our meridian every 24 hours exactly. Sun dials give us the real sun's time, not clock time or the time of the imaginary sun, and so you must change your watch to solar time in order to set the sun dial.

"Now according to our almanac the real sun will reach our meridian to-morrow at 11:49:36; that is, 10 minutes and 24 seconds before the imaginary sun is due, so all you have to do is to set your watch 10 minutes and 24 seconds fast, and then adjust and mark your dial by it. If you were in New York you would have to set your watch 14 minutes and 24 seconds fast, because New York is 1 degree east of us and the real sun is due south there 4 minutes before it is here. If you were in Washington, D. C., which is at longitude 77 west, you would have to take off 8 minutes, setting your watch only 2 minutes and 24 seconds fast."

Marking the Dial Face

"Doc" went to the watchmaker's to get the correct standard time and set his watch exactly 10 minutes and 24 seconds fast. When it was just 12:00 noon by his watch, the dial, which he had placed on the stump, was carefully adjusted so that the gnomon lay edgewise to the sun and the shadow just filled the narrow crack between the two boards. Every hour that afternoon we came back to the dial and drew a line along the shadow. Five o'clock was the last shadow we caught, but we did not need to depend upon the sun for the six o'clock line because we knew that at this time of the day the shadow would be at right angles to the gnomon. The morning hours were then marked off to correspond with the afternoon hours; that is, the angle between XI and XII was the same as that between XII and I, and X was as far to the left of XII as II to the right, and so on. VII and

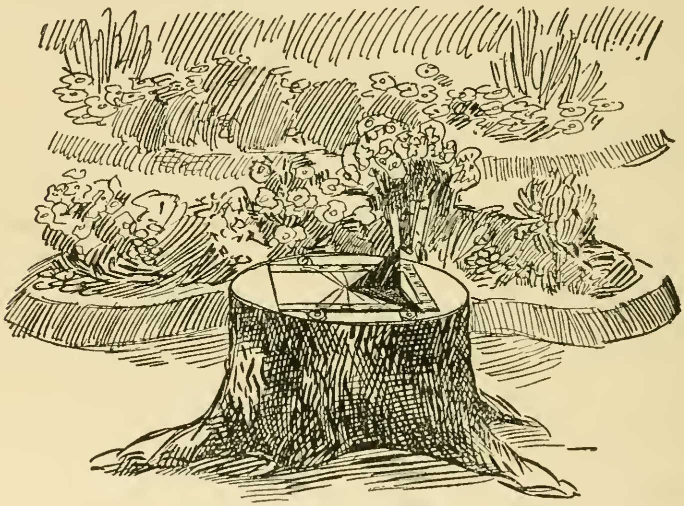


Fig. 214—The dial made quite an artistic appearance

VIII P. M. were found by prolonging the lines VII and VIII A. M., and IIII and V A. M. by prolonging IIII and V P. M. These marks would only be of use during the long summer days.

The position of the dial was carefully traced on the stump, after which it was taken off and delivered to "Jig" Sonches to be carved and embellished. With a penknife and chisel he carved the border, shadow lines, numerals and motto in the wood, painting the depressions black, after which the whole dial was given a coat of spar varnish to protect it from the weather. Finally the dial was set back on the stump in the same position as it had been before and made fast by nails driven through the cleats. At the furniture store "Doc" found some tacks with fancy copper heads which he used to cover up the nails on the cleats. The dial made quite an artistic appearance and Aunt Mirandy and her father were highly pleased.

The Sun Dial on the Lawn

At Professor James's request we rigged up a large sun dial on the front lawn of the Academy. In this case the gnomon was a strip of wood supported on a slant so that it pointed toward the North Star. We drove a post in the ground about 3 feet high and sawed a slot in it running due north and south as nearly as possible. Then we took a strip of wood about 6 feet long and 3 inches wide and drove two nails in the edge. (See Fig. 215.)

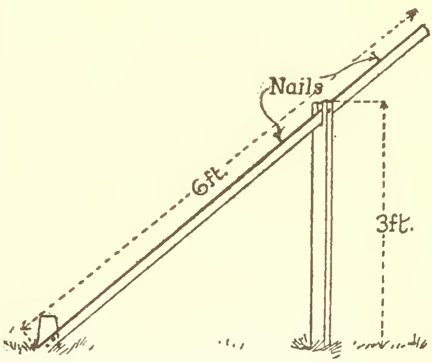


Fig. 215—It pointed toward the north star

Finding the North Star

On the first favorable night "Doc" and I went out to train the gnomon at the North Star. "Doc" showed me how to find the star by using the two stars at the edge of the Great Dipper as pointers and following the path they point out until we came to a moderately bright star which marks the North Pole of the heavens. (See Fig. 216.) At that time of the year the Dipper is below the Pole Star in the early evening. Had our observations been made in May the pointers would have been above the Pole Star.

"Doc" now rested the gnomon in the slot of the post with one end on the ground and sighted across the two nails at the star, moving the foot of the gnomon this way or that along the ground until the star and the two nail heads were directly in line. Then a stake was driven into the ground and the bottom of the gnomon was nailed fast to it.

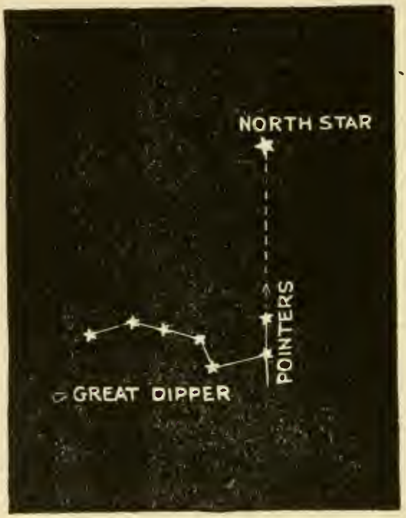


Fig. 216—The "pointers" in the "Great Dipper"

The next day with a cord attached to the foot of the gnomon "Doc" traced a 10-foot circle on the lawn, driving stakes into the ground every 2 feet along the circle. Two or three narrow strips of wood were bent around the stakes and nailed to them, making a continuous wooden arc slightly more than half the circumference of the circle. This arc was painted white as well as the gnomon. Then we consulted the almanac to find out how fast the sun would be the next day at noon. It proved to be 13 minutes and 46 seconds, and "Doc" set his watch accordingly.

The next noon, just at 12:00 o'clock by "Doc's" watch, we found that the gnomon was edgewise to the sun and cast a very narrow shadow across the wooden ring. A line was traced on each side of this shadow. Then each hour that afternoon we marked the circle, drawing the line along the outside edge of the shadow or that part cast by the upper edge of the gnomon. A string was tacked midway between the two lines of the noon mark and as each hour was marked off we would measure its distance from twelve o'clock with

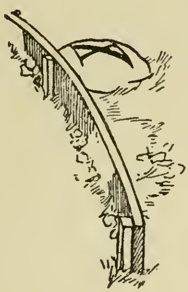


Fig. 217—Strips of wood bent around the stakes

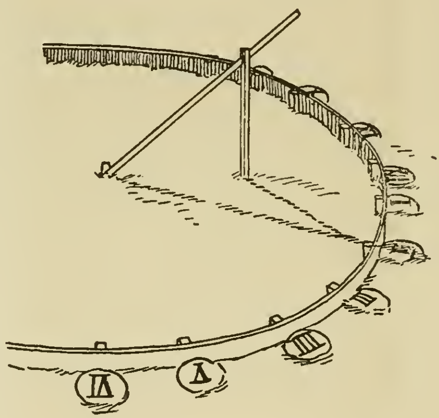


Fig. 218—A stone marked each hour line

the string and then lay off the same distance at the left for the corresponding morning hours. The hours after VI P. M. and before VI A. M. were found in the same way as on Aunt Mirandy's dial. VI o'clock then was just midway between V and VII both in the morning and in the evening. A good-sized stone marked each hour line. It was buried in the ground to the level of the wooden ring, then it was painted white and the hour it represented was put on in black.

A Vertical Dial

"Doc" made one more sun dial the following spring and marked the hours on the 15th day of April when the sun was on time. He did not have to bother with the almanac in marking the dial, but saw to it that his watch was right with the jeweler's chronometer. That was the beauty of working on the 75th meridian. Had he been working in New York he would still have had to set his watch 4 minutes fast.

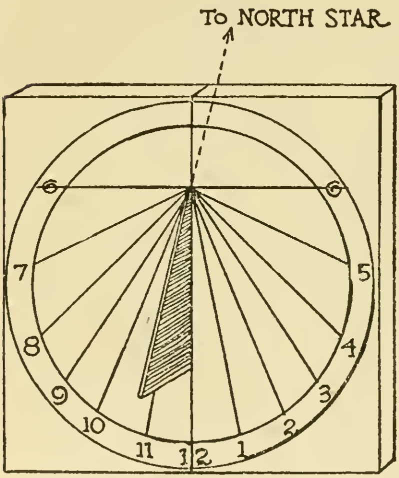


Fig. 219—The vertical sun dial

This dial differed from the others in the fact that the face was vertical instead of horizontal. We nailed it to the south side of the lake house. The gnomon was a piece of galvanized iron cut so that when it was set in place the upper edge would point toward the North Star. (See Fig. 219.) The side of the house was not due south, and so when the hour of noon came "Doc" had to bend the gnomon to the left until it was just edgewise to the sun. The afternoon hours were marked off that day, but we could not lay off the morning hours from them as we had done before because the dial face was not at right angles to the plane of the gnomon. So "Doc" had to get up before sunrise and mark the shadows from five o'clock on.

A Simple Water Clock

The sun dial was not the only timepiece we had at our club house. "Doc" in his study of ancient devices for determining the hours of the day had come across the description of a clepsydra, or water clock. It was a very simple thing to make—merely a pail with a tiny hole in the bottom through which the water in the pail escaped drop by drop. There was a cover *A* (Fig. 220), over the top of the pail and a float *B* on the water inside. A rod *C* fastened to the float passed through a hole in the cover board, and as the water fell the rod sank slowly through the board. The hours were marked on this rod reading upward, and we could tell what time it was by noting the lowest mark that showed above the cover board. The hour marks at the bottom of the rod were not so close to each other as were those at the top, because the water dripped out more rapidly when the pail was full than when it was nearly empty.

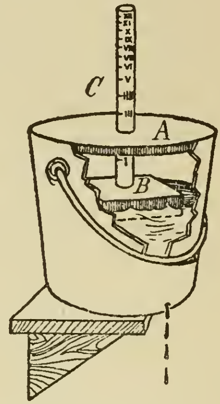


Fig. 220—As the water fell the rod sank

A Siphon Clepsydra

Bill designed a much more elaborate clepsydra in which the float fell at a constant rate no matter how low the water was. Then, too, the hours were marked on a dial and the float was arranged to move clock hands over the dial face. Instead of a pail he used a large cider barrel. No hole was punched in the bottom of the barrel because the water was drawn off over the top instead. A large block of wood was used for the float. A stick *A* was nailed to this float and it was connected to another stick *B* at the top by a broad crosspiece *C*. The upper corners of the crosspiece were cut round, as shown in Fig. 221. A small rubber tube *D* ran from the float up over the crosspiece and down the other stick. It was held in place by means of staples driven just tightly enough to hold the tube without pinching it. The float was set in the water with the leg *B* projecting outside of the barrel. The inner end of the rubber tube dipped into the water and the outer end hung about an inch below the level of the water in the barrel. Putting his mouth to the outer end of tube Bill sucked the tube full of water, and then it began to flow out quite rapidly. The rate of flow depended on the difference in height between the water surface inside the barrel and the outer end of the tube. This difference in level is known as the "head" (see Fig. 221), and it remained the same whether the barrel was full or nearly empty, because the siphon fell with the float, and consequently the rate of flow did not vary. By clipping off the outer end of the tube the

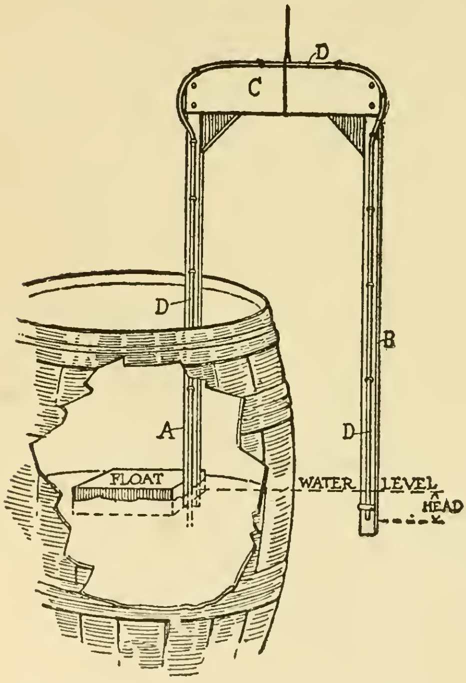


Fig. 221—The water was drawn over the top

head was reduced and the flow was made less rapid. A cord and a piece of tape were attached to the crosspiece *C* and ran up to the dial mechanism, where the cord passed over a V-grooved pulley *E*. A small weight was fastened to the other end of the cord to keep it taut.

The Dial Mechanism

The clepsydra was set up on the porch. Two brackets *F* (Fig. 223) were nailed to the wall and they supported the dial face. Across the top of the bracket two strips of wood

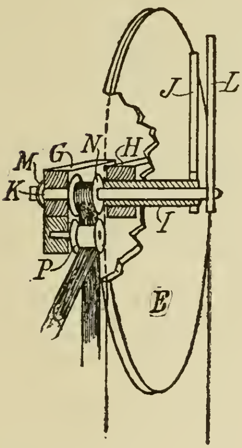


Fig. 222—The dial mechanism with the dial face removed

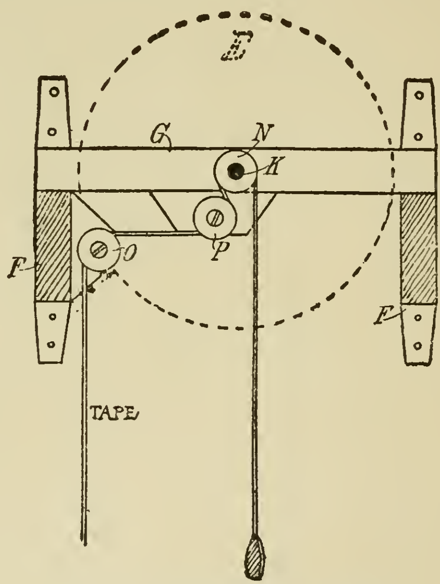


Fig. 223—Details behind the large pulley *E*

G and *H* were fastened. The pulley *E*, 9 inches in diameter, was wedged tightly onto a piece of brass tubing *I* which was journaled at one end in the cross strip *H*, while the other end projected through the center of the dial board or clock face.

An hour hand *J* carved out of cigar box wood was secured to the projecting end of the tube. Bill bought the tube at a hardware store and selected a size large enough for a pencil to pass freely through it. This pencil was now put through the tube and through a hole in the cross strip *G*. A minute hand cut out of cardboard was fastened to the outer end of the pencil by means of a tack, and a ring *M* was driven onto the opposite end of the pencil to prevent it from slipping out of place. A spool *N*, between the strips *G* and *H*, was wrapped with sticky tire tape until it was just one-twelfth of the diameter of the larger pulley, that is, ¾ of an inch. A spool *O* (Fig. 223) was journaled on a screw driven into a block on the left-hand bracket. A piece of tape attached to the crosspiece ran over this spool and thence under another spool *P* and over the pulley *N*. A small sinker tied to the end of the tape served to take up the slack.

Testing the Mechanism

The dial face was painted with the usual Roman numerals to indicate the hours and minutes. Then Bill tested the mechanism by letting the float fall slowly to see whether the minute hand would turn twelve times while the hour hand turned once. Something was wrong. The hour hand went too fast. Apparently the small pulley was a little too large. However, the matter was easily remedied by filling the bottom of the V-groove in the larger pulley with cord until it was just the right diameter.

The Siphon Regulator

A regulator was fastened on the outside leg of the siphon. It consisted of a stick of wood (Fig. 224) hinged to the leg *B* of the siphon by means of a bit of leather. The stick was used to pinch the end of the rubber tube *D* and thus control the flow of water through the siphon. A screw *X* was threaded through the end of the stick and into the siphon frame, and by feeding this screw in or out the rate of flow could be regulated to a nicety. A piece of zinc was placed between the tube and the framework to prevent the water from soaking into the wood and

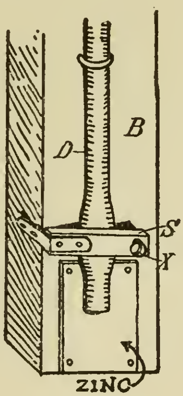


Fig. 224—The siphon regulator

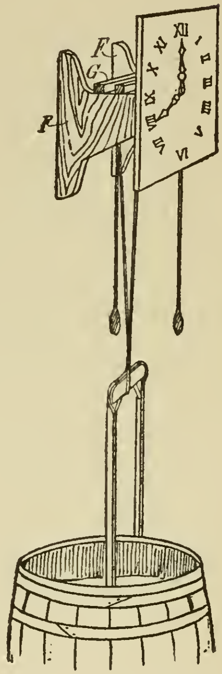


Fig. 225—The siphon clepsydra

swelling it so as to pinch the tube too much. On the floor, under the tube, was placed a wooden trough to catch the drip and carry it off the porch into the lake.

CHAPTER XIX.

THE FISH-TAIL PROPELLER

THERE was one thing Bill never liked about the pedal-paddle-boat, and that was the paddle wheels. He wanted something more modern. If our club was to be truly up to date the "Lady Bug" would have to be driven with a propeller instead of paddle wheels, but he couldn't for the life of him figure out how the thing was to be rigged up so that a bicycle would drive it, and then, too, the propeller was a rather difficult thing to make. He pondered over the subject a long time and finally called in council his Grand Vizier, the Chief Admiral, and the Chief Engineer. We discussed the subject, thoroughly examining it from every point of view, and finally gave it up as impracticable. But Bill was not satisfied, I was sure of that.

One afternoon we were up in Silver Lake taking fish pictures. Our roll of films was used up and Bill was idly peering through the camera box as we drifted with the wind. He staid there an uncommonly long time and finally I called to him.

"What's got you, Bill? Is it a mermaid this time?"

He raised himself up slowly and stared rather abstractedly at me.

"Well, what is it?" I asked.

"Did you ever hear of a fish with paddle wheels?" he asked.

"Paddle wheels!" I exclaimed.

"Did you ever hear of a fish with a propeller?" he continued.

"Propeller? Why, yes, the fish's tail is a sort of propeller, isn't it?"

"It doesn't go around, does it? You never saw anything on a fish that goes around like the propeller of an ocean liner, and yet a porpoise can swim circles around the fastest boat afloat. I have just been watching the minnows down here. They simply wave their tails from side to side and glide along as easily as you please. Now why can't we rig up a sort of fish tail on our boat?"

"There's nothing new in that," I said. "Just a case of sculling that any boatman knows how to do."

"But their tails aren't stiff like an oar. Come and look at them. They bend back and forth just like a piece of paper. Now, if we had a very thin——"

"Would a tin blade do?" I asked.

"No good," he said; "it would break off in no time. We ought to have a blade of spring steel."

"Well, we can't get that. So you might as well forget it."

"Forget it nothing!" said Bill. "This is a great discovery, and I am going to get it patented. Some day all the ocean liners will have fish-tails on them and run across to Europe faster than an express train."

"Yes," I answered; "millions in it; millions in it. Bill, you're a real inventor. Dreaming of the golden future before you've even built a model of your propeller. I'd advise you to keep quiet about it and rig up a tail on the 'Lady Bug.' Save your shouting until you see whether the thing works."

A Wooden Fish-Tail

Bill built his model, but he could not get a piece of spring steel and so had to content himself with a wooden fish-tail after all that did not flex as he wished it to, but was jointed so that it had some of the fish-tail motion. Fearing that the idea might not work out well he did not build it on the "Lady Bug," because he did not want to mar the boat unnecessarily, and, furthermore, he did not care to disclose his invention to the public until it was fully protected by a patent. So he rigged it up on an old flat-bottom scow that Farmer Fithian loaned him for the purpose.

Construction of the Fish-Tail

First of all he got a piece of ½-inch white wood, 22 inches long by 12 inches wide. This was the blade of the tail. A jog *B* was cut in the front upper corner of the blade *A* (Fig. 226), and then he got a tinsmith to cut him two pieces of galvanized sheet iron to form the hinges *C* with which the blade was to be attached to the handle *D* of the rig. For the handle of the fish-tail he took a stick 1½ inches thick, 3 inches wide and about 4 feet long.

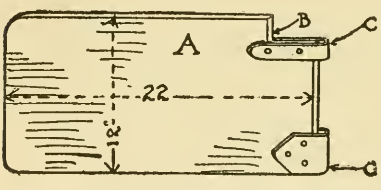


Fig. 226—The blade of the tail

At the point where the stick was attached to the tail he left it full width, but tapered it at the other end to form a neat round handle. (See Fig. 227.) Bill got a blacksmith to make a brace like that shown at *E* (Fig. 228), out of a piece of carriage iron 20 inches long. This was fastened to the stick *D* with a pair of bolts, and then a hole was drilled in the handle directly above the hole in the lower end of the brace. A ⅜-inch chair bolt *F* about 12 inches long was now procured, and it was passed through the brace and the hole in the handle. There were two nuts on the chair bolt, one of which was screwed against the under side of the handle after the other had been screwed down against the top. The tail was now placed with the rear edge against the chair bolt, and the two pieces of galvanized iron were bent

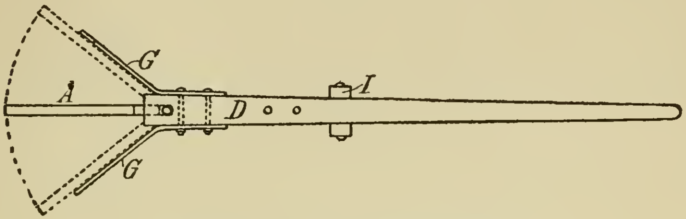


Fig. 227—Plan view of the fish-tail rig

over the chair bolt and fastened to the board with screws that passed through holes punched through the galvanized iron. At the hardware store Bill got a couple of large angle braces *G* which he took to the blacksmith and had him bend them to a wider angle, so that when they were

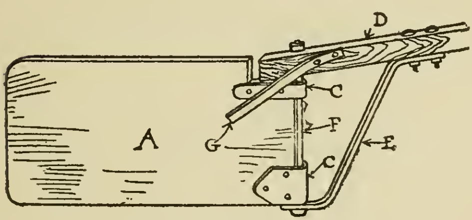


Fig. 228—How the blade was hinged

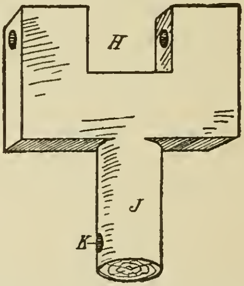


Fig. 229—The swivel block

fastened to the side of the stick *D* they would form an angle of about 45 degrees as shown in Fig. 227. The braces were tipped downward as indicated in the side view Fig. 228 and were fastened with a couple of bolts that ran right through the wood from one side to the other. The handle was fastened to the rear of the scow with a swivel joint. The swivel joint was made of oak of the form shown in Fig. 229. The handle was fitted in the slot *H* and pivoted on a bolt, while the shank *J* passed through a hole in the rear of the screw and was held in place by a peg driven through the hole *K*. With this form of joint the handle could be swung up and down as well as sideways.

Fish-Tail Propulsion

Bill and I tried the fish-tail rig by ourselves first. Bill sat at the rear of the scow and swung the handle back and forth, making the tail move snake fashion, striking first against one of the braces, *G*, and then against the other. The boat moved along at a pretty good clip and Bill was delighted.

"How about it, Jim?" he said. "You can tell your grandchildren how you rode in the first and original fish-tail boat. I'm going to see Professor James about it and get out my patent right away."

"It is quite a success," I admitted, "but look at the way it makes the boat zig-zag. They would never stand for anything like that on an ocean liner."

"Oh, the larger the boat the more steady it would be."

"Maybe so," I responded, "but I don't see why it should zig-zag at all. The fishes manage to swim along in a straight line without wavering the least bit. I don't believe you have quite struck it yet."

Bill was indignant. "The invention's all right," he said. "There's nothing the matter with that. If I could only get a spring steel tail on the boat instead of this wooden affair you'd find that she'd keep to a straight line all right enough."

"I don't believe it," I responded. "What you need is a keel. Fishes have keels, haven't they? They have fins sticking out top and bottom to keep them in a straight line."

"Well, we can put a keel on the scow easy enough."

"No, you don't, either. Farmer Fithian would not stand for it. He can't get up to his cove if the boat draws too much water."

"Oh, what does he care about the old scow anyway?"

"I saw him in it only last week."

"Well, how about a centerboard then? He couldn't kick at that."

"Maybe not. Let's see."

We propelled the boat around to his cove on Jenkin's Lake and went up to the Fithian farmhouse. The old farmer was quite taken with Bill's invention when we gave him a ride in the boat and he was perfectly willing to have us rig up a centerboard in the scow.

The Centerboard

The boat was turned bottom upward and two 1-inch holes were drilled through the center of the keel about 30 inches apart. With a compass saw we connected the two holes,

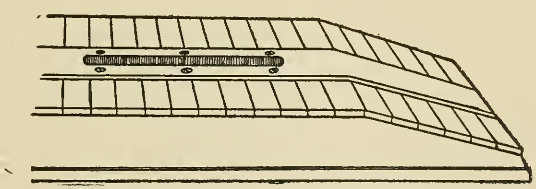


Fig. 230—The slot in the bottom of the scow

making a slot an inch wide. The centerboard box was built around the slot, as shown in Fig. 231, up to a level with the gunwales of the boat. For the centerboard we got a piece of yellow pine ¾ inch thick and a foot wide. One end of the board was cut off on a slant, as indicated at *L* (Fig. 232), so that it would clear the end of the box when it was lowered. The forward end of the board was hinged to the

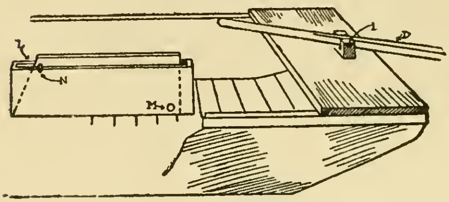


Fig. 231—The centerboard box was built around the slot

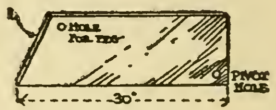


Fig. 232—The centerboard

box close to the bottom by means of a bolt, *M*. The centerboard was raised by means of a cord attached to the aft end and was held by a peg, *N*, which was slipped through a hole at the top and rested across the centerboard box.

Steering with the Fish-Tail

The centerboard was a decided success. It kept the boat on a straight course. No rudder was used for the scow because the steering was all done with the fish-tail. For instance, if Bill wanted to go to the left, he would make several quick strokes of the tail in that direction, or else he would swing the handle end of the stick, *D*, around in a circle, making the blade sink deeper in the water while it was moving toward the left. If he wished to turn toward the right he would reverse the direction of the circle.

Bill never got his patent. He didn't have the cash. He asked his Uncle Ed for help, but Uncle Ed was then in Rhodesia, and it took ever so long to get an answer from him. Then Uncle Ed wanted to see the affair before he invested any money in it, all of which delay considerably dampened Bill's enthusiasm, and in time he neglected his wonderful fish-tail invention. But if any of my readers should chance to visit the old Academy town he will see many a boat fitted with this odd type of propeller, copied after Bill's invention.

CHAPTER XX.

KITE PHOTOGRAPHY

So far we have mentioned only Professor James, Principal of the Academy, and the seven boys of our club. But let no one imagine that we were the whole school and Professor James the whole faculty. There were about thirty boarders altogether and about twice that number of day scholars who came from town and the surrounding farms. There were three teachers besides our Principal, but only one of them was ever admitted into our club and that was Professor Harvey. We made him an honorary member in reward for a valuable suggestion.

Bird's Eye Photography

I was showing him some of our bird pictures one day and he admired them very much.

"I wonder how we must look to the birds?" he said suddenly. "Why can't you take some bird's eye photographs? There's an idea for you. Send up your camera with a balloon or a kite and then take pictures from the sky of the world below. It will give you an idea of the flatness of the earth, the little squat houses and the self-important little people that strut about, as seen from the viewpoint of the bird's domain."

"Bully!" I said. "We'll do that, Professor Harvey, and if it works out all right we'll elect you an honorary member of our club."

The suggestion was put before the club at the very first opportunity.

"The scheme's all right," said Bill. "But how in the world are we going to press the button at the right time?"

"Why, touch it off with electricity," I suggested.

"That sounds easy enough, but we can't send the kite up more than a hundred feet with the wire we have and that's little better than taking a picture from a treetop. We ought to send the camera up five times as high to get a picture worth while. That would take a thousand feet of wire, which is a pretty heavy load for the kite to lift, and we'd have to buy some more batteries; and then, besides, our electric shutter isn't rigged so we can hold the camera upside down."

"Tie a string to the shutter," put in "Jumbo," "and pull it when you get ready."

"Yes; and have it get tangled up with the kite string. That won't do; but there ought to be lots of ways of doing it. I tell you what, let's all of us think it over until to-morrow afternoon, and then we'll see who has the best idea."

Suggestions for Springing the Shutter

It was a varied collection of ideas that were brought around that afternoon, and they spoke well for the resourcefulness of the Scarabs. Bill's plan was to spring the shutter at the right moment with an alarm clock attached to the camera. "Sneezer" proposed that the shutter arm be set off by a rubber band or a spring which could be held in check until we could get the kite well up in the air by a leaky toy balloon or one of those bladders that are sold by street fakirs. "Doc's" idea was somewhat along the same line, except that he suggested using a piece of ice instead, and he put forth a very good argument in favor of his scheme. The block of ice would be heavier than the bladder, to be sure, but it would be getting lighter and lighter all the time, as it melted, and so help the kite to rise, and, finally, it would be lighter even than the bladder, because it would be entirely melted away. Bill's scheme was more mechanical, of course, and we could set the alarm to spring the shutter at any desired time, but it meant just so much more deadweight to be carried by the kite. The arguments for and against each scheme grew louder and louder and threatened to end in a fight. Finally, Bill settled the matter by announcing that we would try out each scheme and see how it worked.

The Bladder Trigger

"Sneezer's" scheme was like this: A bent lever was whittled out of a stick of wood to the form shown at *A* (Fig. 233). A plate, *B*, of cigar box wood was nailed to

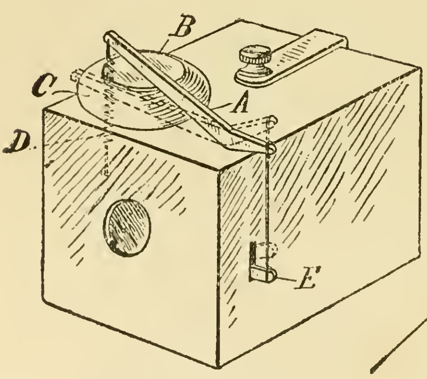


Fig. 233—When the air leaked out the shutter was sprung

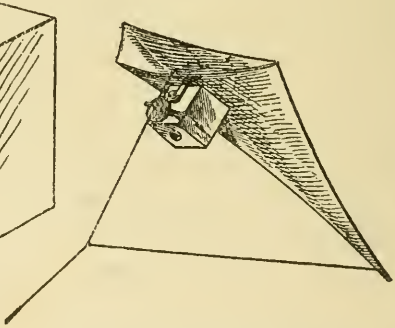


Fig. 234—Taking a photograph by means of the bladder trigger

the longer arm of the lever and rested on the bladder, *C*. The ends of the lever projected beyond the overhang of the camera and a spring, *D*, pulling on the long arm of the lever pressed the plate, *B*, down on the bladder. A string connected the short arm of the lever with the shutter arm, *E*. When the bladder was inflated it raised the longer arm of the lever to the position shown by full lines in Fig. 233; but there was a tiny opening in the bladder through which the air escaped, eventually permitting the spring to pull the arm to the dotted position and spring the shutter.

The Ice Trigger

"Sneezer's" scheme worked fairly well, except that we could not get the bladder to leak slowly enough. In that respect, "Doc's" scheme was better. He used identically the same mechanism, except that the plate, *B*, was dispensed with. A groove was scraped in the ice, *F* (Fig. 235), for the lever *A* to rest in, and this kept the ice from slipping off, but as a further precaution, a board was fastened to the camera with nail points sticking up into the ice. It took quite a while for the lever to cut its way through the ice and spring the shutter, which gave us ample time to fly the kite to a good height.

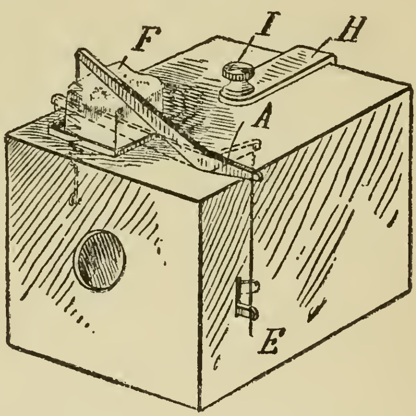


Fig. 235—The lever cutting through a block of ice

The Alarm Clock Trigger

Bill took an inventory of the alarm clocks of the school and found one that weighed much less than the average. For this timepiece he traded his own clock and an old penknife to boot. The clock was fastened on its side with the keys at the back overhanging the edge of the camera, just above the shutter arm. The shutter arm was set so that it would have to be pulled up to make the exposure. A string ran from the arm to the winding key of the alarm. When the alarm was wound up, the string was slack, but when it went off the key turned and wound up the string, springing the shutter.

The principal difficulty of this scheme was the impossibility of telling the precise moment when the alarm would go off. When we first used it we set it to go off within fifteen minutes. After it had been in the air twenty minutes we pulled it down and had nearly brought it to the ground when off went the alarm. The photograph when developed showed a plan view of Bill hauling in the string with hands about twice as big as his head, because they were in the immediate foreground. Next time we left the kite up in the air a good half hour and got a fair picture, but the uncertainty of the thing was annoying.

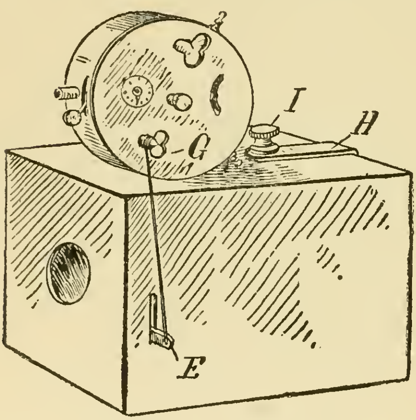


Fig. 236—Wound up the string springing the shutter

"Couldn't you rig up some sort of a signal," I suggested, "so that we can tell when the thing goes off?"

The Key Ring Signal

"Sure," said "Sneezer." "We could fasten a ring up there and let it slide down the kite string when the alarm breaks the thread that holds it up there." He pulled his key ring out of his pocket and slipped it onto the kite string. Then he tied the ring (*K*, Fig. 237), to the alarm key with a thread which he unraveled from his coat lining. When the alarm went off the thread was wound up by the key, but a large pin stuck through the kite string held back the ring, and the thread had to break, letting the ring slide down the kite string. It seemed like a fine scheme, but the very first time we tried it, it failed to work. We let the kite stay up in the air forty minutes, though the alarm was set to go off in twenty minutes. And yet no message came down the string to tell us that the picture had been taken. Finally, we got tired and pulled down the kite. The shutter was sprung and the ring had started down, but the thread attached to it had become tangled with the kite string. The next time we tied the thread with a slip knot in such a way that a good pull would undo the knot and release the ring. This worked perfectly.

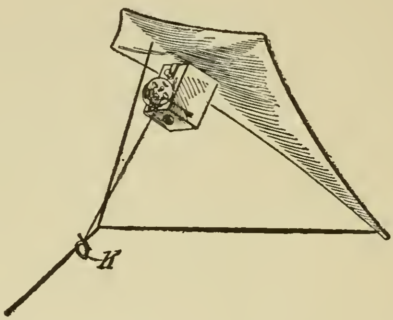


Fig. 237—Arrangement of the key ring signal

Telephone Kite Signal

Bill had another scheme, but whether it was a good one or not we never found out, because the first time we tried it our kite string gave way and the kite sailed off with my precious camera. When we recovered them there was not much left of either and our photographing experiments came to an abrupt end. The scheme was to use a telephone to determine when the alarm went off. The telephone was one of the mechanical kind, consisting of two paper or tin boxes, with a string stretched tightly between them. The bell of the alarm clock had been taken off in our previous experiments so as to reduce the weight as much as possible, but now Bill put it on again and fastened a small tin can, *L*, in front of it, with open side turned toward the bell. A hole

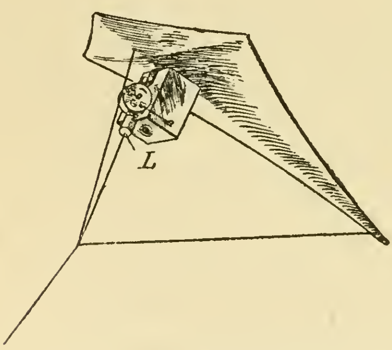


Fig. 238—The telephone transmitter at the kite

Fig. 239—Held the can to his ear

was punched in the bottom of the can and a string knotted on the inside of the can passed through the hole and was pulled taut and tied to the kite string. Another tin can with a string knotted to the bottom of it was made ready for the telephone receiver at the lower end of the kite string. When the kite had risen to about the position we desired, Bill tied the receiver to the string, and then pulling the cord as taut as possible, held the can to his ear, waiting to hear the alarm go off. Bill didn't intend to take the whole pull of the kite, but "Jumbo," who was holding the kite string, didn't understand this and let go. A tug of the kite yanked the can out of Bill's hand. I made a leap for the string that was being trailed along the ground and stepped on it, but the check was too sudden. The string parted and the kite was free. I felt pretty badly over the loss of my camera, but the club chipped in and bought me a new one, and then refused to use it for any more kite experiments, which was pretty decent of them I thought.

The kite we used to support the camera was a Malay tailless kite, just like the one Bill and I built the year before.* It was 5 feet high and in a good wind gave a very powerful pull on the kite string. The camera was fastened just below the crosstick of the kite. An angle piece, *H* (Figs. 235 and 236), was lashed to the frame of the kite. The tripod screw, *I*, was threaded through the angle piece into the socket in the camera. By this arrangement the camera could be pointed to one side or the other. When the kite was first tried, a block of wood was substituted for the camera, so as to find the proper point of attachment.

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*Directions for making this kite are given in the Scientific American Boy, page 231.

CHAPTER XXI.

WATER KITES AND CURRENT SAILING

Bill had a very logical head. Whenever his mind was directed toward any particular line of thought he traced it out to the very end and in that way quite often obtained some rather surprising discoveries. It was only natural that when we embarked on our kite photographing experiments he should investigate the principles of kite flying. When he had thoroughly mastered these he began to look for other applications of the same principles. If this thing could be done in the air why could it not be done in the water? He didn't say anything about it to the rest of us, but I knew from his preoccupied manner that there was something on his mind, and so I was on the lookout for developments. One day I caught him rigging up an odd-looking tin affair.

"What do you call that?" I asked.

"That? Why, that's a kite," he answered.

"A kite?" I said. "Why, who ever heard of a tin kite?"

"I can sail it, though. Just tried it, and it worked fine."

"Let's see you do it again."

"Can't now. The tide isn't right."

"The tide?" I exclaimed.

"Yes, it isn't running strong enough."

"Look here, Bill. Is that a kite you have, or a boat?"

"A little of both, Jim," he answered. "You might call it a 'water kite.' It sails through the water just like a kite through the air. You stand on the bank and hold the string and the kite sails over to the other side of the creek. The current carries it over just like the wind carries a kite up in the air. We'll go down to-morrow, when the tide is right, and I'll show you."

Bill's kite was merely a block of wood with a broad piece of tin fastened to it like a deep keel. The wooden block, which was in two pieces, *A* and *B* (Fig. 240), nailed to opposite sides of the tin, served merely as a float for the tin keel. A cord ran with plenty of slack from the front to the rear of the kite and was fastened to staples, *D*, driven in the ends of the block. This cord corresponded to the "belly band" of an ordinary kite, and the kite string was attached to it at such a point that the bow or the forward end of the

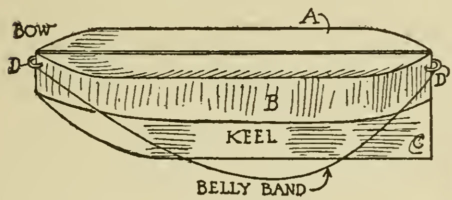

Fig. 240—The water kite

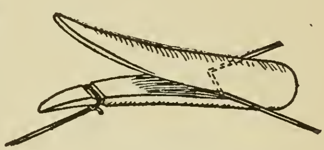
Fig. 241—The hook was a clothespin cut down

kite would point away from the one who was sailing it. The string was not tied to the "belly band," but was fastened to a wooden hook, shaped as shown in Fig. 241, which could be slipped on to the band at any desired point. This hook was merely a clothespin cut down.

Kite Sailing in the Water

The next day we all went down to the creek, which ran through part of the town and wandered aimlessly back and forth through the salt meadows until it finally reached Delaware Bay. The mouth of the creek was but ten miles from town, as the bird flies, but by boat the trip was twenty-two miles. Bill had chosen a spot out of town where the creek doubled back within half a mile of the Academy grounds. We were just a little late. The tide was not running in as rapidly as Bill would have liked, but he adjusted the kite string to the "belly band" so that the forward end of the water kite pointed out-stream at quite a wide angle. Then he tossed the kite out into the current, and as soon as the kite string began to tighten, the water kite commenced moving away from us for the other shore. Bill played with it just as he would with an aerial kite, now pulling in the string and now paying out, and the thing responded perfectly. He succeeded in getting it almost to the opposite shore, but there was not enough current near the shore to carry it all the way over, and the drift of the kite string in the stream dragged it back. The tide was so near flood that soon there was scarcely any current worth mentioning, and the only way that Bill could sail his water kite was to run up and down the bank with it as he would with an aerial kite in a calm.

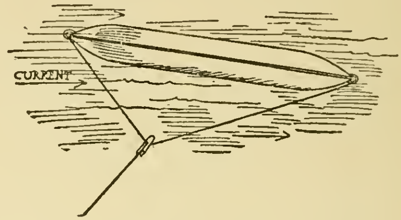

Fig. 242—The forward end pointed out-stream

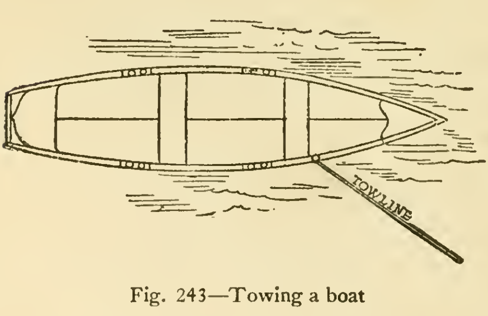

Fig. 243—Towing a boat

That set me to thinking. After all, hadn't we done about the same thing with the "Lady Bug" when towing her between the lock and the dam? We didn't tie the tow line to the stem, but a little ways back, so that the bow would point out-stream, and the boat would not be dragged toward the shore when we towed it. Had we fastened the tow line to the stern the boat would have turned squarely across the stream. (See Fig. 244.) What Bill did with the "belly band" was to tie the tow line to the stern so as to swing the bow out and then tie it to the bow as well, to keep it from swinging out too far. I mentioned this to Bill.

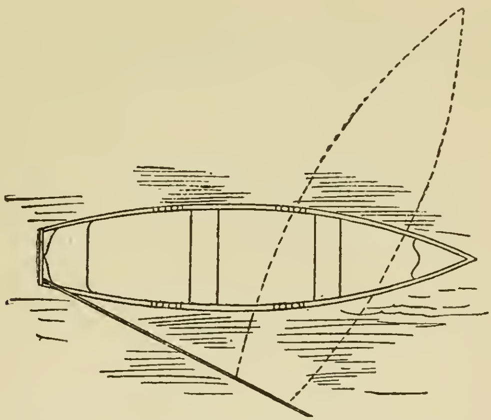

Fig. 244—Had we fastened the line to the stern

"I believe you're right," he admitted. "It must be the same thing, because the stream keeps the boat out from the shore, even when there is no one at the tiller. If we fastened the tow line a little further back I believe the boat would sail right across the stream to the other side when we towed."

We tried the scheme at the first opportunity, but it worked only moderately well.

"We ought to have a deeper keel," said Roy, "for the water to press against."

"But," I protested, "how are we going to drag the boat to the dam if there is a deep keel in the way?"

A Removable Keel

But Roy's plan was to put a removable keel on the boat. It was made out of a strip, *E* (Fig. 245), of wood 6 inches wide and an inch thick. The forward end was tapered, as shown, and a heavy wire link, *F*, was fastened to it, whereby it could be hooked over a notch, *G*, in the stempiece. Two

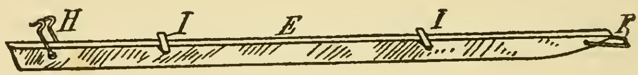

Fig. 245—The auxiliary keel

screw eyes were fastened to the dead wood of the boat and the keel board was made fast by a pair of long hooks, *H*, which engaged these screw eyes. At a couple of points along the keel board, two cross pieces, *I*, were let into the upper edge. These provided a bearing which rested against the

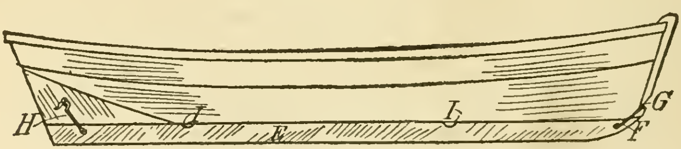

Fig. 246—The keel could be removed at a moment's notice.

bottom of the boat and served to keep the auxiliary keel from twisting from one side to the other when in use. The edges of each crosspiece were chamfered so as to reduce friction as much as possible. The keel could easily be removed at a moment's notice, and it was no difficult task to put it into place on the boat. With the auxiliary keel in place the kite action was much more pronounced.

Current Sailing

"I believe we could get across the creek in the boat without any oars by anchoring the tow line to shore," said Bill. "Let's try it, anyway."

It was quite a job getting the boat down from Jenkin's Pond to the creek, but our enthusiasm lightened the task. We were working out a new invention, and it would have to

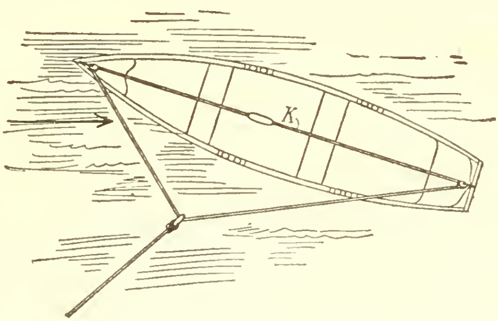

Fig. 247—The line was fastened to an endless "belly-band"

be a very serious obstacle indeed that would hold us in check. We were not disappointed either. The line, which was a very long one, was securely anchored to shore, and its other end was fastened to an endless "belly band," *K*, which ran through a pulley at the bow and another at the stern of the boat, as shown in the plan view (Fig. 247). By pulling the band fore and aft the bow of the boat could be made to point more or less out-stream. The boat was shoved off into the ebbing tide and allowed to drift down stream until the rope pulled it up short. Then Bill manipulated the "belly band" so that the bow pointed toward the opposite shore, and over we sailed, tacking right across the current, actually moving up stream as we described a wide curve that carried us to the opposite side. Bill was enthusiastic.

"Great, isn't it?" he said, slapping me on the back. "Why, if we should ever lose our oars and want to get back across the stream, all we'd have to do would be to fasten our rope to one side and let the current sail us across to the other."

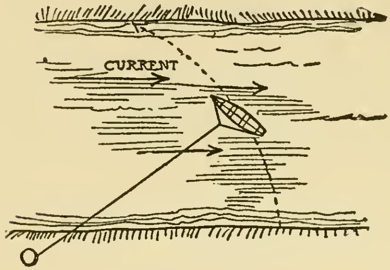

Fig. 248—Actually moving up stream

"Yes," I retorted, "if there happened to be a good current, or if you happened to have a long enough rope. When you're in trouble, things don't happen as handy as all that."

"Oh, well, I shouldn't be surprised if it could be done, even without tying a rope to the shore."

"How?"

"Why, when you are drifting down with the stream, of course you can't steer one way or the other, but you can when the boat is going faster than the stream, or even when it's going slower than the stream. Now, if there was no other way to get across I'd tie a stone to the painter and let it drag along the bottom. Not a big stone, but one just large enough so that the boat would drift slower than the stream."

"All right, here's a stone. Don't tell me what you'd do. Show me."

Sailing with a Drag

Bill fastened the stone to the rope and slung it overboard. Then measuring what he judged to be a suitable length he fastened the line to the gunwale near the first seat from the bow and seated himself at the stern where he could manage the rudder. He kept the boat pointed diagonally across the creek and, as he drifted slowly down stream with the stone dragging along the mud bottom, he moved steadily toward the opposite shore. Then he fastened the rope to the other side of the boat, pointed the bow in the opposite direction, and came back again to our side, although he landed a long ways down the creek. We all had to try the trick then, and had quite a contest to see which would cross the stream and back with the least down-stream drift.

CHAPTER XXII.

THE CANVAS-COVERED WOODEN CANOE

BILL wanted to drag the "Lady Bug" down to the creek again the next day to repeat the current sailing sport. But recollecting our struggles to get the heavy boat up the steep bank of the creek to Jenkin's Lake, for we had not dared to leave the boat where it might be stolen by the Mulligans, we were not eager to fall in with Bill's suggestion. "Jumbo," for one, declared that he could find all the fun he wanted right there in Lake Moeris.

"But it is the command of Pharaoh," said Bill.

"Oh, hang Pharaoh!" retorted "Jumbo." "I nearly burst a blood vessel hauling that boat up here, and I don't intend to run such a risk again."

"What!" said Bill. "I'll teach you to defy Rameses, Pharaoh of the Scarabeans! Seize the rebel! Chain him to the galleys!"

"You'll have to do it yourself, Bill," said Roy. "You won't get any help from us."

"A rebellion, is it? Well, I suppose I'll have to back down, but it's all your fault, Roy, for making such a cumbersome boat."

"The 'Lady Bug' is all right," answered Roy, "but she isn't meant to be carried around in a vest pocket. What you want is a canoe."

"Well, then, make a canoe," said Bill, "and if you need any help Jim can show you how to do it. He and I built one summer before last."

"Yes, I suppose so. One of those barrel hoop arrangements."

"Well, how would you do it?"

"Why, I'd make a wooden canoe and cover that with canvas."

"All right, Roy, go ahead, if you're sure you know how."

"Know how?" replied Roy indignantly. "Don't ask the Chief Admiral of the Scarabeans if he knows how to build a common wooden canoe."

The method of construction that Roy adopted was not according to standard practice, the kind you find in a book. He had to figure out his own design which, as far as his memory served him, was based on the plans of the canoe he owned at home. It was to be 16 feet long over all, with a beam of 32½ inches, and built out of quarter inch white cedar planking and ribs. That meant money, but we were resolved to have the best. The planking was from 2 to 4 inches wide and some of the boards had to be from 16½ to 17 feet long so that they would reach from end to end without break.

Building the Frame of the Canoe

First of all, Roy built five forms, one like that shown at *C* in Fig. 249, for the center of the canoe, and two each of the others, which were placed at each side of the center form. Two end pieces or stems, *F*, both exactly alike, were sawed out of a half inch board to the shape shown in Fig. 250. The curved edge of each end piece was chamfered. Two long planks, *G* and *H* (Fig. 251), were now nailed to the forms at the keel, and also to the end pieces, trimming them as they were nailed on to make a neat joint where they curved into the end pieces. The forms *B* and *D* were spaced 2 feet 11 inches each side of the center form and the forms *A* and *E* 1 foot 9 inches further from the center. In the plan view of the finished canoe the positions of the forms are

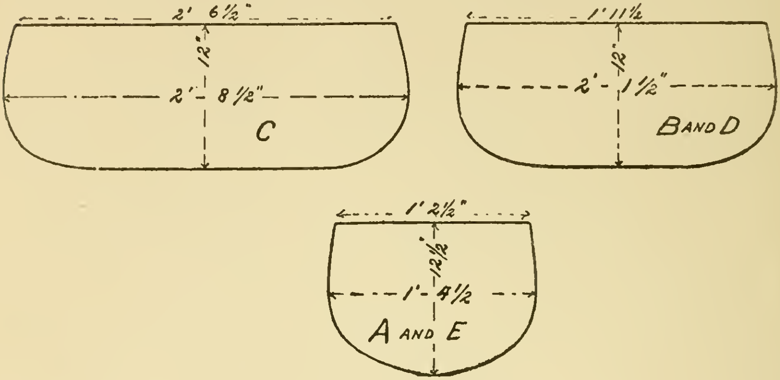

Fig. 249—Forms for the canoe

indicated by dotted lines marked *A, B, C,* etc. The nails were not driven home, but were left with the heads projecting, so that we could draw them out readily when we wished to move the temporary forms. The stems, however, were a permanent part of the boat, and we nailed the planks securely to them. Two more planks, *I* and *J*, were now nailed to the forms at the top, and then we took four 3-foot lengths of cedar planking, 8 inches wide, and fastened two at each end of the boat on the strips *I* and *J*, as indicated by dotted lines at *K* (Fig. 251), after which they were sawed

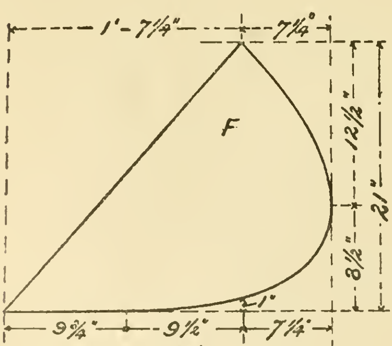

Fig. 250—One of the end pieces

off to form a graceful bow and stern. This done the rest of the planking was nailed on. First, every other plank was

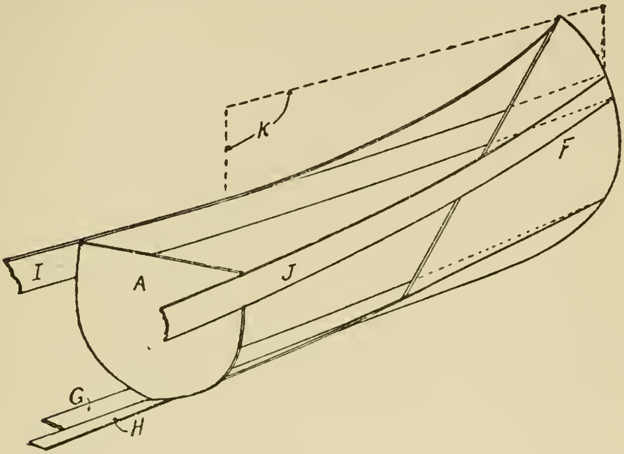

Fig. 251—Nailing on the first planks

nailed on and then we would place a board against the gap between two planks already nailed in place, and with a pencil trace on it the lines to which the board would have to be planed so as to fill the gap exactly.

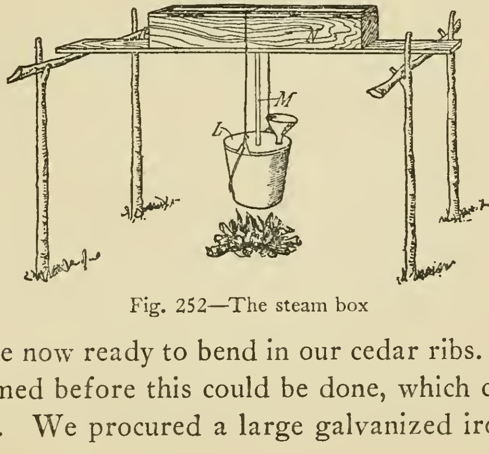

Fig. 252—The steam box

We were now ready to bend in our cedar ribs. They had to be steamed before this could be done, which called for a steam box. We procured a large galvanized iron pail and cut a wooden disk, *L*, just large enough to be jammed tightly in the mouth of the pail. From a plumber we got a piece of 1-inch iron pipe, *M*, threaded at each end. A hole was drilled in the wooden disk, a trifle smaller than the outside of the pipe, and then the pipe was screwed into the hole as far as it would go. We had no pipe wrench with which to turn the pipe, but instead we took a light rope, doubled it, and wrapped it around the pipe. Then a stick was put through the loop at the center of the rope and used as a lever to turn the pipe. (See Fig. 253.) In this way we got quite a powerful grip. At one side of the pipe another hole was drilled into the disk to admit a funnel through which we could fill the pail.

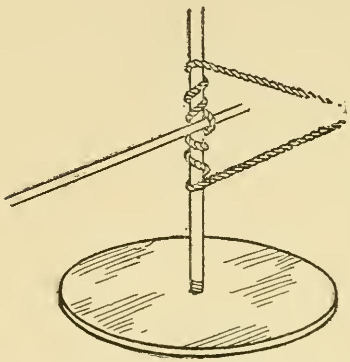

Fig. 253—In this way we got quite a powerful grip

The box *N* was made a foot square and 5 feet long. The bottom board of the box, however, was 8 feet long, so that it would span a good sized fire. The seams of the box were made as tight as possible to prevent unnecessary loss of steam. The lid at the top of the box was lined with strips of woolen cloth along the edges to make the joints steam tight when it was closed. The upper end of the gaspipe was screwed into a tight hole in the bottom of the steam box. In this case we used the disk on the pipe as a handwheel, which enabled us to screw the pipe home without our rope pipe wrench. With the steam box bottom side up we placed the pail over the disk and forced it on tightly, after which the pail was tied to the steam box so that its weight, particularly when filled with water, would not cause it to drop off the disk. This completed our steam box.

Bending the Ribs

A good fire was built on the ground and a couple of posts were placed at each side, while the steam box was supported on sticks laid across the upper ends of these posts with the pail hanging just over the fire. The water in the pail was soon brought to a boil and filled the box with steam. In the box we placed a dozen cedar ribs, each 4½ feet long. They were made of ¼ inch stuff, 2 inches wide at the center, but tapering toward the ends to a width of about 1 inch. We let them steam for an hour or more until they were quite pliable. Then we bent them into place in the canoe. Starting at each side of the center form the ribs were placed about 4 inches apart on centers; in other words, there was a gap of two inches between each pair of ribs. However, beyond the forms, *B* and *D,* the interval between ribs was gradually lengthened. Copper nails were used to fasten the ribs to the planks, and the points which stuck through the wood were bent over and clinched, while a heavy hammer was held against the nail heads. The ribs were nailed to the bottom planks first and then up each side to the gunwales. While these ribs were being nailed to the planking, another batch of ribs not quite so long was being softened in the steam box. At the ends of the canoe we had to cut the ribs in two and fasten them to the planking on opposite sides of the stem pieces. When all the ribs were in place they were sawed off level with the top planks.

Two small deck pieces, *O*, were fitted into the ends of the canoe and fastened by nailing to the planking. Then two thwarts, *P,* were cut out of a piece of ⅝ inch ash 2 inches wide. They were made just long enough to stretch across the canoe at a distance of 2½ feet each side of the center form. When these thwarts had been fastened in place we took out the temporary forms and fitted a thwart across the center of the canoe also. Then the ribs were bound together at the inside by means of a pair of gunwales, *R*, as shown clearly in Figs. 254 and 255. The thwarts were also nailed to the under side of these gunwales.

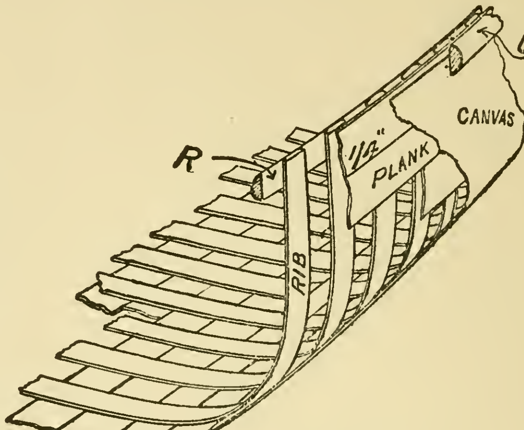

Fig. 254—Details of the construction

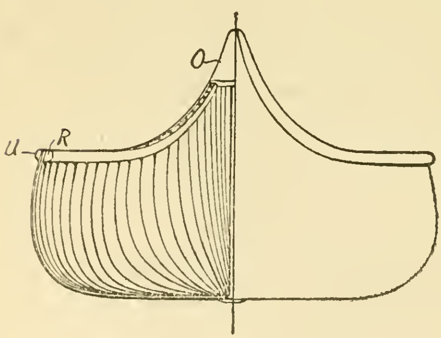

Fig. 255—End view showing left side in cross section

Two seats were fastened in the boat. They were made of wooden slats nailed to cleats and supported at the ends on a pair of wooden strips nailed to the ribs. The forward edge of the stern seat, *S*, which was 4 feet 10 inches from the center of the canoe, was placed just under the gunwales, while the forward seat, *T*, was placed 3 inches lower down. This seat was only 9 inches wide, while the stern seat was 10 inches wide. The shell of the boat was now complete, and we were ready to stretch on the canvas.

Stretching on the Canvas

We bought some No. 10 canvas duck, 30 inches wide. The canoe was turned bottom side up and the canvas, which was first thoroughly wetted, was fastened with copper tacks along the keel of the boat to within a short distance of the bow and stern, after which it was worked up over the curved shell of the canoe and tacked to the top plank. When it had been stretched and smoothly drawn over the entire shell, the surplus cloth was cut away. Then the cloth, while still wet, was treated with a couple of coats of white lead paint well rubbed into the seams. When this was thoroughly dry a coat of dark green enamel was applied. Then a thin strip of oak, ¼ inch thick, and tapering from

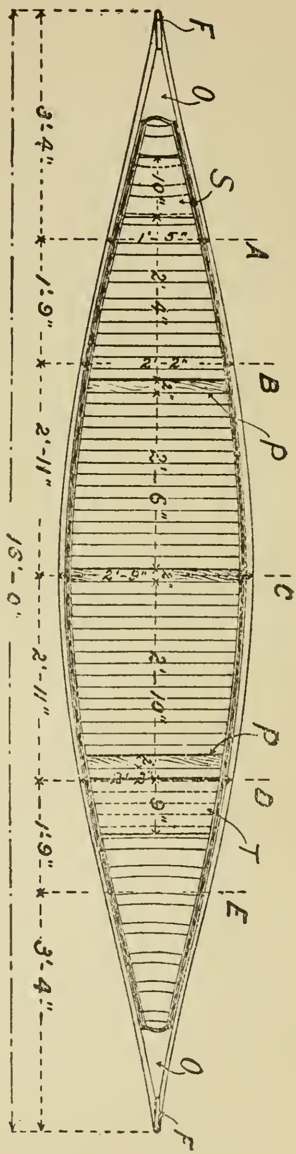

Fig. 256—Plan view of the completed canoe

1 inch in width at the center to ¼ at the ends, was nailed to the bottom of the boat and up the curved stems to form a keel for the canoe. Wear strips, *U*, were nailed in place over the upper edge of the canvas to make a neat finish. The woodwork was covered with two coats of spar varnish.

As we wished to use the canoe for current sailing, Roy

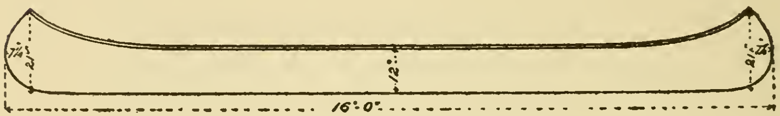

Fig. 257—Side view of the canoe

provided a "deep keel," which could be removed at a moment's notice. This was rigged up exactly like the keel of the "Lady Bug." With the "Iris," as we christened the canoe, we could do much better current sailing than with the "Lady Bug," but we did not have a chance to try the canoe before winter weather had set in.

CHAPTER XXIII.

THE BICYCLE SLED

SNOW came early that winter. There was lots of it, far more than we had had the previous year; and though we welcomed it for the sport it afforded, we dreaded it for another very good reason. The best coasting anywhere about was on Elmer's Hill, just beyond our lake, and, of course, that brought the Mulligans within the danger line of our house. They never bothered the neighborhood at night. "Doc" saw to it that the ghostly sounds and light appeared every now and then, to keep the popular superstition alive. But during the daytime, while we were in school, there was every chance that they could run over and loot the place. The only thing that saved us was the fact that Pat's father insisted on his going to public school. On that point he was so firm that Pat did not very often dare to "play hookey." Without Pat as a leader, we had little to fear from the rest of the gang.

The Waving Bush

Somehow or other, "Doc" always seemed to know when Pat was around; and on two occasions passed a note to such of us as were in the main schoolroom, bidding us to hurry out and defend our property. On each occasion we were just in time to drive away the gang. Whenever I asked him how he detected the presence of the Mulligans, he put on his mysterious air, and I could get nothing out of him. His desk in the schoolroom was next to the window, and I began to suspect that he had rigged up some sort of a mirror scheme for looking around the corner to the lake, though that seemed rather unlikely, because of the woods that intervened. The second time he called us out, I discovered a clue which solved the mystery. I was gazing out the window, when I saw the top of a bush just outside waving frantically back and forth, as if it were being blown by a heavy gale, but not a twig was stirring elsewhere. Just then "Doc" turned around, and noticed the waving bush. Reaching over to the window, he touched the glass with his finger, and the motion stopped. Then he asked to be excused from the room, and as was his wont, dropped a piece of paper on my desk and one on Bill's while on his way down the aisle. We took the hint and followed him, but before going out I crossed over to the window and saw Tommy Fithian running off toward the woods.

It is a wonder that the teacher in charge let all three of us out without suspecting a conspiracy, but he was rather "easy," anyway. Only part of Pat Mulligan's gang was around on this occasion, the rest being presumably at school, and we succeeded in keeping them off until others of the Scarabs could come along and assist us. I said nothing about the waving bush for the time being, and "Doc" continued to enjoy the admiration of the rest because of his seemingly magic powers. These were only minor engagements preliminary to a real fight, which is worthy of a place among the Seven Decisive Battles of History, but we will come to that presently.

The Bicycle Sled

The most important work we did during the coasting season was to rig up what we called a bicycle sled. It was merely a bicycle mounted on runners, so that it could coast down hill as easily as a sled, and then could be pedaled up to the top again. At first we tried barrel staves for the runners, but they were not quite the right shape, so out of a thin board we cut two pieces about 3½ feet long. One piece, *A* (Fig. 258), was 6 inches wide, while the other was but 4. Both of these runners were softened in the steam box, and then bent up at the forward end. A slot, *B*, was cut through the board, *A*, so that the rear wheel of the bicycle could project through it. The tire of the rear wheel was removed, and on the wheel rim we fastened a light rope threaded through a series of wooden cleats, *C*. The cleats were cut from a pole just large enough to fit the hollow of the groove. Fig. 259

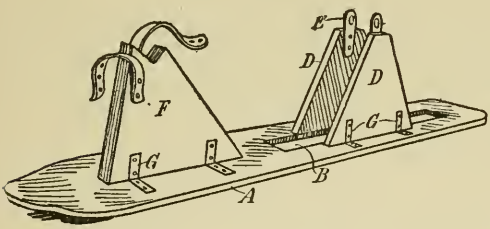

Fig. 258—The rear runner

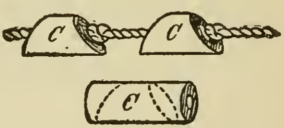

Fig. 259—Cleats for the rear wheel

shows by dotted lines how a pole section was cut to form a cleat. A knot was tied at each side of each cleat, so as to hold it in place on the rope. The rope belt was placed around the wheel and tied as tightly as possible, and to prevent it from creeping along the wheel rim it was strapped at intervals to the bicycle spokes. The rear runner supported the bicycle wheel at such a height that the cleats would dig into the snow and push the machine along. A bracket, *D*, was fastened at each side of the slot, *B*, and the rear axle of the wheel was secured in a pair of iron plates, *E*, fastened to the brackets. Directly in front of the rear wheel another bracket, *F*, was mounted on the runner between the pedals and the bicycle frame, which was made fast to it by means of a strap. The brackets, *D* and *F*, were braced with iron angle pieces, *G*. The rear runners supported the wheels when traveling over soft roads, but on ice they were lifted

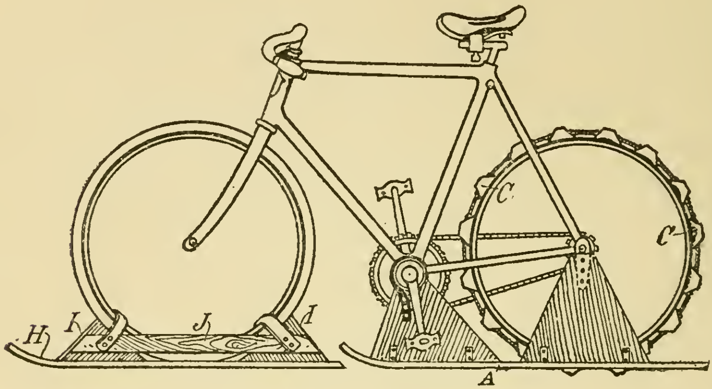

Fig. 260—The bicycle sled

clear, and all the weight came on the cleated wheel. Nailed to the front runner, *H*, were two wedges, *I*, to which a pair of strips, *J*, were nailed. The front wheel was fitted between these strips and fastened with skate straps, as shown in Fig. 260.

Wanted: A Brake

"Doc" was the father of this bicycle sled idea, and he was the first one to pedal it up Elmer's Hill for a coast to the bottom. He got a good flying start, and went down at a terrific pace. At the bottom of the hill the road curved quite sharply around Fithian's Woods. As he came to the turn, "Doc" leaned toward the inside of the curve, to keep from being slung off, but the broad runners did not respond as readily as a round bicycle tire, and the last we saw of him he was reeling on the outer edge of the runner, making a much wider sweep than the road would allow in his effort to keep from upsetting.

"He never made it!" cried Bill excitedly, as he ran full tilt down the hill. We all raced after him. When we reached the bottom, we found "Doc" at the side of the road, sitting in the snow, somewhat dazed, and with a rapidly swelling bruise over his left eye.

"Are you hurt?" we cried. "Where is the machine?"

"The Mulligans!" he gasped.

We caught a fleeting glimpse of Pat on the bicycle sled, pedaling for all he was worth around the next bend, while behind him streamed his gang. Bill led the chase after them, while I stopped to take care of "Doc."

"Why, what happened?" I asked as I helped him to his feet.

"I'm not dead sure," he answered, still very much dazed. "Couldn't seem to make the 'bike' take the curve. Got most of the way around, when it shot off into these bushes. Can't say what hit me, but the first thing I knew the Mulligans were right there, and they swiped the machine and ran off."

"I guess Pat hit you. He must have been laying for you all the time. They'd have stolen the sled just the same, whether you fell off or not. Don't believe they can catch them now; they had too big a start, and Pat was pedaling like 'Sam Hill.' How do you feel now, old man? Let's see what they're doing? Don't take it so much to heart. It was a good-for-nothing old wheel, anyhow."

"It isn't the wheel I mind," said "Doc," running after me. "It's the humiliation of having Pat Mulligan do me."

"Well, cheer up. You've got the best of him every time so far. It happens to be his inning now, but I'll bet you can more than clean up the score next time."

Half way downtown we came upon the Scarabs. They had had a short skirmish with the Mulligans, but in the meantime Pat had gotten clean away, and they had no idea where to look for him.

"Guess your wheel's gone for good," said Bill.

"But you're not going to give it up like that, are you?" asked "Doc."

"Well, it seems to me," answered Bill, "that the Great Arch Priest and Astrologer of the Sacred Scarabeus hardly needs any assistance from mortal man. I thought he was going to laugh his enemies to scorn. It is time he called forth the powers of darkness to confound 'the people of Mulliganus.' "

To this taunting "Doc" made no reply, but merely gritted his teeth.

The next morning, much to everyone's surprise, "Doc" had the bicycle sled in his possession. When he was questioned about it, he replied that as long as his fellow Scarabeans hadn't helped him, he had been obliged to fall back on magic. This magic business was certainly getting tiresome, and I determined to show "Doc" that at least one of the Scarabs was onto his game. That very afternoon, on my way back from one of the recitation rooms, I slipped outdoors and hurried around to the bush, which I shook violently. Presently, I saw a finger pressed against the window glass. It wasn't long before "Doc" came tearing around the corner.

"So this is the magic you've been playing," I said.

"For Heaven's sake, Jim, don't give me away," pleaded "Doc," as he saw Bill emerging from the lobby. "I'll tell you all about it, but don't let on to Bill."

I didn't have time to make any promises.

"False alarm, Bill," I cried.

"Hello! you here, Jim?"

"Yes," I said; "been out here all the time. There are no Mulligans about, so we'd better get back again right away."

"Queer," said Bill. "What's the matter with our Arch Priest these days? The Sacred Scarabeus must be playing tricks on him."

At the very first opportunity I made "Doc" tell me all about his dealings with Tommy Fithian; how he had paid him small sums to guard the lake house during school hours and keep a watchful eye on the Mulligan gang; how Tommy had seen Pat hide the bicycle sled in an old shed, and at risk of being seized as a thief had crept to the shed late that evening and had retaken the bicycle.

After school, when we were all gathered about our little wood stove in the lake house, someone asked "Doc" again about the magic return of his wheel.

"It doesn't matter how I got it back," said "Doc." "But I tell you this much—the Mulligans are having things too much their own way. I have saved this place twice this year by giving the alarm just in the nick of time. But I can't do everything myself. It's time the rest of you did something. As long as we sit around here on the defensive the Mulligans will keep on coming here, and sooner or later they'll catch us off our guard and break up our house again. What we ought to do is to march down into their own territory, and spoil their coasting hill and give them a licking on their own home grounds. Then, maybe, they'll respect us, and think twice before attacking us."

"I don't know but you're right," said Bill. "Only it would take more than seven of us to do it. The whole East Side would be up against us. We might get the rest of the school to help us, though."

"That's the scheme!" said Roy. "We'll organize a raid. We can get half the day scholars anyway, and ten or eleven of the boarders."

Then we all fell to and discussed the details of the attack. The fight was planned for the following Saturday. About ten of the older boarders were approached, and they were glad to give us their services. Of the day scholars, we got only about sixteen who were willing to help us out. "Doc" agreed to do the scouting, which would enable us to locate the enemy, so that we could swoop down on them to the best advantage.

A Raid on the Mulligans

Saturday morning was bitterly cold. I awoke to hear the wagon wheels creaking and whining in protest as they were dragged over the brittle snow. It must have been down to zero, which is pretty chilly for South Jersey.

"Most too cold to make snowballs," I said to Bill.

"If you think this is going to be merely a snowball fight," he answered, "you have another guess coming. The Mulligans aren't the kind to stand off and shy a chunk of snow at you once in a while. They're scrappers, they are. I tell you we are in for the fight of our lives, and the colder it is the better we can fight."

Shortly after breakfast we started off for the East Side, not in a body, but singly and in pairs. We did not want Professor James to know anything about it, because we were not sure that he would approve of our undertaking. Some of us had permission to go to town and others stole off on the sly.

Bill and I met "Doc" down at the Post Office, and he told us that Pat Mulligan and his gang were coasting on Riley's

Hill. The hill was a short one that ran from High Street to Baker Street, where a glass factory stood directly in the way; but there was a narrow alley alongside the factory, known as Biddle's Lane, and if a fellow could get a good start down Riley's Hill he could make an S-turn across Baker Street and shoot through this alley into Elmer Place. It was the skill of making this S-turn that proved the attraction at Riley's Hill, and it was our object to spoil the fun by dumping a can of ashes at the head of the alley. I was to station my forces at the other end of the alley and seize every coaster that came through, and Bill with his detachment was to raid the top of the hill, and while we kept the coasters busy "Doc" and Roy were to haul the ash can to the spot on a sled and strew the ashes over the snow.

"Doc" remained at the Post Office for a while to direct the boys to the rendezvous near Riley's Hill. When all had gathered, we divided our forces, and while my detachment went to Elmer Place, Bill headed for High Street. Aside from trapping the boys coasting down through the alley, we had to catch those who were taking their sleds back around the other side of the factory, before they could give the alarm to the rest. It meant quick work, but we were equal to the occasion. With a sudden swoop we succeeded in taking three or four prisoners before they were aware that anyone was around. Not a Mulligan was among them, and it was an easy matter to make them keep quiet while we laid in wait for the rest. The first fellow to come through the alley was Pat himself, and right behind him came Larry, the next biggest fellow of the gang. We yanked them off their sleds as they were speeding by us, and then came a battle royal. Despite the suddenness of the attack, Pat and Larry put up a game fight, and before we could get them under control two more Mulligans shot through the alley and joined in. Other coasters arrived, and in a moment we had our hands full.

Why didn't "Doc" hurry up with the ash can? When would Bill come to our assistance? The noise of the battle brought other East Siders to the scene and soon we were so outnumbered that we had to beat an inglorious retreat. Bill's detachment in the meantime was having but little better success at the top of the hill, and was soon forced to flee. As luck would have it the two retreating armies met and joined forces several blocks away. We had not realized how serious a matter it would be to invade the East Side. Boys seemed to spring up from every alley and lane. We were far outnumbered and completely surrounded. A policeman —there were only two or three on the day force—came strutting around the corner. A brick knocked off his helmet and another whizzed by his nose. He turned precipitately and fled. We were in a perfect rain of bricks, stones, and chunks of ice. Bruised and battered, we tried to force our way back. Suddenly, there was a lull in the fight. "Jumbo" had been knocked down by a stone that cut an ugly gash in his scalp, and he lay as if dead. Just at that moment Pat Mulligan's father appeared on the scene, grabbed his son by the collar, and marched him off home. We made good use of this opportunity to escape. "Jumbo" was lifted on "Doc's" sled and we made off.

Licked

We had been licked. There was little doubt of that, but Roy and "Doc" had performed their mission. For the first time in history the East Side had been invaded by a hostile army. For the first time in their lives the Mulligans had

had their property destroyed by an enemy. That much we had accomplished, but was it worth all the bruises and wounds we had received? "Jumbo" was soon revived, but his wounds were not the only bad ones. Not one of us but had a swollen lip or smashed nose or a blackened eye as a souvenir of the battle. Worst of all we could not conceal our bruises from Professor James. What would he say, especially to those who had sneaked off? We were not long in doubt. He had us all up at his office at once, where we were rigidly cross-examined. Bill explained the whole situation, and took the blame on himself for getting the other boys out to help the Scarabs. He pointed out how persistently the Mulligans had annoyed us, and how we had decided to settle them once and for all by a fight such as they would never forget.

"No doubt your provocation was great," said Professor James, "but I do not think you made a wise move, judging by the look of your faces. However, be that as it may, what I particularly criticise is the fact that you sneaked off to the fight. I told you before what I think of a sneak. There is nothing I detest so much. Nothing the world detests so much."

Then he gave us a lecture on sneaking and on our betrayal of the pledge to keep him informed of the club's plans. He spoke very quietly and calmly, without the slightest show of anger, but in dead earnest, until we felt like the meanest of boys that ever dwelt on earth. He punished us, too, by keeping us in during the recess hour for a week, and we were glad he did it, because we felt guilty.

As for the Mulligans, so far from settling them once and for all, we had forced them, by spoiling their coasting, to come more frequently to our coasting hill. They bothered us all the time. "Doc" gave up trying to protect the lake house. The teacher in charge of the main schoolroom during the last hour of the afternoon session was beginning to grow suspicious and would not let him go when Tommy waved the danger signal. We caught the Mulligans once in the act of smashing our house and drove them off before they did much damage. Things came to such a pass that we had to dismantle the house and abandon it during the rest of the winter. The Mulligans respected us for the fight we had given them in their own territory, but they were now more persistent than ever in their attacks on us. The secret of the matter was that they thoroughly enjoyed a fight, and instead of punishing them we had furnished them a treat.

CHAPTER XXIV.

MAGIC

THE year before we had spent practically the entire winter sitting around our wood stove, and planning great things for the spring. But the springtime was all too short for our purposes, and was so taken up with building that we had no time to play. This year we decided to take Time by the forelock, and do our work during the winter months, and then when the warm weather arrived and spring fever took possession of us, we could enjoy the fruit of our winter's labor. Unfortunately, we began the winter with an empty treasury. Our canoe was all finished, except for paint and varnish, and we had not enough money to buy that. With the approach of winter the revenue from our canal lock had entirely ceased, and the materials for the canoe soon ate up all we had saved. Roy suggested calling on Professor James for help. He had promised to do "considerably more than his share" when he joined the club, but so far we hadn't let him pay any more than the regular yearly dues which were levied on the rest of the club members.

"I don't fancy that scheme," said Bill. "We ought to find some way of earning the money."

"How about a show?" I suggested. " 'Doc' could demonstrate his powers as Arch Priest and Astrologer of the Sacred Scarabeus, and 'Sneezer' could work the piano, while 'Jig' gave us a whistling performance, and 'Jumbo' might do the clog dance."

"Jig" was really a musical freak. He could get music out of anything. He had a wonderful collection of queer musical instruments. He could play a tune by hitting a pencil against his teeth. He knew several ways of making music by blowing into his clasped hands, and half a dozen methods of whistling through his fingers. Then he had a peculiar way of whistling with his throat, producing a rich flute tone. When it came to trilling and fancy whistling, he could beat any professional I had ever heard. But the stunt *par excellence* was the duet that he rendered all by himself. He would whistle a tune, and at the same time hum the alto or base. With "Sneezer" to accompany him on the piano, "Jig" alone could furnish a very good evening's entertainment. But then with "Doc's" sleight-of-hand and magic to vary the programme, and "Jumbo's" clog dance, which was really a whole show in itself, I felt sure that the audience would get at least ten cents' worth of amusement, and may be they would be willing to pay fifteen.

The Egyptian Entertainment

The rest of the club was enthusiastic. We would make this an Egyptian entertainment, and rig ourselves up in Egyptian style. Professor James gave us permission to use the schoolroom. One of the schoolboys had a small printing press, and with this we printed about two hundred admission tickets. "Jig" made up half a dozen large posters, adorned with the Scarabeus and various Egyptian emblems done in vivid colors. The posters read as follows:

MAGIC *MYSTERY*

A Marvelous Exhibition of Black Art
by the Great Amenophis,
Arch Priest of the Sacred Scarabeus.
An Elephantastic Dance.

Oriental Music, Most Entrancing,
by Pharaoh's Court Musician.
At the Academy, Friday Evening, December Thirteenth.
Admission—Ten Cents.

The posters were tacked up in the Post Office and the Town Library and on several billboards. We got a number of the day scholars to make a house-to-house canvas of the town and sell the tickets for us on the promise of getting one free for every ten sold. Several kindly-disposed friends of the Academy bought a dollar's worth of tickets at a time, and gave them to their friends. Old Farmer Fithian bought twenty tickets. The rest were soon sold, and we had to print more to supply the demand.

Stage Settings

When the night of our entertainment came around, we had an audience of nearly three hundred persons. We were all rigged up in clothes of gorgeous color, made largely of colored paper and white muslin dyed with colored inks. Pharaoh sat on an elaborate throne, made out of an ordinary chair painted with gilt and vivid red and blue paint. In his hand was a scepter. Overhead we fastened a huge fan in the form of a Scarabeus, which was swung slowly back and forth by Tommy Fithian, whom we had pressed into service. His face was blackened to represent an Ethiopian slave. An imitation palm tree was set at each side of the throne. They were made by cutting leaves out of green paper, and fastening them to a stump with strips of brown paper. The stumps were set in large flower pots. At Pharaoh's right stood James Amenhotep, the Grand Vizier, and at his left Amenophis, the Chief Priest and Astrologer, robed in a flowing black gown with a magician's cap on his head. The other four Scarabs sat cross-legged on the floor at the foot of the throne. It was my duty as Grand Vizier to introduce Pharaoh and the Order of the Sacred Scarabeus. Then as Pharaoh pointed with his scepter to "Jig," or "Doc," or "Jumbo," I would announce to the audience what form of entertainment his August Majesty had demanded.

The Arch Priest of the Sacred Scarabeus

It would be hard to say which performer was most appreciated. "Jumbo" certainly brought down the house, and almost literally at that, with his Cyclopean antics, while "Jig" gave us a really first-class musical performance. But "Doc," with his mysterious tricks, probably excited the most admiration. When I had introduced him, taking pains to proclaim his full title as impressively as possible, he came forward and explained that he was but human, and could no more perform a miracle than anyone else in the audience, unless empowered by the Sacred Scarabeus, whose servant he was. He would invoke the aid of the Sacred Scarabeus, and beseech it to come down and rest over his heart, that the audience might see for themselves the author of the wonderful mysteries. With that he raised his right arm, gazed toward the ceiling, and uttered some gibberish.

Advent of the Sacred Scarabeus

Suddenly, without any apparent move on his part, a large Scarabeus in dazzling blue, green, and gilt colors appeared, no one knew whence, right over his heart. The effect was magic, as was indicated by the storm of applause.

The trick is really an old one, but it was new to us. I made "Doc" explain it to me the next day—that and all the other tricks as well. The Scarabeus had been made up for him by "Jig." It was fastened by a black silk thread, which passed through a hole in his robe and was attached to one end of a rubber band. The rubber band passed around his body, and was secured to his vest at the back. Before coming on the stage he had tucked the Scarabeus under his arm, and the silk thread which connected it to the rubber band was invisible against his black gown. When he wished the Scarabeus to appear, he separated his arm slightly, from his body, releasing the device and letting the rubber band pull it up to the hole in his gown, where it remained during the rest of the performance.

A Message from the Scarabeus

"Doc" bowed his thanks to the audience, and then told them that he was sure the Scarabeus had a message for them. He took two slates and held them up before the spectators, to show that there was no writing on the front or back of either slate. To remove all grounds for suspicion, "Doc" handed down one of the slates, and it was passed around the audience. One man, however, was not satisfied, and asked to see the other. Without a moment's hesitation "Doc" handed him what we all thought was the other slate, but he owned up to me the next day that he had really handed back the one that had already been examined, while the other never left the platform. After the audience had satisfied itself that there was no writing on either slate, the two were put face to face with a small piece of slate pencil between them, and then they were fastened together with a rubber band. "Doc" explained that the Sacred Scarabeus would place its invisible hand between the plates, seize the pencil, and write out the message. He held the two slates in his right hand at arm's length, and almost immediately a faint scratching noise was heard, like that made by a slate pencil when writing. When the writing had ceased he separated the slates, and handed one of them around for inspection. On it was written, "Welcome, My Friends."

Fig. 261—The message on the slate

From my position behind the scenes I could see that "Doc" was making the scratching noise on the back of the slate with the nail of his little finger. He had done the writing before the performance began, and concealed it by laying over it a piece of thin black cardboard of the exact size of the slate. When showing the slates to the spectators, he was careful to keep the cardboard cover in place with his thumb. He held the

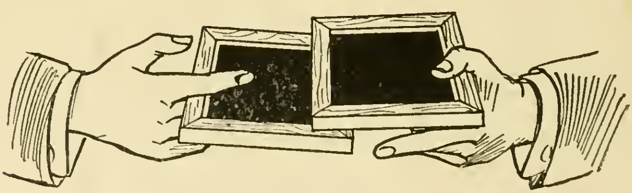

Fig. 262—Making the apparent transfer

slate in his left hand, and when the other slate was being handed to him after being examined, he took it in his right hand. When making the apparent transfer of the slate from his left hand to the right he slipped the two together, one on top of the other, and then he drew out with his right hand the same slate as he had held in this hand before and gave it to the audience for inspection, while the slate with the writing was still held safely in his left hand. After scratching the slate, to make believe that the writing was being done inside, "Doc" had taken off the rubber band and laid the slates on the table with the one on which the message was written on top, so that when he lifted this off, the cardboard cover would be left behind on the other slate. Fortunately, no one asked to see the other slate, but had any one done so, "Doc" would probably have juggled the cover off without being discovered.

Magic Flowers

"Doc" then explained that in Egypt, the home of the Scarabeus, the land is very dry except along the River Nile. There is no water, no rain, nothing but sand; but that the Sacred Scarabeus loved flowers, and on his trips over the desert wastes he would plant magic seeds, and the flowers would spring up and bloom instantly from the dryest sand and the barest rock. It was "Doc's" good fortune to have some of these seeds in his possession, and he would now demonstrate their magic properties. He produced from his vest pocket a little tin box, in which there was an odd assortment of seeds. Selecting one of the seeds, he put it in a small round cardboard box and passed the box around among the spectators to show them that there was nothing in it but the seed. When the box was returned to him he said that he would have to conceal the box for a second, because the flower would not sprout when exposed to the vulgar gaze. Picking up a paper tube that was lying on the table, he placed it over the box. Instantly he withdrew it and showed us a small plant in full bloom growing out of the box.

Of course, the flower was in the paper tube all the time, glued to a false box. Figs. 263 and 264 show the arrangement. Box *A* is the one that was passed around among the

Fig. 263—The flower was in the tube glued to a false box

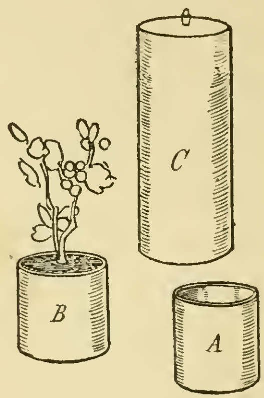

Fig. 264—The boxes of the magic flower trick

spectators and box *B* the false one to which the flowers were glued. When "Doc" first lifted the tube from the table he pinched the sides at the bottom to keep box *B* from falling out. After he had placed the tube over box *A* he raised the tube by the top and left the box *B* covering box *A*.

The Bouquet in the Goblet

The trick was too well known. "The flowers were in the tube all the time," said some one in the audience.

At this "Doc" appeared to grow very angry. "You have chosen to doubt the magic of these seeds," he cried. "You shall be convinced beyond the shadow of a doubt. Here is a goblet. The seeds shall be planted in this transparent vessel, in which nothing is concealed. To shield the flowers from your gaze while they are bursting into bloom I will cover them with the stovepipe hat of our illustrious trustee, Doctor Dubois, if he will be so kind as to pass it up to me."

Doctor Dubois obligingly handed up the hat.

"You will agree with me that there is nothing in it," said "Doc," turning the hat over and shaking it out. "Now, we will convince that doubting Thomas."

He placed the hat over the glass and then lifted it off. Much to every one's surprise no flowers appeared. "Doc" looked puzzled and scratched his head.

Fig. 265—A bouquet of hothouse flowers

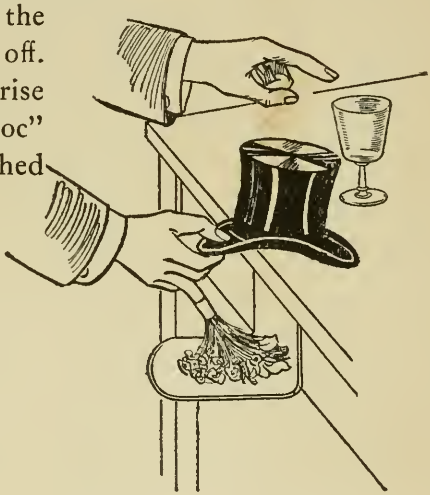

Fig. 266—Lifting the bouquet into the hat

"You forgot to sow the seeds," said some one.

"That's so," said "Doc," and selecting half a dozen this time he put them in the glass and covered it once more with the hat. When the hat was removed there was a beautiful bouquet of hothouse flowers in the glass. In triumph "Doc" handed it down to the astonished spectators for investigation.

The secret of the trick was this. "Doc" had purposely neglected to put the seeds in the glass the first time, so that in the surprise following the apparent failure of the trick he could slip the bouquet into the hat without being observed. The bouquet was wrapped with a piece of paper, forming a tube in which he could stick his finger. A tin shelf was attached to the table, as shown in Fig. 266, and on this the bouquet was supported, with the stem end sticking up. It was a simple matter to hold the hat at the edge of the table and sticking his little finger into the paper tube to lift up the flowers into the hat without arousing the slightest suspicion.

Eggs in the Magic Handkerchief

"The Sacred Scarabeus," continued "Doc," "always takes good care of his priests. When they start on a journey across the desert they take no food with them, for the Scarabeus furnishes the food that is most suited to their needs. All the priest has to do is to take his magic silk handkerchief like this," taking out a handkerchief from his pocket and spreading it before the spectators, "crumple it like this, and behold the food." Out of the crumpled cloth he drew an egg. This he dropped into the hat, while Doctor Dubois fidgeted apprehensively. Then stretching out the handkerchief again, "Doc" crumpled it a second time and drew forth a second

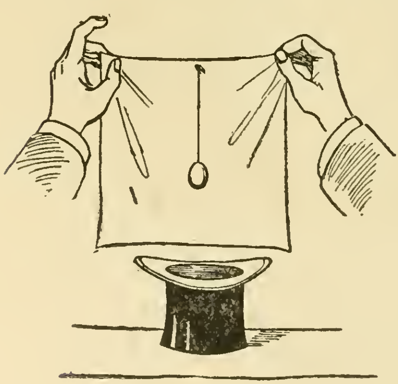

Fig. 267—An empty shell suspended by a fine thread

egg. The same performance was repeated a dozen times, until it seemed that the hat must be full of eggs. But "Doc" turned it upside down, and it was empty.

"There is one thing the Scarabeus insists on," he explained, "unless the eggs are eaten at once they vanish into thin air, nor will he let us have more than one egg at a time. When I produced the second egg, the first one vanished. There was never more than one egg at a time in the hat. Now, the last one also has vanished."

Fig. 268—Yard after yard of paper

We behind the scenes could see how the trick was done. The egg, which was an empty shell, was suspended by a fine thread from one edge of the handkerchief.

The Padded Hat

Before returning the hat to Doctor Dubois, "Doc" played one more trick with it. "Much as I hate to betray a man's secrets, the situation that confronts me is so serious, that I am in duty bound to make it public." "Doc" hesitated a moment, as if he hated to tell on the doctor; then he burst out: "This hat was never meant for Doctor Dubois's head. How he came in possession of it is a matter for you to decide. The hat is certainly too large for him, or he would not have padded the sweatband with paper. So saying, "Doc" drew out a narrow strip of paper, amid roars of laughter. He drew and drew and kept on drawing yard after yard of paper ribbon until the platform was covered with it. In the excitement following the disappearance of the eggs he had slipped a roll of ticker tape into the hat in exactly the same way as he had the flowers, by sticking his middle finger into the hole in the center of the roll.

Changing Ink to Water

After "Jumbo's" clog dance, "Doc" stepped forward with a goblet full of ink. To prove that the black fluid was really ink, he thrust a visiting card into it and showed that it was discolored. He also dipped out a spoonful, poured it into a saucer and passed it around for examination. Then he borrowed a plain gold ring from some one in the house, and as if by accident let it slip out of his fingers into the goblet.

"Doc" apologized profusely for his clumsiness. "Now," he said, "I will have to get that ring out somehow, but I am not going to soil my fingers. I'll use the magic silk handkerchief." He placed the handkerchief over the glass, and when he lifted it up, lo and behold! the ink had turned to water, and there were goldfish swimming around in it! He reached down and picked out the ring from the bottom of the glass and handed it back to the owner.

The secret of the performance was this: The tumbler contained no ink at all. The ink effect was produced by a strip of black rubber cloth that lined the inner surface of the glass. A fine thread attached to the cloth hung over the edge of the glass and a cork was fastened to the thread so that "Doc" could readily find it when he wished to. The card had already been blackened on one side, so that all he had to do was to show first the clean side and then, after dipping it in the goblet, turn it around and show the other side. In the bowl of the spoon he had put a little powdered aniline black. By breathing on the spoon he had moistened it, and the moisture made the powder stick fast. When he

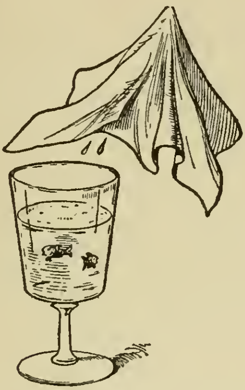

Fig. 269—The ink had turned to water

Fig. 270—A thread attached to the cloth

dipped out the water the powder was dissolved at once, making a black ink. When he covered the goblet "Doc" seized the cork and removed the rubber cloth in the folds of the handkerchief.

The Magic Solvent

"Doc" now took another tumbler and filled it with water. From his pocket he took a small vial, which he said contained a powerful solvent known only to the ancient Egyptian priesthood. One drop of this magic fluid diluted in a gobletful of water would be powerful enough to dissolve a silver dollar instantly. After carefully putting a drop of the stuff into the water he asked if some one in the house was willing to sacrifice a dollar in this way. No silver dollars were to be had and so he fished one out of his vest pocket, passed it around to prove that it was genuine, and had it marked for identification. Then he called for a delegate in the house to come up on the platform and see that he did no trickery. "Doc" had a round glass disk just the size of a silver dollar. He had found a pocket mirror of the required dimensions and had removed the silvering from the back by first softening it in alcohol and then scraping it off. This glass he held in the palm of his hand when he took the dollar between thumb and finger. The goblet he handed to the man who had come up to inspect the performance. Then "Doc," with the dollar still between thumb and finger, placed a handkerchief over his hand and asked the delegate to take the coin in the folds of the handkerchief, as shown in Fig. 271, and drop the dollar into the goblet containing the water. He did so, and plainly heard it drop into the glass. But when he whipped away the cloth there was nothing in the goblet. Not satisfied, he poured out the water, but there was not the slightest trace of the coin in it.

Fig. 271—Taking the coin in the folds of the handkerchief

"Doc" had substituted the glass disk for the coin, and it was the glass that was dropped into the goblet. The bottom of the goblet was flat and so nearly the size of the disk that there was no evidence of the piece of glass in the water. When the water was poured out the glass stuck fast and remained undiscovered. Then "Doc" said he would get the dollar back by filtering the liquid through the magic handkerchief. He placed the handkerchief over the goblet again and poured the water back, filtering it through the cloth. From the folds of the handkerchief he then drew the original dollar, which was handed around for identification.

Making Money

"We have been entertaining you here this evening," said "Doc," "so that we can raise money enough to carry on the work of our society, but really, you know, we don't have to get our money in that way. The Arch Priest and Astrologer

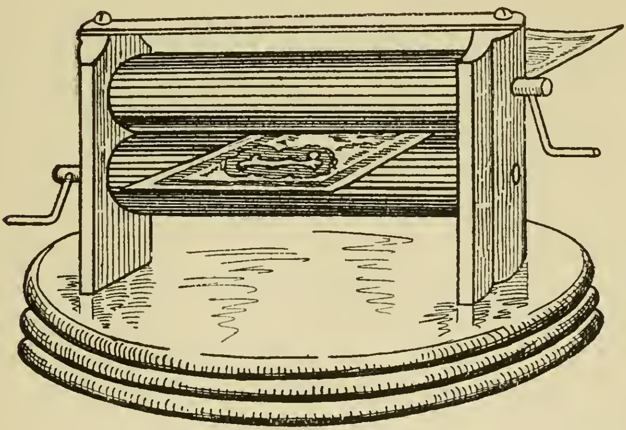

Fig. 272—An affair that looked like a small clothes wringer

of the Sacred Scarabeus has a magic device with which he can turn out dollar bills as fast as he can turn a crank. However, knowing that it is against the law of these United States to manufacture money, he has refrained from using the little machine. But if any one in the audience so desires, a demonstration of the machine will now be made." He showed them an affair that looked like a small clothes wringer. Taking a piece of white paper he slipped it between the roller and turned the crank. A dollar bill emerged from the other side. The performance was repeated until he had half a dozen crisp bills scattered around the table. He let a delegation of the spectators come up and examine them. They were genuine enough.

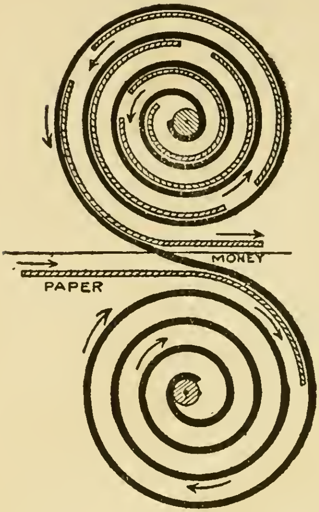

Fig. 273—A strip of paper coiled about the rolls

Around the two rollers of the machine was a strip of paper coiled, as shown in Fig. 273. The bills were coiled around one of the rollers between the folds of the paper, and when the crank was turned they were ground out while the blank strips were wound up on the other roll. After the bills had been examined, "Doc" said that he did not care to lay himself open to charges of counterfeiting, so he would put the bills through the machine backwards and take off the printing on them. Turning the other crank of the device he wound in the bills and ground out the blank strips.

The Disappearance of Tommy

For the final act of the entertainment, "Doc" said he would give the spectators a demonstration of the wonderful power that had been granted him by the Sacred Scarabeus. A large wooden box was dragged to the front of the platform, lifted up, and turned over so that the audience could see that it was sound. Tommy Fithian was called forth and placed in it. The box was closed and locked. Then "Doc" turned it over on its side so that he could get at the buckles of a large leather strap that apparently passed around the box. Then standing up he raised his hand on high and uttered some gibberish. When the box was opened it was found to be empty. "Doc" called "Jig" and Roy to help him lift the box up on end so that there would not be the slightest doubt of the disappearance of Tommy. As they moved forward, one on each side of "Doc," I saw Tommy sneak out the back of "Doc's" gown and hide behind one of the imitation palm trees.

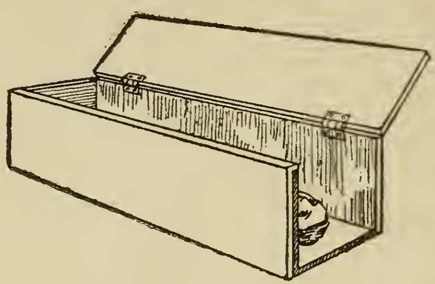

Fig. 274—The box had a double bottom

The box in which Tommy had been hidden had a double bottom arranged in the form of an L, as shown in Fig. 274. This was hinged in place by means of a couple of stout nails at each end of the box, which entered the bottom at the corner of the L. When the box was turned over on its side, the bottom on which Tommy lay remained stationary, and the side of the L formed the bottom of the box, while the rest of the box was swung over him. (See Fig. 275.) This let Tommy out of the box, and when "Doc" put his

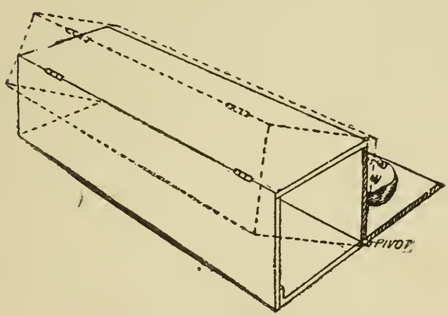

Fig. 275—This let Tommy out

knee on the chest to strap it Tommy crawled under his gown. When the box was turned face upward again the parts resumed their original positions, the bottom being held by a spring catch that Tommy had held open when he was inside.

Tommy's Return

While the audience was wondering what had become of Tommy, "Doc" spoke up and told them that the slave was too valuable a servant of Pharaoh's to be lost in such a manner. He would call him back. Pointing to a distant corner of the room he spoke some mystic words, and then, with a sudden sweep of his arm, pointed toward Pharaoh's throne, and there was the grinning Tommy pumping away at the fan.

To say that our entertainment was a success would be putting it very mildly. Professor James congratulated us heartily, as did Doctor Dubois, and several others. A number of the spectators urged us to repeat the performance, as they had friends who must see it. We did the entertainment before an even larger audience two weeks later, which helped out our treasury considerably.

CHAPTER XXV.

THE SAIL BOAT

OUR best work for that winter was the construction of a sailboat. Not a rowboat with a patch of canvas stuck up in front, but a genuine round-bottom sailboat with deck and cockpit. It was not a large affair, not much larger than our "Lady Bug." It was hard for all of us to crowd into it at the same time, but that difficulty was easily remedied by dividing the club into two divisions, with Roy captain of the first division, and myself captain of the other. My division would have the boat for a week, and then we would turn it over to Roy and his crew for the following week.

Forms and Side Planks

Of course, Roy designed the boat. He was in charge of everything nautical. It was to be 14½ feet long, with a beam of nearly 5 feet. We started by cutting out two side planks out of ⅞-inch boards. To allow for the swell of the boat, they were made 14 feet 9 inches long. One edge was

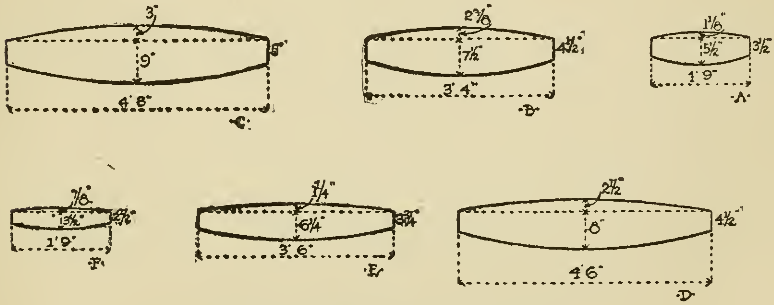

Fig. 277—The five forms and transom

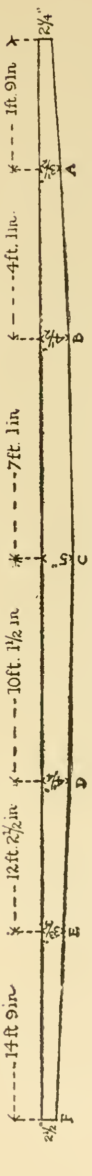

Fig. 276—One of the side planks

left straight, but the other was cut on a curve, as shown in Fig. 276. Then five temporary forms, *A—E,* and a transom, *F,* were cut to the dimensions given in Fig. 277. We

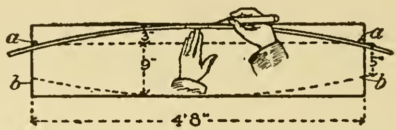

Fig. 278—A line was drawn along the lath

used a lath as a flexible ruler when laying out the curved sides of the forms. Take the center form, *C,* for example. This required a board 12 inches wide and 4 feet 8 inches long. The upper curve had a crown or swell

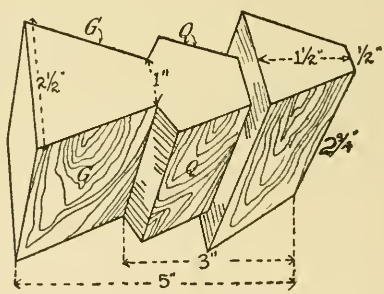

Fig. 279—The oak stem

of 3 inches. We measured in 3 inches from the edge of the board at each end and drove two nails, *a.* Then the lath was placed back of the nails and bent outward at the center to the edge of the board, while a pencil line was drawn along it. Two more nails, *b*, were now driven 5 inches back of the nails, *a*, and the lath was bent in the opposite direction to give us the lower curve of the board. In this way all the forms and the transom were laid out. And then we sawed out a stem from an oak block to the form indicated in Fig. 279. The two side planks were now nailed to the steps, *G*, of the stem, and then sprung around the forms and nailed to the transom. The forms were spaced at 2, 4, 7, 10, and 12 feet from the bow, but because of the swell of the boat they came at the points marked *A, B, C*, etc. The side planks, after they were nailed to the molds, were chamfered, as indicated at *H* in Figs. 281 and 282, so as to make a good joint with the bottom and deck planking. A keel plank 6 inches wide and ⅝ inch thick was then fastened to the stem and sprung around the forms to the transom, where it was nailed fast. A temporary strip, *I*, was then sprung over the top of the forms.

Cutting Out the Ribs

The next job was to cut out the ribs. These were spaced a foot apart, and we had to have twelve altogether. In order to get the proper curve for the ribs we had to place a board across the boat, holding it up against the lower

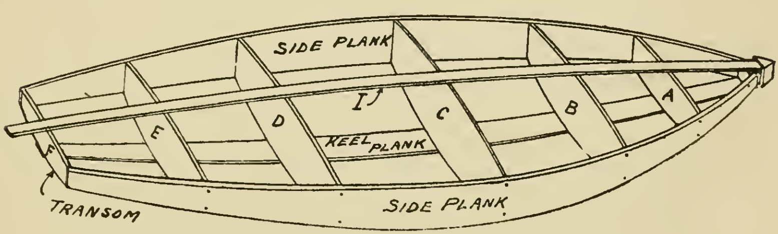

Fig. 280—Binding the planks around the forms

edge of the side planks, and measure down to the keel board. In the same way we obtained the curves for the deck beams by measuring up to the strip, *I*, from a board resting across the side planks.

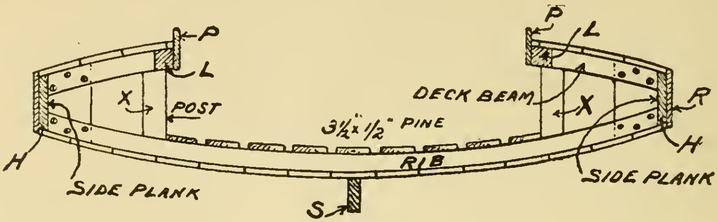

Fig. 281—Cross section of the boat

Our cockpit was to be 5½ feet from the bow and 6 feet long, so that there were only 6 deck beams that would run all the way across the boat. At one foot from the transom we put in a solid board or bulkhead, *K*. The ribs were now

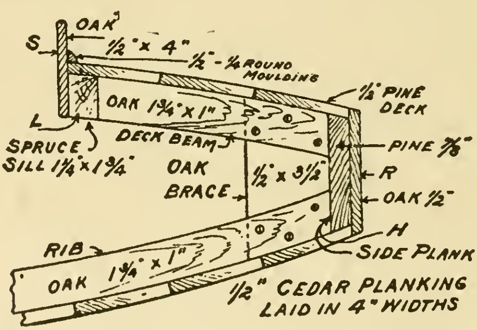

Fig. 282—Each deck beam was connected to the rib below

nailed in place and then the boat was turned upside down and the deck beams fastened in place. Each deck beam was connected to the rib below it with a brace. (See Fig. 282.) Two sills or stringers, *L*, of 1 x 1½-inch spruce were now screwed in place each side of the cockpit. They were given the proper curve by springing them around a temporary form at the center. The curve at the forward end of the cockpit was continued by means of a pair of brackets, *M*. The short deck beams at each side of the

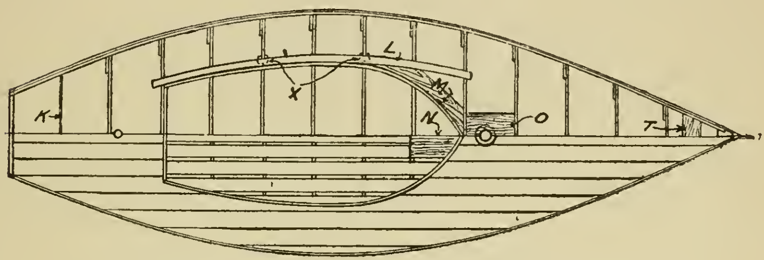

Fig. 283—Plan view showing only half of the deck planks in place

cockpit were now fitted between the side planks and the sills, and connected to the ribs by means of braces. The temporary forms were now removed and two posts, *X*, were placed under each sill, as shown in Figs. 281 and 283.

Our mast step, *N*, was a piece of oak, 2 inches thick and

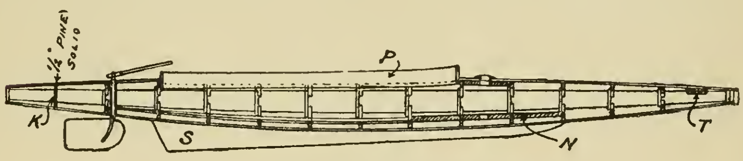

Fig. 284—Longitudinal section of the boat

3 feet long. It was jogged ½ inch, to fit over each of the four ribs that it spanned. (See Fig. 284.) A slot was cut in this step for the foot of the mast. Just above the mast step a deck brace, *O* (Fig. 283), was placed between the deck beams with a mast hole in it 3 inches in diameter. The way we cut the mast hole was to drill a ring of ½-inch holes,

and cut out the wood between them with a chisel. In order to be sure to get the hole in the brace and the slot in the proper alignment, the hole in the brace, *O*, was cut first, and after the mast was slipped through this hole and adjusted to a vertical position, the place for the slot was marked with a pencil and then cut.

Planking the Frame

The frame of the boat was now done, and we were ready to nail on the planking. We used ½-inch pine boards 4 inches wide for the deck, while for the bottom cedar boards of the same dimensions were used. The boards were nailed securely to the ribs and deck beams, and also to the side

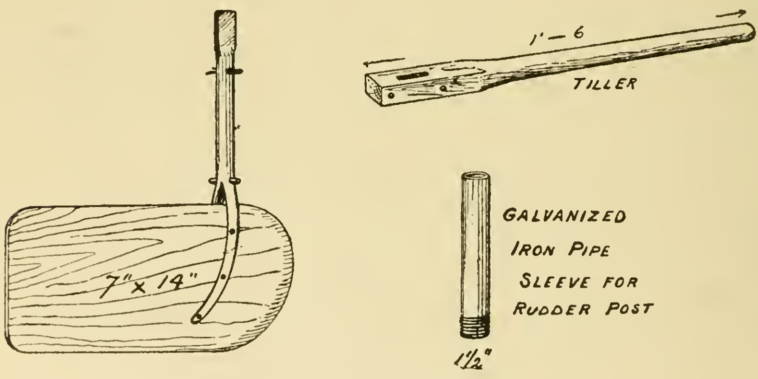

Fig. 285—The rudder details

planks and the sills at each side of the cockpit. Then the planking was sawed off neatly along the cockpit and the side planks. The cockpit was now finished off with a coaming, *P* (Fig. 281), consisting of two ½-inch boards 4 inches wide, which were sprung into place. The edge of the deck and bottom planking was covered by a couple of ½-inch boards, *R*, which were nailed over the side planks and then planed down to a level with the deck and bottom. These boards were seated in the steps, *Q*, of the stem head. Then a flooring of 1-inch pine 3 inches wide was nailed to the ribs. The boat was now turned bottom upward, and a keel, *S*, cut out of a 1-inch board to fit the bottom was nailed to it.

Our rudder was made of a ¾-inch yellow pine board, cut to the dimensions shown in Fig. 285. We got cut two pieces of iron pipe, one of which fitted within the other with plenty of play. The larger piece was threaded at one end, and screwed into a tight hole through the bottom of the boat. The pipe was just long enough to reach through a hole in the deck closely to the coaming. The second pipe, which was about 1-inch pipe size, was split with a hack saw to a length of about 7 inches, and then a blacksmith bent the split ends for us, as shown in the illustration. The rudder blade was forced between the two arms of the pipe and was fastened in place by means of bolts. It was quite a revelation to me that iron could be drilled with an ordinary twist drill. But though it was slow work, and took lots of oil to keep the tool from heating too much, the holes were bored through. The opposite end of the pipe was flattened in a large vise to fit a slot in the tiller. The tiller was cut to the form shown in Fig. 285. A bolt was passed through it at each side of the slot to prevent it from splitting. To hold the rudder post in place, two holes were drilled in it, one just above and the other just below the ends of the larger pipe, or rudder sleeve, and pins were driven through. The tiller was not fastened to the rudder post, but could be slipped off whenever we desired. It was our custom when leaving the boat to remove the tiller, in order to prevent thieves from making away with the sailboat.

The Spars

Next we turned our attention to the spars. The bowsprit was made, as shown in Fig. 286. It was fastened in place by means of two lag screws and a ring bolt which passed through a cross-piece, *T*. The mast was made out of the gaff of a larger boat that we picked up at the wharves. It was 14 feet long and 3 inches in diameter at the base, taper-

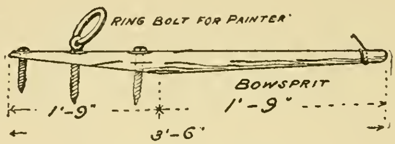

Fig. 286—The bowsprit

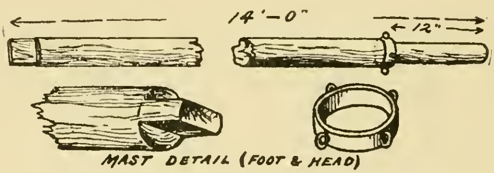

Fig. 287—Details of the mast head and foot

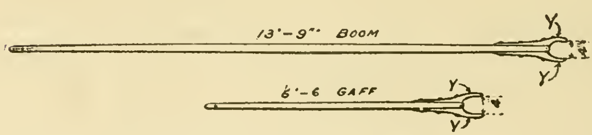

Fig. 288—The boom and gaff

ing to about 1¾ inches at the top. The foot of the mast was cut as shown to fit the slot in the mast step. We bought a mast ring, *U*, and fitted it to the upper end of the mast; the shroud, *V*, and forestay, *W*, were fastened to the ring. The boom was 13 feet 9 inches long and 2 inches in diameter at the center and the gaff 6 feet 6 inches long and 1¾ inches in diameter at the center. Oak pieces (*Y*, Fig. 288) were fastened to the boom and gaff to form the jaw and throat which fitted around the mast.

The Sails

The sails were made of No. 4 yacht duck, cut to the dimensions given in Figs. 289 and 290. They were reinforced at the corners, as shown. The dotted lines indicate where the reef points were placed. (Reef points are short pieces of

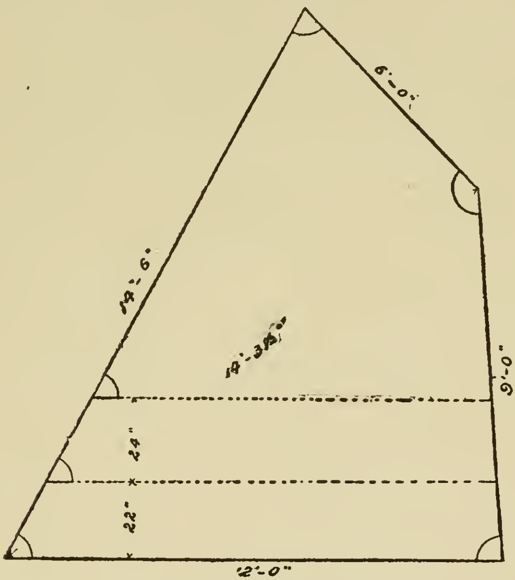

Fig. 289—The mainsail

rope fastened to the sail at each side, which are tied around the boom when taking a reef.) The 12-foot side or "foot" of the mainsail was lashed to the boom, and the 6-foot side or "head" to the gaff. The 9-foot side or luff was fastened to hoops on the mast. The sail was raised by a "throat halyard," which ran from a block at the masthead under a pulley block at the throat of the gaff, back over the pulley at the masthead, and then down to a cleat on the deck near the foot of the mast. The "peak" was raised by a "peak halyard" attached to the outer end of the gaff (Fig. 291), which ran to a block at the masthead, thence over a block secured to the center of the gaff, back to the masthead, and down to a cleat on the deck. The "sheet" ran

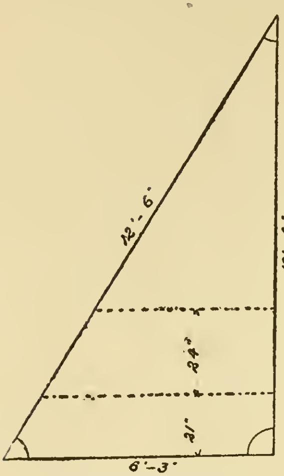

Fig. 290—The jibsail

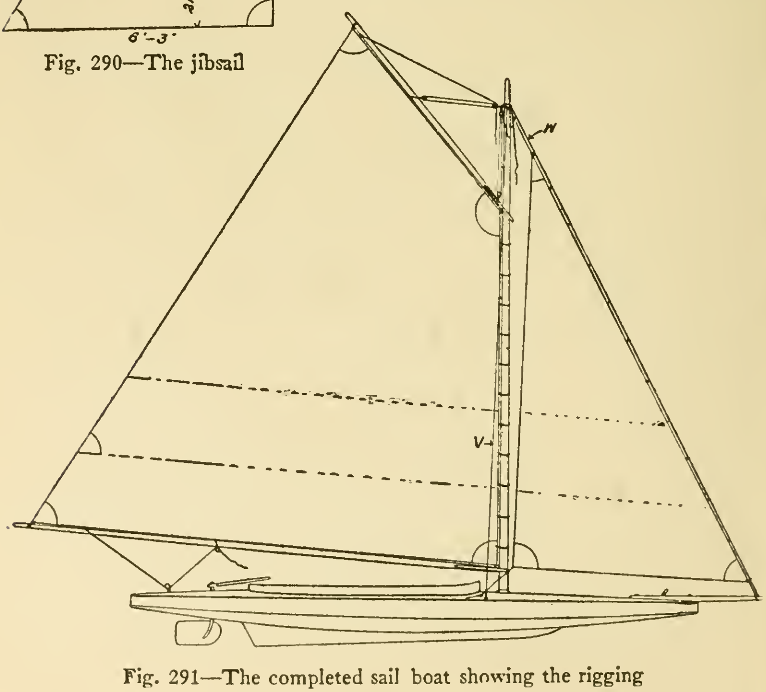

Fig. 291—The completed sail boat showing the rigging

from a point near the after end of the boom to a block on the stern deck, thence over a second block on the boom, and to within convenient reach of the man at the tiller, where a cleat was provided.

To the 12½-foot side of the jib sail we sewed a set of small galvanized iron snap hooks, which were snapped over the forestay, *W*. The jib was raised by a halyard that passed over a block at the masthead. The jib "sheets" ran through pulley blocks on the deck, to a conveniently located cleat.

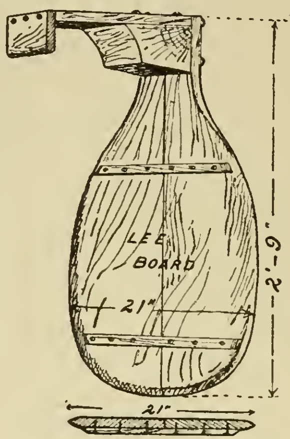

Fig. 292—Details of the leeboard

The Leeboard

The keel on our sailboat was

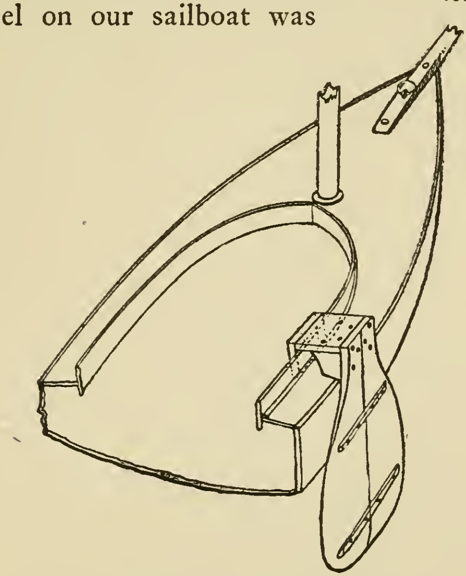
Fig. 293—The leeboard in use

hardly adequate, and yet, because of the shallow water of the creek, we hardly dared to make it any deeper. In order to avoid the nuisance of a leaky centerboard box, we used a leeboard instead of a centerboard. This was constructed as shown in Fig. 292. Fig. 293 shows how it was applied. A corner block on the board rested on the deck, while a hook at the end of the top piece was caught over the coaming around the cockpit. The board was always placed on the lee side of the boat (the lee side is the opposite of the windward side) and when tacking we had to shift it from one side to the other.

CHAPTER XXVI.

WATER SPORTS

We were all prepared for spring when it came, and a wonderful season it was. The weather was perfect. Our sailboat was carted down to the creek and launched about the middle of March. Doctor Dubois let us moor it at his dock, where it was comparatively safe from the Mulligans. With it we could sail down the creek and out into Delaware Bay. Our canoe, on the other hand, gave us the range of the ponds and lakes in the neighborhood. We paddled for a long distance up the stream that emptied into Silver Lake, carrying the canoe around the rapids and shallows and discovered two new ponds whose existence we had never suspected. The ponds were in the heart of the woods and apparently belonged to no one in particular, so a post was driven in the center of each and a sign was nailed to each post, reading, "Property of the Scarabeans by right of discovery."

The Diving Swing

A hot spell started in April and lasted so long that early in May the water of Lake Moeris were warm enough for swimming. A fine springboard was set up near the head of our lake, where the water was pretty deep. From the branches of a large tree that reached out over the water Bill rigged up a swing. Standing on the seatboard, we would swing up high in the air and then leap into the water. This had to be done carefully or we would strike flat on the water with a slap that would smart like fury. Roy became so expert that he would turn somersaults backward into the pond. The swing swept within about two feet of the water, so that we could just reach it to pull ourselves up.

Dredging a Swimming Hole

Encouraged by the success of the swing, Bill set up a pair of trapezes. They were swung from the overhanging branches of two large trees, one at each side of the mouth of the stream, that entered the northern corner of Lake Moeris. The mud bottom of the lake was dredged out to

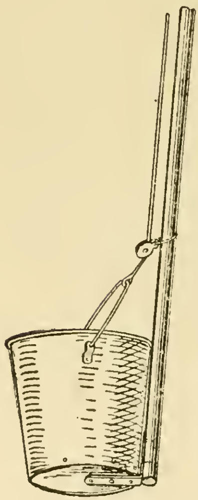

Fig. 294—The mud scoop

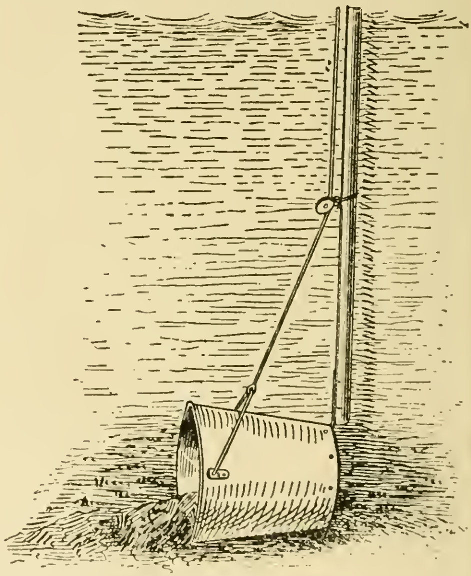

Fig. 295—Dragging the scoop along the bottom

a depth of over 5 feet by means of a scoop arranged as shown in Fig. 294. An old discarded pail was discovered in the ash heap. The bottom of a peach basket was nailed to the bottom of the pail. A stout stick about 7 or 8 feet long was hinged to this board with a piece of leather. A rope attached to the bail of the pail ran through a pulley to the handle of the stick. The pulley was a small one made of galvanized iron—the kind used for awnings and porch screens. When the scoop was lowered into the pond and was dragged along the bottom, the rope was slack, permitting the pail to swing away from the stick, as in Fig. 295, but when the scoop was raised the rope was pulled, bringing up the mouth of the pail so as not to spill the contents. The mud was dumped out of the scoop into a large packing box, the seams of which we had stuffed to make it water-tight. When the box was loaded with as much mud as it would carry it was towed to the opposite end of the lake and dumped on the marshy shore above of the dam.

The Outdoor Gymnasium

Over the spot we dredged the trapeze swings were hung

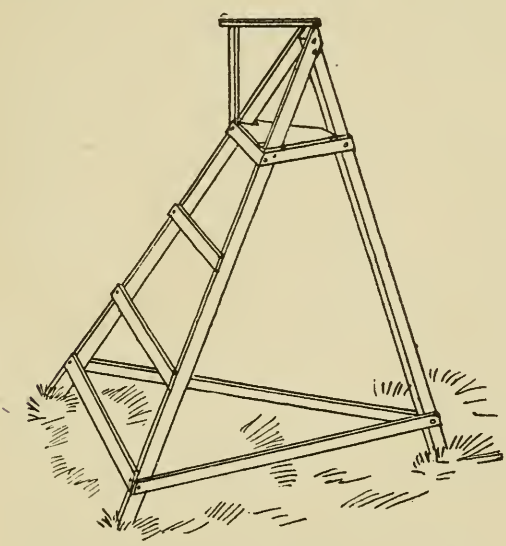

Fig. 296—A stand was rigged up on the bank

just far enough apart, so that we could swing from one to the other. Our gymnastic feats could be performed in per-

Fig. 297—Roy would swing out backwards and twist around

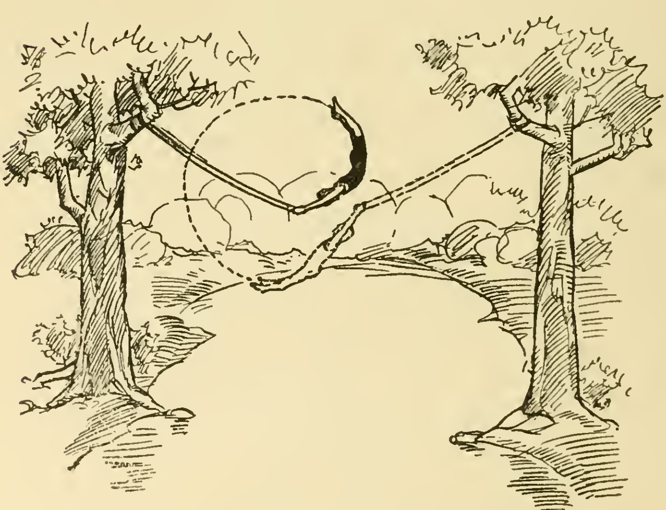

Fig. 298—He could turn a somersault while making the leap

fect safety, because a fall meant nothing more than a clumsy dive into the water. A stand was rigged up on the bank at each side of the stream, as shown in Fig. 296, and standing on the platform of this stand one boy would start the trapeze to swinging, empty; then another boy would swing out from the other stand and leap across to catch the empty trapeze.

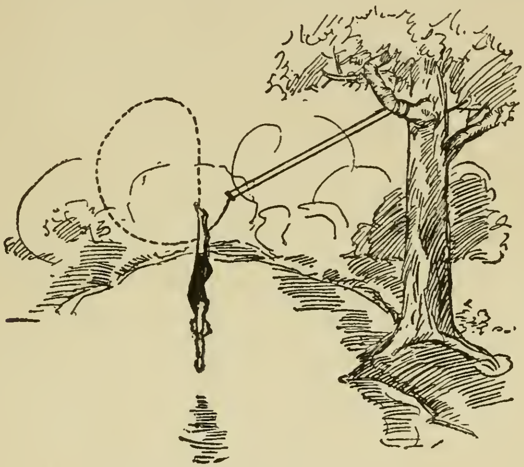

Fig. 299—Diving from the trapeze

Roy, who was quite a gymnast, would swing out backward and twist around so as to face in the opposite direction, while leaping across. He would also time his jump so that he could turn a somersault while making the leap. It was great fun diving from the trapeze in a variety of ways. In addition to the swing we rigged up parallel bars, rings, etc., until we had quite a gymnasium.

A Swimming Sail

"Jumbo" was about the only one who failed to take interest in this form of amusement. He preferred plain swimming and, more especially, floating on the water. We told him he was getting too lazy for any use and that he needed exercise to bring down his avoirdupois, but we could not get him to try the trapeze swings. While we were amusing ourselves in our outdoor gymnasium "Jumbo" was busy in his workshop. One day, much to our surprise, a small sail appeared on Lake Moeris heading toward our gymnasium. There was a stiff southwest breeze blowing, and the sail was making good headway toward us, but the odd thing about it was that there appeared to be no boat under the sail. As it came nearer we made out "Jumbo's" head behind the sail. We swam out to meet the queer craft.

"What have you got there?" we demanded in chorus.

"It's a swimming sail," said "Jumbo." "Fine, ain't it? Don't have to move a hand. I just let the wind pull me right along and steer it with my feet. See?" He made for shore and hauled the thing out on the bank to show it to us.

Construction of the Swimming Craft

The body of the boat was a deckboard, *A,* about 4 feet long and a foot wide at the forward end, tapering to 4 inches at the stern, with another board, *B,* fastened on edge to the center of it as a sort of fin or keel. The mast, *C,* was a pole about 6 feet long, nailed securely to the fin in front of the deckboard. Of course, when the boat was in the water, supporting "Jumbo's" weight, the body was not horizontal, and in order to have the mast vertical he fastened it not at right angles to the deck, but at a slight incline toward the bow, as indicated in Fig. 303. The mast was guyed to the ends of the crosspiece, *D,* which was nailed to the forward end of the deckboard. At each end of the crosspiece there was a float, *E*, consisting of a 4 inch square block of wood 18 inches long. (See Fig. 302.)

The sail was a square rig fastened to a screw hook at the top of the mast in such a way that it could be taken off at a moment's notice, whenever desired. The sheet ropes, which were attached to the ends of the lower yard arm and ran through small pulley blocks at the ends of the crossbar, *C*, coming together back of the mast where they were tied. "Jumbo" lay at full length on the deck, *A*, with his head at one side or the other of the mast, depending upon the direction in which he was tacking, and with the sheet in his hands he could control the sail.

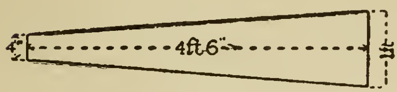

Fig. 300—The deckboard

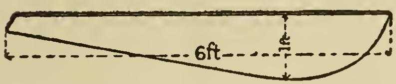

Fig. 301—The fin of the swimming craft

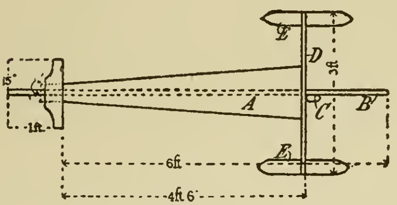

Fig. 302—Plan view of the swimming craft

Hinged to the end of the fin, *B*, was a rudder, as shown in Fig. 303. As he wished to have the rudder horizontal, "Jumbo" cut the end of the fin on a bevel and then hinged the rudder to it with a couple of staples and eyes. "Jumbo" operated the rudder with his feet, which rested on the yoke. He couldn't make much

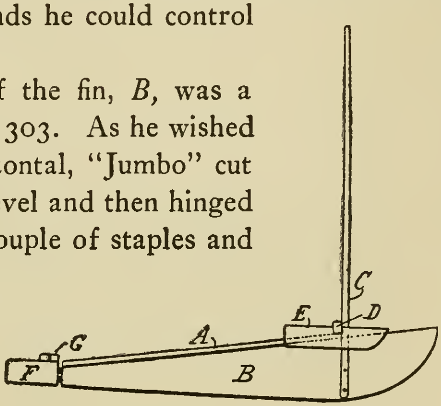

Fig. 303—Side view of the swimming craft

speed with a boat like that, but it was easier work than swimming when there was wind enough to fill the sail. Of course, the rest of us had to try the queer craft. It was rather tipsy, despite the floats, *E*, but that added to the fun. I liked the novelty of it, but as I was not exercising my arms and legs I found that the water was a little too cool for comfort. On a hot July day it might have been very enjoyable.

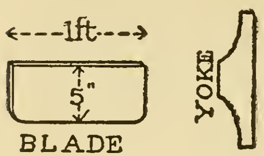

Fig. 304—The rudder blade and yoke

The Human Fish

Bill improved "Jumbo's" craft a hundred per cent. by removing the mast and sail and fitting it with a fish-tail propeller instead. He took the propeller he had used on the scow, sawed off the handle and fastened a cross piece

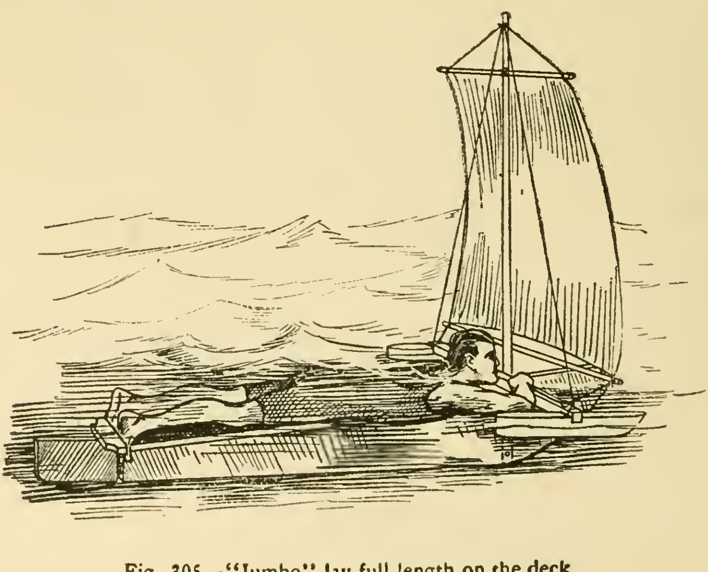

Fig. 305—"Jumbo" lay full length on the deck

to it. The fin, *B,* of "Jumbo's" craft was cut away to make room for a reinforcing block, *F,* nailed to the underside of the deck, *A.* The fish-tail was then hinged to the craft by means of a bolt which passed through the deck and the block, *F.* Lying at full length on the deck with his feet on the cross piece, as shown in Fig. 306, he could work the propeller and travel through the water at a surprisingly rapid pace.

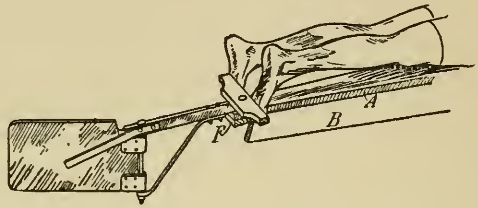

Fig. 306—Working the propeller with the feet

One Thing Lacking

"There is one thing lacking about our Egyptian lake," said "Doc," once when we were alone, "and that is the crocodiles. We ought to have a few of those reptiles to make it interesting around our water gymnasium. Now, couldn't we rig up some sort of a fake alligator on the quiet, and then spring a joke on the rest of the boys?"

"Doc" had taken me into his confidence ever since the waving bush episode. "Better ask 'Jumbo,' " I said, "he is our craftsman."

"No, he could not keep a secret. Suppose we made it so that a fellow could get inside of the head and tow the thing along. It would be pretty real, now, wouldn't it?"

"Yes, but the boys would be suspicious if you were not around. They know your tricks."

"You have forgotten Tommy," he said. "I can make him do anything for me. He can swim like an eel, too."

"Well, what are your plans? I will do what I can to help you."

Together we rigged up a sort of dragon or sea serpent. We made only the head, assuming that the rest of the body and tail would be under water anyway.

The Framework of the Monster

Fig. 307 shows how the framework of the head was constructed. The front float consisted of two boards, *A*, 4 feet long, fastened together with a pair of cleats, and cut to form the lower jaw of the dragon. Two similar boards, *B*, served as the rear float of the head. Two strips, *C*, of

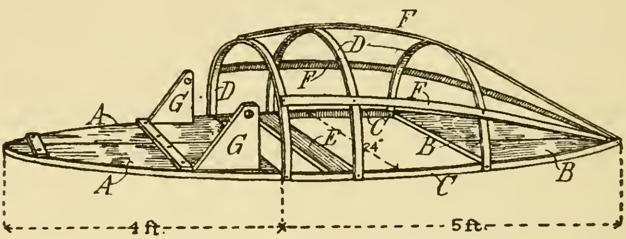

Fig. 307—Framework of the head

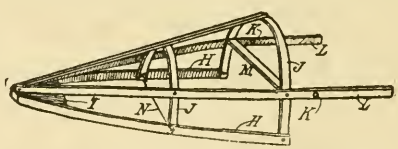

Fig. 308—Skeleton of the upper jaw

wood connected the floats, leaving a space of about three feet between them. Three arched ribs, *D*, connected the strips, *C*, which were braced by a crosspiece, *E*. On the ribs, *D*, we laid several longitudinal strips, *F*. On the front float, *A*, two brackets, *G*, were fastened on which the upper jaw was hinged.

The frame for the upper jaw is shown in Fig. 308. It consisted of two strips, *H*, fastened to the edges of a short block, *I*, and connected by arched ribs, *J*, to which longitudinal strips were secured. Two of these strips which projected beyond the rear rib were hinged at *K* to the brackets *G*, and extended into the head portion, forming handles, *L*, by which the jaw could be opened and shut. The rear rib of the jaw was braced with a cross strip, *M*, and a wire, *N*, was tied across the strips, *H*, where they were joined by the forward rib of the jaw.

Covering the Framework

Our framework completed, we covered it with burlap, stretching it tightly and tacking it in place. Heavy brown paper was pasted to the burlap with shellac, the shellac being thickly applied so as to water-proof the material. For the snout of the beast we used two small tin cans, painted red inside, which projected through the cloth and burlap. Two large green bottles served as the eyes. They were tied to the framework so that the bottoms projected slightly from the paper, and to make them more hideous large black and red rings were painted around them. Two large tusks whittled out of wood and painted white were fastened to the upper jaw, and a pair of horns protruded from the head just back of the eyes. The beast was provided with a bristling spine made of red cloth fastened to wooden spines that stuck out of the framework. After the paper had been painted dark green with large scales outlined on it, the whole material was coated with shellac so as to preserve it from the water. The jaws inside were painted red and were provided with teeth cut out of celluloid. Altogether the reptile presented quite a terrifying appearance. The thing floated on the water and Tommy, diving under the edge, could enter the head and resting his arms on the crosspiece, *E*,

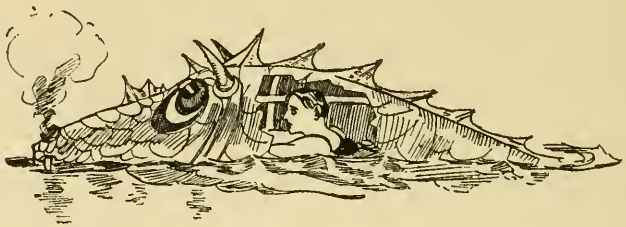

Fig. 309—The swimmer inside the head

could swim along and propel the head. Whenever he wished to he could make the jaws snap by operating the handles, *L*.

The Sea Serpent in Lake Moeris

When one afternoon a queer looking object came sailing down the stream, it made quite a commotion. No one noticed it until it was quite near us. Then, suddenly, "Sneezer" looked up and gave a yell.

"W-w-what is it?" cried "Jig."

"Snakes alive!" shouted Roy. "There is a sea serpent, Bill."

Bill looked around laughing, but the laugh froze on his face as the reptile was almost upon him. Bill suddenly had a very pressing engagement ashore.

Of course, the hoax was discovered at once, and "Doc" was mobbed and ducked on general principles. Nevertheless, the sea serpent was appreciated. Bill declared that it was too good a joke to be kept to ourselves and suggested that we take it down past Garrison's picnic grounds the next day, which was Decoration Day. Tommy agreed to do his part. We carted the thing down to the creek early the next morning and concealed it in a cove just below the picnic grounds. The tin cans in the snout were filled with red fire powder and a touch-hole was punched in each so that Tommy with a long piece of lighted punk could reach forward and set them off at the dramatic moment.

The Sea Serpent in the Creek

In the afternoon we all went down to Garrison's and joined the picnic crowd. There was a tremendous mob of people. The little merry-go-round, razzle-dazzle and the ridiculously short roller tobaggan were crowded to their utmost capacity. Others were enjoying their first swim of the season, while there was a large crowd on the long low pier, waiting for the return of the electric launch, which made

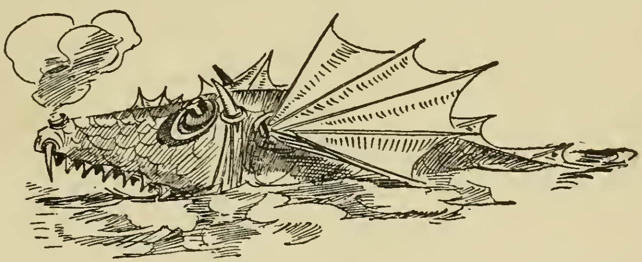

Fig. 310—Opened its jaws and snapped them together

hourly trips down the creek. Suddenly, some one pointed to a large floating object which was coming in with the tide. "It looks like a sea serpent, don't it?" said one person. "By jinks, it does," said another. A cry was raised, and every one flocked to the water's edge to see this strange thing. A boy shied a stone at it that struck very near. With that the floating object suddenly came to life. It opened its jaws and snapped them together, letting out volumes of red smoke from its nostrils, and then turned about and headed straight for the dock. Immediately there was a panic. The crowd stampeded. Women and children shrieked in terror, as they fought and struggled to get off the pier. In the excitement, one little girl was knocked overboard, but every one was bent on his own safety and paid no attention to her cry for help. Bill saw her, however, and leaped into the water, fully dressed as he was. Swimming to the spot he caught the girl by the hair and dragged her to the pier and up to safety. There was really nothing phenomenal about the rescue, but every one made a hero of Bill for daring to venture forth into the vicinity of the sea serpent.

Tommy's Peril

In the meantime some one ran to the shooting gallery for a rifle, and poured shot after shot into the sea serpent. It had stopped coming toward the pier and was drifting with the tide toward the opposite bank. We were thoroughly alarmed for the safety of Tommy, but were too frightened to stop the shooting. Just as the last shot was being fired, and I was running forward to stop the man, I caught sight of Tommy's head bobbing up from under the pier. It seems he had not been having all the fun either. When he opened the jaws a large quantity of red fire spilled out of the cans on to the lower jaw and blazed up fiercely. This fire let forth such a volume of smoke as to nearly stifle Tommy, and he was compelled to dive out from under the head and make for shore. Seeing the commotion at the pier, he had swam under water as far as he could until he reached the shelter of the pier and could mingle with the other swimmers unobserved. Some one went over in a boat to the point where the sea serpent was stranded and discovered the hoax. The crowd was divided between its anger at the practical joke that had been played, and its apprehension lest some one had been killed by the rifle shots. The creek was dredged and the coroner was notified, but no trace of a body could be found, no one was missed from the neighborhood, and the thing passed into legend as one of the mysteries of the locality.

As for Bill, he was quite a hero about town. A glowing account of the whole affair was published in the Philadelphia papers the next day.

"I felt like a fool," he told us, "to have them make such a fuss about it, when all along I knew it was a fake sea serpent that was chasing them; but, of course, I did not dare to let the secret out during the panic or they would have mobbed us sure. It was a pretty bad scare we gave them, now, wasn't it? It might have been serious, too. Lucky I happened to see the girl."

"Lucky in more ways than one," answered "Doc." "Do you know who the girl was? That was Mary Mulligan, Pat's youngest sister."

"Pat's sister?"

"Yep. He dotes on that little girl; thinks the world and all of her, and I guess you will find you are solid with him from now on. Wish this had happened last year, it would have saved us all the trouble we have had with his gang."

"Doc" was right. No Mulligan showed up in our vicinity again that summer, and when, one day after the sea serpent episode, Bill and I met Pat's gang on a deserted side street, instead of attacking us with a volley of stones, Pat sang out: "Howd'y, Bill," and let us by without the slightest molestation.

CHAPTER XXVII.

THE GEYSER FOUNTAIN

THE school term was fast drawing to a close, and it began to look as though it would mark the end of the Modern Order of Ancient Engineers. "Doc" and Bill were to graduate that year. Roy's father had to move out West with his family, and Roy could not come back for the following term. I received word from home to the effect that I would have to finish my course at the State Normal School, where my brothers expected to go, now that they had outgrown the little country school at home. There was not much left of the Modern Order of Ancient Engineers. "Sneezer," "Jumbo" and "Jig" said that they would organize the following year and continue the Society of the Scarabeus. "Sneezer" wrote me that they had initiated four new members into the club and were starting the year with some fine new ideas, about which he would tell me when they materialized. But whether they were never carried out, or whether "Sneezer" was too busy or lazy to write, I never received any further word from him.

A Token of Gratitude

Shortly before Commencement, when we began to realize that more than half the club would soon be lost, Bill called a meeting of the Scarabeans, the object of which was to determine upon some method of showing our gratitude to old Farmer Fithian for letting us build the lake on his property and cut down his trees for our dam, lake house and other engineering undertakings, and finally for his kindness in many little ways too numerous to be recounted. We talked it over for an hour without coming to any decision, and at last resolved to ask the old farmer himself whether there was not something we could make for him.

"Bless ye, boys," he said. "Ye can't do nothin' fur me. It's a pleasure to have had ye around, and I ain't seekin' no pay for lettin' ye play on that there swamp land."

"Oh, we couldn't begin to reward you," answered Bill, "but we'd like ever so much to make something for you that you'll remember us by."

"Much obleeged to ye, boys, but I guess I got everything I want."

"How about Aunt Mirandy? Isn't there anything she would like to have?"

The old man's eyes brightened. "Wal, now, maybe thar be. I ain't sayin' as how ye can do it, but Mirandy sets such a store by that there garden of hers. She's been a-wishin' she could have a fountain there with fish in it. But, shucks, you couldn't do that, could ye? Ye couldn't make a fountain for her."

Bill scratched his head. "That's a tough one," he said, "but we'll see what can be done."

Farmer Fithian's Spring

Right back of Farmer Fithian's house there was a hill, at the foot of which was a small spring. We all went over to see if the spring could be utilized for the purpose.

"I had thought of that," said Farmer Fithian. "There ain't enough water in it to make much of a fountain."

"I guess you're right," agreed Bill, "if you mean to have the thing running all the time. But how about a geyser fountain. Say it ran for a minute and then stopped for five. How would that do? We could have it spout up pretty high."

"Could ye, now?" said the farmer eagerly.

"No, I don't believe *we* could. It would take a plumber to lay the pipes from the spring, but I believe it could be done quite easily by using the siphon principle."

"I'll get the plumber," said Farmer Fithian, "if you'll tell him how to do it."

A Temporary Fountain

"I tell you what, we'll rig the thing up temporarily with garden hose and see how it works. Then if it's a success you can have the iron pipe laid and make a permanent thing of it. We'll have to scour the neighborhood for more garden hose, though, because it must be over 200 feet to the garden from here. The first thing we want is a big rain barrel and a couple of spades, and we'll start right to work at once." They were procured, and Bill set us to digging a hole just below the spring for the barrel. He himself jumped on his wheel and rode down to the hardware store for a short piece of 1-inch pipe which he had threaded at one end for about 2 inches. On his way back he stopped at the lake house for "Jumbo's" brace and a bit just a trifle smaller than the pipe. By the time he got back we had the hole dug and the barrel was set in place with its upper end a few inches below the level of the spring.

Bill bored a hole in the barrel, just below the upper edge, and then forced the pipe in it as far as it would go, threading it into the wood as we had done before with the pipe in the steam box. A V-trough, made of two boards nailed edge to edge, carried the water from the spring to the barrel. Clay was packed all round the mouth of the trough to prevent the water from escaping and the tiny stream that trickled from the other side of the spring was dammed up. A short piece of garden hose just long enough to reach to the bottom of the barrel was now forced on the inner end of the iron pipe. This done we went foraging for garden hose. Half a dozen lengths were procured, and these were coupled together with hose couplings, making a rubber tube long enough to reach to Aunt Mirandy's garden. The hose was

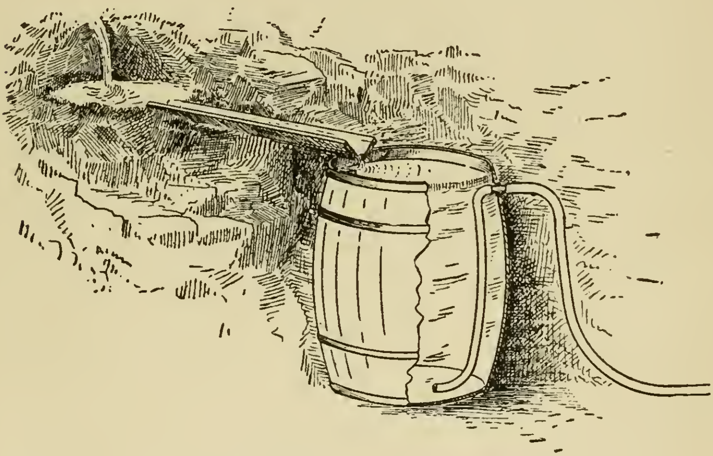

Fig. 311—A V-trough carried the water from the spring to the barrel

attached to the pipe sticking out of the barrel and wired fast, while the nozzle at the other end was propped upright in the garden. The water which had been pouring out of the pipe now flowed into the hose to the nozzle. There was quite a drop from the barrel to the nozzle which made the stream shoot up fully five feet in the air. It kept this up until the barrel was nearly empty, and air could enter the short piece of hose, then the fountain stopped flowing until the barrel was filled and covered the pipe again.

Aunt Mirandy was so delighted with the geyser fountain that we felt highly flattered.

"I tell you what we'll do," said Bill, "we'll make the fountain basin for you out of concrete after the plumber has laid a pipe from the water barrel, and another to drain the basin."

The Iron Pipe Line

Of course, the garden hose had to be returned at once. Farmer Fithian had the plumber at work within a couple of days. He replaced the hose in the barrel with an iron pipe connected by an elbow to the short piece we had inserted, and then ran a line of pipe down to the site of the fountain basin, burying it under the ground. A valve was placed in the pipe at the barrel so that the geyser fountain could be stopped whenever desired. A hose nozzle was fastened to the fountain end of the pipe. Near the nozzle he placed a discharge pipe. The upper end of this pipe was almost on a level with the surface of the ground. It dropped vertically for about two feet and then branched off to a drain nearby.

The Concrete Basin

After the plumber was through we started work on the basin. It was to be 6 feet in diameter inside. With a cord attached to the nozzle we laid out two circles, one for the outside and the other for the inside of the basin wall. Bill's idea was to dig a trench for the concrete wall and thus save making forms. For the sake of appearances the wall was to be 10 inches wide at the top, though it narrowed down considerably toward the bottom. The trench was dug to a depth of 2 feet, the sides being neatly and smoothly cut with a sharp spade, particularly the inner vertical side, which would show. When the trench had been dug we bought a barrel of cement. Farmer Fithian loaned us his horse and wagon, and we went off in search of three barrels of good

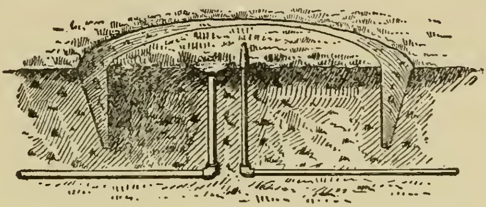

Fig. 312 – The trench was dug to a depth of two feet

sharp sand and five barrels of small stones for the concrete mixture. The proper material was found on the shore of Silver Lake.

The Concrete Mixture

The cement and sand were mixed in a large wooden box. With a barrel and a half of sand we mixed half a barrel of cement. The stuff was turned over and over with a spade until it was thoroughly mixed. Farmer Fithian loaned us a lime trough in which the concrete mixing was done. Two and a half barrels of stones were dumped in the lime trough, and then the stones were well wet down, after which the cement and sand mixture was shoveled in and turned over and over with a spade until each stone was crusted with cement. Enough water was added to make a thick pasty mass, which was then dropped into the trench and tamped down. We had to be careful not to put in too much water, or it would soak into the ground at each side and carry off much of the cement. However, enough was added so that it would show slightly as the material was being tamped down. The batch we made up was not quite enough to fill the trench, and we had to mix some more in the same proportions, viz.: one part cement, three parts sand, and five parts stone.

After several days, when we thought the concrete was sufficiently hardened, the earth was dug out inside the circular wall and smoothed off to make a level floor. A layer of

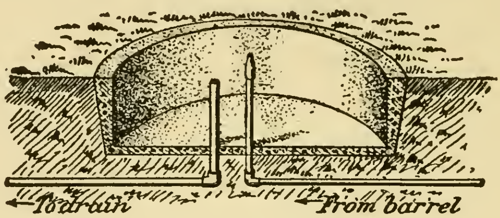

Fig. 313—A Sectional view of the basin

concrete about 2 inches deep was laid over the floor. Where the bottom touched the side walls they were swept clean and washed down with water, so that there would be a perfect union of the dry concrete with the fresh mixture.

The water was turned on in the geyser fountain on the day before Commencement. The concrete was not perfectly

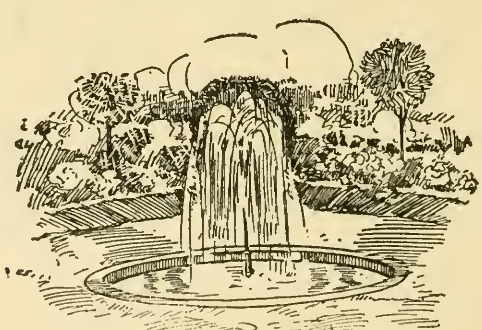

Fig. 314—The last act of the Scarabeans

hard, but that didn't matter so long as it had set, because concrete hardens readily under water. Aunt Mirandy was tickled to death with the fountain. She got her goldfish and fixed up the basin with rocks and moss so that it looked very pretty indeed. Of course, the edge of the concrete wall was not perfectly smooth, because it had been cast in the earth, but if anything this added to the rustic effect of the fountain. This was the last act of the Scarabeans of which I have any record and, of all our achievements, the one which gave the greatest satisfaction.

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