Experiment 13. Magic.

Place the pollywog in a bottle filled to overflowing with water, insert the solid rubber stopper, and press it down hard. Does the pollywog sink?

Now release the stopper quickly. Does the pollywog turn somersaults in a most magical manner (1, Fig. 26), and also rise?

Make one or two more pollywogs, place them all in the bottle together (2, Fig. 26), and entertain your friends with a pollywog circus.

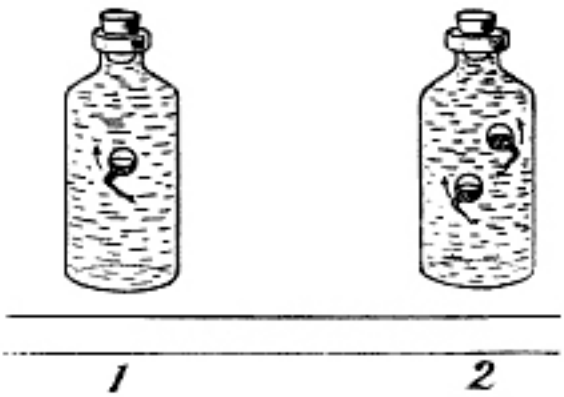

FIG. 26

ACROBATS

The pollywog sinks when you press down on the stopper because you compress the air in it and force water in until it weighs more than the water it displaces.

The pollywog rises when you release the stopper because the compressed air drives the water out until the pollywog weights less than the water it displaces.

The pollywog turns a somersault because the water rushes out sidewise in one direction and forces the nozzle in the other direction.

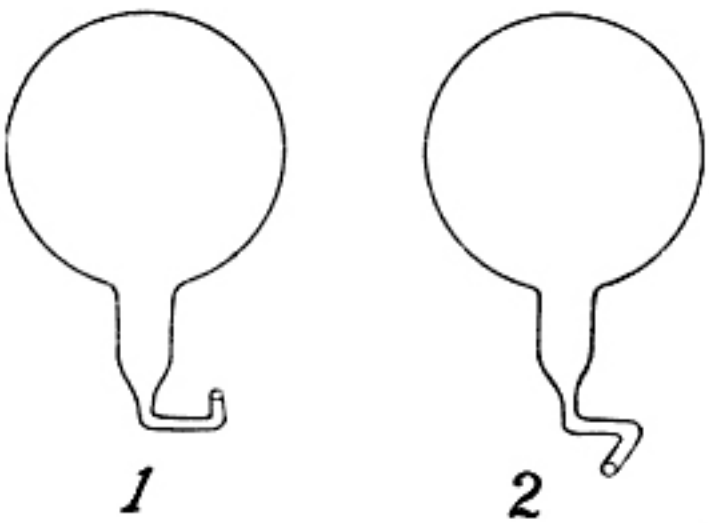

FIG. 27

DANCING POLLYWOGS

Air may escape from the pollywog when it is turning a somersault; if so, water will take its place, and may make the pollywog too heavy to float. You can restore its buoyancy by sucking out the water.

FIG. 28

DRAWING GLASS SPIDER-WEBS

Experiment 14. A dancing pollywog.

Make a pollywog as in Experiment 12, but bend its tail twice as shown in 1, Fig. 27; the nozzle is at one side and points sidewise.

Put it in the bottle full of water, then press down and release the stopper. Does it and rise, and does it also whirl around most beautifully as it rises?

Make another pollywog (2, Fig. 27), but bend its nozzle in the opposite direction. Does it whirl in a direction opposite to that of the first pollywog?

Put them in the bottle together and treat your friends to a pollywog dance.

FIG. 29

THE SPIDER TRICK

The pollywog whirls because the water rushes out of the nozzle in one direction and forces the nozzle in the opposite direction.

Experiment 15. To make a glass spider-web.

Heat the end of a piece of No. 2 tube in the blowpipe flame until it is melted and very hot. Now touch the end of another piece of glass to the melted glass, remove from the flame, and quickly pull the two pieces apart as far as you can (Fig. 28). Do you find that you have pulled part of the melted glass out into a very fine glass spider-web?

Repeat, but ask a friend to touch the second piece of glass to the first and run away as fast as he can.

Do you get a much finer spider-web?

Is the glass spider-web fairly strong and very flexible?

Experiment 16. The ancient spider trick.

Attach an imitation spider-- or the dead body of a real spider-- to the end of the glass spider-web and surprise your friends, as shown in Fig. 29. The glass spider-web is much less visible than a thread for this purpose.

Experiment 17. To make working handles.

You can save glass in many cases by attaching a short piece of glass to the piece you intend to work with, as follows: Heat an end of each piece in the lamp flame until red hot, press them together, remove from the flame, and hold until solid. The short piece then serves as a working handle (Fig. 30) for the large piece.

FIG. 30

ATTACHING A HANDLE

Experiment 18. To close a large tube.

You closed small tubes in Experiment 3 by simply heating the end in the blowpipe flame. This method does not serve for

large tubes, however, because it leaves a very large lump of glass which may crack on cooling or reheating.

Practice the following method of closing a large tube; first

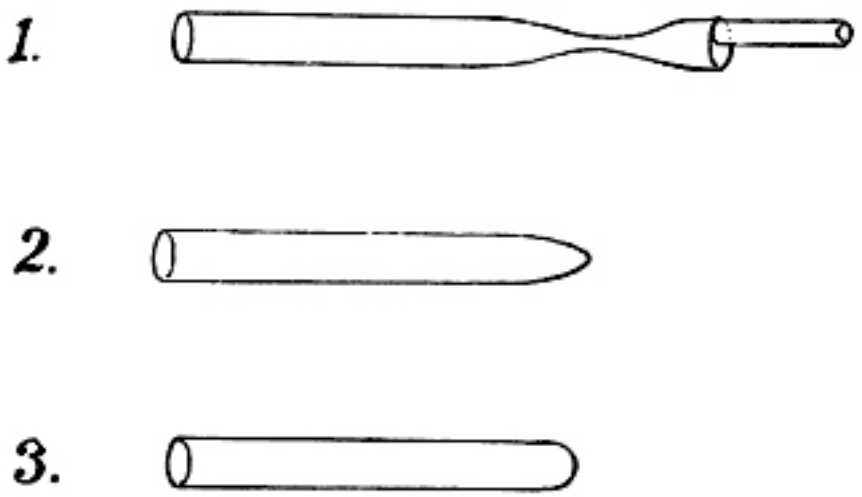

FIG. 31

CLOSING A LARGE TUBE

with a piece of No. 4 tube, then with a piece of No. 6: Attach a working handle to the end to be closed, heat the tube ½ inch from the end in the blowpipe flame, turn constantly, and when soft pull apart until the tube has the shape 1, Fig. 31. Heat, turn, and pull the end away to leave the tube as in 2. Heat the end and blow out until it has the shape 3. The end is now closed and the glass has about the same thickness as the remainder of the tube.

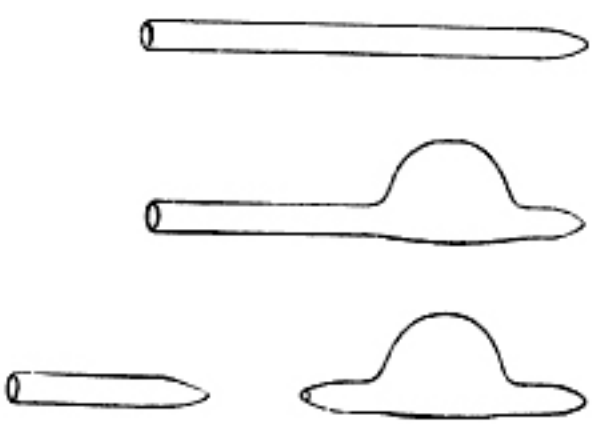

FIG. 32

MAKING A SUBMARINE

Experiment 19. To make a submarine.

Close one end of a piece of No. 2 tubing as described above, but leave the end somewhat pointed (1, Fig. 32). Heat the tube on one side at a distance ½ inch from the end and blow a bulb about ½ inch in diameter (2). Heat the tube ¼ inch from the bulb, draw it down into a fine tube, and break off the tube, leaving a small hole in the end (3). Place the submarine in a glass of water, and if it floats it is complete.

Experiment 20. Magic.

Fill a bottle to overflowing with water, insert the submarine open end down, insert the solid rubber stopper and press down hard (Fig. 33). Does the submarine submerge?

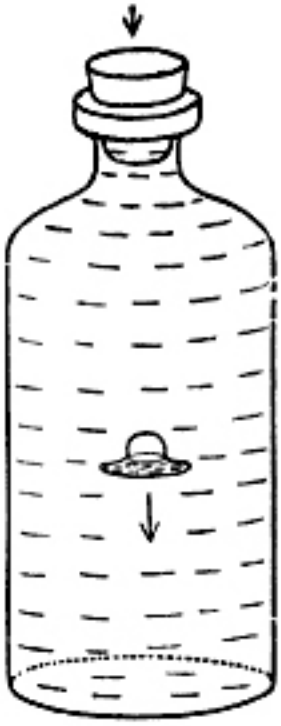

FIG. 33
THE SUBMARINE SUBMERGES

Release the stopper. Does the submarine rise and does it also move forward?

Turn the bottle on its side and release the stopper quickly. Does the submarine shoot forward at a great rate (Fig. 34)?

The submarine acts in this magical manner for the reasons given in Experiment 9. When you press the stopper in, you compress the air in the submarine and force water in until the submarine weighs more than an equal volume of water and it sinks. When you release the pressure on the stopper, the compressed air forces the water out until the submarine becomes lighter than an equal volume of water and it rises. The water rushing out through the opening exerts pressure backwards in the water in the bottle and the reaction drives the submarine forward.

Experiment 21. Fun with the submarine.

If your friends do not know about the little submarine, you can mystify them as follows: Tell them that submarines are

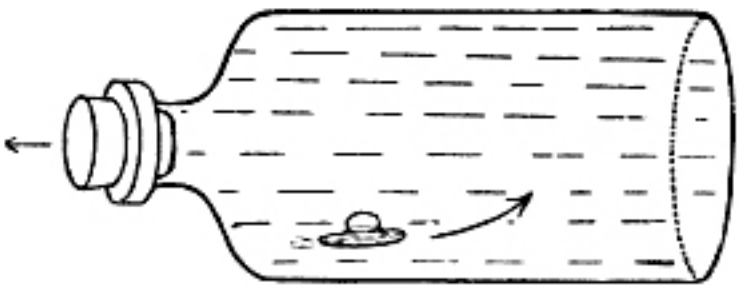

FIG. 34

THE SUBMARINE SHOOTS FORWARD

just like other fish; namely, they lay eggs, and the little eggs hatch out after a certain number of days (of course, yours friends will know that you are only joking). Pretend that you found one of these submarine eggs, hatched it out in lukewarm water, and that you have trained the baby submarine to do some simple tricks. For example, that you have trained it to submerge, rise, and attack, when you issue the commands "submerge," "rise," and "attack."

Tell them to watch the submarine carefully and to notice that it takes in water and submerges when you issue the command "submerge" and, while your friends are watching the submarine, press down on the stopper unknown to them.

Tell them to watch the submarine carefully again and to notice that it expels water and rises when you issue the command "rise." Issue the command and unknown to them release the pressure on the stopper slowly.

Repeat with the command "attack" and release the pressure quickly.

Experiment 22. A submarine battle.

Make a second submarine, place it in a large bottle

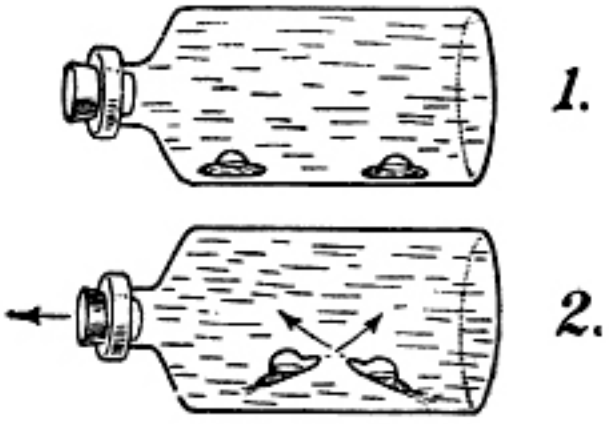

FIG. 35

A SUBMARINE BATTLE

with the first submarine, turn the bottle on its side, and make the submarines manœuver by moving the stopper in and out.

Finally, arrange them so that they are on the bottom, facing each other bow to bow, two or three inches apart (1, Fig. 35), and release the stopper quickly. Do the submarines try to ram each other (2, Fig. 35) in a most realistic manner?

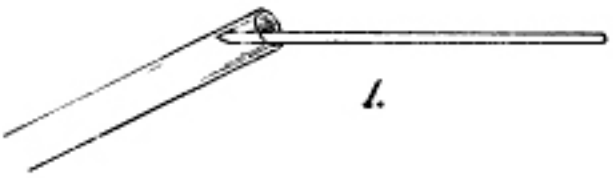

FIG. 36
FLARING A TUBE

FIG. 37
AN AIR GUN

Experiment 23. To flare the end of a tube.

Heat the end of a piece of No. 2 tube until it is red hot, take it out of the flame, hold the flaring wire inside the end, and press outward gently while you revolve the tube (1, Fig. 36). Do you find that the end is flared out (2, Fig. 36)?

Experiment 24. To make an air gun.

Take a full-length piece of No. 4 tube and flare both ends slightly. This is the air gun (Fig. 37).

Now to make an arrow, cut off the lighting end of a match and insert a pin in the other end (Fig. 38).

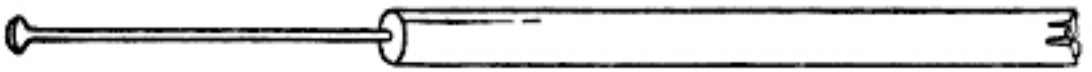

FIG. 38

THE ARROW IS SHOT PIN-END FIRST

Insert this arrow in the air gun and blow it out. Does it come out with considerable speed?

Experiment 25. A shooting match.

Draw a target on a piece of paper and hang it up, away from the wall or at the end of the table, where there will be space behind for the arrows to pass through.

FIG. 39

A SHOOTING MATCH

The bull's-eye of a target is usually 1 inch in diameter, the next circle outside is 2 inches in diameter, the next 4 inches, and the outer circle 5 inches.

Get up a shooting match and keep track of the score made by each.

If the bull's-eye is cut anywhere by the arrow, the count is 5 points; a cut anywhere inside or touching the 2-inch circle counts 4 points; anywhere inside or touching the next two circles counts 3 and 2 points respectively.

The one who makes the highest score in five shots is the winner.

It is more sanitary if each shooter has his own gun and arrows.

Experiment 25. A shooting match.

Go outside and see which of you can shoot his arrow to the greatest height and to the greatest distance.

Give each contestant five shots.

You can make fair estimates of the heights if you shoot up beside a building or tall tree.

FIG. 40

THE PEA SHOOTER IN ACTION

Experiment 27. To make a pea shooter.

Take a full-length piece of No. 6 tubing, smooth both ends and flare them out slightly. This makes an excellent pea shooter. Try it with peas. Do you find that they come out with great speed?

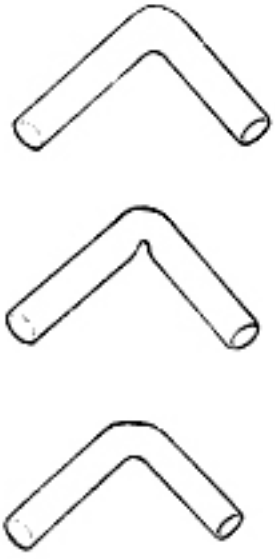

FIG. 41

BENDS

Experiment 28. A pea-shooting match.

Make a target on a piece of paper, hang it up away from the wall or at the edge of the table, and shoot at it (Fig. 40). Do you find that the peas goes right through the paper?

Arrange a match with your friends and keep track of the score as in Experiment 25.

Experiment 29. To make a good bend.

A good bend has the same diameter in the bend as in the remainder of the tube (1, Fig. 41). It is rather difficult to make

because the tube tends to cave in on the inside of the bend (2) or flatten on the outside (3), or both.

Make the bend as follows: Heat a piece of No. 2 tube about 2 inches from one end in the lamp flame, turn it constantly and move it back and forth endwise to heat a length of about 2½ inches. When soft, take the tube out of the flame, and bend the ends upward until the angle is 90°.

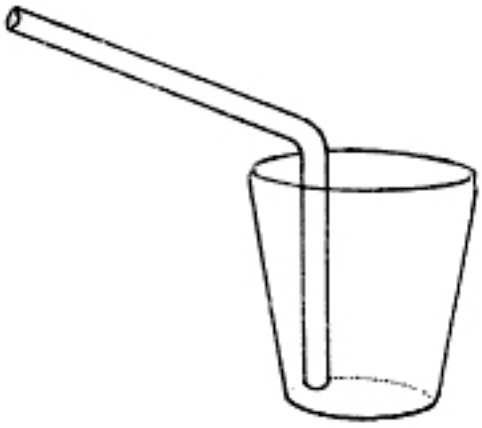

FIG. 42
A DRINKING TUBE

If the bend is flat on the inside or outside, close one end of the tube in the blowpipe flame, smooth the other end and allow them to cool, then heat the flat side of the bend in the blowpipe flame and blow it out slightly. This makes the diameter of the tube at the bend equal to that of the remainder of the tube. Cut off the closed end, smooth the edge, and your bend is complete.

Make bends with No. 4 tube.

Experiment 30. To make a drinking tube.

Many times when there is sickness in the house, it is convenient to have a glass drinking tube (Fig. 42), through which the patient can drink without raising his head.

Make such a tube from a piece of No. 4 tubing. The short arm is equal in length to the depth of the tumbler; the long arm, or mouthpiece, is about 1 inch longer than this.

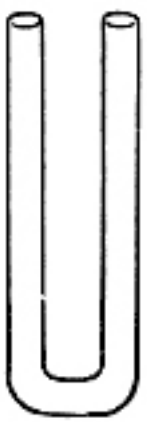

FIG. 43
A SIPHON

Experiment 31. To make a siphon.

Cut off a piece of No. 4 tubing 8 inches long, make