

Heat the small part of 4, without heating the alcohol, and close the tube (6). Now attach the level to a smooth board as 2 or 3, Fig. 66, mark the center of the bubble, and your spirit level is ready for use.

Experiment 47. To make a fountain-pen filler.

Attach a rubber coupling to the large end of one of your No. 4 nozzles, close the other end of the coupling with a glass plug, and your fountain-pen filler is made (Fig. 67).

To make the plug, close one end of a piece of No. 4 tubing, allow it to cool, cut off to a length of 1 inch and smooth the rough edges. Insert the closed end of this plug into the rubber coupling.

Practice using the filler by drawing up and shooting out water.

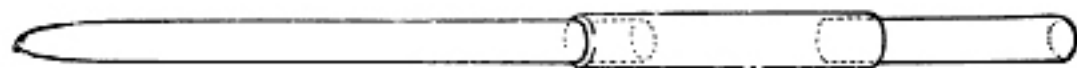


FIG. 65

A FOUNTAIN-PEN FILLER

Experiment 48. To make a syringe.

Take a half length of No. 6 tube and smooth both ends in the lamp flame or blowpipe flame.

Now to make a plunger: Cut an 8½-inch length of No. 2, smooth one end, close the other end and blow a slight bulb. When cold, wet the closed end and insert it into small wet rubber coupling.

Note: Always grasp a tube near the end when you insert it

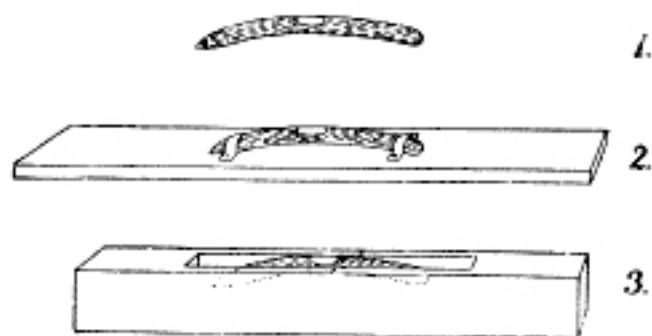


FIG. 66

MOUNTING THE SPIRIT LEVEL

into a coupling or stopper, because if you hold it too far back you may break it. Insert it with a twisting motion, after wetting the end and the inside of the coupling or stopper.

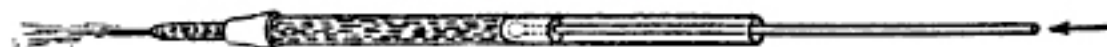


FIG. 68

A SYRINGE

Wet the inside of the large tube, wet the plunger and rub it on a cake of soap to make it slippery, then try it in the large tube. if the plunger is too large, stretch the coupling lengthwise; if it is too small, crowd the coupling together lengthwise. if the bulb is too large or too small, dry it, heat it in the blowpipe flame until it shrinks, and blow another.

When the plunger is made, attach a No. 4 nozzle to the No. 6 tube with a large coupling, arrange as in Fig. 68, and your syringe is made.

Fill the large tube with water and see how long a stream you can make.

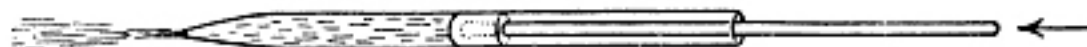


FIG. 69

ANOTHER SYRINGE

Experiment 49. To make another syringe.

Heat a piece of No. 6 in the blowpipe flame at a length of $7\frac{1}{2}$ inches and draw it out into a nozzle; smooth the outer end in the lamp flame. Use the same plunger as in Experiment 48, and your syringe is made (Fig. 69). Try it out with water.

Experiment 50. To make a third syringe.

Heat a piece of No. 6 tube in the blowpipe flame at a length of $7\frac{1}{2}$ inches, draw it out, and close the end, then smooth the other end.

Now to make a plunger: Heat a piece of No. 2 tube $8\frac{1}{2}$ inches from one end in the lamp flame, draw it out into a nozzle, and break it off, leaving a small hole at the end of the nozzle. Smooth the other end in the lamp flame, flare it out slightly, allow it to cool, dip it into water and insert it into a small wet coupling.



FIG. 70

A THIRD SYRINGE

Now fill the large tube with water and insert the coupling plunger (Fig. 70). Do you get a fine long stream?

Experiment 51. To make a diablo whistle.

Use the No. 6 tube and the No. 2 plunger from Experiment 48, arrange as in Fig. 71, blow across the top, and move the plunger up and down. Do you get a most diabolical sound?

The sound is produced by the vibration of the air column between the top of the tube and the top of the plunger. Do you find that the pitch of the note is higher the shorter the air column?

Experiment 52. Fun with the diablo whistle.

Start with the air column long and blow the note, shorten it a little and blow the next note, continue, and try



FIG. 71

THE DIABLO WHISTLE



FIG. 72
JOINING TWO TUBES

ends opposite each other near the top of the lamp flame (Fig. 72), rotate constantly, and when nearly red hot bring the ends accurately together in the flame, press together slightly, draw out slightly, and remove from the flame.

The ends are now stuck together, but the glass is in a slight lump around the joint and if allowed to cool will crack very easily. It is necessary to work the glass back and forth to get rid of the lump

to blow the eight notes of an octave.

Try to play a tune.

Try to make the most weird sound you can.

Experiment 53. To join two tubes end to end.

Take a piece of No. 2 tube about 7 inches long, close one end, smooth the other, and when cool, cut the tube at the middle.

Now join these two pieces as follows: Hold the



FIG. 73
WORKING THE JOINT

and to make the glass uniform on both sides of the joint. Do this as follows: Heat one third of the joint in the blowpipe flame (Fig. 73), and when red hot blow a slight bulge. Now turn the joint one third, heat the next third red hot and blow a slight bulge. Repeat with the remaining third.

Now heat the first third again until it is red hot and shrinks, then blow a slight bulge again. Repeat this with the other two thirds.

Repeat this whole operation a third time and blow just enough to leave the joint the same size as the remainder of the tube or a little larger.

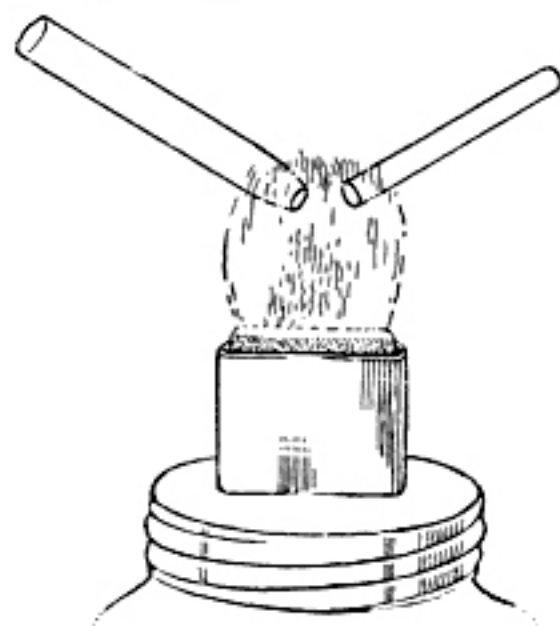


FIG. 74
JOINING TUBES OF DIFFERENT
SIZES

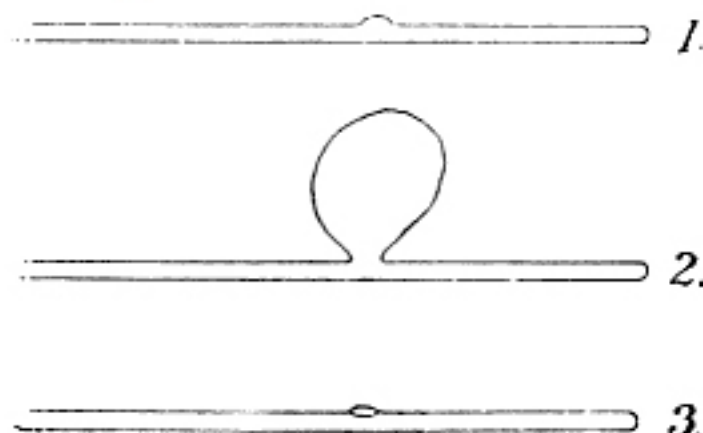


FIG. 75
MAKING A LARGE HOLE

The heating and blowing has worked the joint back and forth until the glass is fairly uniform. It makes a strong joint.

Cut off the closed end and smooth the edge.

Repeat with a piece of No. 4 tube.

Experiment 54. To join tubes of different sizes.

Take a piece of No. 4 tubing about 3 inches long and close one end.

Take a piece of No. 6 tubing, attach a handle

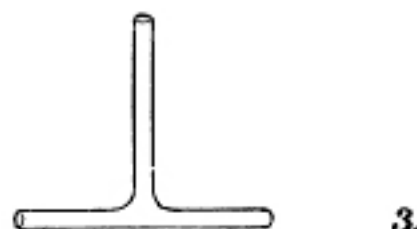
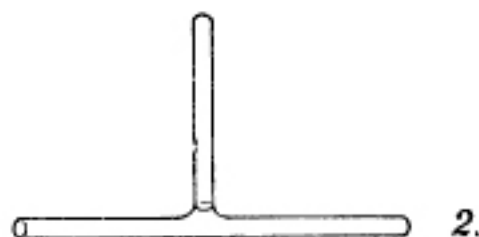
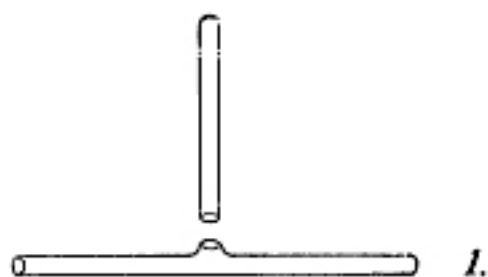


FIG. 76
MAKING A TEE

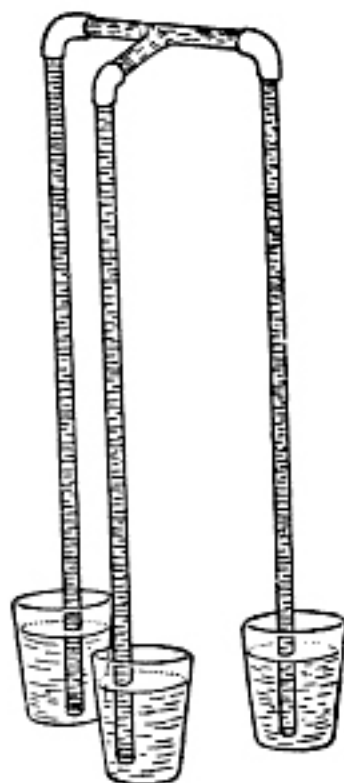


FIG. 77
THREE-ARMED SIPHON

to one end, heat the No. 6 tube in the blowpipe flame about 1 inch from this end and draw it down to smaller size.

Break the small part at a point where it is about the size of the No. 4 tube. If the hole is too large, heat the edge until it is a little too small, and flare it out with the flaring tool. If the hole is too small, heat the edge and flare it out.

Now heat the ends of both tubes (Fig. 74), and join them as described in the last experiment.

Repeat the operation of heating and blowing at least three times. Join a No. 4 and a No. 2 tube in the same way.

Experiment 55. To make a large hole.

Take a piece of No. 4 tube about 6 inches long, close one end, smooth the other, and allow it to cool.

Now to make a large hole in the side of this tube, proceed as follows: Heat in the blowpipe flame the point at which you wish to make the hole, and blow a slight bulge (1, Fig. 75). Then heat the top of this bulge until it is red hot over an area about equal to the size of the hole you wish to make, and blow hard to make a thin bubble (2, Fig. 75). Break away the thin glass of the bubble, smooth the edges, and the hole is made. The edge of this hole will project beyond the side of the tube (3, Fig. 75). If you wish to make the edge even with the side of the tube, heat it in the blowpipe flame until it shrinks back level with the tube.



FIG. 78

A REPEATING AIR GUN

Experiment 56. To make a tee.

Take a piece of No. 4 tube about 6 inches long, close one end, smooth the other, and allow it to cool. Take another piece 3 inches long, close one end, and allow it to cool.

Now make a hole in the side of the first tube at a point 3 inches from the closed end. Do this as described in the last experiment but leave the hole projecting beyond the side of the tube (1, Fig. 76).

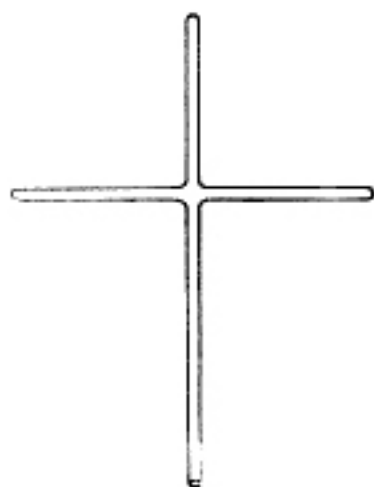


FIG. 79

FOUR-WAY JUNCTION

Now heat the edge of the hole and the end of the short piece in the lamp flame, and make a joint (2, Fig. 76) exactly as described in Experiment 53. Be particular to heat and blow all around the joint at least three times to make the glass uniform, and on the last blowing leave the joint a little larger than the tube. Cut off the closed ends, make the arms equal in length, smooth the ends, and your tee is made (3, Fig. 76).



FIG. 80
MAKING A Y

Your first attempt may not be beautiful, but if you will repeat the heating and gentle blowing often enough, the joint will be strong, which is the main point.

Repeat until you can make a tee easily.

Make a tee with No. 2 tubing.

Your flame is hardly large enough to make a tee with No. 6 tubing.

Experiment 57. A three-armed siphon.

Make a three-armed siphon as shown in Fig. 77. Put two arms in tumblers filled with water, suck air out of the third arm until the water runs, and then out it in an empty tumbler.

Stand the three tumblers on the table. Does the water run until the levels are the same?

Put one tumbler on a book. Does the water run into the other two tumblers until the levels are the same?

Return the one tumbler to the table and put the other two on

the book. Does the water run from both tumblers to the lower tumbler until the levels are again the same?

Experiment 58. To make a repeating air gun.

Take a full length of No. 4 tubing, put a branch about 3 inches long at a point about 2 inches from one end; leave the end of the branch closed (Fig. 78). Now load the branch with shot or coarse dry sand, and your repeating air gun is ready for use.

Tilt the branch slightly above the horizontal and blow intermittently. Does your gun reload after each blow, until the ammunition is used up?

Experiment 59. To make a four-way junction.

Make a tee as in Experiment 56, but do not cut off the closed ends. Now attach a fourth arm, as in Fig. 79, and heat and blow gently as before to work the glass into uniform condition. Cut off the closed arms at equal lengths, smooth the ends, and your four-way junction is made.

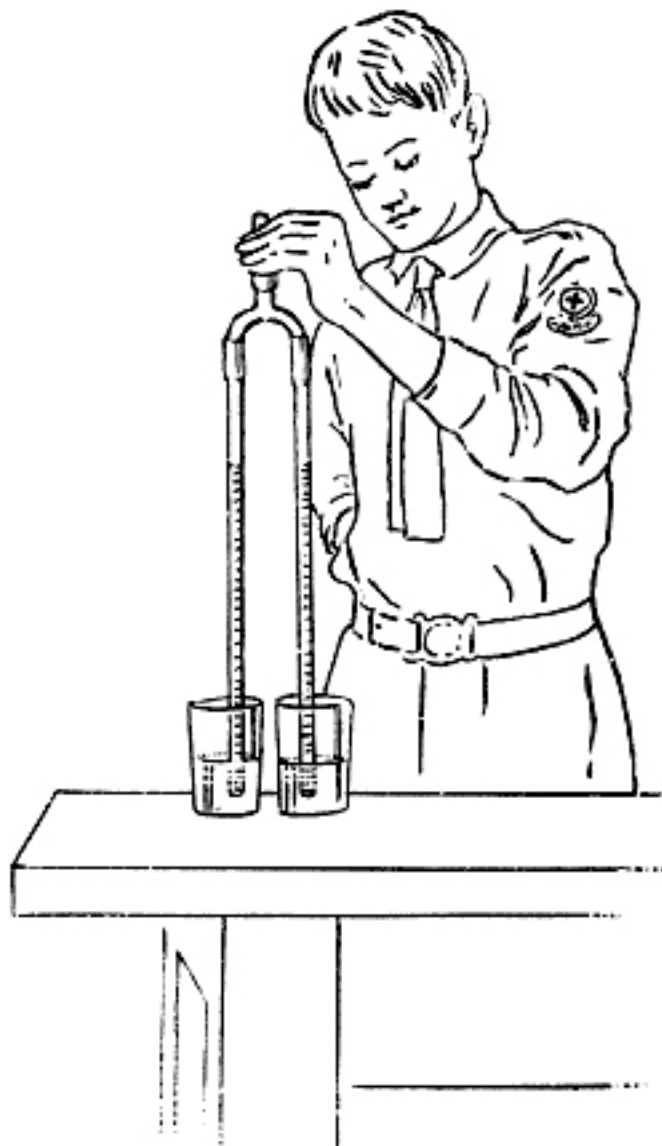


FIG. 81

BALANCING COLUMNS

Experiment 60. A four-arm siphon.

Make a four-arm siphon, repeat the experiments described in Experiment 57, and make others of your own.

Experiment 61. To make a Y.

Make a tee as in Experiment 56, then make a bend about $\frac{1}{2}$ inch from the stem on each side (Fig. 80), and your Y is complete.

Experiment 62. Balancing columns.

Arrange the apparatus as in Fig. 81, put the arms together in a glass of water, suck a little air out of the top coupling and close it with a glass plug. Do you find that the water rises to the same level in each?

Place the arms in separate tumblers filled with water to the same level and repeat. Does the water rise to the same level?



FIG. 82

THE WATER LEVELS ARE THE SAME

Add an extra length to one arm and repeat. Are the levels different but are they equal distances above the water in their respective tumblers?

Place the tumblers on the table, make one tube slanting, and repeat the experiment (Fig. 82). Are the levels again the same?

When you suck air out of the tee, you decrease the air