GILBERT

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GLASS BLOWING

Experimental Glass Blowing FOR BOYS

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EXPERIMENTAL GLASS BLOWING

Boys, glass tubes are made in the sizes shown in Fig. 2, and in larger sizes. You will use sizes 2, 4, and 6 in the following experiments.

Experiment 1. Fun bending glass.

Hold a piece of No. 2, with both hands, in the flame of the alcohol lamp, and turn it constantly (Fig. 3). Do you find that when the glass becomes nearly red hot, it becomes soft and bends easily?

FIG. 2
SIZES OF GLASS TUBING

FIG. 3
HEATING GLASS TO SOFTEN IT

Take the tube out of the flame, bent it into any shape you wish (Fig. 4), and allow it to cool. Do you find that the glass hardens when it cools and retains the bent shape?

Heat the tube near the first bend, turn it constantly, take it out of the flame, and make another bend.

Repeat this and make all kinds of fantastic shapes.

Place all hot glass on the cooling blocks, not on the table.

Glass is used in many, many ways by the human race; for example, to make bottles, tumblers, window glass, and so on, and

FIG. 4
BENDING GLASS

all of these uses depend upon the facts which you have just illustrated, namely, that glass becomes soft when heated and hard when cooled again.

THE LAMP

The wick should be cut straight across and should project above the wick holder about 1/8 inch (Fig. 5), or a little more if you require more heat. Burn wood alcohol or grain alcohol, because they give flames without soot or smoke. Fill the lamp to within ½ inch of the top only; it will burn one hour. The hottest part of the flame is not down close to the wick, as most beginners suppose, but up just beneath the tip.

Buy your alcohol at the drug store in quantities of one pint or more. When you are through experimenting for the day pour the alcohol from the lamp back into the pint bottle and cork the bottle tightly. Alcohol left in the lamp gradually evaporates and is lost.

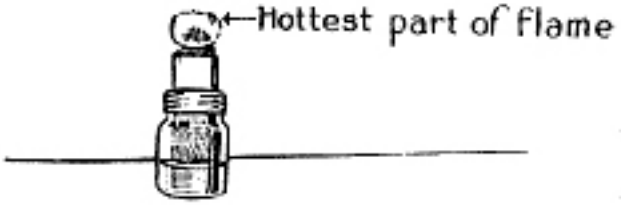

FIG. 5
THE LAMP

Do not let the lamp stand with alcohol in it for any considerable time-- overnight for example-- because fuel alcohol contains water and when it evaporates from the wick, the alcohol

evaporates first and leaves the water in the wick. Then when you try to light the wick again, you will find that you cannot do so, because, of course, water does not burn. If this happens to you, take the wick out, dry it, and start the lamp again.

It is perfectly safe to use kerosene in the lamp, but it gives a very smoky flame which deposits soot on the glass and fills the air with soot particles. Your mother will object very strenuously to this because the soot particles settle and blacken everything. Burn alcohol only, at least in the house.

FIG. 6
MATCHING A SCRATCH

Experiment 2. To cut glass tubing.

Cut off a six inch length of No. 2 as follows: Lay the tube flat on the table, mark the six-inch length and draw the file across the tube at this point, pressing hard enough to make a good scratch (Fig. 6).

FIG. 7
BREAKING THE TUBE

Grasp the tube with both hands near the scratch, as in Fig. 7, pull apart and bend slightly. Do you find that the tube breaks across easily?

Repeat this with No. 4 and No. 6 tubes.

Experiment 3. To make the edges smooth.

Hold one end of the six-inch piece of No. 2 in the tip of the flame (Fig. 8), and turn constantly until it is just red hot. Take it out and let it cool on the blocks. Do you find that the edges are smooth?

Repeat with the other end.

Repeat with both ends of the six-inch piece of No. 4.

If thick glass is heated quickly it may crack, because the hot exterior expands more quickly than the cooler interior and produces internal strains.

FIG. 8
MAKING THE EDGES SMOOTH

The No. 6 tube is comparatively thick and should be heated **gradually** as follows: Hold the end in the flame for 1 second, then withdraw it for about 1 second; hold it in the flame again for 1 second, and withdraw it for 1 second. Repeat this eight or ten times, then hold and turn it in the flame until red hot.

FIG. 9
THE BLOWPIPE FLAME

Smooth both ends of the No. 6 piece in this way.

Experiment 4. Practice with the blowpipe.

Hold the small end of the blowpipe just inside the flame at one edge, about 1/8 inch above the wick (Fig. 9), and blow air through the lamp parallel to the top of the wick.

Keep your mouth closed on the blowpipe, **breathe through your nose,** and **practice keeping a steady stream of air going for a long time**. You will be able to do this with a little practice.

Do you observe that the blowpipe flame is pointed, also that it is made up of a pointed cone inside and a lighter-colored cone outside? The hottest part of the flame is inside the outer cone just beyond the point of the inner cone.

The blowpipe flame is hotter than the lamp flame because the heat of the burning alcohol is concentrated at one point by means of the air blast, and because the alcohol is more completely burned by the extra air.

Experiment 5. To close the end of a small tube.

Hold one end of a piece of No. 2 tube in the blowpipe flame (Fig. 10), turn it slowly, and heat it until the end closes. Does it close nicely?

FIG. 10
CLOSING ONE END OF A TUBE

Close one end of a piece of No. 4 in the same way.

You can close No. 6 tubing in this way, but it leaves a large lump of glass which may crack on cooling or on reheating. You will practice closing No. 6 tubing later.

The "why" of it

The glass becomes soft when heated because it becomes almost a liquid, and if it is heated sufficiently it comes entirely a liquid. In this respect it acts very much as pitch, rosin, and wax act when heated by the sun or by a fire.

The end of a glass tube becomes smooth, or closes entirely, when heated, for the following reason: The surface of any liquid tries to take the smallest possible area (this is explained in detail under "Surface Tension" in the Gilbert book on "Experimental Mechanics"), for example, a small particle of water takes the shape of a drop, a sphere, and the surface of a sphere has the least area for a given amount of water. Now when the end of the glass tube is heated it comes a liquid, and the surface of this liquid contracts the glass into a smooth rounded surface of least area. If the tube is heated still more, the surface contracts still more and closes the end.

FIG. 11
MAKING A GLASS BUBBLE

Experiment 6. Fun blowing glass bubbles.

Smooth one end of a piece of No. 2 tube and allow it to cool. Close the other end in the blowpipe flame, turn it slowly, put the smooth end into your mouth quickly, and blow as hard as you can (Fig. 11). Do you get a fine big glass bubble which bursts with a pop?

If you get only a small bulb at the first trial, heat the end, and try again. Do you find that the bulb shrinks when heated but blows out again readily?

When you get a big bubble, place the bubble end of the tube on a cooling block and break all the thin glass away from the tube by striking it with the file or blowpipe. Then close the end and blow another bubble.

Repeat until you can blow bubbles easily.

Repeat with a piece of No. 4 tube.

FIG. 12
BLOWING A BULB

BUBBLE COLORS

Do you find that the thin glass of the bubbles shows colors, especially in sunlight, just as soap bubbles do? You boys who have had the Gilbert set on "Light Experiments" will know that these colors are due to "interference." The colors produced by a thin film of oil on water are also produced by "interference."

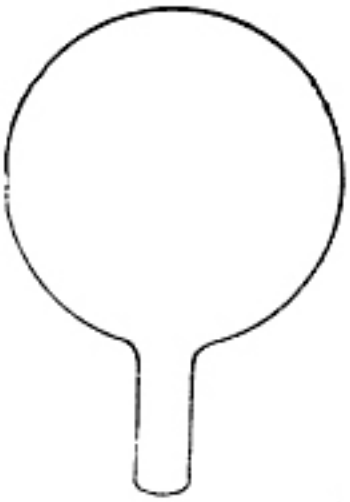

FIG. 13
A WATER BALLOON

Experiment 7. To make water balloons.

Close one end of the No. 2 tube in the blowpipe flame again and while it is still hot blow carefully into the open end until you have a bulb about ½ inch in diameter (Fig. 12). Now let it cool,

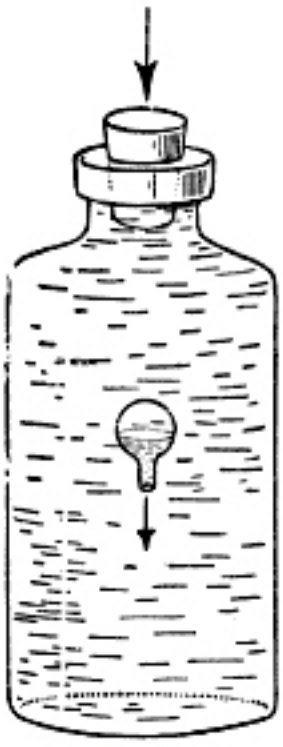

FIG. 14

THE BALLOON SINKS AND RISES

make a scratch with the file about ¼ inch from the bulb, break the tube at this point (Fig. 13), and smooth the rough edge.

Put the bulb in a tumbler of water. Does it float? If not, make another balloon with a larger bulb.

Experiment 8. Magic.

Find a large bottle made of clear glass, the neck of which will fit your solid rubber stopper.

Fill the bottle with water to overflowing, insert the balloon, and then the stopper.

Now press down hard on the stopper. Does the balloon sink in a most magical manner (Fig. 14)?

Release the stopper. Does the balloon rise in an equally magical manner?

Experiment 9. Balloon races.

Make another water balloon. Put the two balloons together in the bottle filled to overflowing with water.

Insert the stopper and press down hard. Do the balloons sink (Fig. 15), and does one sink more quickly than the other?

The most buoyant balloon sinks last and rises first.

FIG. 15

A BALLOON RACE