THE BOY CHEMIST

CHAPTER I

WHAT YOU NEED TO EXPERIMENT WITH

THE two chief things you need to make the experiments described in this book are *the apparatus* and *the chemicals.* You can improvise some of the apparatus and use household china and glassware for other pieces, but it is better to buy whatever equipment you need, for it costs but very little, and having been designed especially for the purpose, it will prove far more satisfactory. However, I shall tell you how to construct whatever pieces of apparatus I think you can make, so that in case you happen to be far removed from a chemical supply house you can go ahead with the experiments, anyway, and not lose valuable time.

The Apparatus You Need. If you can, it is the better way to get the following pieces of apparatus before you start in to experiment, as you will need them right along:

1. A Ring-Stand.
2. An Alcohol Lamp, or a Bunsen Burner.
3. A Sheet of Iron Gauze.
4. A Set of 6 Test Tubes.
5. A Test-Tube Rack.
6. A Test-Tube Brush.
7. A Glass Stirring Rod.
8. A Pipette, or Medicine Dropper.
9. An Ordinary Teaspoon and a Tablespoon.
10. A Nest of 3 Beakers.

11. One or Two Flasks.
12. A Glass Funnel.
13. A Mortar and Pestle.
14. Two or Three Wide-Mouth Bottles.
15. Some Corks, or, better, Rubber Stoppers to fit the Bottles.
16. A Cork-Borer.
17. A Graduated Glass.
18. A Porcelain Crucible.
19. A Glass Retort.
20. Several Watch Glasses.
21. A Glass U-Tube.
22. Several Pieces of $\frac{3}{8}$-Inch Glass Tubing.
23. Some $\frac{1}{4}$-Inch Rubber Tubing.
24. A Pair of Forceps, or Tweezers.
25. A Dozen Sheets of Filter Paper.
26. Two Sheets of Litmus Paper.

What the Apparatus Consists of. Now before we go any farther, let us find out just what each of the above pieces of apparatus consists of.

A bought ring-stand is shown in Fig. 1, and one that you can make in Fig. 2. Take a piece of $\frac{1}{8}$-inch or $\frac{3}{16}$-inch iron wire 2 feet long, and form a ring on one end 4 inches in diameter so that it will stand on the table. Now take a piece of $\frac{1}{8}$-inch iron wire and make a ring $2\frac{3}{4}$ inches in diameter and then bend the free end into a spiral of three or four turns with a pair of round-nose pliers, so that it will slip snugly over the support rod of the ring-stand, and it is ready to use.

The proper kind of an alcohol lamp to use is shown in Fig. 3, but if you are hard-pressed for a flame you can make a lamp of an empty inkstand; to do so, bend a strip of tin 1¼ inches wide and 1½ inches long into a tube and then bore a 5/16-inch hole through the cork and push the tube into it so that it will project at both ends. Next, make a

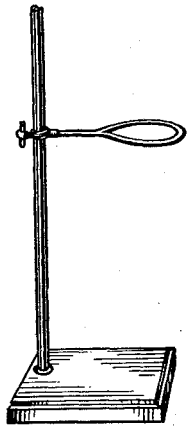

FIG. 1.—A Bought Ring-Stand.

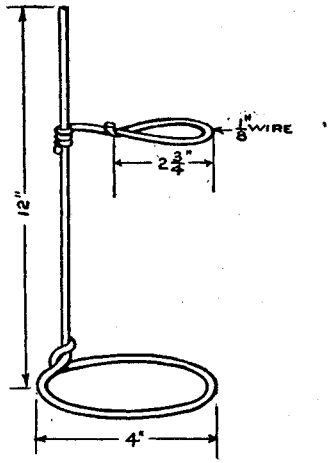

FIG. 2.—A Home-Made Ring-Stand.

wick of string about 4 inches long and put this in the tube, half fill the bottle with methyl alcohol (CH_3OH), which is ordinary *wood alcohol*, put the long end of the wick into it, and then the cork in the bottle, and your alcohol lamp will look like Fig. 4.

You can buy a Bunsen burner, Fig. 5, for 50 cents or less, and this will give you a much hotter flame than an alcohol lamp. Again, if you are pressed for the want of

one, take a piece of iron pipe ⅜ inch in diameter, inside measurement, and 6 inches long, and drill a ¼-inch hole through it about 1½ inches from one end. Then make a tin ring ½ inch wide that will just slip over the pipe and cover the hole, and you can regulate the supply of air.[1]

Now bore a hole in the center of a block of wood that is ½ inch thick and 3 inches on the sides and push the

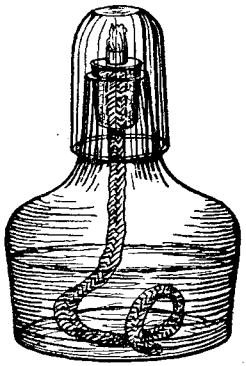

FIG. 3.—A Bought Alcohol Lamp.

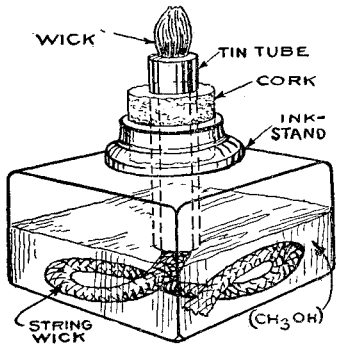

FIG. 4.—A Home-Made Alcohol Lamp.

tube into it; glue two strips of wood, ½ inch thick, to the bottom of the block along its edges, then put a rubber tube on the lower end of the pipe and connect it with a gas jet from which you have taken out the tip, and the burner is complete, as shown in Fig. 6. A sheet of iron gauze is laid on the upper ring of the stand and the flask, or other piece of chemical glassware, is set on it when you want to heat any liquid to the boiling point. Iron gauze comes in

[1] The reason for regulating the air supply is explained in Chapter XI.

sheets 4 by 4 inches on the sides, and you can also buy it with the meshes filled in with asbestos for slow evaporation.

A set of three 5-inch and three 6-inch test tubes, see Fig. 7, will serve for your experiments, at least at first. To clean the test tubes you will need a test-tube brush, as shown in Fig. 8, and you can buy or make a test-tube

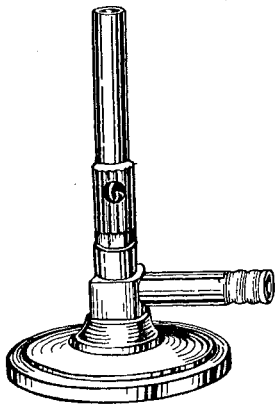

FIG. 5.—A Bought Bunsen Burner.

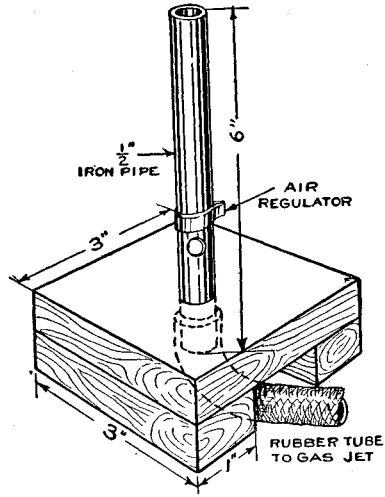

FIG. 6.—A Home-Made Bunsen Burner.

holder, as shown in Fig. 9. A regular test-tube rack is shown in Fig. 10, but you can make one by bending a piece of 3/32-inch brass or iron wire 4 feet long into the shape shown in Fig. 11.

A glass stirring rod is a solid glass rod about 3/16 inch in diameter and 6 inches long, as shown in Fig. 12. You can use a glass tube instead, though some of the liquid usually gets up into it and stays there. A pipette is simply a

medicine dropper, see Fig. 13, and this enables you to put one or more drops of a liquid into a test tube or beaker with neatness, accuracy, and dispatch.

A beaker is a tumbler-shaped glass with a lip on it, as shown in Fig. 14, so that you can pour a liquid from it without spilling it. You can use an ordinary glass tumbler instead of a beaker except when you have to heat it. You should have a set of three beakers, or *nest*, as it is called,

FIG. 7.
A Test Tube.

FIG. 8.—A Test-Tube Brush.

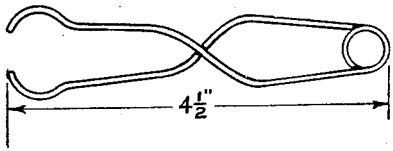

FIG. 9.—A Test-Tube Holder.

because one goes inside another, and the smallest can be 2 inches, the next 2½ inches, and the third 3 inches in diameter.

You can buy in two shapes flasks of annealed glass that can be heated without breaking, and these are shown in Figs. 15 and 16. The first is the regular spherical form with a flat bottom, and this can be set directly in the ring of your stand over the flame. The second is called an *Erlenmeyer* flask, and its shape is such that while it can-

not be easily tipped over, it can be set only on a ring-stand on a piece of wire gauze.

A glass funnel will be found useful where you have to transfer the contents of one vessel into another, especially

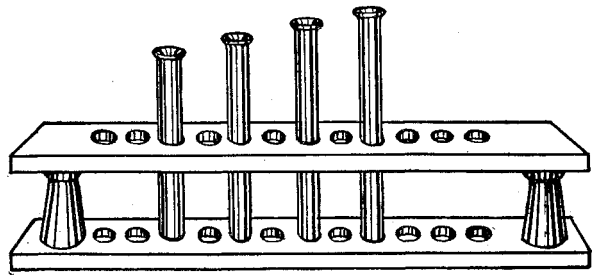

FIG. 10.—A Bought Test-Tube Rack.

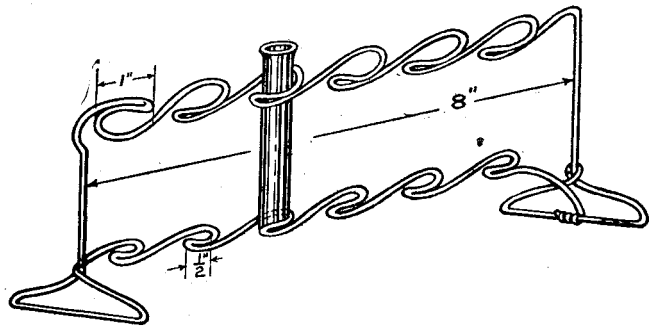

FIG. 11.—A Home-Made Test-Tube Rack.

if these are bottles, as well as for filtering solutions. A funnel with a mouth 3 inches in diameter, and with the stem cut at an angle, as shown in Fig. 17, will be large enough. You will need also a package of 5-inch filter paper. A 2½-inch or 3-inch glass or porcelain mortar and

a pestle, see Fig. 18, must be used where you have to grind a substance to a powder.

A 4-ounce or an 8-ounce wide-mouth bottle, like that pictured in Fig. 19, is used in many operations, especially in purifying gases. You can use a ½-pint fruit jar in a pinch, but a bottle is better. An ordinary cork will serve as a stopper, but a rubber stopper makes a tighter fit. While you can make a hole in a cork with a knife and smooth it up with a rat-tail file, an easier, quicker, and, hence, better way is to use a cork-borer. Rubber stoppers can be bought with holes in them, ready for inserting glass

FIG. 12.—A Glass Stirring Rod.

FIG. 13.—A Pipette or Medicine Dropper.

tubes. In experiments where two or three glass tubes have to be inserted in a bottle, you can also use a *Woulff's bottle* that has two or three necks, as shown in Fig. 20.

With a graduated glass, Fig. 21, you can measure out liquids in fluid ounces, and you can get at the drug store a small one with which you can measure 1 to 8 teaspoonfuls and from 1 to 2 tablespoonfuls; it is shown in Fig. 22, and for many of the experiments described in this book it is very convenient. A porcelain crucible fitted with a cover enables you to heat compounds to a high temperature; a small one having a diameter of 1¼ inches, see