The Laboratory

Some Suggestions for Home Experiment

An Easily Made Vacuum Apparatus

By Russell Edson.

AN amateur who possesses the means of making a good vacuum has within his reach a great number of very interesting experiments. There are three principal methods of producing a vacuum: The first employs the suction pump, with piston and plunger; the second, the mercury or water pump; the third, condensation of steam. The first two methods are usually beyond the reach of the amateur, as they are expensive or difficult to make. The condensation of steam method is, however, very easy and simple, but as usually carried out is very limited in its application. The usual way is to boil some water in a flask or other vessel and after steam has been coming off for a minute or so to take away the fire and close the mouth of the vessel tightly. By cooling the vessel a very good vacuum can be produced in it. Such a vacuum is of very little use, however, as the water in the bottom of the vessel and the heat used in exhausting the air render it worthless for most experiments. A modification of this method, illustrated herewith, avoids these difficulties and allows a very good vacuum to be obtained in any vessel without direct contact with either heat or water.

Steam vacuum producer.

See Fig. 1. *K* is a kettle on a stove with the water boiling at a brisk rate. It must be provided with a rather tight fitting lid or a gasket which can be pressed down so as to force most of the steam to issue from the spout when desired. The spout is provided with a cork in which is fitted a short piece of glass tubing. *P* is the vacuum pot, the most important part of the apparatus. It is either a can made for the purpose of rather heavy galvanized iron, or a small coffee pot or other cooking utensil which can be soldered air-tight. When the vacuum is formed this pot has to stand a pressure of nearly 15 pounds to the square inch on the outside and must have sufficient strength to resist this pressure and withstand collapse. Three openings are made in this pot, and a short length of brass tube is soldered into each hole, projecting out about an inch and a half. Two of the openings should be near the top and the third near the bottom. A Florence flask, such as used in chemical work, was found to stand the pressure well and made a good vacuum pot. It is easier to arrange than a metal pot, but must be used with more care to prevent cracking from sudden changes in temperature. Fig. 2 shows the method of setting up this flask. A three-hole rubber stopper is used with glass tubing which fits tightly in the holes and is well greased to prevent leakage. Two of the tubes are long and bent as shown. The other is short and straight. The flask, stopper and glass tubes can be obtained at any drug store. The tubes are easily bent by heating in a gas jet.

Whether the metal pot or the flask are used the balance of the arrangement is the same. The three tubes *A*, *B* and *C* are fitted with short pieces of rubber tubing, each provided with a spring clothes pin to act as a valve. The tube *B* is connected with the tube in the spout of the kettle; the tube *C* is simply an outlet for water and steam, and the tube *A* is connected by glass or rubber tubing with the vessel *V* to be exhausted. The apparatus is worked as follows:

- (1) *A* is closed. *B* is opened, then *C*, and by closing tightly the lid of the kettle, steam is forced through *P* and out of *C*.
- (2) When the steam is coming freely *C* is closed, then *B*, and by pouring cold water on *P* the steam contained within is condensed.
- (3) *A* is opened for a moment, then closed.
- (4) *B* is opened slowly to draw in steam, but not so rapidly as to suck air through the kettle. Then *C* is opened, steam forced through for a few moments,

then *C* is closed. Next, *B* is closed, cold water poured on *P*, and the operation repeated. Each time a good part of the air in *V* is exhausted. After a number of these cycles, which are quickly performed, a very good vacuum will be produced in *V*.

To ascertain how good the vacuum is a barometer should be constructed. This is easily done by closing one end of a three-inch glass tube (in a flame), filling it with mercury and inverting it over a shallow cup of mercury. The whole is then placed in a small bottle with a one-hole rubber stopper, and, before the operations commence, placed in connection with *V*. After a number of cycles the mercury in the tube will begin to sink. The perfection of the vacuum will be shown by the height of the mercury above the level of the mercury-cup. In the air the height would be about thirty inches. The degree of vacuum that can be obtained depends upon the tightness of the apparatus and also upon the vapor tension of water. This latter in turn depends upon the temperature to which the flask is cooled before *A* is opened on the last few cycles performed. If the temperature is 60 degrees the best possible vacuum will show 0.5 inches of mercury. With temperature at 50, 0.35 inches; at 40 degrees, 0.25 inches; at freezing, 0.18 inches.

The vessel *V* can be any wide-mouthed container closed by a rubber stopper penetrated by a tube. Of course the strength of the bottle must be considered. When the bottle is exhausted it may be disconnected from the apparatus by removing the rubber tube *A* from the vacuum pot.

Of the many interesting experiments possible with this apparatus a few are indicated below:

- (1) Place a fly in the bottle and exhaust part of the air. He will vibrate his wings, but will be unable to fly.
- (2) An electric bell placed inside the vacuum can be heard only when there is air present, becoming almost inaudible when the air is withdrawn. Do not allow the bell to touch the bottom or sides of the bottle. Suspend it by a string, and pass fine bare wires through the rubber stopper for carrying the current.
- (3) A feather in a vacuum rattles around, when shaken, like a piece of wood.
- (4) Observe the action and growth of a plant when it is placed for several days in a partial vacuum.
- (5) A rubber bag or toy balloon, rather loosely blown up, when placed in a vacuum will expand rapidly to the bursting point.

An Improved Laboratory Label

By William P. Munger

WHEN a number of samples of the same kind are undergoing analysis at the same time mistakes frequently occur, because the chemist is interrupted by other work and cannot remember the exact contents of each dish. If paper labels are used, they are constantly dropping off when the glassware is heated, and if labels are ground on the glassware, confusion results by forgetting to erase the symbols when transferring the liquid from one vessel to another.

To obviate these difficulties, the writer has devised the detachable label shown in the figure. It consists of a small flat piece of glass with a hook drawn out at one end, and having the flat side opposite the hook

Convenient glass label.

ground for writing. Besides obviating the difficulties encountered by the customary labels, this device is a labor saver because, as the sample is transferred from dish to dish, the label will accompany it, and therefore only one inscription is necessary. The label can accompany the precipitate on the filter paper to the oven, as it of course would be unaffected by the moderate heat. The labels can be easily cleaned and used again and again, and if by chance some of the solution should get on the label, it can be washed off.

If the chemist wishes to make these labels for himself, an easy way is to take a piece of soft glass tube, about one-fourth inch in diameter, and hold it vertically in a horizontal blast flame. When the end is closed and the tube is soft and red for about three-

fourths inch down, lay the hot end on a piece of asbestos board and flatten the end with another piece of asbestos board nailed to a block of wood. While yet holding the flattened end, with the asbestos, pull on the free end, and bend back so as to form the hook. When moderately cool, cut it off with a small flame or the blast flame. When entirely cool, grind the face for writing, by putting emery powder and lard oil on a glass plate and rubbing the label thereon till the desired surface is attained.

An Audible Timer

By C. S. Bourne

IT is often desirable to mark short intervals of time for various purposes such, for instance, as the boiling of eggs or other operations in cooking, or it may be to time a debater in his talk when so agreed.

Device for marking short time intervals.

To confine the eyes to a watch is to lose the use of them for other purposes for the time being. To set an alarm-clock index hand would involve more trouble and would be inaccurate for very short intervals. Having a love for useful novelties, the writer devised a simple apparatus to perform this service. Perhaps some SCIENTIFIC AMERICAN readers may like to duplicate it.

As shown, in the drawing, it consists of an ordinary nicked alarm clock turned face side down on a base board. The blocks *A*, *B*, *C*, *D* are glued to the base to keep the clock in place, but permit the clock to be lifted out when used for other purposes. Below the clock there is an electric "buzzer" of the type used for door-bell purposes and costing from 30 to 40 cents. This is screwed to a block to bring it to the proper height, and the block is glued to the base board. To the end of the knurled piece *Q* which turns the clock hands, as shown in the detail drawing, is soldered a flat-head machine screw. This will need a nut to fasten the looped wire *G*, and may be taken from an old dry battery if of the right size.

At *K* is shown the manner of attaching the spring wire *G*, which need not be very stiff. At *H* is a piece of tin or brass bent to conform to the shape of the clock case and rising about three-sixteenths inch above the edge. This may be soldered to the brass work, and serves as a bearing over which the spring piece *G* slowly slides as the clockwork turns it.

When the spring reaches *I* it suddenly drops, and forms a connection with the "buzzer" terminal *E*. The other terminal *P* is connected by wire to a dry battery, and wire *L* is connected with *G* to the other pole of the same. The bearing piece *H* may be graduated to indicate the number of minutes required for the spring to travel from a given point to the drop at *I*. When this happens, the "buzzer" tells the cook, who is about other business, perhaps, that the eggs are done. The next batch may require a shorter or longer time, and the nut *K* is quickly loosened, the spring placed back over the proper mark on *H*, and the nut tightened. In the case of timing a speech maker, the "buzzer" not only tells him when his time is up, but *continues* to remind him.