of the intermediate process will not add, including the bleaching, more than \$4.00 per ton to the cost of the pulp. Both the process and the apparatus for producing the solution (which makes use of a novel process in electrolysis) are patented, and there is no other known means of fully bleaching matured bamboo, except the antediluvian Chinese method of "retting."

Under intelligent administration of tropical labor, especially under the farming system, which is so successful a feature of the sugar cane industry in some of the West Indian islands, the raw material should not cost more than \$2.00 per long cord (approximately a ton), delivered at the mill, and the total cost per ton of pulp at a factory turning out 1,000 tons per month should not exceed \$30 for a high grade bleached pulp, worth, at an extremely modest estimate, \$50.

To epitomize, the bamboo is the cheapest of all materials; the bisulphite is the cheapest of all chemical processes, and the new method of bleaching is much cheaper than any other method in present use.—*American Forestry*.

LABORATORY DEVICES FOR ELEMENTARY CHEMISTRY.

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For the preparation of nitrogen, by removal of oxygen from air many manuals direct that phosphorus be placed upon a crucible cover or piece of tin floated upon a cork, ignited, and a bottle inverted over it. When thus performed on a large scale, as for lecture purposes, such manipulation may be successfully carried out, but in the hands of the student with bottles of such size as are usually employed for the collection of gases, difficulties are frequently experienced. The sudden expulsion of air due to the expansion by the heat of combustion is apt to capsize the small phosphorus-bearing craft and stop the combustion before the oxygen is removed.

The device shown in Fig. 1 consists of a piece of brass wire¹ to which the cup of a deflagrating spoon is riveted and inserted into a cork. Fig. 2 shows this in position, inserted in a hole in a block representing a section of a shelf of a pneumatic trough. In case the shelf is not provided with a hole, the wire may be inserted in a piece of lead as shown in Fig. 3. When using the

¹Length 6.5 cm. for a twelve ounce wide mouth bottle used as receiver.

device the cork is inserted *lightly*, the phosphorus is put in the cup and ignited by touching it with the end of a wire or file that has been heated in a flame, and a bottle inverted over it as usual. The expulsion of some air takes place but the stationary support withstands the efflux and influx of water satisfactorily and the bottle may be shaken to hasten the dissolving of the phosphorus pentoxide.

When the oxygen is thought to have been removed the holder

FIG. 1.

FIG. 2.

is dislodged from its place in the hole by means of the bottle, and moved over the edge of the shelf by sliding the bottle, whereupon it drops down into the water, entirely out of the way, extinguishing any remaining bit of burning phosphorus, and leaving the receiver quite free for experimentation.

FIG. 3.

FIG. 4.

With the lead base the manipulation is similar, the standard being slid over the edge of the shelf by means of the bottle.

In this experiment the student should not overlook the fact that argon and other gases are present as well as nitrogen.

In Fig. 4, is represented a simple form of electrode holder for elementary experiments to illustrate chemical change brought about by the agency of the electric current, the converse of this, or phenomena upon which the theory of electrolytic dissocia-

tion is based. It consists of two brass connectors such as are used to join wires, put through holes in a block to which is screwed a round piece of such size as to be grasped by an ordinary retort-stand clamp, by means of which, adjustment in almost any position is easy. The device is shown in position for use in Fig. 5.

FIG. 5.

The conductors to the electrodes may be of copper wire (No. 8) over which is slipped tightly a rubber tube of appropriate size, or gutta-percha-covered battery wire may be used. The terminals may be of platinum let into the ends of the copper wire, any exposed copper being covered with a drop of sealing-wax. It is advantageous to have the covered copper wires long as shown, so that the holder may be out of the way and not obstruct view of the terminals. From the upper ends of the conductors run covered cables to the plug to connect with the source of current. The plug may be fitted with a fuse to protect the main circuit.

To illustrate the use of the apparatus the directions for an experiment are given herewith.

ELECTROCHEMICAL ACTION.²

Experiment 65.

- (a). Clean carefully and rinse a No. 1 beaker (small size) and measuring cylinder. Pour 25 cc. of distilled water into the beaker. Lower³ the electrodes into the water. Insert plug. Is there any evidence of the passage of the current, as indicated by the formation of bubbles of gas at either electrode?

Withdraw plug. Raise electrodes out of the water.

- (b). To 15 cc. of distilled water in the beaker, add 10 cc. of alcohol. Lower electrodes into the solution. Insert plug. Does the current pass?

²From Laboratory Exercises, Baskerville and Curtis. D. C. Heath & Co.

³When the electrodes are to be raised or lowered, loosen the screw holding the collar to the vertical retort-stand rod, not disturbing any of the other adjustments.

Withdraw plug. Raise electrodes.

- (c). To the solution used in (b) add 10 drops of chloroform. Lower electrodes into the solution. Insert plug. Does the current pass?

Withdraw plug. Raise electrodes.

- (d). To 20 cc. distilled water in the beaker add 5 cc. dilute sulphuric acid. Lower the electrodes. Insert plug. At which electrode is hydrogen given off? How can you tell? Is this the positive or negative electrode? The cathode or anode? If the hydrogen is given off from the spiral, reverse the current by withdrawing the plug reversing and reinserting it.

Withdraw the plug. Raise electrodes.

- (e). Pour 25 cc. of sodium hydroxide solution into the beaker. Lower the electrodes. Insert the plug so that hydrogen will be given off at the sheet platinum electrode.

Withdraw plug. Raise electrodes.

- (f). Pour 25 cc. of copper sulphate solution into the beaker. Lower the electrodes. From your experience in (d) and (e) insert the plug so that the sheet platinum electrode will be the cathode. Allow the current to pass about two minutes.

Withdraw plug. Examine deposit on cathode. Test the liquid in the beaker with litmus paper. Rinse the electrodes with water.

The application of a device already in use in other departments, as for giving out qualitative "unknowns," is shown in Fig. 6, for the purpose of distributing a number of chemicals for experimentation. In the manual referred to above, a new departure is made in the study of the metals, their oxides, sulphides and chlorides, in the work of the second semester.

For example the student is asked to examine samples of fifteen oxides⁴ of typical metals and record in tabular form his observations of their properties, such as color, physical appearance and so forth. Their action with water is then tried systematically, the action of reducing agents (on selected ones) and finally the action of acids. It thus becomes necessary for every student

⁴Sodium peroxide, magnesium oxide, calcium oxide, aluminum oxide, stannic oxide, lead monoxide, red lead oxide, lead peroxide, arsenic trioxide, zinc oxide, cadmium oxide, mercuric oxide, copper oxide, ferrous oxide, ferric oxide.

in a division of, say, twenty-five, to take fifteen samples. This, if done in the usual way, each student going to the proper reagent bottle for a sample, would cause much confusion, disorder, loss of time, mixing of reagents, and waste of material. All

FIG. 10.

these evils are avoided and other advantages gained by the use of the simple block holding fifteen two-drachm homeopathic vials as shown. Labels, preferably printed, and painted over with collodion, should show the chemical name, common name if any, and formula of each compound.

One set of bottles may serve for two students' use if necessary.

It was thought that inconvenience might be experienced from the necessity of frequently refilling so many small containers, but experience showed the contrary. The smallness of the bottle seemed to exercise some psychological effect that brought about a surprising economy of reagents, an item worthy of consideration when some mercury compounds, for instance, sell for a dollar and a half a pound.

It was found that one filling sufficed for six divisions of twenty-five students, hence for classes of one hundred and fifty requiring but one filling a year. Filling may be easily accomplished, excepting in the case of hygroscopic substances, by standing all the bottles of a given compound together in a box cover used as a tray, and allowing the reagent to flow into them from a paper trough held in the hand.

The interest aroused and valuable experience gained by the handling, examining, comparing and contrasting of substances in this way can hardly be overestimated. The student is given an opportunity to acquaint himself with the peculiarities of reagents, seldom gained otherwise, excepting by persons engaged in handling chemicals in a commercial way.

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