

THE HANDLING OF NOXIOUS GASES IN THE HIGH SCHOOL LABORATORY.

BY HARRY CLIFFORD DOANE.

Department of Chemistry, Central High School, Grand Rapids, Mich.

One excellent service that the newer text-books have rendered the teaching of high school chemistry is in the simplification of the apparatus and methods of their illustrative experiments, both for class room use and for the laboratory. None of the text-books, however, have given special attention, so far as I know, to the handling of noxious gases in laboratories that are unprovided with suitable ventilating hoods. The authors all take it for granted that all schools have these very useful contrivances; but unfortunately a very large share of our schools do not have them, and where they do have them, they are usually so few and so small that they cannot be satisfactorily used in most laboratory exercises.

This matter is one of great importance. It is assuredly not right for the teacher and pupils to work in poisonous and irritating fumes, and this must be done, if the usual text-book methods are followed in a laboratory without ventilating hoods.

In the Grand Rapids Central High School we enroll about one hundred pupils in chemistry. When the building was erected ventilating hoods were constructed, but for some reason they worked so poorly that they were removed previous to my coming to Grand Rapids. So we have been working on the problem as it has confronted us in this school. This is written with a hope that some other teachers may be helped by the methods that have proved successful with us. The methods themselves are not original, as will be seen. As an indication of our success in avoiding the bad results of handling bad gases in the open laboratory, I would say that our laboratory has been unpleasant from bad fumes but once or twice during this school year. I believe that we have not sacrificed anything of importance to gain this end. Fortunately our laboratory has fair general ventilation.

The apparatus that we use in the preparation of chlorine is a modification of one suggested by J. A. Giffin in his little book

entitled, "A Handbook for Teachers of Chemistry in Secondary Schools," a book full of good suggestions. The accompanying sketch (Fig. 1) will give at once an idea of how it works. The flask (a) is one of 125 c. c. capacity. From this a delivery tube

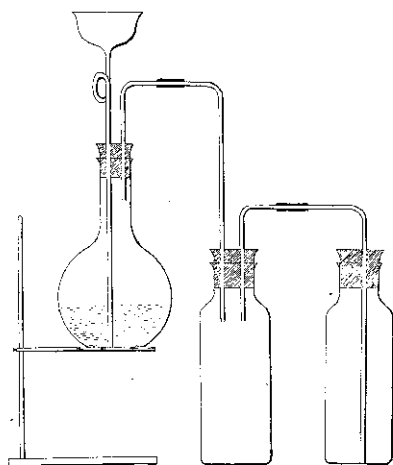


Fig. 1.

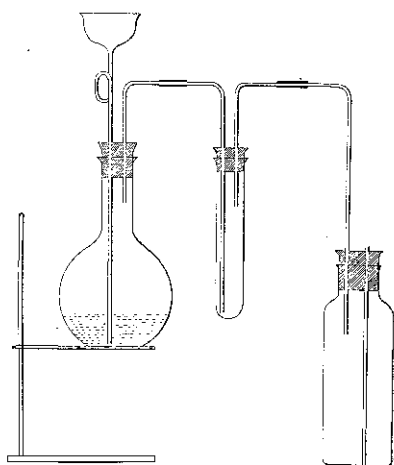


Fig. 2.

extends nearly to the bottom of a rubber stoppered 20 cm. test tube (b), from which again a tube leads to a rubber stoppered half liter (or perhaps better liter) bottle (c), having an exit tube extending from its bottom. The bottle (c) is filled with water and stands in a pan to catch the overflow. As the gas passes over into the test tube, the air and superfluous gas displace the water in the bottle. Calico, indigo solution, sodium, etc., can be placed in the test tube. When one has been used, another can be quickly put in its place. When through experimenting with the chlorine we set the whole apparatus outside the window until all action ceases and all the accumulated chlorine has escaped. Great use can be made of the window ledges in this way. In one school where they were too narrow, I made a shelf outside of the window for this purpose. At the beginning of the experiment each pupil may warm an evaporating dish and pour into it two or three cubic centimeters of ammonia, and place it near the apparatus. This will help to neutralize any chlorine that may escape. Hydrogen sulphide and sulphur dioxide may be handled in the same way.

Gases that are collected over water, such as nitrous oxide and nitric oxide, can be handled in the usual way without trouble, provided small amounts of materials are used and pupils are especially cautioned to be careful. With nitric oxide it is best to remove the apparatus and all used receivers to the outside window ledge as soon as possible after using. Keep covers on the receivers until they are placed outside of the windows.

Hydrochloric acid and ammonia can be easily handled by arranging the apparatus as in the sketch (Fig. 2). The bottles are filled about one-fourth full of water and the tube extends just into the water in the second bottle.

It does not seem best to have pupils attempt Marsh's test for arsenic in the open laboratory, and it may be wise to omit the preparation of carbon monoxide, as this gas, being odorless, does not give warning when escaping.

Nitric acid can be nicely prepared by using a 20 cm. test tube with cork stopper and delivery tube, collecting the acid in a small test tube standing in a pan of water. Use only a small amount, one or two grams, of sodium nitrate. For the class room bromine may be prepared by the use of the same apparatus as used for nitric acid, except that the test tube in which the bromine is collected should be partly filled with water.

We have found it hardest to find a satisfactory method of handling hydrogen sulphide. As suggested above it can be managed the same as chlorine in the study of the gas itself, but in qualitative analysis it is a harder proposition. We are using the solution, believing this to be better, even with its disadvantages, than to suffer the annoyance of using the gas in the open laboratory. The solution does very well where only a small amount of time is given to qualitative analysis, and I believe we ought not to give it much time in the high school.

In some of these experiments two pupils can advantageously be allowed to work together. This makes the danger from escaping gases less. When teaching in a small school I used frequently to take my classes out of doors for some of the experiments.

To be successful in this, as in all laboratory work, the teacher must keep everything well in hand himself.