35.5 grams of chlorine, or some whole multiple of 35.5 grams, but never less. Similarly, no compound of oxygen in the gaseous condition contains less than sixteen grams of oxygen, no compound of nitrogen less than fourteen grams of nitrogen.

If, then, 22.4 liters be taken as the standard volume, the weight of the various elements that it contains will be once, twice, three times, or some other multiple of the atomic weight. Twenty-two and four-tenths liters of ammonia contains 14 grams of nitrogen, and as no gaseous compound of nitrogen contains less than fourteen grams in this volume, it is reasonable to represent fourteen grams by the symbol N. There are three grams of hydrogen in this volume of ammonia, and so ammonia is represented by the formula N.H_3 . Water vapor contains two grams of hydrogen and sixteen grams of oxygen in 22.4 liters. No compound of oxygen contains less than sixteen grams of oxygen in this volume, hence the formula of water is written H_2O . If any new gas was discovered containing eight grams only of oxygen in 22.4 liters, eight grams would require to be represented by the symbol O, and the formula of water would be H_2O_2 . Hitherto no such gas has been discovered, and it would be strange if among all the compounds known none should have the minimum quantity of oxygen.

Expressed in terms of the atomic hypothesis, it would be strange if among all the compounds of oxygen known, none should have less than two atoms of oxygen in the molecule, and still further that none should have an odd number of atoms. It is hoped that this article may be of use to teachers in their endeavor to help pupils to understand the real meaning of chemical formulæ.

APPARATUS FOR TRANSMITTING GAS FROM ONE VESSEL TO ANOTHER.

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The teacher of chemistry frequently finds it necessary to use small quantities of pure gas for experimental purposes. Having prepared a small quantity of gas he often finds it difficult to transfer the gas from one vessel to another without mixing it

with air. To overcome this difficulty the apparatus described in this paper has been used with good results. It is simple and easily prepared, the gas can be easily controlled and any pressure may be obtained to transfer it from one vessel to another.

The accompanying diagrams, 1 and 2, will fully explain the method. A and B are two Wolff bottles fitted with perforated

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rubber stoppers having two pieces of glass tubing, E and F, passing to the bottom of the jars and connected, outside, by rubber tubing. If Wolff bottles are not available any large bottles with wide mouths and fitted with double perforated stoppers will do. Fill A with water or other liquid which will not absorb the gas. Arrange as in Fig. I. Leave the neck, G, open. Connect D with the gas generator. Raise A above B so as to diminish the pressure in driving the liquid from the vessel A to B. Open the stopcock or clamp at D. The liquid in A passes into B through the tubes E and F. Do not force all the water out of A, but leave enough to cover the bottom of the tube E as far as C. Close the clamp D and disconnect from the generator. Connect D with drying tube and then to the vessel to be filled with gas. Fill or nearly fill B with water. Place B above A. Put a funnel with glass stopcock in G and make the stopper air-tight. The apparatus will now be arranged as in Fig. 2. Greater pressure can be ob-

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tained by having a long funnel in G. Now open the clamp at D and the stopcock in the funnel. The liquid in B will pass into A and the gas in A will be forced where desired. By closing the stopcock in the funnel the pressure is removed and the gas ceases to pass out of A.

If sufficient pressure cannot be obtained in this way, a glass tube may be placed in the stopper in G and this connected with a rubber bulb such as is used in an ordinary atomizer. Very great pressure may be obtained in this way.

AN IMPROVED PORTABLE GAS GENERATOR.

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The great number of gas generators described in the literature is good evidence that a wholly satisfactory form has not yet been produced. The popular Kipp apparatus has two serious defects, which are only too well known: (1) on account of imperfect circulation of the solution the action stops long before all the acid is exhausted; (2) the apparatus must be completely emptied at each addition of fresh solution. The two defects have been completely overcome in Ostwald's generator.* The latter gives highly satisfactory results as a stationary apparatus, but it is not compact,

* Ostwald, *Principles of Inorg. Chem.*, 270 (1902).