AN EASY AND QUICK METHOD OF DETERMINING THE AMOUNT OF CARBONIC ACID IN AIR FOR HYGIENIC PURPOSES.

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SINCE the amount of carbonic acid (CO_2) in indoor atmospheres is taken as the best and most accessible index of their fitness for breathing and of the efficiency of ventilation, an easy and quick method of estimating the amount of this gas in air is a matter of considerable practical importance. Some three years ago the process I am about to describe occurred to me. Having found it satisfactory, I propose to make it public.

The method is based on the fact that the beautiful pink colour which is produced in a solution of lime or baryta by the addition of phenol-phthalein disappears entirely when the alkalinity of the solution is removed by CO_2 . A very weak solution of baryta is therefore made, and to it is added a solution of phenol-phthalein until the pink colour ceases to deepen. It is not necessary to weigh the baryta or graduate its solution further than to make it just so strong that a distinct but not deep colour is produced on the addition of the phenol-phthalein. I find it convenient to have two solutions of baryta, one saturated and the other graduated as described. The solution of phenol-phthalein is made according to the directions given in Parkes's *Hygiene*. For making the solutions, if distilled water is not attainable, ordinary clean water will do.

Apparatus—1, Receiver; 2, Air-pump; 3, India-rubber tube.

The apparatus consists of (1) a graduated glass receiver, which has the half of the cylinder opposite to the graduation marks painted white, and which is fitted with a cap bearing a two-way stopcock; (2) a brass air-pump; and (3) an india-rubber tube with fittings to connect the pump and receiver. The receiver I use has a capacity of 75 c.c., and is graduated in 5 c.c. divisions.

Before experimenting with the apparatus, the amount of air which one stroke of the pump will exhaust from the receiver when the latter contains a definite quantity of solution is found out by putting a measured quantity of water in the receiver and drawing one stroke of the pump. After immersing the receiver in water, the stopcock is opened, water rushes in to fill the vacuum, and its amount is noted. If the amount of water which enters is not accurately measured by the graduation of the receiver, the quantity originally put in should be varied until this takes place, and then the operation should be repeated several times to see that the pump works uniformly. Of course it is not necessary to do this at each experiment, but it should be done from time to time to test the working of the pump.

In making the experiment the determined amount of pink solution is put into the receiver and the cap screwed on. The stopcock is closed and the receiver is well shaken to expose the contained air to the action of the baryta. The solution should be strong enough to be still pink at this stage. The receiver is now connected with the pump, the stopcock is opened, and one stroke made. Then the stopcock is quickly closed to the pump, the other way opened, and air allowed to enter. Both ways are now closed, the receiver

shaken again, and the colour of the fluid observed. This operation is repeated until the pink colour entirely disappears. The amount of air which brought about the change is obtained by adding together the quantity at first in the receiver and that drawn through by the total number of strokes of the pump. If the fluid is put into the receiver in a different atmosphere to that to be examined the contained air must be all exhausted by making several strokes of the pump and then the air under examination allowed to take its place.

If the strength of the baryta solution were known the amount of CO_2 present could be calculated from a single experiment. For sanitary purposes, however, it is not necessary to discover the absolute amount of CO_2 in an indoor atmosphere; all that is required to be known is the amount of the gas there compared with the external air. The latter is therefore taken as the standard and assumed to contain the usual amount of CO_2 , namely, 0.4 per 1,000 volumes. When, therefore, the experiment is made in the external air and in the air to be examined the relative amounts of CO_2 present in the two atmospheres is obtained.

Taking an experiment made in the external air as a standard I consider much better in many ways than working with a standard solution. It does away with the necessity of delicate balances, which are possessed by few, and dependence on the correctness of an unstable solution. Besides, it has only to be done once for all the examinations, no matter how numerous, made with the same solution about the same time. It is of importance to point out that the colour of the fluid in the receiver, in all experiments of a given set, must be judged by the same light. Thus it would not do to judge the colour in the external air experiment by daylight and that in an indoor atmosphere by candle or lamp light. When working at night I find it most convenient to use the same candle for all the experiments.

At the same time that the examination for CO_2 is made the temperature of the air should be taken, in order that the necessary correction may be made. That is, if the internal atmosphere is warmer than the external—as in most cases it is—0.2 per cent. must be added to the result for each degree F. of difference.

I may now illustrate the working of the method by an example. Suppose that into a receiver of 75 c.c. capacity, 30 c.c. of solution are put, and that one stroke of the pump exhausts from the receiver, after the addition of the fluid, 25 c.c. of air. Now suppose the experiment to be first made in the external air, the temperature being 60° F., and that it is found that, besides the 45 c.c. of air at first remaining in the receiver, 20 strokes of the pump have to be made before the pink colour is removed, or, in other words, $45 + (25 \times 20) = 545$ c.c. of air bring about the change. Again, suppose the experiment to be repeated in an indoor atmosphere, the temperature of which is 70° F., and that besides the 45 c.c. of air in the receiver, 8 strokes of the pump are required to discharge the pink colour, or $45 + (25 \times 8) = 245$ c.c. of air. The amount of CO_2 , therefore, in the latter atmosphere is $0.4 \times \frac{245}{545} = 0.889$ per 1,000 volumes uncorrected for temperature, or $0.889 + 0.889 (\times 0.002 \times 10) = 0.906$ per 1,000 vols. corrected.

There will be abundance of opportunities for employing a method of examining air such as I have described this one to be—quick and easy.

LITERARY INTELLIGENCE.

MESSRS. LONGMANS will shortly publish a work by Professor and Mrs. Percy Frankland, entitled *Micro-organisms in Water*. It will not only deal with the presence and significance of bacteria in water, but also with the various means of effecting their removal, and an account will be given of what is known concerning the vitality of pathogenic microbes in various waters. A tabulated description of the micro- and macroscopic characters of all the micro-organisms, both pathogenic and non-pathogenic hitherto discovered in water, will be appended, whilst a special part will be devoted to the methods involved in the bacteriological examination of water. The work is intended to serve as a handbook for all interested in the sanitary aspects of water supply.

On Monday evening the Royal College of Physicians of Edinburgh entertained the Lord Mayor of London, the Lord Mayor of Dublin, the Lord Provost of Edinburgh, the President, Councillors, and certain members of Congress and other guests to dinner in their Hall in Queen Street.