SIMPLE EXPERIMENTS IN PHYSICS.

BY GEO. M. HOPKINS.

The experiments in the diffusion of gases described in the last article may be tried on a large scale by employing a porous Turkish water cooler instead of the porous cell, and using a larger and longer glass tube. A large bell glass or glass shade may serve as the gas-containing vessel. The action may be made more distinctly visible by coloring the water.

A convenient and inexpensive way of showing the same phenomena on a small scale is illustrated by Fig. 1. An ordinary clay tobacco pipe answers for the porous vessel. A short, centrally apertured cork is fitted to the bowl of the pipe, a glass tube, of about one-eighth inch internal diameter, is fitted to the bore of the cork, and the cork is carefully sealed. By connecting the stem of the pipe with a gas jet or hydrogen generator, by means of a flexible tube, and inserting the glass tube a short distance into water, the gas will bubble up through the water. After shutting off the gas at the burner, or by doubling or pinching the rubber tube, the water will immediately rise in the glass tube—showing that in the exchange of gas and air through the pores of the clay, the outward movement of the gas has been much more rapid than the inward movement of the air, thereby producing a partial vacuum, which causes the water to rise.

By breaking off the stem of the pipe near the bowl, the pipe and glass tube may be plunged in a deep glass jar, when the experiment may be proceeded with as follows: A little water, say one-half inch in depth, is poured into the jar, after which the jar is filled with carbonic acid gas. Illuminating gas, or hydrogen, is allowed to flow through the pipe while it is removed from the jar, so as to drive out all the air and fill the pipe with gas. The gas is now shut off and the pipe is immediately placed in the jar with the glass tube plunged in the water. The effect is the same as in the case of the air and gas, *i. e.*, the carbonic acid gas goes in and the hydrogen gas goes out; and when equilibrium is established, the pipe will contain some carbonic acid. This may be proved by removing the pipe from the jar and plunging the glass tube into some clear lime water, then allowing the gas to flow only long enough to force out the contents of the pipe. The presence of the carbonic acid is indicated by the milky appearance of the lime water, which is due to the formation of carbonate of lime.

There is sufficient carbonic acid in the exhalations of the lungs to show an action which is the reverse of that observed in connection with illuminating gas. When the pipe is blown through, and the end of the stem is quickly and completely stopped, one or two bubbles will escape from the glass tube, showing that the inward movement of the air through the pores of the clay is more energetic than the outward movement of the carbonic acid.

The diffusion of gases may be shown by the well known experiments illustrated by Figs. 2 and 3. A medium sized fish globe, a very small fish globe which will pass into the larger one, and a piece of bladder, are the requisites for this experiment.

The small globe is filled with carbonic acid gas, and the bladder, previously moistened, is placed loosely over the mouth of the jar and tied so as to render the connection between the bladder and the globe airtight.

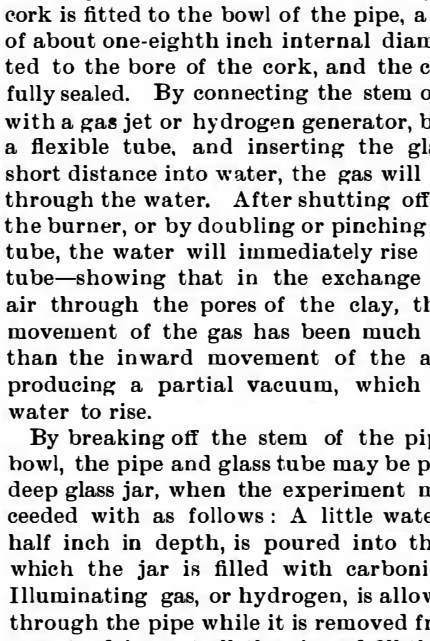
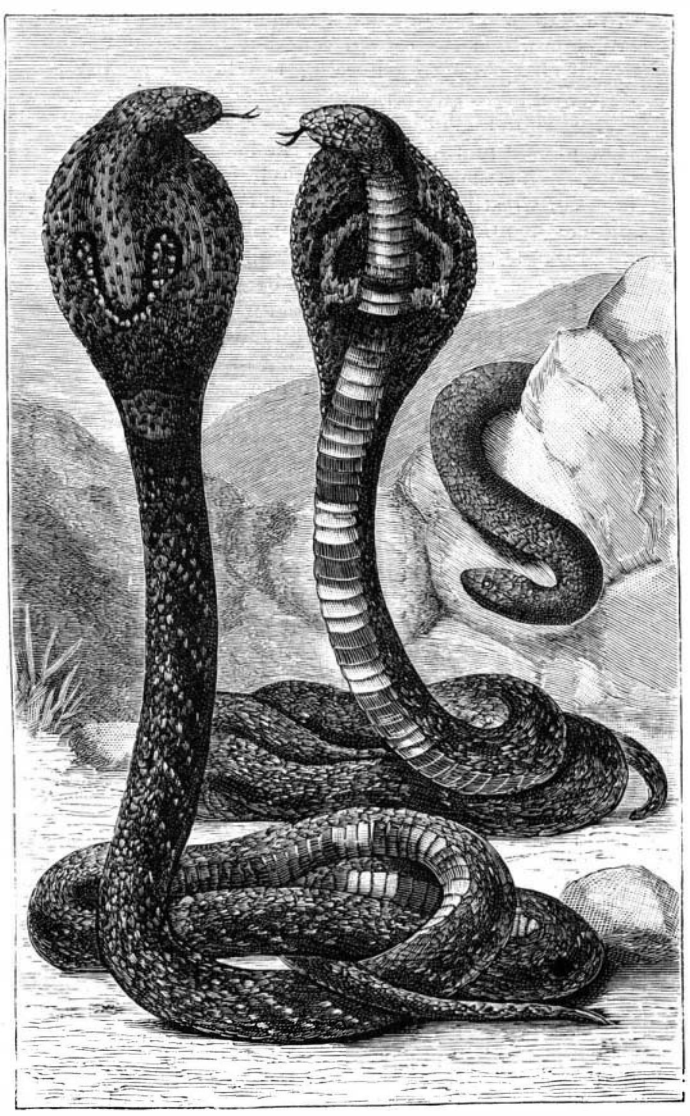


Fig. 1.—SIMPLE WAY OF SHOWING THE DIFFUSION OF GASES.

A good way to insure a tight joint is to stretch a wide rubber band around the neck of the globe before applying the membrane. The large fish globe is filled with hydrogen or illuminating gas, and the small globe is placed under it, as shown in Fig. 2. As the hydrogen passes inward through the membrane mu more rapidly than the carbonic acid passes outward, the membrane is distended outwardly. It requires a little time to produce a visible effect. When the small globe is filled with hydrogen, and the large one with carbonic acid, the membrane will be distended inward as shown in Fig. 3. In this latter case the experiment may be performed with the least trouble by placing the large globe with its mouth upward, and closing it by means of a plate of glass.



THE COBRA DE CAPELLO.

Endosmose proceeds from the rarer toward the denser gas. The law governing the diffusion of gases, according to Graham, is that *the force of diffusion is inversely as the square roots of the densities of the gases.*

When two miscible liquids are separated by a porous partition, they diffuse one into the other. A simple endosmometer for showing this action is shown in Fig 4. It consists of a small funnel having its mouth closed by a piece of bladder held in place by a wide rubber band stretched around the rim of the funnel. The funnel thus prepared is immersed in water, for example, and is filled to the level of the water with sirup of sugar. The water passes through the bladder into the funnel and the sirup passes out. The rise of the liquid in the funnel indicates that the water enters more rapidly than the sirup escapes. The presence of the sirup in the water may be detected by taste. That the water passes through the membrane into the funnel may be proved by adding to the water a small quantity of sulphate of iron, and after the experiment has proceeded for a time, adding some tannin to the contents of the funnel. If sulphate of iron is present in the funnel, the sirup will turn dark upon the addition of the tannin.

If the neck of the funnel proves to be too short, a glass tube may be connected with it by means of a short piece of rubber tubing.

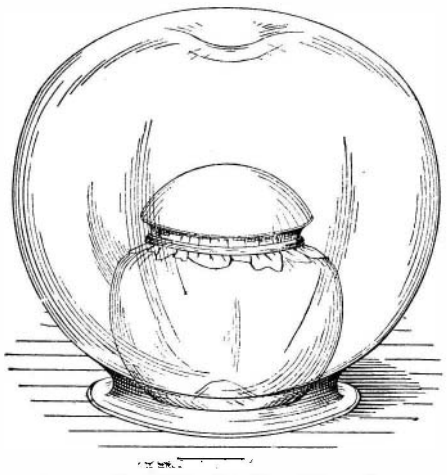


Fig. 2.—PRESSURE BY ENDOSMOSE.

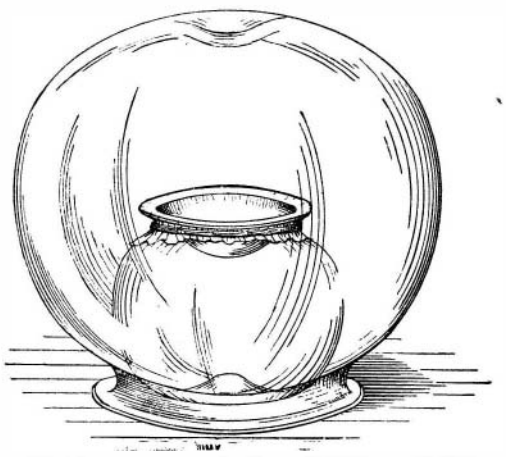


Fig. 3.—PARTIAL VACUUM BY EXOSMOSE.

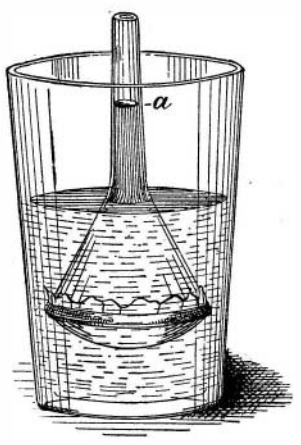


Fig. 4.—ENDOSMOMETER.

THE SPECTACLED VIPER.

The menagerie of reptiles of the Paris museum is at present in possession of three specimens of the serpent called the cobra or spectacled viper (*Naia tripudians*, Merrem). One of these was brought from Ceylon several years ago by Mr. Errington, while the two others, which are of remarkable size, have been obtained very recently, and came from Calcutta.

The cobra has attracted attention in all ages, not only on account of the peculiarity of its markings, whence it derives one of its names, but especially from the singular attitude that it assumes when excited, and from the number of victims that it annually makes. It is related to the *Elaps* (harlequin snake), and, like it, belongs to the colubriform group of venomous reptiles.

It has an elongated, rounded body, slightly inflated in the middle, and the head is of the same size as the neck, so that, when at rest, the animal has the aspect externally of an adder. As with the latter, the top of the head is covered with large scales arranged in a similar manner. When excited, it immediately raises the fore part of its body, while at the same time it dilates its neck into a broad membraneous disk, convex on the dorsal side, at the extremity of which is situated the horizontally directed head. The dilatability of the neck, which has given the serpent the name of *Cobra de capello* (hooded snake), is due to the great length and slight curvature of the cervical ribs. These, directed backward and applied to the sides of the vertebral column during repose, take, at the moment the animal is excited, a transverse direction, through the action of muscles under the control of its will. The skin in the region of the neck is thus distended into a broad, elongated disk, which the posterior extremity of the head joins in front and upon which the scales, separated from one another through the effect of the distension, and having light colored intervals between them, present the aspect of a network of which they occupy the meshes. When the excitement ceases, other muscles draw the ribs back to their first position, and the neck resumes its ordinary form.

The mouth is very wide, and the upper jaw, on each side, is provided in front with an immovable venomous fang, followed by one or two small, smooth teeth. In most cases, the general color is a uniform dark brown and almost black, sometimes marked at the sides with transverse white striæ. In a state of distension, the neck exhibits two white blotches above, which are roundish and symmetrical and have a black center, and are connected on the posterior side by a white, black bordered arch, the convexity of which is turned backward. The whole arrangement offers the aspect of a pair of spectacles, and has obtained for the animal one of the names that it bears. The anterior portion of the ventral surface is whitish and marked with one or more transverse black bands.

Two of the museum specimens are colored in this way. In one of them, however, the fundamental color is not so dark, and in the third it is of a very pale brown. The characteristic cervical blotches are frequently more or less effaced or modified in form, or even entirely absent.

The spectacled adder attains considerable size. The largest of our specimens has a length that may be estimated approximately at five feet; but, among the natural products exhibited by the Cingalese at the Garden of Acclimation, two years ago, there was a cobra's skin whose length beyond a doubt exceeded six feet.

The serpent is oviparous, that is to say, the development of the embryo is effected wholly within the body of the mother, and the egg is not laid until that is finished. The covering of the egg is then a very thin, weak membrane, which the young animal promptly ruptures immediately after the egg leaves the mother's body.

The cobra inhabits the Indies, Bengal, Siam, Cam-