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.

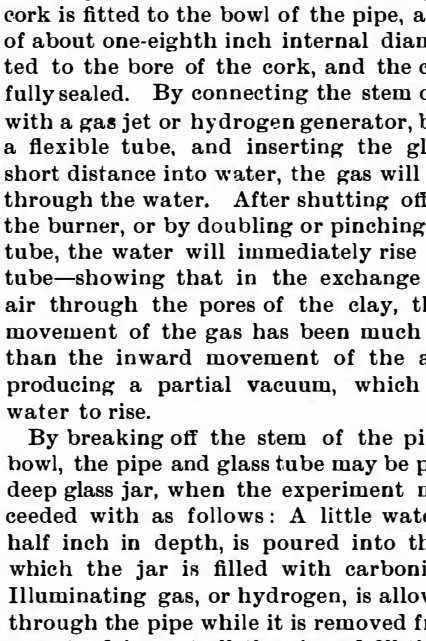
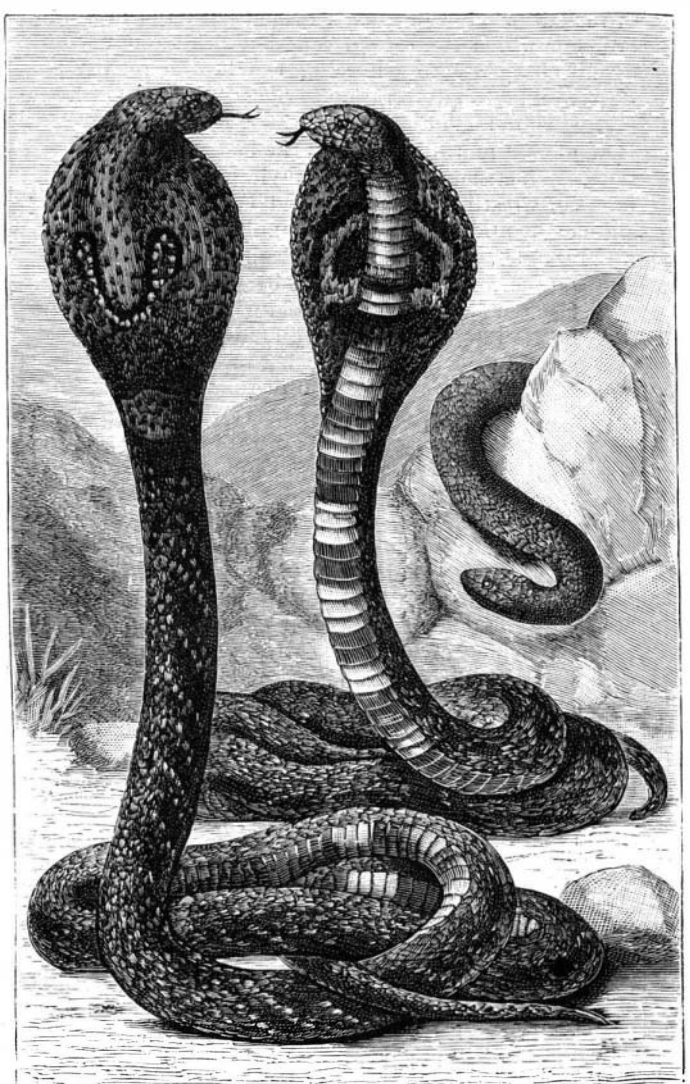


Fig. 1.—SIMPLE WAY OF SHOWING THE DIFFUSION OF GASES.

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.

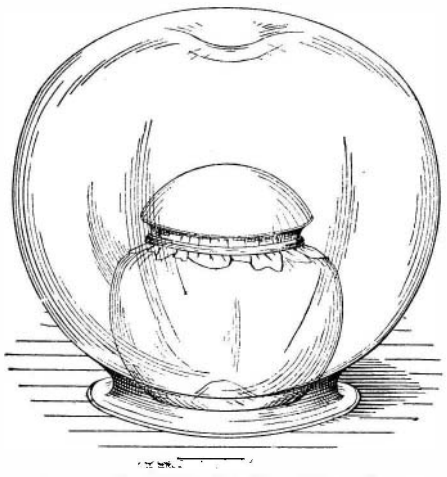


Fig. 2.—PRESSURE BY ENDOSMOSE.

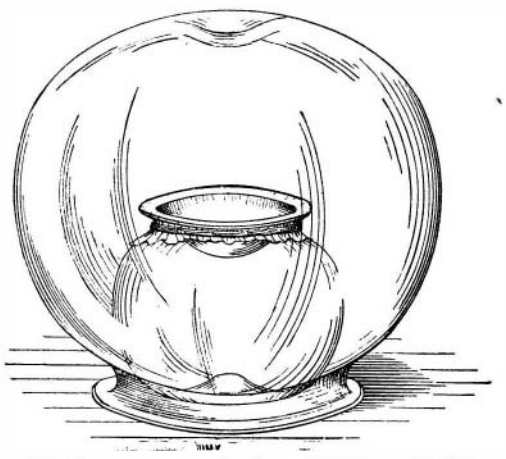


Fig. 3.—PARTIAL VACUUM BY EXOSMOSE.

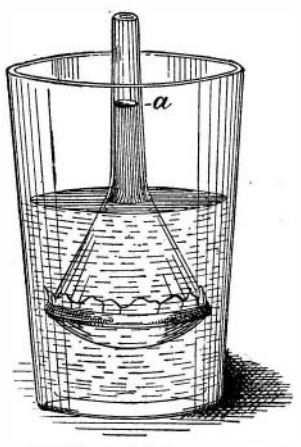


Fig. 4.—ENDOSMOMETER.

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-

bodia, Cochin China, Tonkin, Annam, China, Malabar, Ceylon, and the principal islands of the Indian Archipelago, Sumatra, Java, Borneo, and the Philippines. Up to the present, it has not been found in the Celebes or the Moluccas. In the eastern parts of Asia, in Afghanistan and in Persia, it is replaced by the *Naia haje*, which likewise inhabits the greater part of Africa, and especially Egypt, where, under the name of asp, it has played a role no less celebrated than its congener in the Indies.

The cobra keeps itself habitually in the trunks of old trees, in ruined walls, in piles of stones, and in bamboo brush. It seems to seek the vicinity of man, where it perhaps more easily finds the small rodents that form its principal food. It is especially at sunset or during the night that it emerges from its retreat to seek food. It seizes not only small mammals and birds, but also lizards, frogs, toads, and fishes. The batrachians just named, along with rats and mice, constitute the exclusive food of the museum specimens. The cobra willingly climbs up roofs with the hope of surprising some animal there. It has sometimes been observed on the top of cocoanut trees hunting for birds. It is a good swimmer and frequents watercourses, and it has even been met with at sea at a great distance from the coast. It attacks its prey in the manner that adders do, by seizing, and at once swallowing it, without encircling it with its coils in order to crush it, as boas do, and without waiting for it to die after injecting its poison into it.

It is extremely irascible, and, provided that it is excited, it dilates its neck, turns its head to the left and right to see where the danger is, and then pounces upon its enemy with the rapidity of an arrow, and at the same time emits a sound analogous to that made by blowing into a narrow tube, whence the name of spitting serpents, given to the Naias in general. This appellation, due to the notion that the Naias first project their saliva or even their venom upon the enemies that they attack, is but partially justified by facts. Observation of specimens kept in captivity shows that, in the conditions that we have just supposed, the respiration is quickened, the inspirations are deep, and the body alternately expands and contracts. An abrupt expiration coincides with the animal's attacking motion, and causes the noise mentioned above. The expelled air is evidently capable of carrying along a little saliva (although we have never verified this), but this is a thing not peculiar to the Naias.

The cobra is the most widely distributed of venomous serpents in the countries that it inhabits, and, as its poison is very active, it annually causes, especially in the Indies, a large number of deaths. So it is justly dreaded by the natives. Its nocturnal habits and its tendency to approach dwellings still further increase the danger, by rendering its vicinage more immediate. It is even said to introduce itself under the floors of houses. Cases are relatively rare in which persons who are bitten become cured outside of any treatment. The Hindoos, and particularly the snake charmers, possess various empiric remedies, whose secret they keep, and which, according to the accounts of travelers, are not always devoid of efficacy.

The curious, graceful, and haughty attitude assumed by the cobra when irritated, and the subtle and so often mortal venom that it secretes, have very naturally exerted a profound impression upon the mind of the poorly enlightened nations among which Nature has confined it. They have regarded it as a mysterious being favored by Buddha himself for having protected him against the rays of the sun when he descended to earth, its malevolent power being designed to avenge the injuries done to the divinity. Governed by a superstitious fear, they have spared its existence, and surrounded it with a respect carried to veneration. Volumes might be filled with the legends and stories, more or less veracious, to which it has given rise.

In the Indies, all the mountebanks are provided with cobras, which they exhibit to the public for pay, and it appears that the industry is quite lucrative. The charmers are capable of rendering the animal harmless, at least for a certain length of time, by breaking off its fangs by means of a bit of cloth that they hold out to it and then pull back suddenly after it has seized it. Well authenticated cases are cited in which the serpents used by jugglers had their venomous fangs intact. After a more or less prolonged training, the charmer ends by exerting upon his subject a genuine and very curious power. The people consider such power as magical and supernatural, and the Brahmins carefully keep them in this belief.

The cobra seems to be completely subjugated, fascinated, and submitted to the will of the charmer. Under the influence of the monotonous and slowly drawn tones of a small flute, the snake performs cadenced motions. Certain touches suffice to throw it into a state of lethargy, and at certain orders it becomes as stiff and inflexible as a rod, while a few signs cause it to resume all its flexibility. These facts, affirmed by authors worthy of belief, merit being submitted to verification by science. In the meanwhile, let us remark that the processes employed by the charmers much resemble those used by physicians to produce hypnotism, and that the phenomena observed have much analogy with those seen in the hypnotized, and that perhaps they are of the same nature.—*La Nature.*

Microscopy.

One of the most comical things that we have seen in a long time, says the *National Druggist*, was a United States internal revenue agent, who came into the office of the editor a few days ago, armed with the new microscope which the department has dealt out to the agents charged with enforcing the law in regard to butter and lard adulterations. The official, a polished and educated gentleman, was in a heap of trouble. He had that morning received the instrument and the book of instructions accompanying it, and several hours of wrestling with both had thrown him into a state of mental and physical anguish, from which he sought relief. He had brought the apparatus along and wanted to know how to use it. The microscope, a new fashioned cheap affair, fitted with French or German triplets, looked more like an old time candlestick than anything else, the slide being inserted in the base and illumination obtained by directing the instrument bodily toward the source of light. It was accompanied by a polarizing apparatus, which was to be inserted in the base after the manner of the slide. After this had been done the instrument would no longer stand upright, and when laid on its side, after the fashion of such things, it would persist in rolling off the table. As dents in it showed, this must have happened several times during the few brief hours in which it had been in use. We know it happened three or four times within the hour or so that the gentleman was wrestling with it while in our office.

The "book of directions" informed the official that he was to pull out one tube "about five-eighths of an inch" and another "about three-quarters of an inch," and then he was to smear a little of the grease under examination on a slip, cover it with a cover glass, and insert the slip in the instrument, turn the polarizer, and if he saw nothing the specimen was lard or butter (we forget which), but if he saw something it was not lard or butter. These are not the words, but convey *the sense which the agent was able to extract out of them.* After some examination of the apparatus, and the exercise of a little patience, we were enabled to show the official how the thing was intended to work. Whether he will ever be able to make any use of the apparatus and the information thus gained is quite another thing. The idea of sending out men entirely ignorant of microscopy, and armed with contract toy microscopes, to determine questions which are even now matters of controversy among experts, is one which would be supremely ridiculous were it not such an outrageous travesty upon science and common sense. It is, however, an illustration of the prevalence of the idea that all that is necessary to make a microscopist is to own a microscope.

Removal of Filaria from a Horse's Eye.

A Baltimore letter to the Atlanta *Constitution* says:

Recently Dr. Thomas W. Spranklin, assisted by Veterinary Surgeon John S. Colton, successfully removed a living worm or "snake" from the eye of an old mare belonging to Mr. Stansberry, of Patapsco Neck, Md. The animal, a dark bay, about fifteen and a half hands high, has been in the stables of Rice & Marshall, on North Frederick Street, for several days, and has attracted a good deal of attention from the curious. The parasite, technically known as filaria oculi equinus, was three inches long and had the general appearance of a piece of gray silk thread. It had its abiding place in the aqueous humor of the mare's left eye, and was in a state of incessant motion, wriggling about after the manner of the animalcules seen in a drop of water under a microscope.

It was first noticed in the mare's eye about six months ago, when it was so small as to be barely discernible. It grew steadily until it attained its present size. It was never still a moment, but kept up its activity without pause day or night. The poor old mare was kept in a state of perpetual nervous excitement by it, and wasted away till her ribs protruded through her rusty coat, and her flanks were as thin as it was possible for anything of flesh to be. Many showmen visited her and offered to buy her for exhibiting purposes, but her owner would not sell.

Dr. Spranklin began his operation by securely binding the old mare so that she could not move, and then laid her down on her right side. Then her left eye was treated with a solution made of ninety-three parts of rosewater and seven parts of cocaine. Small quantities of this solution were dropped into the eye, at intervals of five minutes, seven or eight times, until partial anæsthesia was obtained and it could be touched by the finger without pain to the animal.

Then an incision was made in the eye from the outer canthus or corner, between the cornea or eyeball and the sclerotic coat or white of the eye. The incision was made at about right angles with the eyelid, and so that it would be almost wholly covered by it when in its normal position. The instrument was kept in the wound until the aqueous humor had exuded. Then it was still retained in position, and used as a guide for a pair of very delicate spring forceps, whose blades were inserted into the opening.

The lance was then removed, and Dr. Spranklin, placing the index finger of his left hand upon the opposite side of the cornea, gently but firmly pushed the parasite toward the blades of the forceps. It was so very active that four or five times it wriggled away from their grasp. At last he was able to get a tight hold upon it and draw it out. It was very lively and lived for several minutes, in fact, until it was placed for preservation in a small vial of alcohol. The lips of the incision were drawn together and closed in a flap, the aqueous humor again flowed into and filled the cornea, and in less than three-quarters of an hour the old mare was back in her stall eating as calmly as though such a thing as a delicate surgical operation was beyond her ken.

Dr. Spranklin is firmly of the opinion that unless inflammation should ensue from want of proper nursing of the eye, it will soon be as well as it ever was, both in appearance and strength of sight. As to how the worm got into the animal's eye, he inclines to the idea that its germ was taken into the mare's system through water which she drank.

Curious Doings of Lightning.

A telegram from Crescoville, Pa., says: During the thunder storm that visited this region July 9, a maple tree in front of Miner Cresco's residence was struck by lightning. The only damage done to the tree was the splintering of a piece out of the trunk, midway between the ground and the lower branches. After the storm was over, Mr. Cresco went out to look at the tree. On the ground at the foot of it lay an immense black snake dead, and holding in its mouth a young robin. There was a robin's nest in the tree, and it was known to have had three young ones in it. As the tree had been struck by lightning, it was supposed that they had been killed. A boy went up the tree and found two young robins in the nest, alive and lively. It is supposed that the black snake had climbed the tree and robbed the nest of one of the newly hatched birds, and was descending the trunk as it was struck by lightning and killed with its prey in its mouth. The lightning thus avenged the robin.

A dispatch from El Paso, Texas, says: On the night of the 4th of July, this city and vicinity was visited by a thunder storm which, in the amount of electricity discharged, was unprecedented in this section. One of the peculiar manifestations of the lightning was in the striking of a tree under which a flock of goats had taken shelter. Fifty-two of the animals were killed, but only a slight trace of the lightning could be noticed on the tree.

Increase of Russian Home Industries.

The British Consul-General at Warsaw, Russia, states that the increases which are constantly being made in the Russian duties are having a serious influence in preventing imports into Russia, and German trade has suffered severely in consequence. The consul, reporting on the trade of last year, also points out that business with Great Britain has also decreased, there being a noticeable falling off in fancy cloths, Manchester cotton velvet, jute, felt carpets, cocoanut mattings, Nottingham curtains, leather and cotton beltings, Birmingham goods, Sheffield cutlery and tools, agricultural machinery and implements, leather for bookbinders, earthenware, and glass. There is also a decrease in cotton yarns and twist, knittings, Irish linen, chemicals, and aniline dyes. The only articles which seem to have held their own are power looms and spinning machinery. The consul further states that in consequence of the diminished importation of foreign manufactured goods, many small manufacturers in Warsaw have lately taken to producing articles which were formerly obtained from abroad, such as pins and needles, leather goods, umbrellas, cravats, silk ribbons, stays, etc., also silk, cotton, woolen, and kid gloves, felt and straw hats, small iron wares, tin goods, buttons, ready made clothes, knitted goods, musical instruments, toys and dolls, basket goods and carpets. Warsaw is, in consequence, rapidly becoming an industrial center.

New Naval Observatory at Washington.

The contract for the erection of the new Naval Observatory buildings, on Georgetown Heights, near Washington, has been awarded by the Secretary of the Navy for $307,811. This contract does not cover the piers or the domes, which are to be built by experts under the direct supervision of the observatory officers. There are to be nine buildings in all, including the main building—the great equatorial building, where the great telescope will be mounted; the clock room, where the observatory clock will be set up and the naval chronometers kept and corrected; two buildings for observers' rooms; the east and west transit buildings; and a boiler house. The material used will be Tuckahoe marble. Work is to be begun immediately, and the buildings are to be completed within eighteen months.