SIMPLE EXPERIMENTS IN PHYSICS.

BY GEO. M. HOPKINS.

A simple and efficient rotator, in which the means of communicating rotary motion does not appear on the screen, is shown in Figs. 1 and 2. In this apparatus a glass wheel, provided with a brass rim, is furnished with a shaft, which turns in a hole bored in the center of a thick glass supporting disk. The brass rim of the wheel is provided with a series of radial vanes, also with three clamping screws bearing on springs in the interior of the rim for clamping the objects to be rotated. A nozzle attached to the back piece is arranged to direct a jet of air upon the vanes, and thus cause the glass wheel to revolve. A Fletcher blow-pipe bellows furnishes a suitable blast for this purpose.

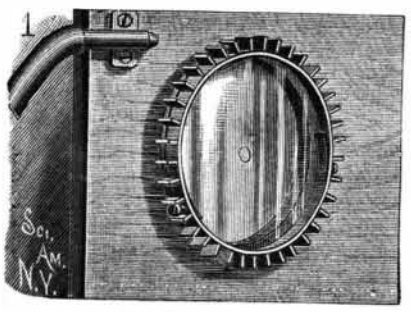

Fig. 1.—ROTATOR FOR THE LANTERN.

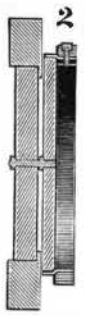

Fig. 2.—SECTION OF ROTATOR.

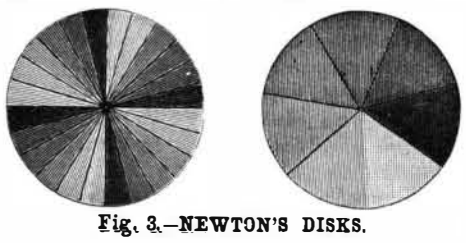

Fig. 3.—NEWTON'S DISKS.

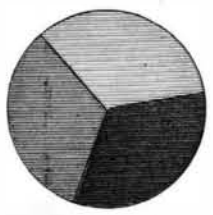

Fig. 4.—BREWSTER'S DISK.

To the rim of the glass wheel are fitted disks for blending colors. Among these are Newton's disks, Fig. 3, in one of which the colors of the spectrum are four times repeated, also a Brewster's disk. These disks are made by attaching colored films of gelatine to glass, or by tinting the glass by means of colored lacquer. The rotator is also provided with a circular cell filled with the liquids of different densities, to which allusion has been made in a previous article. This cell, when at rest, appears as in Fig. 5, and when in motion as in Fig. 6, the different liquids being compelled to assume certain relations with each other by centrifugal force, the heavier liquid, *a*, taking the position as far from the center of rotation as possible, the liquids, *b c d*, arranging themselves in the order of their densities.

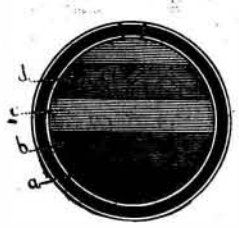

Fig. 5.

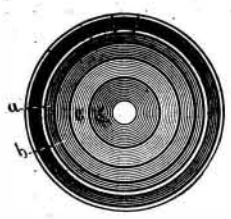

Fig. 6.

ACTION OF CENTRIFUGAL FORCE ON LIQUIDS.

The effect of a helix on particles of magnetic material suspended in a liquid isshown in the experiment illustrated by Fig. 7, which is arranged for projection or for individual observation. A short section of glass tubing, 2¼ inches in diameter and ¾ inch long, is ground true and smooth at its ends and clamped between two plates of glass with intervening rings of elastic rubber. Before clamping the parts together, one end of the glass tube is cemented to the packing ring, which in turn is cemented to the glass, and a small quantity of fine iron filings is placed in the cell, the cell is filled with a fifty per cent solution of glycerine and alcohol, and a helix formed of five or six layers of No. 16 magnet wire is placed upon the glass tube. The remaining packing ring is placed on the end of the glass tube, the second glass plate is put in position, the clamps are applied, and the apparatus is ready for use. This method of making the cell leaves an air bubble, which is needed to allow the liquid to expand freely.

By thoroughly agitating the liquid, the iron filings will be evenly distributed throughout the cell, and they will be prevented from falling immediately by the viscid nature of the solution.

When four or five battery cells are connected with the helix, the iron particles arrange themselves radially or at right angles to the wire surrounding the cell.

The effect produced in the magnetic field by the pressence of an armature is shown by the lantern experiments illustrated in Figs. 8 and 9.

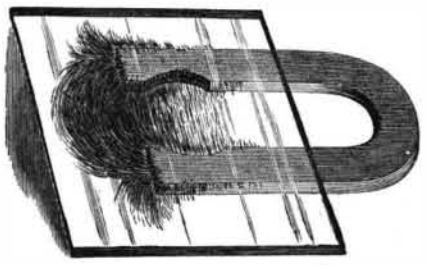

Fig. 8.—THE MAGNETIC FIELD.

In Fig. 8 is shown a permanent magnet having the form of a field magnet of a dynamo. This magnet is cemented to a plate of glass. When the magnet thus arranged is placed in a vertical lantern, with the glass uppermost, and a few fine iron filings are sprinkled on the glass, the usual magnetic curves are formed. The lines will extend straight across from one polar extremity of the magnet to the other, and at the ends will be formed symmetrical, approximately semicircular curves. When a cylindrical piece of iron, representing the armature core of a dynamo, is inserted between the poles of the magnet in the place usually occupied by the armature, the lines are deflected inward, becoming perpendicular to the periphery of the armature. The iron representing the armature is cemented to a second plate of glass. The iron particles arrange themselves in a more pronounced figure if the glass plate upon which they are sprinkled be jarred slightly.

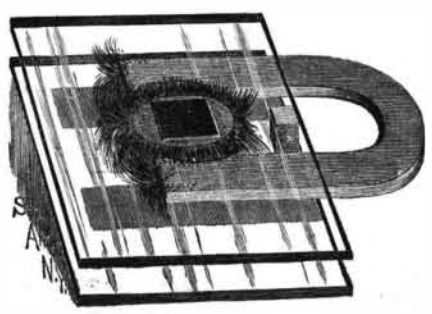

Fig. 9.—EFFECT OF AN ARMATURE ON THE MAGNETIC FIELD.

A very simple, pleasing, and at the same time instructive lantern experiment is illustrated in Fig. 10. A loadstone supported by a brass wire from the baseboard is arranged to project into the field of the lantern without showing the wire. Under the loadstone is placed a small cup filled with fine iron filings, and also in the field of the lantern. An unmagnetized needle is dipped in the filings and removed, showing that it has no power to lift the filings; then while it is still in the field of the lantern, the needle is rubbed across the end of the loadstone and dipped the second time into the filings. This time the needle takes up a quantity of the filings, showing that the loadstone has imparted magnetic properties to the needle.

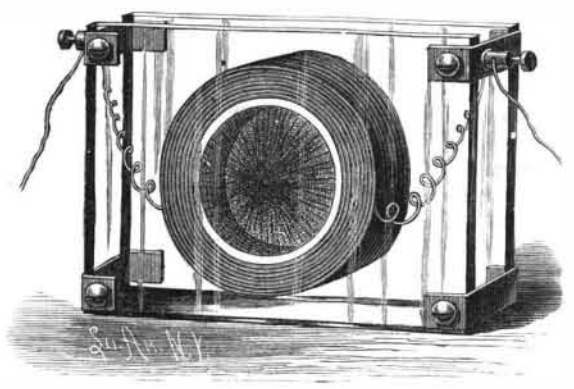

Fig. 7.—EFFECT OF A HELIX ON SUSPENDED PARTICLES OF IRON.

To render this experiment complete, an erecting prism must be used to cause the image to appear right side up on the screen.

THE LOWTH TELEPHONE.

This is a new and in some respects remarkable instrument, by which speech is transmitted, without making use of sound waves as in the Bell and other forms of electrical telephones.

In the Lowth telephone the transmission is effected by means of an electrical plug which is placed against the neck of the operator, near the vocal organs. The vibrations of the neck produced by the act of speaking shake or move the plug, thereby giving rise to corresponding electrical undulations, which pass over the wire to a receiver at the opposite end of the wire, and are there heard by the listener. A receiver and plug are both combined in one instrument, as shown in our engraving, which is from a photograph, and the telephone is used in the manner there represented. The instrument is held to the ear with the plug resting against the throat, as shown. The operator then speaks, and the voice is heard at the other end of the line, with the utmost clearness.

Fig. 10.—MAGNETIZATION BY LOADSTONE.

THE LOWTH TELEPHONE.

It is claimed that this new telephone is entirely distinct from what is usually called the Bell system, as the instrument employs no diaphragm, and is not operated by atmospheric or sound waves, but by the muscular vibrations that precede and also accompany the utterance of words and other sounds. These vibrations are imparted to the button which is held against the exterior surface of the throat, and conducted by proper mechanism connected therewith to the electrodes or current-controlling elements, thereby causing the distant receiver to reproduce the words or other sounds.

Another valuable and peculiar feature of this instrument is that the operator may be surrounded by all manner of loud noises and only his voice will be transmitted, and then he may speak almost in a whisper. This is a very valuable quality, as city lines are generally troubled with induction, accidental disturbances on the diaphragms of transmitters of the common type furnishing their full share of the load. This new method shuts out all accidentals.

James Lowth, the inventor, was the first and has been the only experimenter in this field, and to his efforts and exhaustive experiments is due the present perfection of the system, which is now controlled by the Lowth Stotho-Telephone Company, of Chicago. This novel device will rank among the most curious and wonderful of inventions.

A GAS-PROPELLED CARRIAGE.

At the exhibition of machinery which was held in Munich during the past year, the attention of the visitor was attracted to a vehicle with a motor constructed by the Rhine Gas Motor Works, Benz & Co., of Mannheim. This motor is driven by gas which it generates from benzine or analogous material. As can be seen from the accompanying cut, this new vehicle is well shaped compared with others of the same class. The motor, which is not visible from the outside, is placed in the rear of the three-wheeled carriage over the main axle, and the benzine used in its propulsion is carried in a closed copper receptacle secured under the seat, from which it passes drop by drop to the generator, and which holds enough benzine for a journey of about 75 miles. The gas mixture is ignited in a closed cylinder by means of an electric spark—a very safe and reliable arrangement. After regulating the admission of the gas, the motor can be started by simply turning a hand lever. The operator climbs upon the seat and, by pressing the lever at his left, sets the motor into operation, and it starts the vehicle, being connected with the back wheels. The speed of the motor can be increased or diminished at will by turning the lever backward or forward, and it can be stopped by pulling on the lever. The vehicle is steered in the same manner as a tricycle, by a small front wheel. It can attain a speed of about ten miles an hour, but in crowded streets it can be made to move as slowly as an ordinary vehicle. A quart of benzine is sufficient for an hour's trip, making the cost of the motive power about seven cents per hour, and the experiments with the vehicle in the streets of Munich during the exhibition proved the practicability of substituting this kind of motive power for the more expensive horse power in many cases.—*Illustrirte Zeitung.*

A GAS-PROPELLED CARRIAGE.

A Crew Disabled by Lightning.

The Guion line steamer Alaska, from New York, which lately arrived at Queenstown, brings intelligence of the ship Edward, from Havre, with a cargo of iron ore, whose captain reported that the vessel encountered a terrible electrical storm in the Atlantic on the night of the 31st ult., when in latitude 41 42 N., longitude 54 42 W., lasting for several hours. The vessel was continuously enveloped in lightning, which prostrated on the deck eleven seamen, and deprived them of sight for nearly half a day. The second officer and the boatswain were also dashed to the deck, and received serious injury, and the former was speechless for five hours. Three balls of fire exploded with a tremendous report over the main rigging, scattering flaming fragments over the ship, and driving the remaining members of the crew in terror into the forecastle. From 3 A. M. until 7 P. M. the captain and mate were the only persons on board capable of doing any work, and on them devolved the task of keeping the vessel before the easterly gale. The captain states that all on board the ship were trembling with fear during the time that the electrical storm lasted, which was the most terrible he ever witnessed, and he adds that no doubt the iron ore with which the Edward was laden acted as a magnet to attract the lightning.

The Texan Tarantula and Its Foe.

Dr. Horn, Philadelphia's distinguished entomologist, writes to the *Ledger* the following:

"In the not too fertile parts of the region from Texas to California lives a large spider known to the inhabitants as the tarantula and to naturalists as Mygale Hentzii. Its body is two inches or more in length, clothed with rusty brown hair, the legs long, and when extended covering an oval of four by five inches. As may be imagined, the mygale is not a handsome insect, and while it is looked upon with terror by most people, no one cares to handle it unless quite certain it is dead.

"In place of the web which usually forms the house of spiders, the mygale excavates a burrow in the loose soil, from which it wanders in search of its prey, consisting principally of members of the grasshopper family, or Cicades. The jaws are large and powerful, armed with long, stout fangs, with which they can pierce and kill their prey. One full meal will at times supply their needs for several weeks. In fact, during the moulting period they remain torpid and take no food.

"During its growth the mygale makes an unknown number of moults, that is, it sheds its outer coat when that has become uncomfortably close fitting, in the same manner as the common crab of our coast. At these times members lost from the body by accidents are partially replaced. If a leg is lost, the first moult produces a perfectly formed but short leg, subsequent moults increasing the size of the leg.

"While the mygale is a dread to most forms of insect life, there is one of which it, in turn, stands in mortal terror. Abundant in the same regions is a large wasp, with bluish-green body and golden-red wings. The body is about two inches long, the spread of wings nearly an inch greater. These wasps (Pepsis formosa) fly uneasily about in search of food for themselves until they discover a 'tarantula,' when a more definite course of action is assumed. The flight of the wasp is now in circles around its prey, gradually approaching it, the mygale meanwhile, in terror, showing fight, standing semi-erect on the two hinder pair of legs. A favorable opportunity presenting, the wasp stings the spider and renews the circle flight, repeating the sting until the spider becomes completely paralyzed. When the wasp is assured of the helplessness of the spider, it seizes him and drags him to a previously prepared nest. The eggs of the wasp are then deposited and the spider covered up. The eggs soon hatch, the spider is gradually eaten, and a new wasp appears to repeat the actions of its parent.

"By the sting of the wasp the spider is not killed, simply paralyzed, so that during the time it is being fed upon it retains vitality, furnishing living food to the newly hatched larvæ, which, by a curious instinct, feed first on those parts of the spider not essential to the maintaining of the little vitality remaining.

"Our common mud wasp, Chalybion, has similar habits. Its nests, made of elastic mud, are familiar to most people, as they are found abundantly in sheltered places about barns and other outhouses. These, when opened, will be found filled with spiders in the helpless condition already mentioned, among them a larva and some partly eaten spiders."

The Population of Germany.

The results of the German census, taken on December 1, 1885, have been long known. But it is only in this month's number of the Statistical Record of the German Empire that the details are published. Total, 46,855,704.