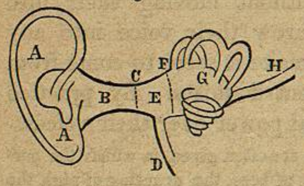
ner ear. These parts and their connections are represented in Fig. 265.

Fig. 265.



THE HUMAN EAR.

A A is the *outer ear*, which acts on the principle of the ear-trumpet, collecting the sound-waves and reflecting them along the pipe B to the membrane C, called the *membrane of the tympanum*. E is the *tympanum* or *drum*, bounded by the membrane C on the one side, and the membrane F on the other, and filled with air, which it receives from the tube D, communicating with the mouth. G, the *inner ear*, contains a number of ducts, and is filled with a liquid in which the acoustic nerve floats.

The sound-waves transmitted from the outer air cause the membrane C to vibrate. C excites vibrations in the air confined in the drum, and this in turn causes F to vibrate. The liquid in the inner ear receives the vibrations from the membrane F, and transmits them to the acoustic nerve, by which they are conveyed to the brain, and the sensation of hearing is produced. When a person takes cold, the tube which connects the drum with the mouth is apt to be obstructed, and temporary deafness is the consequence.

EXAMPLES FOR PRACTICE.

1. (*See* § 724.) If the air were perfectly still and uniform in density, how would the report of a musket heard by a person 50 feet off compare in loudness with the same report heard at a distance of 250 feet?
2. A cannon is heard a quarter of a mile off with a certain degree of loudness. How far must a person be removed, to hear it with only $^1/_{100}$ of its former distinctness?
3. (*See* § 725.) How far does sound travel through air in 10 seconds? In 20 seconds? In one minute?
4. How much faster does the sound produced by the discharge of a cannon travel, than that produced by the snapping of a whip?
5. (*See* § 726.) I see the flash of a cannon two seconds before I hear its report. How far is it off?
6. A clap of thunder does not reach the ear till four seconds after the accompanying flash is visible. How far off is the thunder-cloud?
7. A thunder-cloud is distant about one mile. How many seconds will elapse between the flash and the clap?
8. (*See* § 727.) About how many feet will sound travel through water in 10 seconds? Through iron? Through wood?

---

757. Name the parts of which the human ear consists. With the aid of Fig. 265, point out the different parts, and show the operation of the organ. Why is temporary deafness produced by a cold?

CHAPTER XVI.

ELECTRICITY.

758. If a dry glass tube or a stick of sealing-wax be rubbed with a piece of flannel, and then held a short distance above some shreds of cotton, they will be instantly attracted to it, and after adhering to its surface for an instant again thrown off. A peculiar odor is perceived; and the face, when brought near the glass or wax, feels as if a cobweb were in contact with it. If the tube or sealing-wax be presented to a metallic body in a dark room, a spark, accompanied by a sharp cracking sound, will be seen darting from it to the metal.

The property thus developed by friction is called Electricity. The body in which it is developed is called an Electric, and is said to be *excited* or *electrified*. The attraction exerted by the excited electric over light bodies is called Electrical Attraction. The substance by whose friction the electric is excited is known as the Rubber.

759. Electricity as known to the Ancients.—The term *electricity* is derived from the Greek word *electron*, amber, the property in question having been first observed in that substance.

Thales, one of the seven wise men of Greece, who flourished 600 years B. C., is said to have discovered electricity in amber; Theophrastus and Pliny, at a later date, speak of the attraction of amber for leaves and straws. Both Pliny and Aristotle were acquainted with the electrical properties of the torpedo; and we are informed that a freedman of the Emperor Tiberius cured himself of gout by the use of its shocks. Yet the ancients appear to have known nothing more than a few isolated facts connected with the subject; and as a science Electricity had no existence till the commencement of the seventeenth century.

---

758. If a glass tube or a stick of sealing-wax be rubbed with flannel, what phenomena will be observed? Name and define the terms used in connection with this experiment. 759. What is the derivation of the term *electricity*? What allusions are made to this property by ancient authors? When did electricity originate as a sci-

760. SOURCES OF ELECTRICITY.—Electricity is developed—1. By friction. 2. By chemical action. 3. By magnetism. 4. By heat.

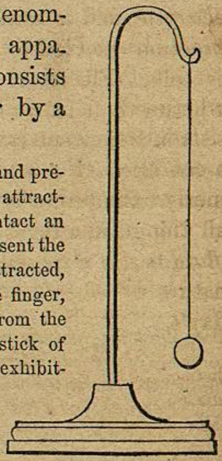
Electricity developed by Friction.

761. Friction is one of the commonest sources of electrical excitement. Every one has noticed how his hair crackles under the comb in frosty weather. The same sound is heard on stroking the back of a cat, and if the room is dark sparks may be drawn from its fur.

A striking example of the exciting power of friction is often afforded in factories. The endless bands by their friction on the wheels develop electricity in great abundance, sometimes yielding sparks at a distance of two or three feet. In the carding-rooms of cotton mills, fibres of cotton are kept dancing to and fro by alternate attractions and repulsions, so that steam has to be let in from time to time to dissipate the electric fluid.

762. ELECTRICAL ATTRACTION AND REPULSION.—We have already noticed the alternate attraction and repulsion of shreds of paper, cotton, and similar substances by excited electrics. These phenomena may be further exhibited with the apparatus represented in Fig. 266, which consists of a pith ball suspended from a pillar by a long silken thread.

Fig. 266.

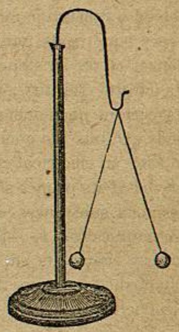


Experiment 1.—Rub a glass tube with flannel, and present it to the pith ball; the latter will be instantly attracted to the tube. After they have remained in contact an instant, the ball will be thrown off. If we now present the tube a second time, the ball, instead of being attracted, will be repelled. After touching the ball with the finger, to deprive it of the electricity it has received from the tube, repeat the experiment with an excited stick of sealing-wax, and the same phenomena will be exhibited,—that is, the ball will at first be attracted, but on the second application of the wax will be repelled. We find, then,—1. That both the

vnce? 760. By what is electricity developed? 761. What familiar instances are mentioned of the production of electricity by friction? What striking example is afforded in factories? 762. What does Fig. 266 represent? What may it be used to illustrate? Describe the first experiment with the pith ball. What two facts are

glass and the sealing-wax attract the ball before they have communicated to it any of their own electricity. 2. That, after so doing, they both repel the ball.

Fig. 267.



Experiment 2.—Suspend two pith balls from a pillar by silk threads, and present to them an electrified glass tube or piece of sealing-wax. They will both be attracted; but, on withdrawing the electric, instead of hanging vertically, they will repel each other, as shown in Fig. 267.

Experiment 3.—Excite the glass tube, present it to the ball represented in Fig. 266, withdraw it after a second or two, and then present the excited sealing-wax. The ball, instead of being repelled, is now attracted. Reverse the experiment by presenting first the excited wax and then the glass, and the latter in like manner will be found to attract the ball.

763. From these experiments it has been inferred that there are two kinds of electrical excitement: that produced by glass, which has been called Vitreous or Positive Electricity; and that produced by sealing-wax, which has been called Resinous or Negative Electricity. We may lay down the general law that *substances charged with opposite electricities attract each other, while those charged with like electricities repel each other.*

764. NATURE OF ELECTRICITY.—What electricity is,—whether it is an imponderable material substance, or consists in the vibrations of some subtile medium, or is simply a condition of matter,—we are unable to say. It was formerly supposed to be an exceedingly subtile fluid pervading all things, and for convenience' sake the expression *electric fluid* is still retained. The leading theories respecting the nature of electricity are Du Fay's, Franklin's, and Faraday's.

Du Fay's Theory.—Du Fay, a French philosopher, held that there are two distinct electric fluids (named by him Vitreous and Resinous), each of which attracts the other, but exhibits repulsion among its own particles. That in their natural state these fluids pervade all bodies in equal quantities, and

shown by this experiment? Describe the second experiment. The third experiment. 763. What has been inferred from these experiments? What general law may be laid down? 764. What is said of the nature of electricity? What was it formerly supposed to be? By what names are the leading theories respecting the nature of electricity distinguished? Give the substance of Du Fay's theory. Of combining nullify each other; it is only when this quiescent compound fluid is decomposed by friction, or any other agency, that electrical phenomena are exhibited.

Franklin's Theory.—Dr. Franklin, whose views were once generally received by scientific men, believed that there is but one electric fluid, of which every body in its natural state possesses a certain quantity. That no evidences of the existence of this fluid are observed as long as a body retains its natural quantity; but, when it has either more or less than this, it exhibits certain phenomena and is said to be *electrified*. When overcharged, a body exhibits the phenomena displayed by glass when excited by flannel, and to such an electrical condition Franklin applied the term Positive; when deprived of its proper share, its phenomena are the same as those of excited resinous substances, and such an electrical state he called Negative. When communication is established between a positive and a negative body, the former shares its superfluous electricity with the latter, till equilibrium is established between them. Du Fay made the difference between the two electricities to consist in quality; Franklin, in quantity.

Faraday's Theory.—Faraday, an eminent English authority, regards electricity as simply a condition of matter. According to his theory, an electrified body is not pervaded by any fluid at all, but simply endowed with a certain property which under other circumstances it does not possess.

765. Why the electricity of one body when excited is positive and that of another negative, we can not tell. There is no law by which it can be determined, before experiment, what kind of electricity a body will exhibit. Indeed, the same body exhibits different kinds when rubbed by different substances. Thus, polished glass is positively electrified, when excited with flannel, but negatively when rubbed on the back of a cat. Rough glass is negatively electrified when rubbed with flannel, but positively when excited by dry oiled silk.

766. Electricity is confined to the surface of an excited body; it does not extend to the interior. A hollow ball may therefore contain just as much electricity as a solid ball of the same size.

767. Positive electricity is never produced without negative, or negative without positive.

Franklin's. In what did Du Fay make the difference between the two electricities to consist? In what, Franklin? What is Faraday's theory? 765. Why is the electricity of one body positive, and that of another negative? What is said of the electricity of a body when rubbed by different substances? Give examples. 766. In what part of a body does its electricity reside? 767. By what is the production of

When a glass tube is excited, the rubber is negatively electrified; and positively, when sealing-wax is excited. This may be shown by applying the rubber to a pith ball charged with the electricity which it has excited either in glass or sealing-wax. The ball is invariably attracted, which shows that the electricity of the rubber is opposite to that of the electric it has excited.

768. Electrics and Non-electrics.—All bodies can be electrified, but not with equal facility. Those that are easily excited, are called Electrics; those that it is hard to excite, Non-electrics. The metals generally are non-electrics.

769. Conduction of Electricity.—If we touch the two pith balls represented in Fig. 267 as repelling each other (because charged with the same electricity) with a glass rod, they will continue to repel each other; but, if we touch them with a metallic rod, they will fall and hang vertically. This is because glass does not draw off their electricity, while metal does. Some substances, therefore, conduct electricity, while others do not.

Substances that transmit electricity freely are called Conductors; those that do not, Non-conductors.

As a general thing, the non-electrics are conductors, and the electrics non-conductors. Some of the chief conductors are the metals (silver and copper ranking among the best), charcoal, water, snow, living animals, flame, smoke, and steam. Among the principal non-conductors are gutta percha, shellac, amber, the resins, sulphur, glass, transparent gems, silk, wool, hair, feathers, dry paper, leather, baked wood, air, and gases generally.

Good conductors, when brought in contact with excited bodies, at once draw off their electricity, and transmit it to all parts of their own surface, however extended. Bad conductors, on the other hand, receive electricity slowly, and diffuse it over their own surfaces no less slowly. A good conductor connected with the earth or a body of water, does not for an instant retain electricity communicated to it, but merely serves as a highway for its passage to either of those media.

770. *Insulators.*—The best non-conductors are called

---

one kind of electricity always accompanied? How may this be shown? 768. What are Electrics? Non-electrics? To which of these classes do the metals belong? 769. How may it be shown that there is a difference in the conducting power of different substances? What is a Conductor of electricity? A Non-conductor? To which of these two classes do the electrics generally belong? To which, the non-electrics? Mention some of the chief conductors. Some of the principal non-conductors. Show the difference between good conductors and bad conductors, when brought in contact with excited bodies. What is said of good conductors connected

Insulators, because they insulate electrified bodies,—that is, cut off their communication with such objects as would withdraw their electricity. The air is an insulator; were it not, no substance could remain electrified for an instant. When insulated, an excited body retains the electricity communicated to it, and is said to be *charged.* The pith ball in the experiment described in § 758 was insulated by the silk thread. Had it been suspended by a wire, the metal, being a good conductor, would have withdrawn the electricity from the ball as fast as it was received, and none of the phenomena that followed would have been exhibited.

Even when insulated, excited bodies will in time part with their electricity. This is because no insulation can be perfect.—Air, when imbued with moisture, acquires conducting power; and hence in damp weather it is impossible to keep an electric excited for any length of time. Well insulated bodies, slightly excited, may be kept several months in a dry atmosphere without any perceptible loss of electricity.

771. Path of an Electric Current.—An electric current always follows the best conductor, and of two equally good it takes the shorter.

772. Velocity of Electricity.—Various experiments have been made to determine the velocity of electricity. Their results show that electricity travels from 11,000 to 288,000 miles in a second, according to its intensity and the nature of the conductor along which it passes. In the case of the velocity last mentioned, which far exceeds that of light, and is so great as to be absolutely inconceivable, the conductor was copper wire.

773. Electrical Machines.—The Electrical Machine is an apparatus for developing large quantities of electricity by the friction of a rubber on a glass surface. Two kinds of electrical machines are in use, known as the Cylinder

---

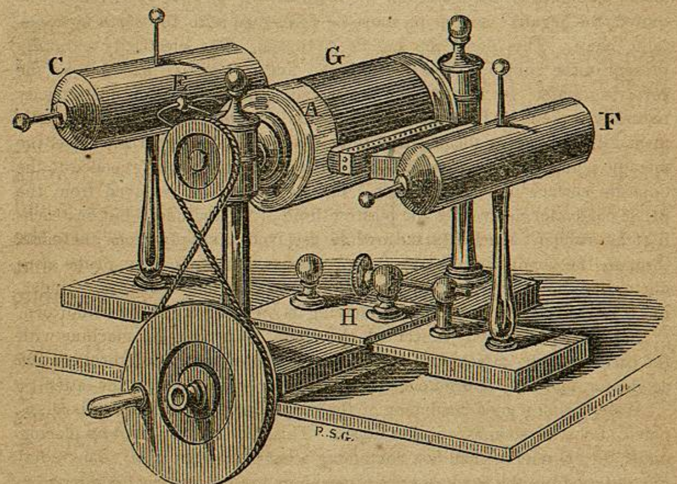
with the earth or a body of water? 770. What is meant by Insulators? Why are they so called? Give an example of an insulator. When is an excited body said to be *charged?* Give an example. How is it shown that no insulation is perfect? Show the difference in conducting power between dry and damp air. 771. What path is always taken by an electric current? 772. How great is the velocity of electricity? 773. What is the Electrical Machine? How many kinds of electrical machines are

and the Plate Machine,—a glass cylinder being used in the former, and a circular plate of glass in the latter.

774. Experiments in electricity were originally performed with a glass tube rubbed with fur or flannel. Otto Guericke, the inventor of the air-pump, was the first to contrive a machine for developing the fluid more abundantly. It consisted of a globe of sulphur, turned with a winch, and submitted to the friction of the hand. Newton substituted a glass globe for the sulphur. About the middle of the eighteenth century, two further improvements were made,—the use of a rubber instead of the hand, and the addition of a metallic conductor.

775. *The Cylinder Machine.*—In the cylinder machine, represented in Fig. 268, electricity is developed by the friction of a rubber upon a glass cylinder, usually from 8 to 12 inches in diameter, supported between two uprights of well-dried wood, and made to revolve by a couple of wheels, as shown in the Figure, or (as is now generally preferred) by a simple winch attached to one end of the cylinder.

Fig. 268.



THE CYLINDER ELECTRICAL MACHINE.

---

in use? What constitutes the difference between them? 774. With what were experiments in electricity originally performed? Who first contrived an electrical machine? Describe Guericke's apparatus. What improvement did Newton make? What improvements were made about the middle of the eighteenth century?

A is the cylinder. The rubber, B, is a leather cushion stuffed with horse-hair, and set on a spring which makes it press equally against the cylinder in all parts of its revolution. The intensity of its pressure is regulated by a sliding base-board, H, which can be moved by a screw towards or from the cylinder. Connected with the back of the rubber is the *negative conductor*, F, a hollow metallic cylinder, with round ends, insulated by a glass pillar. On the opposite side is a similar metallic cylinder, C, insulated in the same way, and called the *prime conductor*. Attached to this is a rod bearing a row of metallic points, E, like the teeth of a rake, projecting towards the cylinder and reaching to within a short distance of it. Several holes of different size are made in the upper surface of the prime conductor, to admit of the introduction of different pieces of apparatus used in experimenting. To prevent the electricity from escaping in the air before it reaches the prime conductor, a flap of black silk, G (which is a non-conductor), extends from the upper edge of the rubber, across the top of the cylinder, to within an inch of the metallic points.

776. *Operation.*—When the machine is to be used, its parts must be perfectly clean and dry. The rubber is rendered more efficient by spreading on it a thin coat of an amalgam of zinc, tin, and mercury, mixed with lard. The screw must be adjusted so that the rubber may press with moderate force on the glass, and the prime conductor so placed as to bring the metallic points about an eighth of an inch from the cylinder. If positive electricity is required, the negative conductor must be connected with the earth by a metallic chain. This done, the handle is turned. The electricity naturally present in the rubber is thus decomposed, and its positive part follows the revolving glass. On its reaching the metallic points, the neutral electricity naturally present in the prime conductor is decomposed; its negative element is attracted by the positive fluid of the cylinder, and rushes over the metallic points to unite with it, while its positive portion is repelled to the opposite surface of the conductor. The negative fluid received from the prime conductor neutralizes the positive fluid of the cylinder; but on reaching the rubber (which has meanwhile received a supply from the earth through the conducting chain) the process is repeated. The prime conductor does not, therefore, receive any positive electricity from the cylinder, but is rendered strongly positive by having its own negative fluid withdrawn.

If negative electricity is wanted, the chain connecting the machine with the earth must be attached to the prime conductor instead of the negative conductor, and the required electricity can then be drawn from the latter.

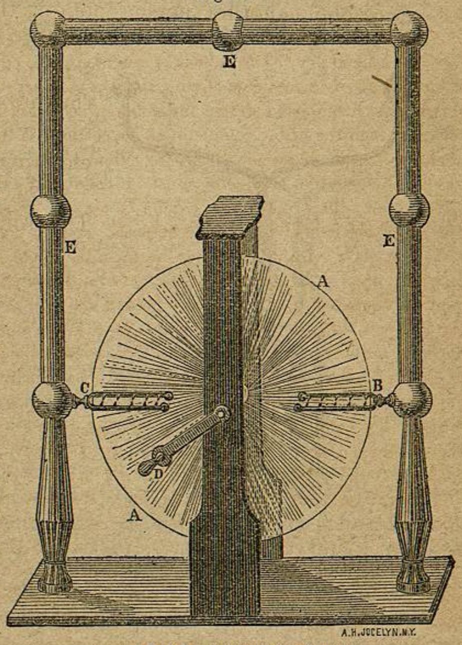
Water being a good conductor, if the air is damp the electricity is dissipated almost as soon as it is developed. This may be prevented by placing under the cylinder a small box containing a bar of red-hot iron. The radiation of heat from the bar keeps the atmosphere around the machine dry.

775. How is electricity developed in the cylinder machine? With the aid of Fig. 268, point out the different parts of the cylinder machine. How is the electricity prevented from escaping before it reaches the prime conductor? 776. Describe the operation of the cylinder machine. If negative electricity is wanted, what must be done? What is the effect of dampness on the working of the machine? How is this diffi-

777. When the machine is working, present your knuckle to the prime conductor; a spark, accompanied by a sharp cracking sound, darts to your hand, producing a pricking sensation. This is called the Electric Spark. Any conductor will draw off a spark; but let a non-conductor, such as a piece of glass, be presented, and no spark will be received.

778. *The Plate Machine.*—In the Plate Machine, a circular plate of glass is used instead of a cylinder. The greatest electrical effects have been produced with these machines. Plates six and seven feet in diameter have been employed, with such power that a spark from their immense conductors is nearly sufficient to fell a man to the earth. The most powerful machine in the world, made in Boston, for the University of Mississippi, combines two plates, each six feet in diameter.

Fig. 269.



THE PLATE ELECTRICAL MACHINE.

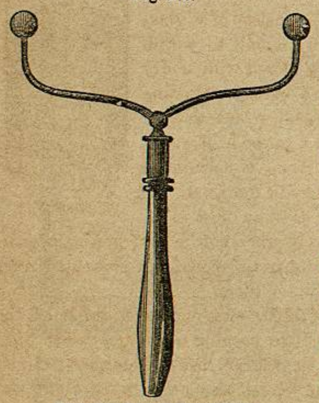
Fig. 269 represents the plate machine in one of its most convenient and efficient forms. A A is the plate, supported on an axis between two uprights and turned by the handle D. The plate is pressed by two pair of elastic rubbers, fastened on the inside of the uprights.

culty removed? 777. When a knuckle is presented to the prime conductor, what follows? If a non-conductor is presented, what takes place? 778. How is electricity developed with the Plate Machine? What is said of the power of plate machines? How large plates are sometimes employed? Give an account of the most powerful electrical machine in the world. With Fig. 269, describe the plate machine.

E E E is the conductor, which consists of three long brass tubes joined at right angles, with large balls at intervals. Opposite the centre of the plate, two brass arms, B, C, provided with rows of teeth, extend on each side from the upright conductor. The plate being made to revolve by means of the handle D, the same results follow as in the case of the cylinder machine.

779. THE INSULATING STOOL.—The Insulating Stool consists of a platform of well-baked wood, supported on glass legs covered with varnish. A person on the stool, brought in connection with the prime conductor of a machine by holding in his hand a chain proceeding from it, may be charged with positive electricity. Sparks may be drawn from his person, and his hair, if fine and dry, will stand on end. If he holds in his hand a silver spoon full of alcohol, another person not on the stool may set the spirits on fire by simply presenting his finger to it, and thus producing a spark. The insulating stool is used when electricity is medically applied.

Fig. 270.



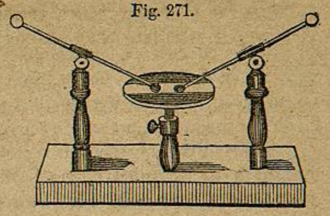
THE JOINTED DISCHARGER.

780. THE DISCHARGER.—The Jointed Discharger, Fig. 270, is an instrument with which an operator can discharge a conductor without having any of the electricity pass through his person. It consists of a couple of curved brass rods, terminating in balls at one end and at the other jointed and fixed in a socket, by which they are attached to a glass handle. The glass, being a non-conductor, cuts off communication with the operator's hand.

The Universal Discharger, represented in Fig. 271, is an instrument for passing a charge of electricity through any substance. Two wires, mounted on insulating pillars, are connected respectively with the positive and the negative conductor of a machine. The substance to be operated on is placed on a stand between two balls at the extremities of these wires, and thus made a part of the electric circuit traversed by the fluid when a discharge takes place.

779. Of what does the Insulating Stool consist? How is it used? 780. What is the Jointed Discharger? Of what does it consist? What is the Universal Discharger? Describe it and its mode of operation. 781. What is the Leyden Jar? Why is it so called? Of what does the ordinary Leyden jar consist? How is the jar charged? With what kind of electricity is the inside charged? The outside? How may the electric shock be taken? How may the jar be discharged without the operator's taking a shock? What is essential in order that a charge may be sent through a body?

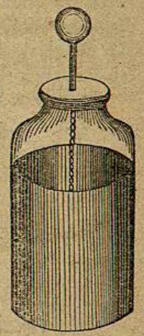
Fig. 271.



THE UNIVERSAL DISCHARGER.

781. THE LEYDEN JAR, OR VIAL.—The Leyden [*lī'-den*] Jar is a glass vessel used for accumulating electricity. It is so-called from having been first used at Leyden, Holland, in the year 1745.

Fig. 272.



LEYDEN JAR.

The ordinary Leyden jar (Fig. 272) consists of a glass vessel, coated inside and outside with tin-foil, to within about three inches of its mouth. It is closed with a dry varnished cork, through which passes a wire, terminating above in a brass knob, and below in a chain, which touches the inner coating. If the knob of such a jar be held within half an inch of the prime conductor when a machine is working, a succession of sparks will pass to the knob. In a short time they cease, and the jar is then said to be *charged*. The inside (being connected with the knob) is charged with positive, and the outside with negative electricity, which are prevented from uniting by the non-conducting glass between them.

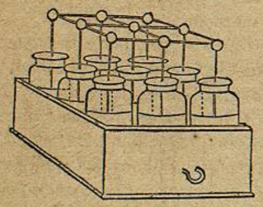
If a person now grasp the outside of the jar with one hand, and touch the knob with the other, he will experience the peculiar sensation called "the electric shock", in his arms, and if the jar is large, through his chest. If, on the other hand, he apply one ball of the jointed discharger to the outer coat and the other to the knob, the jar will be discharged without his feeling anything, because his communication with the jar is cut off by the glass handle. A body through which a charge is to be sent must form part of the circuit between the inner and outer coating of the jar, so that a union of the positive and the negative fluid can not take place without passing through it.—So much electricity is sometimes accumulated in a jar that a discharge takes place through the glass, making a hole in it and rendering the jar useless.

Any number of persons may take a shock at once. Having joined hands so as to form a circle, let the person at one end take hold of a chain connected with the outside of a jar, while the one at the other end touches the knob with a piece of wire. The painful sensation experienced when a shock is taken, is caused by the obstructions which those parts of the body that are imperfect conductors present to the free passage of the electric fluid.

782. An interesting incident is related in connection with the experiments that led to the invention of the Leyden jar. Prof. Muschenbroeck, of Leyden, observing that excited electrics soon lose their electricity in the air, determined to see whether he could not collect and insulate the fluid in a vessel of non-conducting glass, so that it might be kept locked up, as it were, ready for use. Accordingly, he introduced a wire from a prime conductor into a bottle filled with water. After the machine had been working some time, an attendant, holding the bottle in one hand, attempted to withdraw the wire with the other, when he of course received a shock,—so unexpected and so unlike anything he had ever felt before, that it filled him with consternation. Muschenbroeck himself subsequently took a similar shock, which he described in a letter to a French philosopher. He says that he felt himself struck in his arms, shoulders, and breast, so that he lost his breath, and it was two days before he recovered from the effects of the blow and the fright. He would not, he adds, take a second shock for the whole kingdom of France.

783. THE ELECTRICAL BATTERY.—When a very heavy charge is required, a number of jars, coated in the usual way, are placed in a box lined with tin-foil, which forms a communication between their outer coatings, while their knobs and consequently their inside coatings, are connected in the manner represented in Fig. 273. From its powerful effects, such a combination is called an Electrical Battery. By bringing one of the knobs in connection with a prime conductor all the jars may be charged as readily as one, care being taken to connect the outer coatings with the earth. The battery may be discharged in the same way as a single jar, but the operator must not let the charge pass through his

Fig. 273.



THE ELECTRICAL BATTERY.

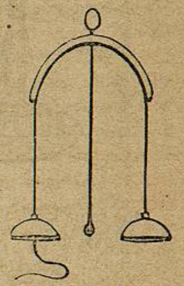
What is the consequence if too much electricity is accumulated in a jar? How may any number of persons take a shock at once? By what is the painful sensation of an electric shock caused? 782. Relate an incident connected with the invention of the Leyden jar. What did Muschenbroeck say of the electric shock? 783. Describe the Electrical Battery, and its mode of operation. What effects may be produced by the

person. The shock of a powerful battery will kill a man and fell an ox; even moderate discharges prove fatal to birds and the smaller animals.

784. EXPERIMENTS WITH THE ELECTRICAL MACHINE.—With the electrical machine and different pieces of apparatus that accompany it, a variety of experiments may be performed.

785. *Electrical Bells.*—This apparatus (Fig. 274) illustrates electrical attraction and repulsion. Two bells are suspended from a frame, with a brass clapper between them. One of these bells having been placed in connection with the prime conductor and the other with the ground, the machine is worked; when the former becomes charged with positive and the latter with negative electricity. The clapper is attracted to the positive bell, strikes it, becomes itself charged by the contact, and is repelled till it strikes the negative bell. Its positive electricity is there drawn off, and it falls back, to be again attracted and repelled. The clapper is thus made to strike the bells alternately.

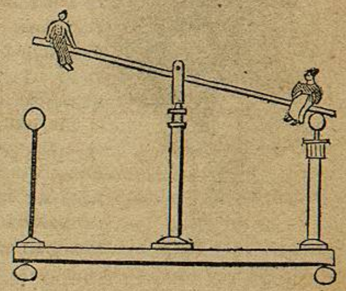
Fig. 274.



ELECTRICAL BELLS.

786. *The Electrical See-saw.*—The Electrical See-saw (Fig. 275) operates on the same principle. A brass beam, with a light figure on each end, is suspended on an insulating pillar, in such a way as to allow its extremities to move freely up and down. Two brass balls are supported at opposite sides of the stand, not far from the ends of the beam,—the one on a glass pillar, the other on a metallic rod. The insulated ball is connected with the inner coating of a Leyden jar, and the other with its outer coating. No sooner is the jar charged than the figure near the insulated ball is successively attracted and repelled, and this causes the beam to teeter. In the same way motion may be communicated to a figure swinging, a floating swan, an insect suspended in the air, &c.

Fig. 275.



ELECTRICAL SEE-SAW.

787. *Dancing Images.*—On a metallic plate supported by some conducting

shock of a powerful battery? 785. Give an account of the experiment with the Electrical Bells. 786. Describe the Electrical See-saw. To what may motion be communicated on the same principle? 787. Give an account of the experiment with the