The bit of pith seems now as eager to avoid contact with the rod as it was before to touch it. This is the characteristic of all electrically excited bodies; at first they attract and then vigorously repel, any light articles in the vicinity.

Here is a rod of vulcanized rubber —an ordinary rubber ruler in fact. We may rub this with flannel or woolen cloth; but better still, with cats' skin, as you see me do now. As I bring this ruler near the pith-balls as before they are first attracted and then repelled. To vary the demonstration, I rub the ruler again, and bring it near the table upon which have been placed some bits of paper, feathers, specks of bran and the like. (Fig. 3.)

Fig. 3. The Excited Ruler.

These tiny particles spring from the table to the ruler with eager haste; and then are driven away again. Here now is the pith ball which the glass rod repelled so vigorously a few minutes ago. You see that the vulcanite ruler attracts it strongly. To make sure we see the manifestation aright, I rub the glass rod once again with silk and bring it near the pith. Yes, the ball is repelled by the glass and attracted by the vulcanite. This second ball is, as you perceive, attracted by the vulcanite, and repelled by the glass. It would seem, then, that we are dealing with two different kinds of force; or, at least, some force under different and indeed opposite characteristics.

The early experimenters noted this difference too; they used principally rods of glass and sticks of resin or sealing wax; and they named the electricity developed by rubbing glass with silk, *vitreous electricity*, and that excited by friction on resin, they called *resinous electricity*. For the sake of convenience, we speak now of the former kind as *positive*, and represent it by the plus sign (+), and the latter we call *negative*, and designate it by (—), the minus sign. As soon as the pith ball had actually touched the excited rod, and had become charged, as we may say, with the same variety of electric force as the rod itself, repulsion occurred. In fact this is always the case; and it is a common rule that *like electricities repel*, and *unlike electricities attract*.

We have here a pair of pith balls suspended from the same hook. You see they hang side by side in perfect agreement. I bring this rod of shellac, already rubbed with cat's skin, near the pair; they are both drawn by this mysterious power of attraction near the rod; they touch it; now they are repelled, having partaken of the same electrical excitement as that of the rod itself; but you notice (Fig. 4), that the two pith balls now exhibit a strong repugnance toward each other.

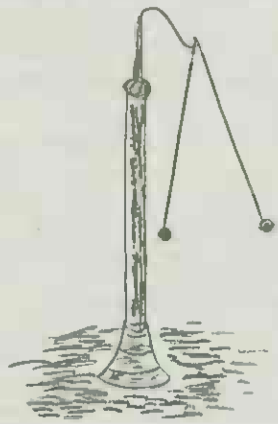

Fig. 4. Mutual Repulsion.

They are charged with the same kind of electricity (resinous or negative—from the resin stick), and consequently they repel. This simple piece of apparatus reveals the existence of electric excitement, and in consequence may be termed an electroscope; but a much more sensitive instrument may be constructed without much trouble. Here is a glass bottle—(Fig. 5)—through the top a rod of brass passes, terminated above by a knob, and ending below in a pair of thin, gold leaves.

Fig. 5. Gold-leaf Electroscope.

Whenever I bring an excited body near, as you see, the leaves diverge, and if the body be highly charged, the tiny strips of gold are thrown into a paroxysm of excitement; they seem to be fairly wild. The explanation is simple. Suppose we approach with the rubbed glass, charged, as we know, with vitreous or positive electricity; the negative electricity is drawn to the point nearest the rod; while the positive is repelled to the farthest limit, which in this case is the leaves, and consequently they diverge. With this instrument we can readily prove the development of electricity in many of our commonest operations.

I have here a rod of copper, suspended in a stirrup, formed by doubling a silk handkerchief; one end of the copper rod is in contact with the electroscope, and the other end I approach with the rubbed resinous stick. The leaves diverge, although the distance of the excited resin is so great that, were no copper rod interposed, the influence would never be shown by the gold leaves. Here is a rod of glass, of about the same length and size as the copper rod. I place that in the stirrup, and bring one end in contact with the telescope while the excited stick of resin is at the other end. No divergence of the leaves is seen; showing plainly that the electric influence can be transmitted through the particles of the copper rod, from one end to the other; but not so with the glass. Substances resembling the copper just used, i. e., those that allow the passage of the electric influence, are called *conductors*, while others through which the electric power seems unable to make a passage, are called *non-conductors*. The chief conductors, in the order of their efficiency are;—silver, copper, gold, brass, tin, iron, lead, platinum, German silver, charcoal, metallic ores, water, alcohol, paper, living plants, and living animals. The commonest non-conductors are, fats, wax, glass, silk, rubber, furs, amber, resin, parchment, and porcelain.

It will be noticed that all the substances thus far used for exciting electricity by friction belong to the class of non-conductors; and at one time it was supposed that these were the only bodies capable of such excitement; in consequence of which non-conductors were called *electrics*, and conductors were termed *non-electrics*.

Let us examine the merits of such a distinction. Here is a good-sized brass tube. I rub it vigorously with silk while holding it in the hand, and bring it near the electroscope; no signs of electric excitement appear. I try rubbing with flannel, then with cloth, then with cat's skin, in each case with a similar negative result. It would *seem* then that brass is not susceptible of electric excitement. Suppose, however, we