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F. WAYLAND CAMPBELL

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CANADA
MEDICAL RECORD

JUNE, 1903.

Original Communications.

LIGHT AS A THERAPEUTIC AGENT

By W. H. DALPE, B.A., M.D.

Being a series of three lectures delivered to the students of the Class in Pharmacology and Therapeutics, University of Bishop's College, Faculty of Medicine, Montreal, March, 1903.

LECTURE III.

THE STATIC MACHINE.

To-day, gentlemen, it is my intention of talking with you on the subject of Static Electricity.

You are no doubt perfectly familiar with the three forms of electricity: 1, magnetism; 2, statical, frictional or electricity at rest; 3, galvanic, dynamic or electricity in motion.

The second form or the statical electricity, which is sometimes called the Franklinic electricity, is a form in which two fluids are assumed, which are separated by mechanical friction, but which, when at rest, exist in a state of union as a neutral fluid, imponderable, subtle, pervading according to Franklin and Symmc all *matter*, but which when separated by friction takes the forms of *positive* or vitrious or electricity on glass, and *negative* or resinous or electricity on silk.

The usual method of generating static electricity is the friction of some insulating or non conductive material. We might obtain as much electricity from the friction of any conductive substance, but here conduction would disperse the electricity as soon as formed.

We are far off from Von Guericke, of Magdeburg, who, in 1647, generated static electricity by rotating a ball of sulphur between his hands.

The first induction machine had only one single glass plate, whilst the Holtz and the Wimhurst's machines have each two glass plates or disks. The *Holtz* machine has two plates of different sizes, a large, posterior stationery one, and a small, anterior, rotatable plate with two electrophori or armatures made of thin cardboard painted with shellac and pasted over the edges of two small windows cut in the plate at the opposite end of any diameter.

In the *Wimshurst* machine the two circular glass plates are mounted on a horizontal spindle, about ¼ of an inch apart, and in such a way as to rotate in opposite direction. On the outer surface of the plates are pasted radial strips of tin-foil. Now as to the method of operating both machines—the Holtz machine has to be primed by touching one *electrophore* with a piece of hard rubber frictioned with catskin, thus inducing *negative* electricity in one set of combs in contact with it, and *positive* on glass disk or plate, which latter is carried by the rotatory movement of the plate to the other combs, and thus to each set of combs and the knobs connected with them. It gives when strengthened by the condensers or Leyden Jars, a spark of 6 or 7 inches.

In the Voss and the Wimshurst machine, the initial charge is obtained from the electricity of the air and are therefore self-exciting, and not materially influenced by the state of the atmosphere. A machine with 12 plates of 30 inches in diameter produces sparks 13½ inches long. As we shall have to go more deeply into the construction of modern induction plate machines, or as we sometimes call them static machines, we will not tire you with needless descriptions of these two machines, but would refer any desirous of familiarizing himself with their construction, to Ganot's admirable work.

Statics is that branch of dynamics, which investigates the relation existing between forces in equilibrium or

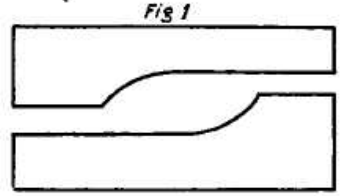
state of rest, so that we mean by a static machine one capable of generating a frictional electricity or electricity at rest. (Franklinic). These machines as they are now made do not materially differ from one another, but even greatly resemble each other in general appearance.

They usually consist of an oak case more or less solidly put together, supposed to be air-tight, fitted with glass panels front and back, and 2 removable glass doors or panels, usually lined with felt or rubber at points of contact, and closing both ends of the case which usually measures 4 feet in height and in breadth and about 2 feet in depth. This is usually supported on a four-legged table of same size, which may or may not contain drawers for storing any accessories of the machine. On an axle fixed horizontally in the case the disks are placed, and it is in the nature and the arrangement of the plates, that the machines mostly differ. The diameter of the plates or disks is usually 28 to 30 inches, other sizes being exceptional. The material used is usually glass, the common and the coarser the better, although for the sake of appearance a polished and accurately turned true-running plate would be more eligible. Some use mica plates instead of glass, and in this case, the plates need not be of so large a diameter, because a much greater speed can be used, and the ampère-volts of the current generated is partly dependent on speed. Glass plates on account of their fragility need to be treated with greater care. Any non-conductive material may be used in the construction of plates or disks, and I believe, asbestos, papier-mache, the so-called red-fibre, etc., will be used at some future date for plate-making. Mica plates are made by pasting and shellacing thin pieces of mica together and compressing them in moulds of the exact size of the plate desired; most of the glass plates used in this country are imported from Belgium, but any glass-cutting establishment can make plates, even in the good city of Montreal, at Pilkington Bros., only you have to pay a great deal for the plates, and which would be liable to wobble.

In the general arrangement of the plates of a static machine, one set of plates are stationary, and the other rotatable. The comparison of the ampère voltage of static machines is made by comparison of the number of plates, but even here there is no uniform standard, for certain makers, "Waite & Bartlett, New York," only take account of the revolving plates, *i. e.*, disks, because the stationary are not disks at all or plates in the common acceptation of the term, whilst others number all the plates whether stationary or revolving. For therapeutic purposes a machine with 8 revolving plates is amply sufficient unless it be in very exceptional cases. For either fluoroscopic or skiagraphic work involving deeper structures of the abdomen or pelvis, 10 to 18 revolving plates may be necessary.

The stationary plates are perforated by a circular aperture much larger than those in the revolving plates, and are suspended on some gutta-percha or hard rubber devices, thus insuring perfect insulation from the other set of plates. In the Wait & Bartlett machine, which has been pushed for all, and, perhaps, more that it is worth, the stationary plates are only half as numerous as the revolving, and instead of being circular, are made up of two irregularly oblong glass plate sections.

Fig 1



The evident purpose of this has been to obviate the vexatious glass boring in circular plates and to facilitate the liberation of the spindle to which are attached the revolving plates; as a matter of fact there is no reason in the world why plates of this type could not generate as much electricity as plates of the circular type, provided the surfaces of

the latter be of a like extent to that of the latter and the oblong type of plates be in proper apposition with their circular mates. You have been told that in the Wait & Bartlett machine the stationary plates were only half as numerous as the revolving ones, hence on that very score the plates are not properly mated.

The space between the stationary and revolving sets of plates is also a matter to which some attention should be given, for if it be too great there is a loss of electrical fluid + and — by their neutralization, which stands in inverse ration to distance, speed and the dryness of the atmosphere in the case of the machine.

The armatures, which may be of different shapes, but which are usually crescent shaped, are placed in pairs on the opposite ends of any diameter of some of the stationary plates, whilst on the revolving plates, there is nothing except on the two outer ones on which are fastened a variable number of brass buttons on which rub the fine wire brushes which act as an excitant of the machine.

In front of the machine a set of balls usually of brass, about 20 inches apart, and perfectly insulated, have connection with a set of collecting combs placed between the revolving and stationary plates, one set at each end. Two discharging rods with smaller balls are connected with the larger accumulating system of brass balls, and in such a way as to be brought closer to each other or separated as necessary.

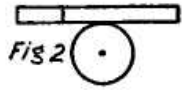
Most machines are self-exciting, but others, as the Waite and Bartlett, and the Van Houten and Ten Broeck modification of the Morton Wimshurst & Holtz influence machines, contain one or more diminutive plates to be used as the starter.

Gentlemen, a static machine to work well must have its plates perfectly insulated by a double or a treble coating of perfectly bone-dry shellac, and this must be renewed from time to time, the previous coatings being removed by alcohol, wood spirits, ammonia or by soaking in a water bath; the

brass parts must be kept clear of oxidations and properly lacquered. The ozone generated in the operation of the machine is to blame for the injury to both and lacquer and shellac.

It is well to have a hygrometer in the case of the machine, so as to keep "posted" as to the condition of the atmosphere, this being especially important from June to September. When the hygrometer marks 40-50 or lower, some means of drying the air in the case must be used, by chopped ice and salt or by CaCl or Ca O_2 (quicklime), baking the Ca Cl, of which 2-3. lbs. should be used, and leave in the box until the hygrometer registers about 25. Crude Ca Cl, owing to evolution of Cl. in presence of O_3, will form a coating over the entire inside of machine and spoil brushes and render it useless. So will CaCl, which is not thoroughly baked.

Gentlemen, a static machine may be actuated by hand, by means of a crank (in more than one sense), but whenever it is possible to use other motive power it is better to do so; some use water motors ($15 to $35) direct current motors $40 to $60 or the alternating current motors, which are the most expensive, ⅓-½ h. p. is necessary. The water motors are fairly capable of altered rate of speed, by regulating the supply of water by means of the tap; likewise the speed of the direct current motors can be modified with a rheostat; not so with the alternating current motors; their speed being thus uninfluenced, we have to resort to different speed-wheels, or what we call friction speed regulators.



All these little details, gentlemen, had better be learned in the school of experience, in which most of you shall soon enter, I hope, ere long. A good static machine will give with proper speed a spark of from 12 to 20 inches. The