or reduced at will by blowing or suction, and it will retain its size constant when placed in open communication with the outer air by means of this tube. This is, of course, the only plane-faced polyhedron which can thus be formed, faces, edges and vertices being entirely made out of soap films. If, on the other hand, a figure has its dihedral angles greater than 120°, then the internal bubble will have concave faces, and will, if placed in communication with the outer air, increase in size until it coincides with the faces of the frame, and will then be kept in equilibrium by their rigidity. This I verified in the case of the eicosihedron.

There is one important law which must be mentioned. I found a certain irregularity in the behaviour of the films in the case of the octahedron and rhombic dodecahedron. This was due to the fact that two films cannot cross one another at right angles, a law which can be put to the test by placing two plane loops covered with film at right angles, when a small lanceolate film will be formed making two curved lines of intersection with the film on the loops, instead of allowing them to intersect in a single straight line. In the case of the rhombic dodecahedron this slightly modifies the form of the internal bubble, introducing a small edge and a little curvature at each of the acute vertices. This defect causes a serious convexity if the bubble is small, but in general we have double curvatures at the points in question, the remaining portion of each face being plain while the figure retains the form of a rhombic dodecahedron. W. F. WARTH.

Reversal of Charge from Electrical Induction Machines.

THE reversal of the poles of a Voss machine by giving some turns in the wrong direction, as observed in NATURE of January 5 (p. 221), is not an unknown phenomenon. It is described in my paper "Essai sur la Théorie des Machines électriques à influence" (Gauthier-Villars, Paris, 1898), p. 38, together with a much more trustworthy and simpler means—an improvement, in theory and in fact. This consists in discharging by hand, at the same time, both the inductors of the fixed disc. Then the reversal is invariably observed without stopping the machine.

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THE CONSTRUCTION OF SIMPLE ELECTROSCOPES FOR EXPERIMENTS ON RADIO-ACTIVITY.

THE electrical method, where it is applicable, is now by far the most sensitive method of detecting small quantities of matter; and the recent advances in physical science made by the method of measuring small leakages of electricity, especially in connection with the phenomena of radio-activity, have excited a very general interest in the experimental arrangements employed. The writer hopes that the following account of simple electroscopes for this kind of work will be found to be of a practical nature and of service to those who, though unfamiliar with many of the devices in general use in a physical laboratory, are nevertheless desirous of making quantitative experiments on radio-activity or some other subject where the electrical method is employed.

In general the final shape of the instrument will depend very much on the purpose for which it is required; in fact, it is one great advantage of the gold-leaf electroscope that it can usually be fixed up in any odd corner of the apparatus which happens to be convenient. There is, however, one part of the apparatus which is always the same in sensitive instruments, and that is the gold-leaf system itself. Before describing this it will perhaps make things clearer if we consider for a moment one or two points about the theory of the instrument.

What we observe usually is the rate of decrease of the deflection of a charged gold leaf from a vertical metal support to which it is attached. Now the deflection in question depends only on the shape and size of the leaf and of the metal support, and on the electrostatic potential of the system, so that the rate of collapse of the leaf measures the rate of decrease of the electrostatic potential. But what we wish to measure is the current or rate of alteration of electric charge, and this is equal to the rate of decrease of potential multiplied by the electrostatic capacity of the system. Thus for a given current the rate of movement of the gold leaves is greater the smaller the capacity of the system. For a sensitive instrument it is therefore absolutely necessary to have the parts which are metallically connected with the gold leaf as small as possible.

Cutting gold leaves is a process which requires a considerable amount of patience, especially from the beginner. The process I always adopt is to take a plate of glass and lay a sheet of smooth note paper on it. On this the gold leaf is spread out flat by blowing gently if necessary, and is cut by means of a razor. To do this, all except a narrow strip at the edge is covered with a second sheet of note paper, the straight edge of which is pressed down with the fingers so as to hold the gold leaf. A fine strip outside the edge of the paper is then cut off from the leaf by dragging the razor gently backwards parallel to itself and to the edge of the paper. It is not necessary to exert any great pressure during this operation, but a little practice will be necessary to get into the way of doing the saw-cut stroke at the proper speed. Mr. C. T. R. Wilson has succeeded in this way in cutting uniform strips one-tenth of a millimetre across, but for most purposes strips one millimetre wide are good enough. In working with gold leaf much trouble will be saved by working in a room which is free from draughts and disturbances generally.

For the metal support to which the gold leaf is attached it is convenient to use a piece of wire of about the same diameter as the thickness of the gold leaf. To fix the leaf on to the wire it is sufficient just to moisten the latter at the point of attachment with the tip of the tongue; on allowing the end of the gold leaf to come in contact with the very slightly moist wire it will be found to attach itself sufficiently firmly for all that is required of it. For obvious reasons the cutting and mounting of the gold leaf should be the very last operation in the construction of the electroscope.

In constructing an electroscope it is of the utmost importance to have trustworthy insulation. When the apparatus has not to be raised to a high temperature, and great mechanical strength is not required, sulphur is a long way better than anything else for this purpose. Generally speaking, it is better to have as small a quantity of insulating material as possible in order to diminish irregularities caused by the superficial charging up of the dielectric. Suppose we wish to insulate the wire carrying the gold leaf from another wire which supports it mechanically we should proceed as follows:—Take a porcelain crucible and gently heat a quantity of pure flowers of sulphur in it until it just melts and forms a clear yellow limpid liquid. It is important that it should not be heated so strongly as to become dark coloured and viscous, as this appears to diminish its subsequent insulating properties. The end of one of the wires is then dipped into the liquid sulphur, when a coating of sulphur forms on the wire. This is allowed to cool until it has solidified, and the operation is repeated a number of times until a bead of sulphur like that shown in Fig. 1 A has formed on the end. The end of the other wire is now heated gently in the flame and applied with a slight pressure to the point *a*, when it melts its way into the sulphur;