## EIGHT LIGHT DYNAMO.

BY GEORGE M. HOPKINS.

(*Continued from page* 262.)

The making of a good commutator is not the smallest item in the construction of a dynamo. It is a very important part of the machine, requiring good workmanship and the best of materials.

The commutator cylinder in a machine of this class is formed of a series of bronze bars, separated a short distance from each other, and carefully insulated. On the eight light dynamo it is 1½ inches in diameter and 2 inches long. The bronze sleeve, A, which is fitted to the shaft and provided with a fixed flange and a set screw at one end, is screw-threaded at the opposite end to receive the screw-threaded bronze flange, B. On the sleeve, A, between the fixed flange and the removable flange, B, is placed a vulcanite sleeve, C, and to the ends of this sleeve are fitted two collars, D, of vulcanized fiber or analogous insulating material. These collars are beveled on their inner surfaces, and are thickest at their peripheries. To the vulcanite sleeve, C, is fitted a bronze cylinder, E, having conical ends, fitted to the beveled collars, D, as shown at 5 in Fig. 6. The bronze cylinder is slitted longitudinally in a gear cutter, or in any other convenient way, so as to divide it into 24 equal divisions, the slits extending nearly through the cylinder, as shown at 1. Before the bars are separated they are marked with figure punches, in regular order from 1 to 24, so that they may be rearranged after separation. Besides this, a sheet of mica is selected which can be crowded into the slits. Now, if the slits have been made deep enough, the bars may be broken off one after another, and the fin may be removed with a file; but if the bars cannot be broken off in this way, they may be removed by means of a hack saw, as shown at 2.

As many strips, F, of mica are cut from the sheet as there are bars in the cylinder, the mica strips being made a little wider than the bars and of exactly the same length, as shown at 3.

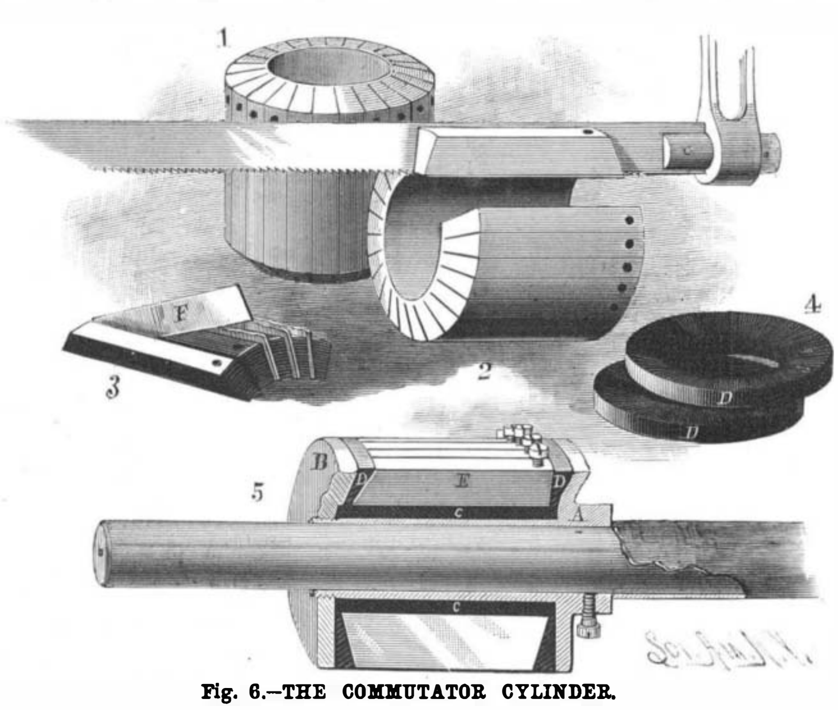


Fig. 6.—THE COMMUTATOR CYLINDER.

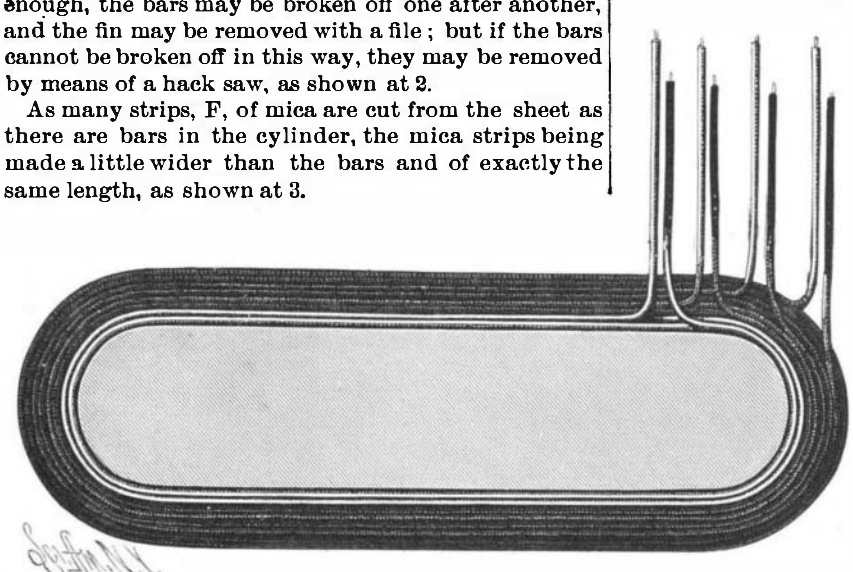


Fig. 9.—SECTION OF ONE ARM OF THE FIELD MAGNET, SHOWING WINDING.

The commutator bars thus formed are placed between the collars, D D, in alternation with the mica strips, with the bars arranged according to their numbers. The flange, B, is then screwed up tightly, clamping all the bars and the mica strips firmly in their places, each bar being thoroughly insulated. The cylinder thus made is placed upon an arbor and carefully turned off to bring it to a true cylindrical form. After turning, each bar is drilled near one end to receive the brass screw by which the armature wire is connected with the commutator bar.

The commutator cylinder, now finished, is secured in its place on the armature shaft, with the screws adjoining the body of the armature.

Now, for convenience in handling, the armature shaft is placed in the lathe, and the inside and outside terminals of one coil are carefully straightened out parallel with the sides of the armature, and their ends are stripped of the insulating covering for a short distance and thoroughly scraped. The screws in two of the commutator bars, say 1 and 2, are loosened so as to permit of placing the looped ends of two wires under them. The outer terminal of the coil is connected with one of the screws, and the inner terminal of the same coil is connected with the screw in the next bar in order in the commutator cylinder. The outer terminal of the second coil is connected with the screw last referred to, and the inner end is connected with the screw of the next bar in advance, and so on around the entire commutator cylinder, the outer end of each coil being connected with inner end of the adjacent coil and with a bar of the commutator cylinder by one of the screws, as shown in Fig. 7.

The brushes which bear upon opposite sides of the commutator cylinder are each made of six thin strips of hard rolled copper, thirteen-sixteenths inch wide and three inches long, split from their free ends toward their clamped ends, to render them more elastic. The brushes are clamped in mortised studs passing through holes in the ends of a bar fitted to and adjustable on a boss formed on the inner side of the bronze yoke around the shaft. By this arrangement the brushes may be adjusted for taking off the current to the best advantage. The mortised studs which hold the brushes are separated electrically from the bar by insulating thimbles and washers, and upon the outer ends of the studs are screwed binding posts, in which are inserted conductors, bent into spirals to permit of the adjustment of the brushes. One of these conductors communicates with one of the binding posts on the machine base, while the other communicates with one of the rods extending to the top of the field magnet. The remaining binding post on the base is connected with the other vertical rod, extending to the top of the magnet. These vertical rods are connected with the terminals of the winding of the field magnet, as shown in Fig. 1.

The circuit of the machine is clearly shown in Fig. 8,

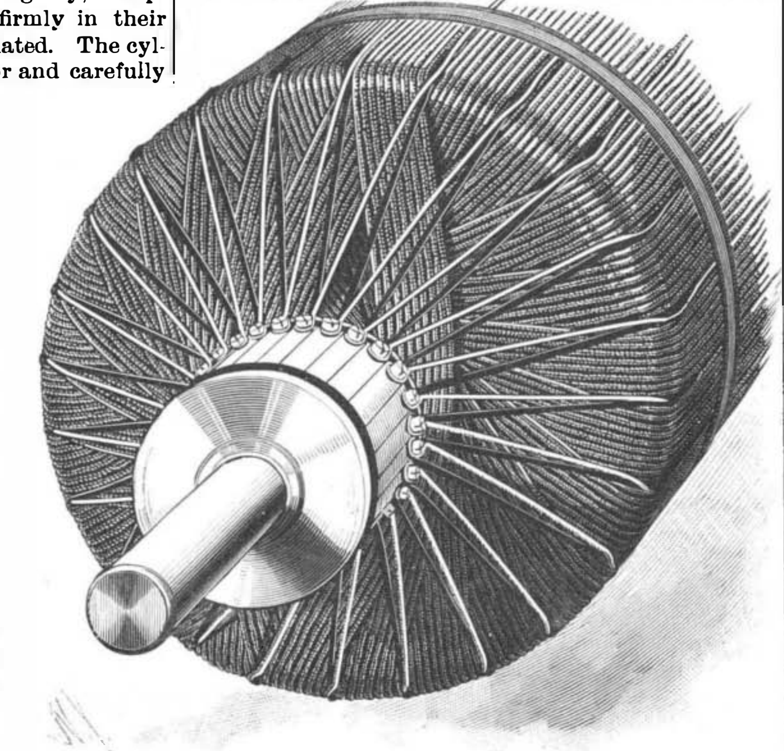


Fig. 7.—CONNECTIONS OF THE ARMATURE COILS AND COMMUTATOR CYLINDER.

the current passing from the armature, C, through the upper brush, thence to the top of arm, A, of the magnet, down that arm, then up to the top, then down the arm, B, and up, then downward to the base of the machine, terminating at *a*. The lower or remaining brush is connected with conductor, *b*. From the terminals, *a b*, the current is taken off for use.

In Fig. 8, for the sake of clearness, only a single conductor is shown on the field magnet, but in practice there are four, each conductor passing down and up once on each arm of the magnet; that is to say, there are eight layers of wire on each arm of the magnet, formed of four wires, each wire being laid on by beginning at the yoke, winding down to the shoulder of the polar extremity, then up again to the top, leaving the inside and outside ends projecting, as shown in Fig. 9. The winding is best done in a lathe.

In the present case all of the inner ends of the wires of the arms of the magnet are connected together, and all of the outer ends of one arm of the magnet are connected with one of the vertical rods, while the outer ends of the wires of the other arm are connected with the other vertical rod, as shown in Fig. 1.

By winding the field magnet with No. 18 wire in the manner described, several advantages are secured, one of which is the facility with which the work of winding may be done; another is the possibility of connecting the wires in different ways, so as to secure more or less resistance in the magnet. Another is that the wires may be conveniently connected up according to the various methods of winding, compound, shunt, series, etc.

As shown in the engravings, all of the wires of the field magnet are in parallel circuit, practically forming a large conductor of small resistance, and the conductor thus arranged is connected in series with the armature, that is, the current from the armature passes directly through the field magnet and external circuit.

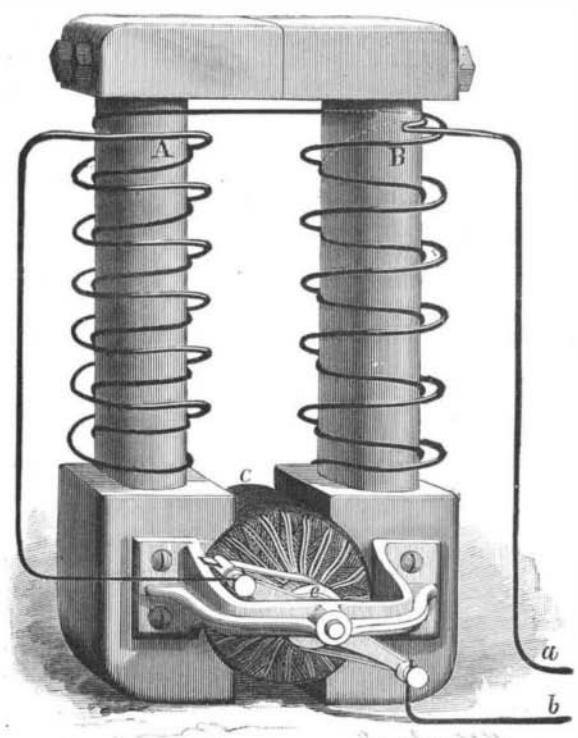


Fig. 8.—THE CIRCUIT OF THE DYNAMO.

Having made the dynamo and connected it up in the manner described, the brushes are to be brought into contact with the commutator cylinder at points diametrically opposite each other, and at points about opposite the center of the space between the polar extremities of the field magnet. The armature is revolved in the direction of the free ends of the brushes, and in the binding posts on the base are inserted short wires, which may be brought into contact with each other momentarily as the armature revolves.

If a spark is seen on the separation of the wires, it shows that the magnetism inherent in the iron of the field magnet is sufficient for the starting of the machine, and no further manipulation other than the adjustment of the brushes is necessary. The brushes should be adjusted to a point where the least sparking is produced. This will not vary much from the original position. The machine from which the engravings were made produces no noticeable sparks at the commutator.

If the machine fails to start, when tried in the manner above indicated, a battery of four or five Bunsen cells must be connected with the binding posts, or a dynamo may be used instead of the battery. It sometimes requires a few minutes to start the current, but as soon as it begins, the battery should be removed.

Some care is necessary in handling the conductors, as it is quite possible to receive a severe shock from this machine. The description of this dynamo, in connection with scale drawings, will be presented at an early date in the SCIENTIFIC AMERICAN SUPPLEMENT, together with the various methods of connecting the wires of the field magnet, and points in regard to external circuits. The results of dynamometric and electrical tests will also be given.

## EXERCISES IN PRESTIDIGITATION.

I recently had an opportunity of being present at some amusing experiments of a prestidigitator, who was good enough to let me into the secret of his most curious tricks for the benefit of the readers of *La Nature*. Although it merely concerns the question of a deception of the eye, I shall make known the means employed for changing ink into water, or, rather, for really making credulous spectators believe that ink can be so changed.

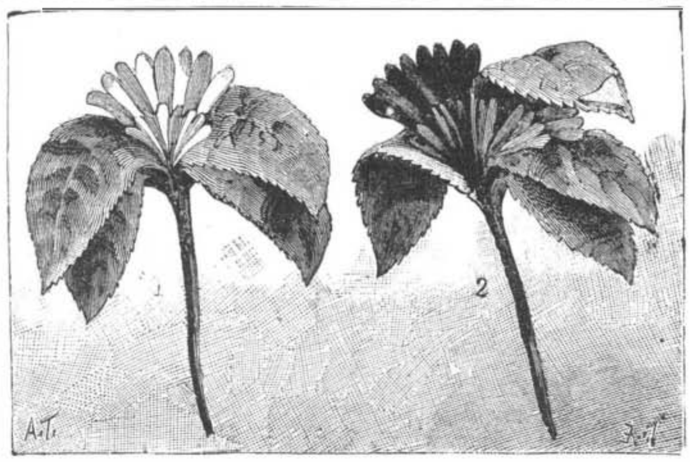


Fig. 2.—THE MAGIC FLOWER.

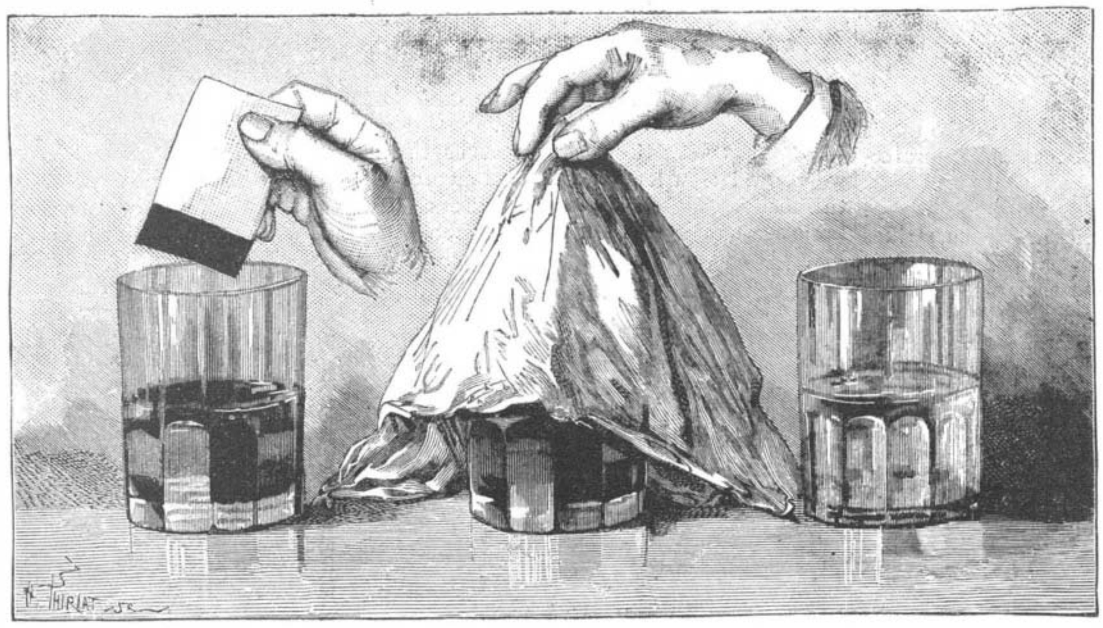


Fig. 1.—INK CHANGED TO WATER.

The prestidigitator places upon a table a glass half full of a black liquid that has every appearance of being ink. He shows the spectators a white card, dips it into the glass, and takes it out stained with black (Fig. 1, to the left). This done, he conceals the glass under a napkin or handkerchief; then he suddenly removes the latter, and the glass is seen to contain a clear liquid, which is water (Fig. 1, to the right). This trick excites very great astonishment when it is well performed; but nothing is easier than to repeat it.

Pure water is poured into a tumbler, and the lower part of the latter is lined with a strip of black cloth, flannel or cashmere, up to the level of the liquid. At a certain distance off this gives the water every appearance of being ink. Previous to this a card has been prepared by coloring a third of one of its sides with black ink. When this card is shown to the spectators, it is presented to them white side foremost. After it has been dipped into the alleged ink, it is turned around so as to show the inked surface, and it then appears as if it had really been immersed in ink.

Then the glass is covered with the fabric, and the latter is inserted into it far enough to allow the fingers to grasp the black lining and quickly remove it, and thus make the black liquid appear as water.

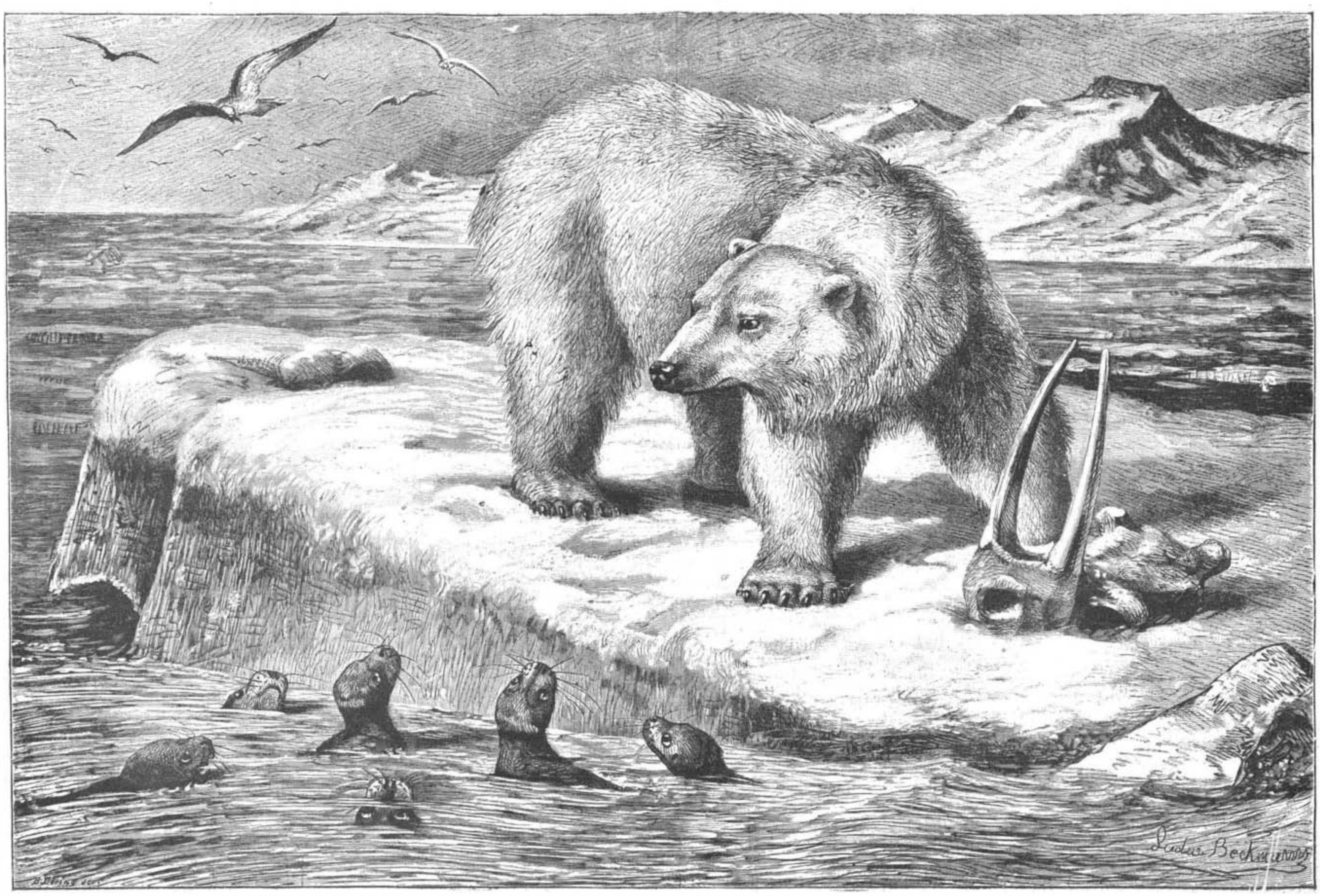
This experiment shows with what facility certain mystificators can practice deceit when they present their experiments as being under the influence of supernatural agents.

Experiments of the same nature may be more scientifically performed by means of chemical precipitates. Add tincture of iodine to crystallized acetic acid, and you will obtain a red liquid having the appearance of wine. Pour into the mixture a solution of hyposulphite of soda, and you will obtain a milk-white liquid, and the wine will seem to have been converted into milk. Put some iodide of potassium into an aqueous solution of a salt of mercury (the bichloride, for example), and you will have a red precipitate of iodide of mercury. An excess of the reagent dissolves the precipitate, and the color disappears. This latter experiment is very curious, since the two liquids have the appearance of water. While we are on this subject, we may mention, in conclusion, the curious tri-colored artificial flower that a toy manufacturer annually brings out (Fig. 2).

To the left of this figure (No. 1) we see a white flower. This, by an abrupt movement of the arm, is rendered red, and then by another movement blue. The white flower, which is of thin paper, is folded like a fan, and is placed between two flexible leaves, that are provided at their upper extremities with a small piece of lead. By a dexterous movement the green leaf is raised and the white flower is folded under its weight, and a red flower makes its appearance on one side and a blue one on the other. If the motion be quick, the eye cannot discern the means that are employed to effect the transformation, which may be regarded as an amusing optical experiment.—*La Nature.*

## THE POLAR BEAR AND SEALS.

On the long stretches of ice-covered coast in the polar regions, the largest beast of prey of the North—the white or polar bear—lives undisturbed by all other animals, seldom meeting even the walrus or seal hunters in this vast desert. If a bear is discovered on floating ice, it will usually jump into the water on the approach of the boat, in order to reach the shore or a larger field of ice, and this is the time when he can be most easily killed. Rowed by strong arms, the boat will soon overtake the fugitive; but it should be kept at a proper distance from him, so that he can be shot by one of the occupants of the boat. The capture is not always an easy matter, however. The Scotchman



THE POLAR BEAR AND SEALS.