EXPERIMENTS WITH THE ELECTRIC ARC.

A few weeks ago MM. Jamin and Maneuvrier, in the Paris Academy, described some instructive experiments in which the electric arc was maintained between various "electropyres" (to use a recently coined word), by action of a Gramme machine with alternating currents. With two quite similar carbons as electropyres, there is no deflection of a galvano-meter in the circuit, the two rapidly-successive contrary currents neutralising each other. But, with one carbon thick, the other thin, there is permanent deflection (as though a battery were inserted in the circuit); the current from the large carbon to the small denominating over the other, and giving a differential current. There is also a differential current where the electropyres are a mass of metal and a carbon point. With lead a deflection of 29° was had; with iron 30°; with carbon 31°; with copper 60°; with mercury 70°. In the case of zinc, the current, at first as strong as with copper, falls off, probably owing to formation of oxide.

The electromotive force of the differential current is small, and about the same, for lead, iron, and carbon. For copper it is equivalent to 50 Bunsens, for zinc (at first) to 66, while mercury shows 103·7. It is proved that the first three substances offer the greatest resistance, while copper and mercury offer the least.

The differential current can only be explained in two ways: by a difference in the resistence, or by an inequality in the inverse reactions of the arc in one direction or the other. As no difference of resistance was observed with change of direction, it is concluded that the current in question is due to a particular property of alternating currents.

Whatever the explanation, it is clear that, the arc once produced with mercury, the differential current quite alters the action of the machine. One system of currents is, if not extinguished, considerably weakened, and the other constituted by excessive currents of greater intensity and duration. The commutator by which alternating current machines, like those of Nollet and Meritens, are rendered available for chemical operations, might be replaced automatically by one or several arcs formed between a bath of mercury and a carbon point. It remains to ascertain the economic conditions of this transformation.

The effects obtained from the Gramme machine, with alternating currents in the electric egg, are remarkable. The two currents contribute equally (say the authors) to the phenomenon, which is that of Geissler tubes, but which assumes incomparable brilliancy, owing to the considerable quantity of electricity which passes and rapidly modifies the appearances observed. The carbons get heated, redden, and reach a pale white, not only at their extremity, but throughout their length; then they are rapidly volatilized by the combined effect of heating and of the currents. Whatever the cause of this volatilization, it is certain that a carbonaceous matter spreads in the state of vapour. The globe gets filled with a blue gas, like vapour of iodine, deepening in hue to indigo. The vapour is abundantly condensed on the glass, rendering it opaque. The authors avoided this termination by using instead of single carbons two bundles of crayons, diverging from the rheophores, conewise, towards each other. Here the currents are divided into a large number of effluves, less intense than the single effluve; all the carbons are illuminated at once, and less the more numerous they are. The volatilization is nearly *nil*. A still brighter effect was obtained with copper rods.

In a more recent paper MM. Jamin and Maneuvrier have described some striking modifications of the arc when sulphide of carbon vapour is introduced into the vacuous space. The carbons in these experiments were parallel—fixed at the base and separable at the top by a simple mechanism. With a vacuum as complete as possible in the receiver, the arc, of course, does not form; there is the Geissler tube phenomenon: but when a few drops of sulphide of carbon are introduced, increasing the pressure about 0·05m. or 0·06m., one sees the arc between the points, and it persists as they are separated. At this moment there is, as it were, an explosion of light, so bright as to be unbearable, incomparably superior to the usual brilliancy of the arc. Looking through colored glass, one observes the arc to be of horseshoe form, or like a large Omega, resting with its two ends on the carbon points, and about 0·05m. in height. A long flame rises vertically from it. The points of the carbons seem red and very brilliant, but the arc is pale-green, and, as this colour denominates, the whole room is as if illuminated by a Bengal flame with copper in it. The brilliancy increases with increase of tension of the vapour; but, the resistance also increasing, the arc may go out and have to be started again and again.

The spectrum of the light is formed of four channeled spaces in the red, the yellow, the green, and the violet, very similar in appearance, though the green is the most luminous. They probably obey the same harmonic law, which remains to be discovered.

While these appearances are in progress, a chemical action takes place. If air has remained in the receiver, the sulphide of carbon burns incompletely; a cloud of sulphur fills the space, and is deposited on the glass; the carbon burns alone. If the air has been well removed these clouds do not form; a brown deposit is produced on the glass and becomes black. This deposit is volatile. Its odour recalls that of sulphur. "It is evidently a compound of sulphide and carbon; perhaps a proto-sulphide corresponding to carbonic oxide, perhaps an isomeric combination of ordinary sulphur. One finds, indeed, neither a deposit of sulphur nor one of carbon, and the crayons have neither lost nor gained. It is probable that the sulphide of carbon is dissociated, the sulphur volatilized, the carbon in vapour disseminated in the arc, and that this carbon and this sulphur recombine in the flame to reconstitute a combination under different conditions; but this is merely a conjecture, no analysis having yet been made. *En résumé*, this experiment is remarkable for the extraordinary quantity of light produced, for the size of the arc, for its colour, for the composition of the spectrum, and for the chemical actions which take place. It is not probable that it could ever be turned to advantage for illumination, on account of the colour, unless for lighthouses and signalling at a distance."

A TORPEDO DETECTOR AND A SCIENTIFIC DIVINING ROD.

Two inventions which are based on the principle discovered by Prof. Hughes and illustrated in his induction balance, claim some little attention, as being probably very useful appliances. These are Capt. M'Evoy's torpedo detector and Mr. C. F. Varley's "divining rod," a simple arrangement by means of which it is believed that it will be possible to discover the existence and position of metallic lodes without the practical test of sinking costly shafts. M'Evoy's apparatus will probably be found of use as an indicator of the position of lost anchors, cables &c., as well as of torpedoes, and the following will give an idea of its construction. It consists of a small mahogany box, containing a pair of coils or bobbins, a vibrator similar to that employed in electric bells for making and breaking contact, and a telephone. To this box is attached a given length of flexible cable, with four conducting wires in it. To the other end of this cable is attached a flat wooden case, in which there are two coils. This case is weighted so that it will readily sink when placed in the water. There are also terminals on the box for attaching battery wires, and an arrangement for putting on and cutting off the current is provided. There are two complete circuits through the box, cable, and wooden case, the one primary, and the other secondary. The battery, the vibrator, one coil in the box and one coil in the wooden case are in the primary circuit, while the telephone, one coil in the box, and one coil in the wooden case are in the secondary circuit. When the battery is on, the coils in the box are adjusted so that little or no noise from the make-and-break action of the vibrator is heard in the telephone. When thus adjusted the instrument is ready for work, and if the wooden case is then brought near a metallic body a loud noise is heard in the telephone, thus indicating the proximity and locality of such a body.

Mr. Varley's instrument, which has been patented (No. 5353, 1881), consists of a rod of one metre to two or three in length, pivoted in a frame. At each end it carries two helices of 20 to 30 centimetres in diameter, the planes of the rings being parallel with the axis, and the centres of the two helices placed about one metre apart, more or less. These helices are connected together by two wires passing along the rod so as to form one circuit, but broken at a convenient part of the axis and attached to two insulated semi-cylindrical pieces of metal mounted upon the axis and against which two springs press. This arrangement forms a commutator, and the contacts change during the rotation as the planes of the rings or helices become vertical. The axis is connected by means of a pulley and cord with a large wheel carried on the frame, which sup-