my hands the wires leading from the + and the — plates, corresponding to the copper and the zinc in the simple cell. One wire I attach to the end of this file, and the other wire I draw over the roughened surface; at every breaking of the circuit, you see a succession of brilliant sparks, and these follow each other so rapidly as to be dazzling. You notice that the whole file, and, in fact, my own hands, seem to be in a blaze of light. The obvious explanation of this phenomenon is, that by the passage of the current, particles of metal from the wire and the file are heated so highly as to become incandescent; just as sparks ar caused when a horse in rapid motion strikes his steel-shod foot against a stone. These particles may be, in either case, of almost inconceivable minuteness, yet they become visible through their luminosity.

By way of farther illustration and proof of the heating effects of the electric current, and the luminous manifestations naturally resulting, I connect the two terminal wires of this battery by a fine wire of platinum; and as soon as the current passes, you observe that the platinum becomes heated to redness, then to whiteness, then to almost indescribable brilliancy, and soon thereafter it is melted. These changes were almost too rapid to follow; and the demonstration is the more impressive, when we remember that platinum is so refractory that no heat, short of that of the compound blowpipe, is effectual in producing a melting or fusion of the metal.

The conducting power of a wire depends, to a very great extent, upon its size, other conditions being the same; the larger the wire is, the easier and the more completely will the current be transmitted. The battery just experimented upon was sufficiently powerful to melt the fine wire; but now I will pass the current through a much thicker wire, also made of platinum, however.

This wire is fitted to the two terminal rods of a convenient stand, (Fig. 3.) forming a spiral bridge between them, and the battery wires are fastened by the binding screws upon its base. By the passage of the current, the platinum, as you readily see, becomes heated to intense brilliancy, though the heat is not sufficient to melt it. This illustrates the fundamental principle upon which all the so-called *incandescent lamps*, so widely used in electrical lighting, are constructed; they all depend for their efficacy upon the luminosity of some poor conductor.

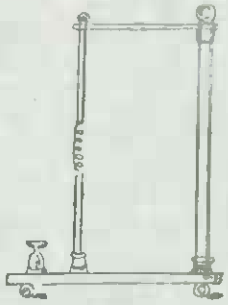

Fig. 3. Simple Electric Lamp.

Metals are not now generally used, however, for the light giving medium, as there is always danger that they will melt through the heat and thus render the lamp useless. Fine filaments of carbon are now employed. These are prepared in various ways—a single hair, or a bamboo fibre being thoroughly carbonize, becomes an admirable medium for the production of the light. If this carbonized filament were heated in the air, however, oxidation would occur, and the filament would be speedily destroyed. To avoid this, the filament is enclosed in a glass bulb, (Fig. 4), from which the air has been exhausted.

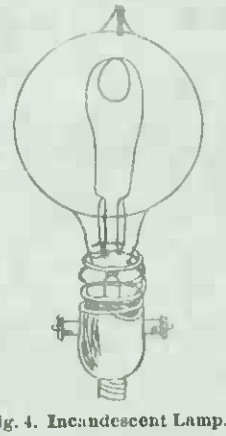

Fig. 4. Incandescent Lamp.

Platinum wires are fused into the foot of the lamp, and to the inner ends of these the carbon thread is affixed; while the outer ends are connected with convenient attachments, forming a socket for the chandelier or stand.

Here is a small table lamp of the same description, set upon a suitable support, and provided with binding screws for the attachment of the battery wires. The current, it is perceived, raises the filament to brilliant luminosity; though the actual light-giving capacity of the lamp, is low—only about five candle power. These lamps are now made in great variety of form. Here is a tiny specimen—not larger than a pea, and capable of giving but a single candle-power light. Of course the battery power required for such a lamp, is correspondingly low; the whole battery, you perceive, being scarcely larger than a church hymn-book, and of such a shape that it can be readily carried about the person. I place the battery in my pocket, and pass the wires under my coat, to the tiny lamp, which is affixed by a pin to the cravat. As I close the circuit, the lamp shines forth with a brilliancy exceeding that of the most famous of real or fabled diamonds.

[The lecturer wore this ingenious ornament during the rest of the evening, blazing with a fascinating lustre.]

The large arc lamps, the kind most generally used for electric lighting on a large scale, are made on a plan somewhat different. Two rods or pencils of hard carbon are held point to point. As the current passes, they are automatically separated to a short distance; the current drives minute particles of the carbon from one pole to the other, forming, in fact, a bridge of such particles; and these are brought to the incandescent condition, by the heating effects of the passing current.

This heating effect of the current may of course be applied in other ways than for illumination purposes. I have here (Fig. 5) a small cup, through the bottom of which a pair of wires pass, leading from a battery. Inside the cup, the copper wires are joined by a thin wire of platinum. I place in the cup a quantity of gun cotton, and request the gentleman assisting me, to carry the cup to a distance, while I hold the wires.

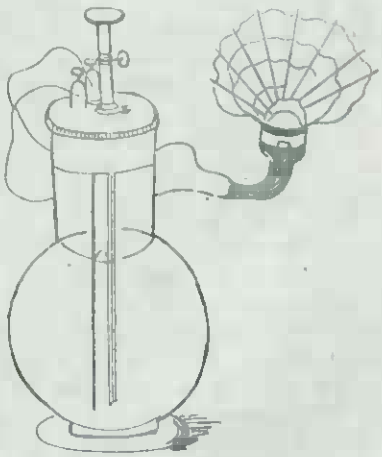

Fig. 5. Electric Explosion.

As I close the circuit, the platinum wire is heated and fires the explosive material in contact with it.