left, and the return journey was made by the way of the Makalaka and West Matabele countries, and a hearty welcome was given to the traveller on his arriving at Shoshong by the Mackenzies. While here the news arrived that war had broken out in the Transvaal between the Boers and Sekokuni. The journey to the Diamond Fields was made by Limpopo, and shortly Kimberley was for the fourth time reached. Settling at Bullfontein, the doctor with indefatigable energy soon got into large practice, and during two years, surrounded by the various animals and birds he had collected in this journey, his establishment was quite a menagerie. One holiday he paid a visit to the Orange Free State. When he viewed the Rocky Caves used by the Bushmen, he was particularly attracted by the remarkable carvings on the rocks done by the Bushmen to adorn their primitive abodes. A sketch of some of these is represented in the adjoining woodcut (Fig. 5). The rock is chiefly a sandstone, and the drawings are frequently executed in coloured ochres.

After a considerable period spent at Bullfontein, at Grahamstown, at Port Elizabeth, and at Cape Town, he embarked on board the *Germania* for Europe in August, 1879, bringing with him large ethnological and natural history collections. While the author's travels have added something to our previous knowledge of the geography of the portions of Africa he traversed, his account of them is really pleasant reading, and will be found of special interest to the naturalist and sportsman.

ELECTRIC LIGHTING[1]
III.

DECIDEDLY the most successful application of the electric light in London is at the Cannon Street station of the South Eastern Railway. The Charing Cross station of that Company has been lit up by the Brush system, and the Bricklayers' Arms goods-yards and sheds by Mr. Crompton's system, so that the South Eastern Railway officials have an admirable competitive trial proceeding within easy reach of inspection. The Cannon Street station is lit up by the British Electric Light Company with Gramme machines and Brockie lamps.

The engine—one of Marshall's semi-portable type—is of 14 horse-power nominal, and has a double cylinder on a locomotive boiler. The power is transferred by counter-shafting to the dynamo-machines by a system specially designed for the purpose, which is shown in the following sketch (Fig. 2). Large heavy fly-wheel pulleys give a second motion to the fly-wheel, which secures great steadiness—an essential feature of electric lighting. The engine is controlled by Hartnell's automatic governor, which regulates the expansion-gear of the engine and secures great uniformity of action.

The dynamo-machines are of a new class of Gramme, of high electromotive force, and they generate currents powerful enough to work five lamps. The current produced is of 26 vebers strength, and works a circuit of about 8 ohms resistance, thus giving an electromotive force of 208 volts. There are two machines at work, working ten lamps—eight being inside the station and two outside. The dynamos are fed by smaller Grammes, as shown in Fig. 2.

The lamps are Brockie's, the mechanism of which is extremely simple, consisting only of one magnet with a clutch, which, by means of a branch circuit, periodically interrupted by the commutator, readjusts the arc by letting the clutch fall, which releases the carbons and brings them momentarily together, and then picks them up again very smartly, so as to separate them the required distance. This gives the lamp a blinking habit,

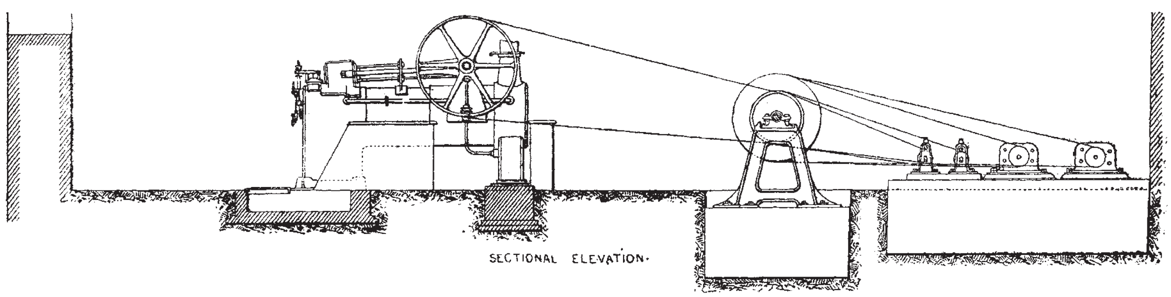

FIG. 2.

which at first is peculiar, but which one soon gets accustomed to and ignores. The diagram (Fig. 3) clearly illustrates how this is done. The magnets are fixed on shunts, two lamps being on two shunts and one lamp on the other. The shunts are of smaller wire than that of the main circuit, but they do not interfere with the main current, which passes through the carbons —in fact the shunts reduce the total resistance of the circuit. The lamps burn for four and a half hours, but it is intended to introduce a double set of carbons, which will of course duplicate this time.

Mr. Brockie has introduced quite a new principle into electric lighting, and certainly, to judge from the effect at Cannon Street, his success is unqualified. It remains to be seen how far this success is repeated at the General Post Office, at Victoria Street, Manchester, at Prince's Dock, Liverpool, and in the town of Liverpool itself. We certainly would like to see a good west-end street, say Piccadilly, Regent Street, or the Haymarket, lit up by this system.

Another system, not yet extensively employed, is Joel's improved incandescent electric lamp. In the latter part of 1878 considerable interest was excited in both scientific and commercial circles by the announcement that M. Werdermann had succeeded in the so-called division of the electric light by an invention based on the incandescent principle. His system was exhibited on an experimental scale only for some time, and then suddenly disappeared from public notice.

This incandescent principle has recently been revived, with many and ingenious improvements in the mechanism of the lamp, by Mr. Joel. An illustration of the hanging lamp is shown in Fig. 4. The light is reproduced, as was the case in M. Werdermann's system, by the heating to incandescence of the end of a small rod or pencil of carbon forming one electrode, which protrudes through a pair of contact jaws and abuts upon a fixed cylinder of copper forming the other electrode. The carbon pencil consumes at the rate of 2½ to 3 inches per hour for lights of 100 candle-power and upwards, and is fed forward according to the consumption. The length of carbon in circuit between the contact jaws and the fixed electrode is about three-quarters of an inch, and this, by the passage of the

[1] Continued from p. 35.

current, is rendered highly incandescent, chiefly however at that part near the copper electrode where the pencil becomes pointed, and therefore more intensely heated. There is also, in addition to this, a glow or flame-like appearance from the sides of the consuming carbon to the copper electrode, the light thus apparently taking an intermediate position between the purely incandescent system and that of the arc. The heated point of carbon becomes curled at the tip in a peculiar manner, as though it were viscous in shape, somewhat like a mushroom where it wastes away, and is replaced by the gradual forward motion of the pencil.

The fixed electrode, which may be entirely of copper or with a graphite insertion, remains intact without any appreciable wear.

The chief improvements in this lamp consist in the simplification and certainty of action of the mechanism in connection with the contact jaws for clamping the carbon pencil, by which means the lateral pressure of the jaws and the feeding of the carbon are attained by the combined action of one actuating weight, as shown in the diagram, Fig. 5. It will be seen from this that the lateral pressure is thus always proportional to the downward pressure, and may be varied to suit any conditions. The details devised for rendering the lamps in the same circuit independent of each other, and its general adaptability for interior and domestic lighting, constitute an important advance on anything which has gone before.

On referring to the sectional view of the lamp, Fig. 5, E is the fixed copper electrode upon which abuts the point

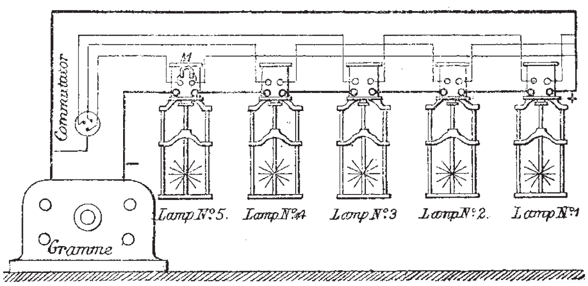

FIG. 3.

of the carbon *e*, which is rendered intensely incandescent by the passage of the current between the jaws and the copper cylinder. The jaws are shown at J clamping the carbon pencil. The actuating weight, W, which gives both the feeding motion to the pencil as it consumes, and the lateral pressure to the jaws, is suspended by continuous cords to the top of the lamp B, the cords then passing down through the weight and under one of the rollers at R, up again through a roller attached to the carbon holder, then back again through another roller at R, and ending at the weight. The rollers R are attached to a light tube, P, which passes down through a nipple, N, and terminates in a flange under the horizontal arms of the jaws and lifts them according to the leverage, thus producing the lateral pressure on the pencil. The top of this tube has also attached to it the armature, A, of an electro-magnet S, wound with fine wire and arranged in a shunted circuit in such a manner that as long as the normal condition of the light is maintained it is neutral; but if an arc should be accidentally formed between the carbon *e* and the copper E, the electro-magnet comes into action in opposition to the controlling weight, and frees the jaws from lateral pressure, thereby allowing the carbon pencil to descend freely and establish contact.

The carbon-holder is also arranged (Fig. 6) so that when the pencil is very nearly consumed the lamp is automatically short-circuited by the lever at L making contact with the arm carrying the copper electrode.

The stem or body of the lamp forms an important part of the whole, being formed of metal tubing in two semi-circular halves, each half forming part of the electrical circuit, the current traversing one side, of which the jaws form part, passing through the carbon pencil to the copper electrode, and returning by the other side of the lamp.

The two sides are kept closed mechanically (but insulated electrically from each other) by the latch and knob T, Fig. 5, which also automatically short-circuits the lamp when opened for the purpose of putting in fresh carbon, thus rendering it perfectly safe in handling. There are

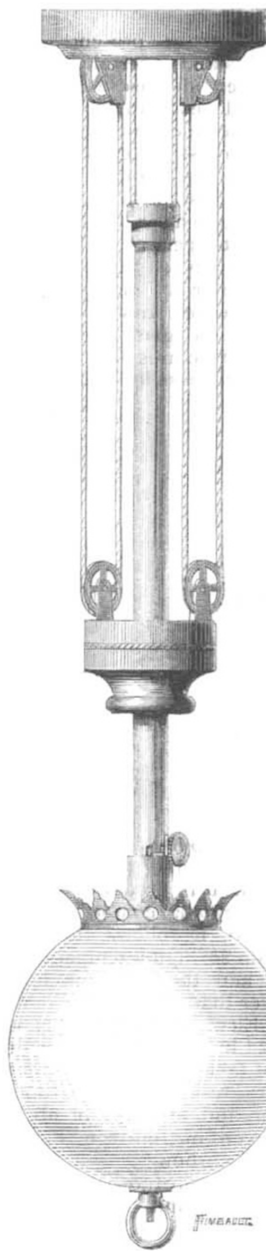

FIG. 4.

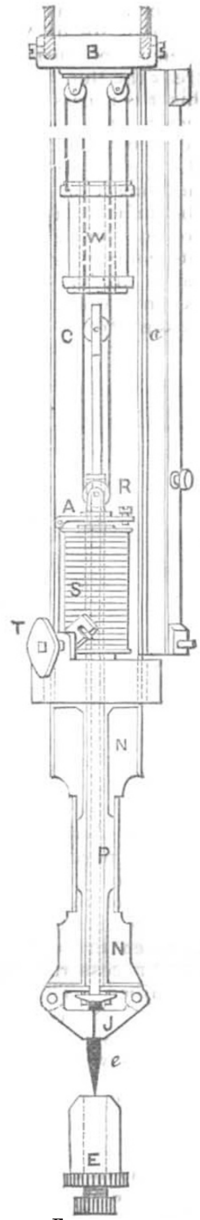

FIG. 5.

ingenious arrangements attached to this system for switching a lamp on or off, with resistances equivalent to that of the lamp; but upon these it is unnecessary to dwell, these adjuncts being common to many systems.

Prof. Adams stated at the Society of Arts that with this system an illuminating power of 715 candles per horse-power could be obtained.

If incandescent lighting is more expensive than the arc system, which it necessarily is when the current has to traverse a number of small lights, it has the great advantage of possessing perfect steadiness, which an arc lamp can never rival, and for interior lighting this is of great importance. The cost of carbons constitutes an important item in the expenses attached to electric lighting as now employed, and if we consider that in some incandescent systems the consumption of material is for a considerable period nothing at all, we may still work economically even though using considerably more horse-power to obtain our results.

Incandescent lamps, however, as at present constructed, are limited to small lights and a certain steady strength of current, as any sudden increase is apt to break the thin carbon filament employed. In addition to this it is necessary to protect the incandescent carbon of such lamps from the influence or access of oxygen, as it would be rapidly consumed by even the slightest amount of oxygen present. Therefore it must be protected by inclosing it in a vacuum, and it is a matter of considerable difficulty to produce a sufficiently perfect vacuum to prevent some small quantity of free oxygen from coming into contact with the light-giving material. Incandescent lamps are very capricious. Difficulties arise from the extreme thinness and delicacy of the glass employed, leakage from defective sealing or fractures, the liability of the incandescent material to shake loose in its supports,

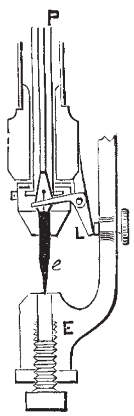

FIG. 6.

and the great care required in manipulation. The Joel lamp is free from these objections, and as in lamps that are purely incandescent, the heat is produced by the current only (the carbon not undergoing combustion by reason of the absence of oxygen), it follows that the incandescent portion cannot attain so high a temperature as when the carbon consumes, and therefore the light must necessarily be of less power than that in the lamp described. The offices of the Electric Light Agency in Queen Victoria Street are lighted by this system, and in the workshop two of these lamps take the place of fifteen gas jets with highly satisfactory results. The carbons employed are of 5 mm. diameter, and in length of about 1 m. The lamp burns for seven or fourteen hours, according to the dimensions of the carbon.

The Swan lamp is the only purely incandescent lamp that has met with any success in England. The Maxim light, the most successful in America, has not reached here yet. Dr. Draper's house in New York is lit by it, and he is able to manipulate his lamps with all the ease and comfort of gas-fittings. Sir William Armstrong, at Craigside, near Newcastle, has utilised a brook to run a dynamo-machine by means of a turbine, and he is able to maintain thirty-seven Swan-lights in his house. Mr. Spottiswoode occasionally gratifies his friends by illuminating his rooms with Swan-lights, and the rooms of the Royal Society were so lit at their last *soirée*. But such lamps remain luxuries, and nothing more.

Wherever the electric light has been introduced for internal illumination it has met with considerable favour. It not only lowers the temperature of a gas-lit room within reasonable bounds, but it clears the atmosphere of vitiations, and men work more cheerfully and better. In fact the extra amount of work got out of men is said in some instances to pay for the change. Moreover, since it renders the illumination comparable with that of daylight, it enables the aged and the weak-sighted to read and work without spectacles.

Electric lighting has however passed the experimental, it has now reached the practical stage.

HOW TO PREVENT DROWNING

I WISH to show how drowning might, under ordinary circumstances, be avoided even in the case of persons otherwise wholly ignorant of what is called the art of swimming. The numerous frightful casualties render every working suggestion of importance, and that which I here offer I venture to think is entirely available.

When one of the inferior animals takes the water, falls, or is thrown in, it instantly begins to walk as it does when out of the water. But when a man who cannot "swim" falls into the water, he makes a few spasmodic struggles, throws up his arms, and drowns. The brute, on the other hand, treads water, remains on the surface, and is virtually insubmergible. In order then to escape drowning it is only necessary to do as the brute does, and that is to tread or walk the water. The brute has no advantage in regard of his relative weight, in respect of the water, over man, and yet the man perishes while the brute lives. Nevertheless any man, any woman, any child who can walk on the land may also walk in the water just as readily as the animal does, if only he will, and that without any prior instruction or drilling whatever. Throw a dog into the water and he treads or walks the water instantly, and there is no imaginable reason why a human being under like circumstances should not do as the dog does.

The brute indeed walks in the water instinctively, whereas the man has to be told. The ignorance of so simple a possibility, namely the possibility of treading water, strikes me as one of the most singular things in the history of man, and speaks very little indeed for his intelligence. He is, in fact, as ignorant on the subject as is the newborn babe. Perhaps something is to be ascribed to the vague meaning which is attached to the word swim. When a man swims it means one thing, when a dog swims it means another and quite a different act. The dog is wholly incapable of swimming as a man swims, but nothing is more certain than that a man is capable of swimming, and on the instant, too as a dog swims, without any previous training or instruction, and that by so doing without fear or hesitancy, he will be just as safe in the water as the dog is.

The brute in the water continues to go on all fours, and the man who wishes to save his life and cannot otherwise swim, must do so too, striking alternately, one two, one two, but without hurry or precipitation, with hand and foot, exactly as the brute does. Whether he be provided with paw or hoof, the brute swims with the greatest ease and buoyancy. The human being, if he will, can do so too, with the further immense advantage of having a paddle-formed hand, and of being able to rest himself when tired, by floating, a thing of which the animal has no conception. Bridget Money, a poor Irish emigrant, saved her own life and her three children's lives, when the steamer conveying them took fire on Lake Erie, by floating herself, and making them float, which simply consists in lying quite still, with the mouth shut and the head thrown well back in the water. The dog, the horse, the cow, the swine, the deer, and even the cat, all take to the water on occasion, and sustain themselves perfectly