apparently a second and higher plateau. The abrupt change of level, together with the alteration in the internal structure and the presence of intrusive rocks at the base of the mountain seem to point to the existence of a fault of considerable magnitude, which probably is the eastward extension of a great fault to be described further on.

The rocks composing this high tract of country consist mainly of clay-slates with the original bedding still very distinct. What may be their exact relations to the granites which they probably overlie, or to the metamorphic rocks of the coast-range, we have as yet no means of ascertaining. Careful research will be required before anything definite can be said about them. The mountains cut out of these rocks by denudation are rounded in form, smooth, and by no means picturesque. They are devoid of trees, but covered with grass.

As we approach Lake Nyassa we observe evidence of much disturbance, till at a distance of about ten miles from the Lake we come upon the ancient pipe of a volcano, and five miles further on enter amongst a series of volcanic porphyrites, tuffs, and agglomerates forming mountains several thousands of feet in height, and which extend round the north end of the Lake. Along with this marked change of internal structure we have as decided a change in the scenery. The rounded mountains with smooth, grassy, and uncut sides give place to jagged peaks, serrated ridges, sharp yawning valleys, and irregular, rocky, notched sides, forming a landscape of no ordinary description.

The extraordinary series of volcanic rocks which form the magnificent mountains round the north end of Lake Nyassa probably belong to the same period as a similar series which characterise the Cape geology. The latter have been assigned to the Trias, and doubtless the immense development of volcanic rocks in Abyssinia described by Blandford is of the same age. Indeed we might almost say we have connecting links between the two places, as on my return march through Ugogo I observed evidence of volcanic outbursts, and it is well known that Kilimanjaro, further north, is of volcanic origin. It seems then that in Triassic times a great line of volcanic action stretched from the Cape by Nyassa, Ugogo, and Kilimanjaro, to Abyssinia.

But at the north-west corner of Nyassa we have evidence of later volcanic activity. In a niche cut out of the surrounding plateau and on a comparatively level plain, through which the River Jumbaka winds to the lake, a number of beautifully isolated cones rise to a height of about 300 feet. On examination these prove to be perfect volcanic craters, so entire and symmetrical as to appear almost artificial. One crater which I examined forms a beautifully bowl-shaped hollow, descending to the level of the plain, the bottom being a charming circular pond, where a number of hippopotamuses live.

It is clear from the perfect shapes of these cones, and from the fact that the surface features of the surrounding country have remained unchanged since their origin, that they must have arisen in comparatively recent times. Besides these cones there are two pretty circular lakes, which also appear to have been originally volcanic craters.

On leaving this interesting country and proceeding on our way to Tanganyika we rise once more to the top of the plateau, cross over mountains 8000 feet in height, and then descend to a general level of from 4000 to 6000 feet. We pass over clay slates and schists whose relative positions could not be determined with intrusive masses of granite. At one point an interesting section was revealed, showing the granite completely inclosing a mass of greenstone.

On nearing the south end of Lake Tanganyika we pass abruptly from these ancient rocks to red and variegated sandstones much hardened and broken, but preserving their original horizontal bedding. Rounding the end of the lake and continuing our march northward along its western side, we come to almost a sheer precipice, suddenly lowering the altitude from nearly 5000 feet to less than 3000. Running east and west along the precipice there occur intruded rocks, while on the northern or lower side of the precipice the sandstones almost disappear, being only represented by a small extent of crushed and tilted beds. Such a condition of things clearly indicates the existence of a great fault. This theory is strengthened by a similar abrupt change of rocks on the eastern side of the lake; and it will be remembered that we have already noticed among a different series of rocks still further east a sudden change of level almost on the same parallel of latitude.

The sandstones thus abruptly brought to a finish in their extension northward are succeeded by felspathic rocks which form huge mountain masses both on the east and west sides of the lake. Near the middle of the lake on its western side there occurs a curious apparently isolated area of fine red sandstones, surrounded on all sides except the east by mountains of metamorphic and felspathic rocks. These sandstones would seem to have been deposited in a small lake eight miles in diameter. Mount Malumbi, figured in Stanley's "Dark Continent," belongs to the same formation.

Still proceeding along the lake we cross a high mountain range named Tchansa, formed of metamorphic rocks with felspathic rock in the centre. We regain the sandstones once more in the country of Uguha. The sandstones here, unlike those of the south end, are very red in colour, extremely friable, and marked by the abundance of quartz pebbles. Through this formation the Lukuga River finds its way to the Congo, its course determined not by any great convulsion as some travellers have been inclined to believe, but by the long-continued action of streams wearing down the soft and friable barrier which hemmed in the lake at this point. These sandstones have an extension over a large area. They are found away towards Manyema and up the Congo Valley as far as Lake Moero, probably turning round and joining the strata we have noticed at the south end of Tanganyika. On the east side they are found from Kaboga to the north of Ujiji, though here shales are not uncommon and the strata much curved.

The absence of all fossils leaves the question of the age of these rocks in some mystery. A reference to Cape geology may, however, as in the case of the volcanic rocks, throw some light on this subject. The Tanganyika sandstones have evidently been formed in an enormous inland lake, beside which the present African lakes would look insignificant.

In Cape Colony a similar series of rocks occur of a lacustrine origin, and which have been assigned to a period not later than the Trias, and probably they belong to Palæozoic times. In the absence of anything but lithological evidence we cannot do better than place the Tanganyika sandstones in the same era as the Cape series, an era which would seem to have been emphatically characterised by the presence of great lakes.

JOSEPH THOMSON

INCANDESCENT ELECTRIC LIGHTS

THE recent experiments of Mr. J. W. Swan of Newcastle-on-Tyne have gone far towards demonstrating the practicabilty of a system of electric lighting based upon the so-called principle of incandescence. As the solution of the whole question of the possible domestic application of electric lighting depends in all probability uppon the successful application of this method, these experiments have claimed already a considerable share of public attention, though no panic has yet arisen like

that created two years ago by the far less formidable experiments of Mr. Edison in the same direction.

The material which Mr. Swan proposes to render incandescent by means of an electric current is a "wire" of prepared carbon of extraordinary density and elasticity. Twenty years ago he prepared carbon filaments for the very same purpose from calcined cardboard, inclosing them in a glass vessel from which the air was withdrawn as perfectly as the imperfect air-pumps of that date permitted. In October 1877, or one year before Mr. Edison had begun to attempt the construction of lamps with carbonised paper, Mr. Swan had some prepared carbons mounted in glass globes and exhausted by the Sprengel air-pump by Mr. Stearn of Birkenhead. This enabled Mr. Swan to discover that when the carbon was properly fixed and heated during exhaustion so that the occluded gases might be expelled, there was an end of the causes that hitherto had seemed to defeat all attempts to utilise this method of procuring an incandescent electric light; for when these conditions were observed there was none of the disintegration of the carbon rods, nor of the blackening of the globes that with less perfect vacua had proved the ruin of carbon lamps. The filaments of carbon now produced by Mr. Swan indeed resemble steel wire rather than carbon, so extraordinary is their tenacity and texture. The secret of their manufacture has not yet been made known, being the essential point of the patent rights which Mr. Swan has just secured. Each filament is about three inches long, and not more than the hundredth of an inch in diameter, and is so slight as only to weigh from one-fifteenth to one-twentieth of a grain. The durability of these filaments is remarkable. In the course of a lecture delivered on November 25 last before the Society of Telegraph Engineers, Mr. Swan stated that he had had lamps lighted continuously since August 30, with an intermission of three weeks only, and that this seemed to be far from the actual limits of durability. When the currents employed are not too strong, the lamps will last longer. The light yielded by these lamps varies, according to circumstances, from thirty to fifty standard candles. On the occasion of Mr. Swan's lecture thirty-six of these tiny lamps were exhibited working by the current of a dynamo-electric machine requiring four horse-power to drive it. In the debate which followed Mr. Swan's communication, the remarks made by Prof. Tyndall, Dr. Hopkinson, Mr. Alexander Siemens, and others, showed the real value of the advance made by Mr. Swan. The question however of the economy of the system remains yet to be decided by the practical test of durability. At a previous lecture at Newcastle-on-Tyne Mr. Swan exhibited twenty lamps fed by a current generated by a gas-engine consuming 160 cubic feet of gas per hour. The light obtained exceeded that of the seventy gas-jets which usually supplied the same room, and which consumed 280 feet per hour. Mr. Swan proposes to connect these lamps in series of fifty or a hundred in one circuit, using automatic circuit-closers to close the circuit in the rare case of the failure of a lamp. He considers his method of arranging the system to be superior to that proposed by Mr. Edison, whose method of placing the separate lamps in single branches of a divided circuit would involve the use of very heavy and costly conducting-wires without any counterbalancing advantage. With this important difference Mr. Swan's further proposal to erect central stations from which to supply currents of electricity over large areas resembles that suggested by Mr. Edison. Should the anticipations of the inventor and the present promise of the new lamps be fulfilled, domestic electric lights will certainly become a fact at no distant date.

Meantime Mr. Edison has not been idle. It is stated that he is at present laying down a service of about seven miles in length upon which to test the success or failure of his system upon a large scale. He has developed several ideas since his last appearance before public notice. He now makes his dynamo-electric generators of a much larger pattern than any heretofore attempted. He has abandoned charred cardboard in favour of a filament of carbon prepared from a cultivated variety of the Japanese bamboo. We shall hear before long whether his indomitable perseverance has been rewarded with final success. In spite of being in point of date behind Mr. Swan, he has the enormous advantages of a unique workshop and laboratory under his own direction, of a wealthy company at his back, and of the extraordinary prestige won by his previous inventions. If Mr. Swan appears to be nearer to a genuine success, Mr. Edison has a popular reputation that of itself will win a hearing for the most trivial of his inventions. Whichever of the rival systems succeeds science and mankind are the gainers. But up to the present point it seems to us that beyond question Mr. Swan is nearer the goal of practical results than his famous rival.

It may interest our readers to know that Mr. Edison's first carbon lamp is now on view along with his original phonograph and his earliest tasimeter in the Patent Museum at South Kensington.

SUBTERRANEAN FOREST IN INDIA

THE accompanying notes and illustrations on the underground forest recently discovered in excavating the Prince's Dock, Bombay, were forwarded by Col. C. J. Merriman, R.E., C.S.I., Member of the Legislative Council, and Secretary to Government (Public Works Department), Bombay.

The trees were generally found in a dark loamy soil composed of underlying rock disintegrated. The upper

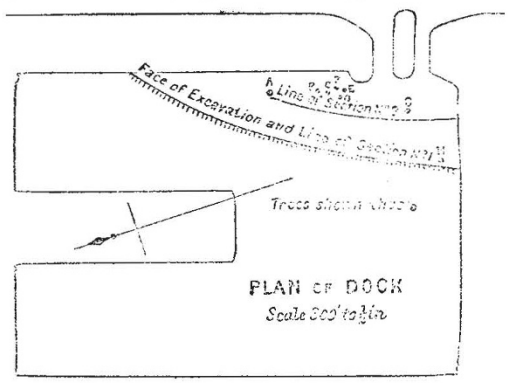

FIG. 1.—Dock.

portion of the trunks stopped at the soft black clay, which is silt. A few went a little way beyond; but as far as they protruded into the silt they were completely

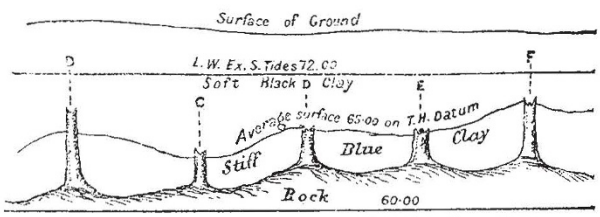

FIG. 2.—Section in line of trees B to F. Scale $\frac{1}{30}$ inch to 1 foot.

riddled by the teredo, the nearer the root the bigger the hole, showing that the boring began from the top.

The roots of the highest tree found were at 72·20 on T.H. datum, or close on Low Water extreme springs, about six feet under the surface of the mud. The lowest root was