HARNESSING THE VICTORIA FALLS FOR ELECTRICAL POWER.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

The continent of Africa has been the scene of many colossal engineering achievements, even from the Egyptian era. Within recent years many notable works have been completed in that vast country, notably the Nile irrigation works. Now, however, another ambitious scheme is to be carried out—the harnessing of the Victoria Falls on the Zambesi River, which when completed will constitute one of the greatest engineering monuments of the day.

The Victoria Falls have been described as the eighth wonder of the world, and certainly the cognomen is not misapplied. As is well known, Livingstone was the first white man to see them in 1854, and he narrates the impression they created upon his mind. Long before he reached the falls, the traveler had heard them described in awe by the unsophisticated natives as "Mosi oa Tunya" (the smoke that sounds). That was all the information he could obtain respecting them, and he experienced considerable difficulty himself in adequately describing them, so impressed was he by their colossal magnificence, for they constitute one of the most remarkable phenomena of Nature yet discovered. "The entire falls," wrote Livingstone, "are simply a crack made in a hard basaltic rock from the right to the left bank of the Zambesi."

It is difficult either to describe the peculiar construction of the Victoria Falls or to convey a comprehensive idea of their stupendous proportions, but some estimate can be gleaned from a comparison with the Niagara Falls. The latter measure about three-quarters of a mile in width, with a height varying from 158 feet to 167 feet. In the case of the Victoria Falls, however, the total width of the fall is about a mile, while the height of the falling water varies from 400 to 420 feet.

The course of the Zambesi River in the proximity of the falls is roughly from north to south. About half a mile above the falls the river is 1½ miles wide, but it gradually narrows as it approaches the falls, until it is only 1,936 yards in width. At this point there is a yawning chasm, or cañon, into which the river appears to fall to an interminable depth. The fall is nothing more or less than a huge fissure in the level of the river, caused by volcanic agency. This abyss is about 225 feet across. The rock is of a basaltic nature of a dark-brown color. The Zambesi for the whole mile of its breadth thunders down into this narrow gorge, which extends at right angles to the river's course, from shore to shore. The opposite wall of the fissure is as precipitous and as high as that ledge over which the water plunges. In this abyss the water boils and seethes like a gigantic cauldron. It has only one exit, and that is a narrow cleft in the opposite wall, about the center. This opening is only 300 feet in width, and through this contracted doorway the water, after pouring over a ledge a mile wide, is compressed.

The course of the river after it has plunged over the falls is no less extraordinary than the falls itself, for it flows through a narrow gorge only 150 feet in width for a distance of 45 miles. The Niagara gorge extends for only six miles.

The river level in this gorge is 400 feet below the level of the land through which it runs, and the walls of this ravine are precipitous, as may be seen from our illustrations. It is impossible to reach the river from the tableland above owing to the perpendicular nature of the cliffs, except at four places, which are called "doors" by the natives. What the depth of the river water in this gorge is has never yet been ascertained, but it must be considerable, for the river flows comparatively smoothly, only eddying round the projecting rocks.

A curious feature of this river bed is that it does not follow a comparatively straight course, but zigzags in a remarkable manner. For instance, it flows in a straight direction for a few miles, then turns abruptly and flows in a diametrically opposite direction for another few miles, turns again, and so on throughout the 45 miles of its course through the gorge. This channel has only been explored by one white man, Mr. F. W. Sykes, the district commissioner for the falls area, who has secured a splendid selection of photos, many of which we are enabled to reproduce herewith.

Some estimation of the force of the water as it plunges over the ledge may be gathered from the fact that the columns of vapor can be seen, even when the river is at low water, for a distance of five or six miles. In full flood the spray is hurled to such a height that it is visible ten miles away, and the sound of the falling water can be heard from a similar distance.

The idea of harnessing the Victoria Falls for the development of power was first mooted by Prof. George Forbes, the well-known electrical engineer who was largely responsible for the project of harnessing the Niagara Falls, but the first practical steps in that direction were taken simultaneously and independently by the Africa Trust, Ltd., of London, and Mr. H. B. Marshall, of Johannesburg. Upon the suggestion of the late Mr. Cecil Rhodes, who at once grasped the possibilities of the scheme and gave it his warmest approval and support, the two propositions were amalgamated, and took form as the African Concessions Syndicate, Ltd., which syndicate under certain terms and conditions holds the sole concession for developing electrical power at the falls for a period of seventy-five years. Sir Charles Metcalfe and Sir Douglass Fox, who are consulting engineers to the Rhodesia Railways, visited the falls to investigate the possibilities of erecting an electric power installation.

Since then they have been visiting this country and inspecting the installations at Niagara and Oakland, California, preliminary to a minute survey of the Victoria Falls and the planning of a gigantic power plant.

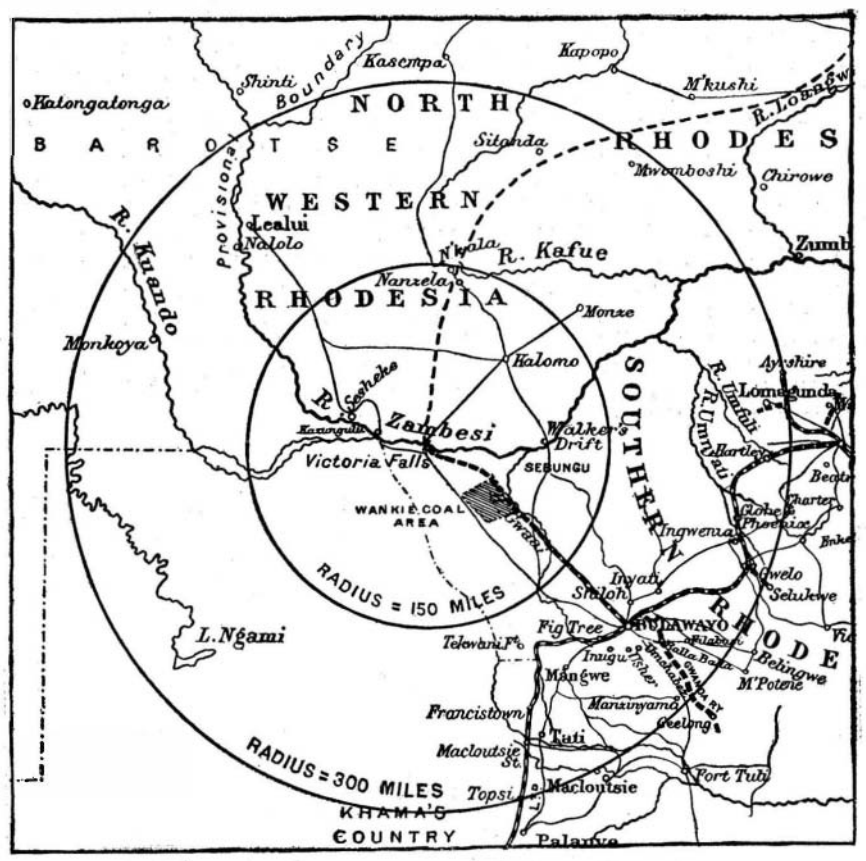
The power which it is possible to obtain from these falls is enormous. In the case of the Niagara Falls, it is computed there is 7,000,000 horse-power running to waste, while at the Victoria Falls, it is estimated that when the Zambesi River is in flood, discharging double the volume of water of that at Niagara over the gorge, there is about 35,000,000 horse-power running to waste.

During the dry season this is much reduced; but, even in the driest years, the volume passing over the lip is very large, so that several million horse-power will always be available.

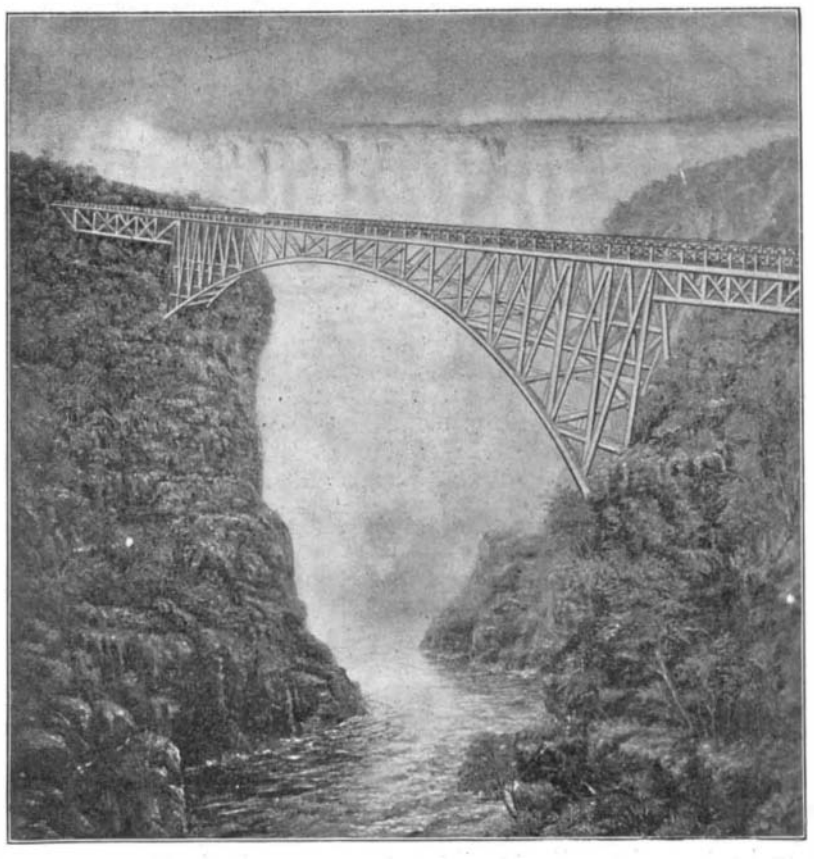
The initial survey of the falls for the purposes of the power scheme is now in progress, and this part of the work alone will cost some $50,000. Details of the installation are now only in preparation and will take several months to complete. The broad principle, however, is to place the power house on a benching in the second zigzag below the cascade of the Zambesi and to draw the water by steel tubes from the falls. Any amount of power required can be obtained, and an available head of at least 250 feet could be utilized. Each pipe or tube will be 8 feet in diameter, and will drive a turbine and generator necessary for 5,000 horse-power, and it will probably be found desirable to lay down the plant in units of this magnitude. The ultimate size of the power house will be determined by the demand for electricity in the neighborhood. The question of voltage will depend to a very large extent upon climatic conditions, and also upon the output and the distance to which power would have to be transmitted. At high voltages the air ceases to be a good insulator, and when moisture is present sparking into the atmosphere takes place, and a large amount of electricity passes through the air from one wire to another. Special transformers and insulators will be designed for much higher voltages than are now adopted. At present the limit is that at which an uncovered copper conductor will retain the current.

It is estimated that the first outlay will represent some $2,500,000. This will only suffice to erect a section of the plant. It is projected to distribute the power over a radius of 300 miles from the power station. In this area is situated the township of Buluwayo, the street railroads and lighting of which it is projected to operate by this electrical power.

The realization of this scheme will exercise a far-reaching influence upon the commercial, industrial, and mining developments of the country. In this region are located the extensive Wankie coal fields, wherein coal seams as much as 37 feet thick and near the surface are to be found. These and the numerous gold, copper and other mineral fields, will be worked by electricity very cheaply and profitably, as the charge for the power generated by the falls will be very low. What is far more important is that several reefs containing only a small percentage of mineral ore, which cannot be rendered by the existing methods financially remunerative, will by this agency be operated at a profit. It is also anticipated that the railroads will be driven by the same power, especially the local lines, as it will be found much cheaper to maintain electrically-propelled trains than steam locomotives and carriages. The possibilities, therefore, of electrical power generated by the Victoria Falls are innumerable.



Three Hundred Miles Radius of Electrical Power Transmission of the Victoria Falls Power Station.



The Zambesi Railroad Bridge As It Will Appear When Completed.

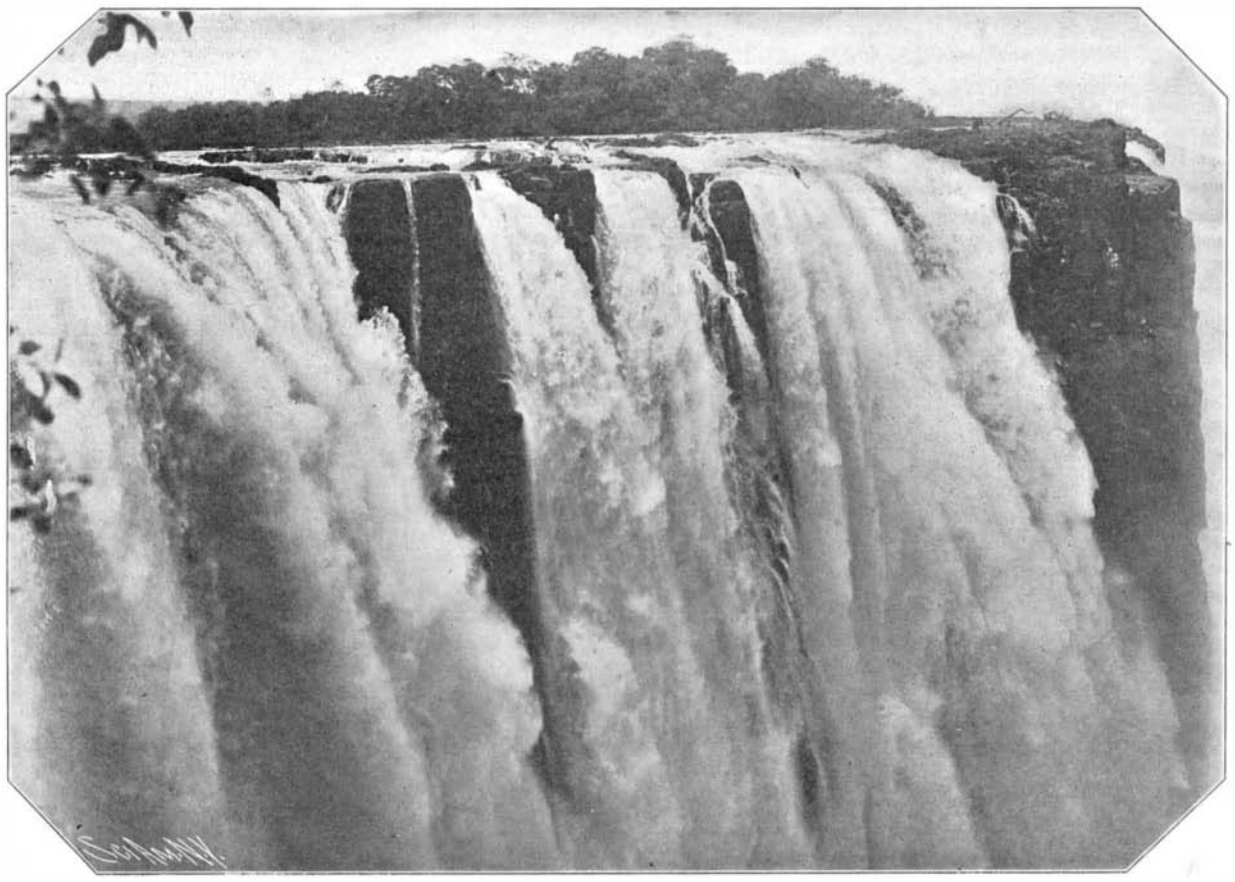
A New Automatic Machine Rifle.

Some highly interesting trials have been carried out before several officers of the British army with the new Rexer machine rifle. A great future may await this weapon if it practically solves the great difficulty heretofore experienced in the use of machine guns firing small arm ammunition, i. e., the necessity of some description of wheeled transport. In general appearance the Rexer automatic machine gun resembles the ordinary rifle except that it has a perforated casing surrounding the barrel. It weighs only 17½ pounds and is carried and used by one man. When in action, unless at exceedingly close ranges, it is impossible to distinguish between a Rexer gunner and an infantry soldier using the ordinary infantry weapon.

The numerous advantages of this weapon comprise lightness and portability, rapidity of fire, ease and quickness with which it can be brought into action and the small target which it affords to the enemy. The gun can be instantaneously adapted for either deliberate or automatic firing. The maximum speed of

firing is about fifteen rounds per second, and the changing of the clips, each of which holds twenty-five rounds, occupies only about the same space of time. The gun consists of a barrel and inclosed casing containing the mechanism and a stock. The barrel is surrounded by an outer tube, in which it travels backward and forward, being driven back by the recoil, and forced forward into the firing position again by the action of a spring. During the recoil and the return, the ejection of the spent cartridge and the insertion of the new in the chamber is effected automatically by the mechanism. Toward the muzzle end of the outer casing of the barrel are two light legs, forming a support, on which the gun can be readily trained in any direction. A very important and valuable feature of the weapon is the dispensing of a water jacket for the cooling of the barrel. Notwithstanding the rapidity or duration of firing, the barrel keeps quite cool. In operation, the soldier lies on the ground in the ordinary firing position. In transport, the gun and 250 rounds of ammunition are easily carried by one man; or it can be carried on horseback in a bucket, in the same manner as a carbine, together with 500 rounds, which are placed in handy magazines strapped to the saddle.

The arm has been adopted with conspicuous success in the Danish army, and experienced soldiers can maintain a fire of 300 rounds a minute. According to official tests, its accuracy is also a prominent characteristic, the percentage of hits being approximate to that of ordinary rifle fire at ranges varying from 300 to 500 meters.



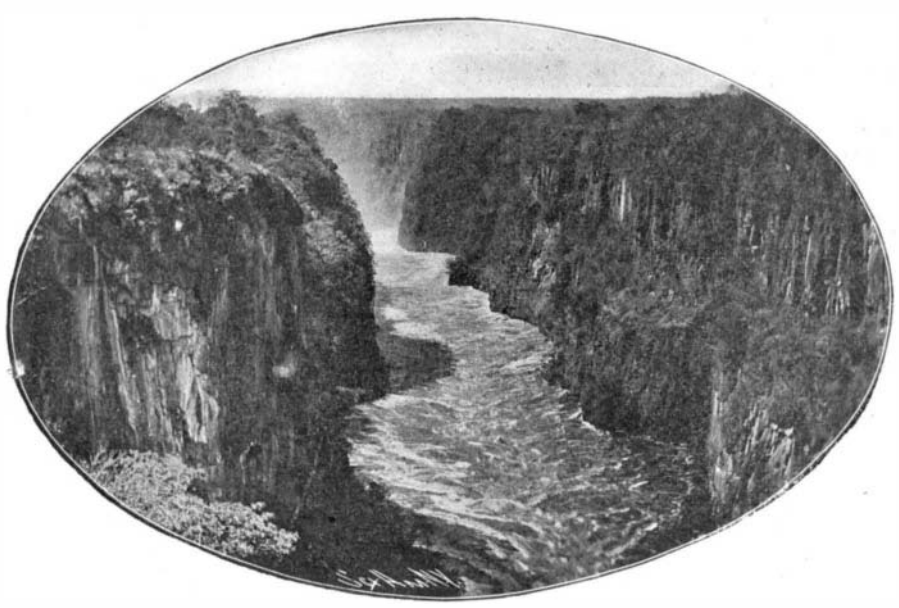
Part of the Central Fall.

The first passenger car ever constructed for a street railway was used in New York city in the third decade of the last century. This car was drawn by horses over strap rails laid on stone ties. Improvements introduced during the next forty years were principally in details, but the introduction of the cable system in 1873 was a decided advance in motive power. At the present time, however, the use of the cable car is confined almost exclusively to Chicago, San Francisco, and Kansas City, while the trolley, which was not used to any great extent prior to 1885, has practically superseded all other systems. In several instances even the steam railways have introduced electric motive power. In view of the movement to abolish overhead wires in the large cities, the success of the open conduit system, which has been introduced in the more populous parts of New York and Washington, is worthy of note. In 1902 the number of miles operated by this system in these cities was 264.

A View of the Falls at Low Water.

The Gorge Below the Falls, Showing the Tortuous Formation of the Channel After the Stream has Leaped the Falls.

The Eastern End of the Falls at Low Water.



The Gorge Below the Falls, Showing the Narrow Passage into Which the Stream is Compressed after Passing the Falls.

The Leaping Waters, or Western Cataract.

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