

THE ORINOCO—A WASTED WATERWAY.

BY G. L. M. BROWN.

Of all the great rivers of the world, with the exception, perhaps, of the Zambesi and, of course, those emptying into the Arctic Ocean, the Orinoco is the least known to commerce. Less remarkable for its length than its volume, in which it is exceeded by only eight other rivers, it has half a dozen tributaries compared with which the Susquehanna or the Potomac are mere pigmies, and drains a territory of 360,000 square miles, more than half the surface of Venezuela, or equal to the combined area of Italy, Spain, and Portugal.

Its actual length is estimated at 1,450 miles to its source in the sierras of the mysterious Guiana region; but to the head waters of the Guaviare, one of its upper branches, the distance is perhaps 1,600 miles or more. This tributary is about the size of the River Loire in France, but the Meta, the Arauca, and the Apure—the latter of which is regarded by some authorities as the true upper course of the Orinoco—all exceed the far-famed Rhine both in length and in volume, and in the rainy season roll down a vast flood such as few rivers of their size have ever been known to discharge. The Orinoco itself averages more than twice the volume of the Danube, and could gain or lose a dozen Hudsons without appreciably affecting its regular rise and fall. On the other hand, it must be remembered that two rivers on the same continent greatly surpass it both in length and volume—the La Plata and the Amazon, the volume of the latter being estimated at six times that of the Orinoco.

Apart from its size, the Orinoco is remarkable for several peculiarities, notably for its communication with the Amazon system through the Cassiquiare, which, it may be noted here, is not the sluggish canal at one time described, but a swiftly flowing river which divides its waters in the ratio of two to one, the Orinoco receiving the lesser current. The famous delta with its thirty-six channels is also an interesting feature, though less unique than the inland delta formed by the Arauca and the Apure where they join the main stream. This has been caused by the enormous force of the "winter" floods, which break through the soft mud banks, forming a confused network of "caños," or channels, which relieve first one and then the other of the streams they so intimately connect.

Like most rivers that flow through vast alluvial plains, the Orinoco is wide and shallow, and contains many shifting sand-bars which hinder the summer navigation; but this is not true of all of its course, for hills of blackened granite are seen at places with here and there a huge boulder projecting above its muddy surface. At the port of Ciudad Bolivar (formerly Angostura) the river is so constricted that it attains great depth, and in the wet season sweeps through its narrowed channel with such force that "lanchas," or sailing barges, have sometimes been known to take a week in passing this point. Its average rise at the narrows is between 40 and 50 feet, but in 1892 it attained the incredible height of 75 feet above low-water mark, and actually flooded the city, which in the dry season is perched high on the hillside, making a prominent landmark for approaching vessels.

The Orinoco is navigable at all seasons from the Atlantic (including seven of its mouths) to the Atures rapids, a short distance above the mouth of the Meta. A special class of steamer has to be used, of course, for this up-river navigation, and the vessel in the accompanying illustration will serve as a type of all the steamers plying west of Ciudad Bolivar, except one recently added to the fleet, which is an exact copy of the boats of the upper Nile, and draws just twelve inches. This latter is designed for the river Meta, the navigation of which has heretofore prov-

en difficult for boats drawing three feet or more, except in "midwinter" (i.e., July and August), when it is easily navigable to the edge of the Colombian highlands. The Arauca presents conditions similar to the Meta, and receives one steamer during the rainy season, which ascends to the village of Arauca, situated

far-distant Andes gave the necessary increase, and the town, one morning, was awakened to activity by the whistle of a small stern-wheeler which carefully felt its way over the bars, and crept in to the bank. Six months later, I reflected, as I watched this diminutive craft, the greatest vessel afloat could be made fast at the selfsame spot, and the ground on which I stood and, indeed, perhaps the whole town, besides countless leagues of savannah, would lie several feet below the onrushing flood.

A short distance above the Atures is another rapids, the Maypures, these two forming the only obstruction to the navigation of the Upper Orinoco, the Cassiquiare, and thence through the Rio Negro to the Amazon, as well as of the Guaviare, already mentioned, which drains the vast and otherwise inaccessible region southeast of Bogotá, and is said to be navigable for 500 miles.

The navigation of these waters was attempted about fifteen years ago by a French company which had acquired valuable rubber concessions in the region of the Cassiquiare and the Rio Negro (known as the Rio Negro district), where extensive forests of the very finest Pará rubber exist. The company, at great cost, transported a small steamer in sections to the foot of the rapids, and thence overland to the Upper Orinoco (their intention, I believe, was

ultimately to build a connecting railroad here), launched the vessel, and began to exploit these priceless forests. Unfortunately, however, as has been the case with so many French companies on this continent, the project failed through gross extravagance and mismanagement, and the little steamer was soon abandoned to the mercy of the floods. The present "Orinoco Line of Steamers," who own or control all vessels on the entire Orinoco system, informed the writer that they intend repairing this boat and encouraging trade with the upper river; but until this is done, we have the astounding spectacle of more than a thousand miles of navigable inland waterways undisturbed except by an occasional canoe or lancha.

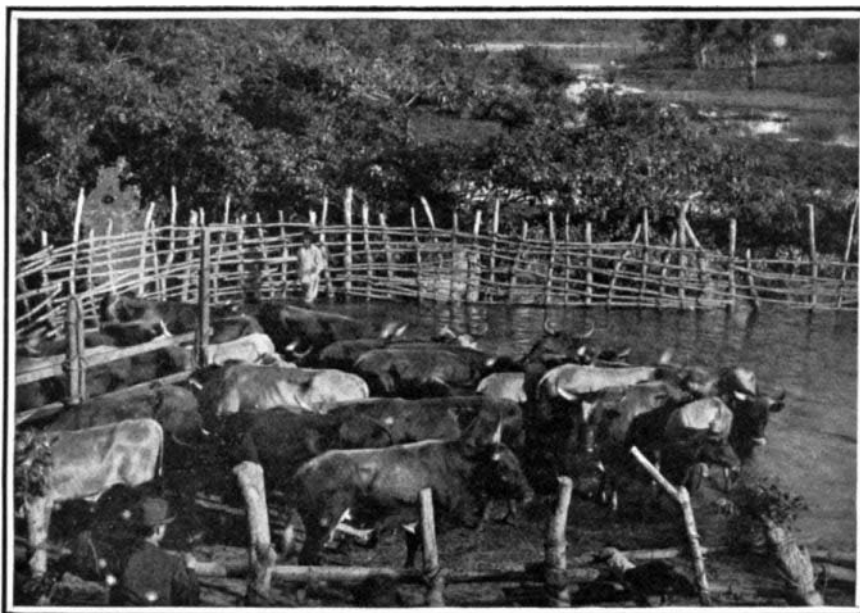
The lancha is simply a light scow, or flat-bottomed boat, fitted with a single mast, from which, however, an enormous sail can be spread. With the summer trade-winds blowing from the Atlantic, good progress up-stream is often made, but for the return trip the mast and sails are stowed away, and the force of the current is depended upon, aided in the dry season by the use of poles or oars. If the westerly winds have set in, of course, it can sail back as well, and at times a little craft may be seen with sail set, tacking down stream in the teeth of an easterly wind; but this is sorry work. On my trip from San Fernando de Apure, indeed, we picked up a passenger from a lancha hailing from the town of Arauca, who informed me, with no little disgust, that the voyage had already lasted two months, and Ciudad Bolivar was still far distant. The lancha, if I remember correctly, reached port just two weeks after we did, and, of course, by no possible good fortune could the owner sell his little cargo of hides so as to make the trip profitable.

Speedier and more picturesque than the lanchas are the "bongos," or large dugouts, one half of which is sheltered by a wicker or palm-thatched canopy; and a sight never to be forgotten is the passing of a bishop or faithful "padre" with his Indian boatmen, making a round of parochial calls requiring, perhaps, several months' almost constant travel. The instant this craft is recognized, the steamer or lancha slackens speed, and when the padre glides alongside he solemnly blesses the voyagers, then thankfully accepting such contributions as are offered him, and exchanging a courteous farewell, resumes his solitary way. His garb, his half-naked boatman, and the primitive bongo make the traveler wonder for a moment if he has not beheld a vision of



A Scene in San Fernando During the Rainy Season.

on the boundary between the two republics. The Apure, however, has a more uniform course, and is said to be navigable for more than 600 miles; but regular steamers certainly do not ascend that distance, the traveler being fortunate if he can get comfortable passage above San Fernando. Even this important town is frequently isolated during February, March, and April, as the writer learned to his dismay on his arrival from the Llanos. The stranger, to be sure, will



Live Stock Ready to be Shipped to Trinidad.

suffer no great hardship by the delay, since the town contains many well-appointed stores and can boast of an ice factory, a Chinese laundry, a small daily bulletin containing foreign cablegrams, and for his entertainment a primitive bull-ring! But even these attractions and the charming hospitality of the people pall upon him, and he constantly watches the sluggish current, hoping against hope that a rise may occur. Fate was kind in the writer's case; a tropical storm in the



The Narrows at Ciudad Bolivar.

SCIENTIFIC AMERICAN

[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1905, by Munn & Co.]

Vol. XCIII.—No. 22.
ESTABLISHED 1845.

NEW YORK, NOVEMBER 25, 1905.

[10 CENTS A COPY.
\$3.00 A YEAR.]



AN ORINOCO "LANCHA."—[See page 420.]

early colonial days when the hardy fathers fearlessly set out to plant the cross in the remotest regions of the interior, and a glance at the shore line of tangled primeval forest and the still, lifeless track of waters in his wake, almost confirm him in the strange fancy.

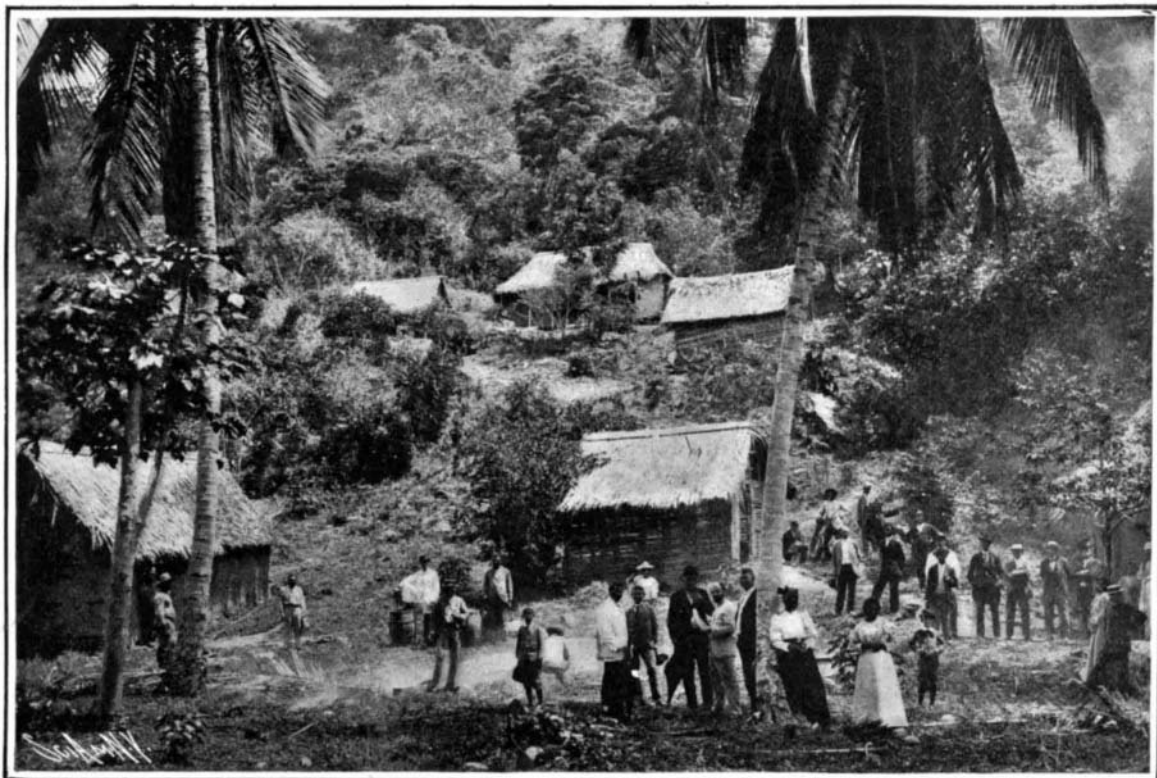
The history of the navigation of the Orinoco is a sad recital of government monopoly and official corruption. The only port open to foreign vessels is the city of Ciudad Bolivar,* a restriction that has wrought untold hardship to mining and trading companies, who often lose on the extra transportation to and from this

service exists between Trinidad and Ciudad Bolivar, and that at least something is being done to better the communication with up-river points.

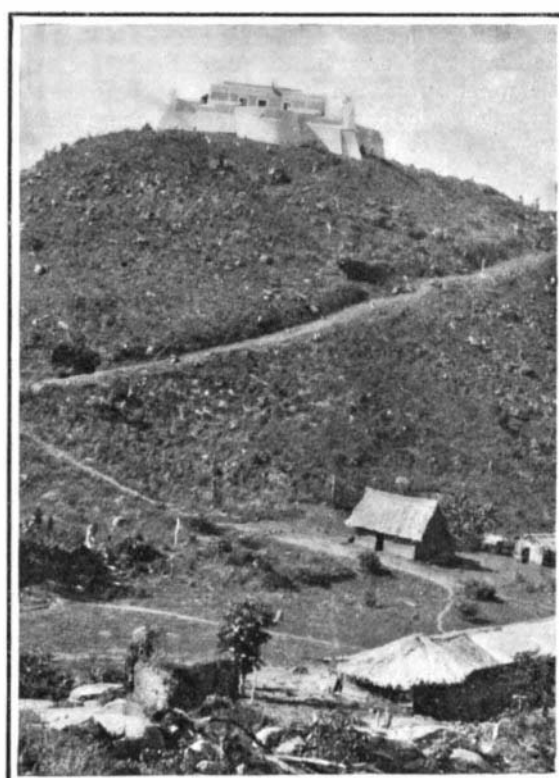
The outlook, however, is not very promising, and it is doubtful if the Orinoco country will be properly opened up during the present generation unless a radical change of administration takes place. Its population to-day is believed to be actually less than it was nearly four centuries ago, when the Spanish explorer Ordaz ascended to the mouth of the Meta; and the Indian stands in such fear of the Venezuelan and his

which are about the same distance apart as are Minneapolis and St. Louis, it is estimated that there are less than 2,000 permanent settlers, apart from the inhabitants of Caicara and one or two other small villages. Most of these settlers, moreover, live among such wretched surroundings that one wonders that they find life endurable. The only evidence of modern progress that I witnessed during the entire trip was a windmill, and of the various craft we sighted not one was propelled by steam.

Yet the natural wealth and fertility of this region



Among the Hills on the Banks of the Orinoco.



The Ancient Fortress of San Feliz.

city the small profit necessary for the working of their concessions, and innumerable enterprises have failed owing solely to this short-sighted policy. The exclusion of all vessels but those of the river fleet from the Macareo channel of the delta, the shortest and safest route to Trinidad, is equally absurd; but these abuses are insignificant compared with the absolute monopoly of the up-river steam navigation, which is in the hands of the company already referred to, the "Orinoco Line of Steamers," who are the successors of the famous Orinoco Steamship Company, an American firm which was accused of aiding Gen. Matos in his ill-fated revo-

lution that he frequently prefers to follow the smaller waterways of the Guiana region, or take overland trips through the virgin forest rather than use the broad highway that is his rightful heritage from countless ancestors.

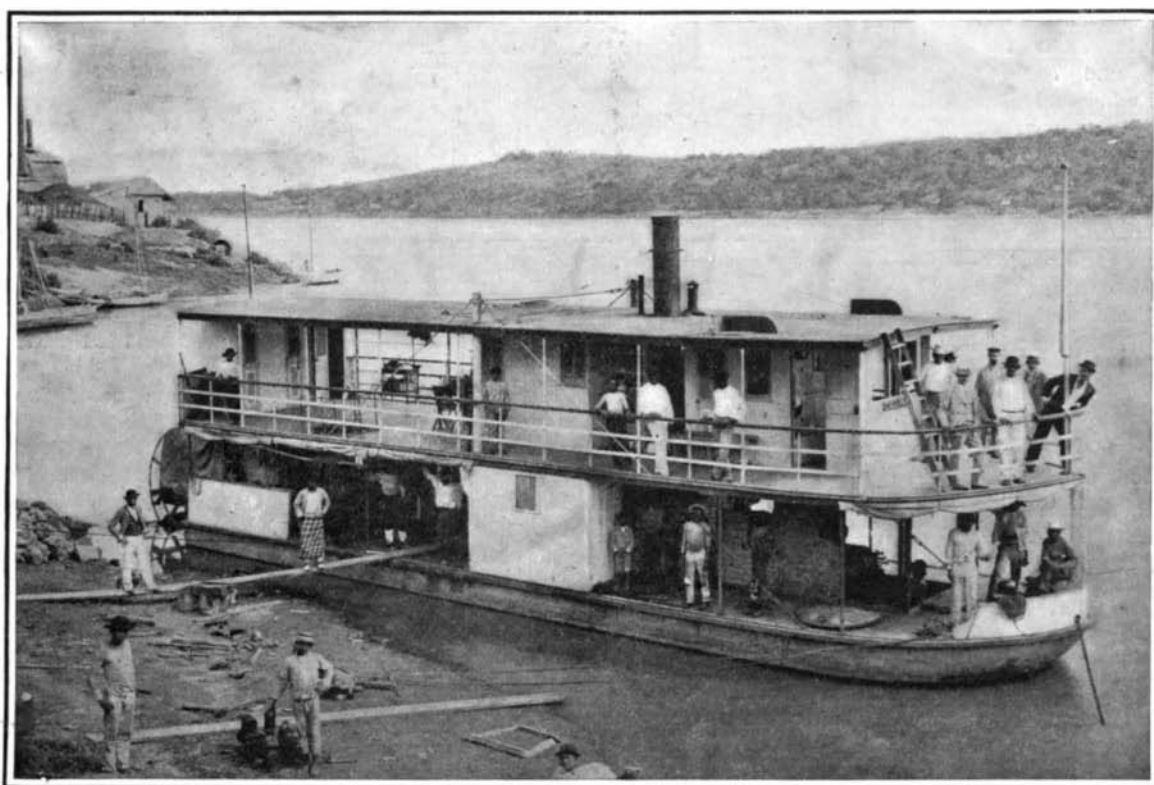
This disappearance of the Indian has greatly impeded the gathering of rubber, tonca beans, and other natural products, and since immigration is not encouraged and continuous revolutions have scattered or killed the settlers of European and mixed descent, it would seem that the country is steadily retrograding. There is a project on foot at present to establish a col-

ony of Boers upon the "llanos," and Gen. Castro is said greatly to favor it;* but the Venezuelans assert that this is because he sees a chance to augment his army with tried fighters, not because he favors foreign colonization. The writer sailed 200 leagues down this giant waterway, and was amazed at the primeval condition of the country. Between San Fernando and Ciudad Bolivar,

is boundless. The cattle of the llanos, as is well known, yield the finest hides that the shoe manufacturer can procure, and with cheap river freights, the traffic in hides from San Fernando alone should employ a fleet of steamers. During my visit to that town, however, the cattle industry was so depressed that animals on the hoof brought only \$5. The rubber forests of the upper Orinoco are as yet almost untouched except on the margins of the streams, and the valuable balatá rubber, which is comparatively new to commerce, is found at various points from the delta to the Rio Negro. Hardwoods of an infinite variety, dye-



Carib Indians of the Lower Orinoco.



A Typical Upriver Steamer.

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lution, and was promptly snuffed out by President Castro. The nominal owners of the present line, indeed, are likewise an American banking and trading house at Ciudad Bolivar, but the president is a silent but very aggressive partner, and dictates the policy of the company, which, it is needless to add, is extortionate in the extreme, as are all other enterprises, controlled by him. To the credit of the American management, however, it must be admitted that an excellent

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woods, medicinal plants, vanilla, tonca beans, turtle oil, and alligator and crocodile skins, will all in time become important exports, as will rice, sugar, tobacco, cacao, and many other agricultural products when the land is taken up and cultivated.

To-day, however, the Orinoco country remains a veritable wilderness, and the Orinoco can best be described as a wasted waterway. Were it not for the attractive little city of Ciudad Bolivar and the enterprising town of San Fernando de Apure, one would not hesitate to call it one of the most backward territories of its size

* A small town near the Delta has recently been declared a port, but its position favors only the shipment of cattle.

* Gen. Pierson, the Boer representative, who recently returned to South Africa, states definitely that plans are completed to bring 8,000 Boers to Venezuela not later than 1906.

in the world. Yet the climate is healthful; the forest, mineral, and agricultural resources are limitless; and the whole region, with the exception of the highlands and sierras of Guiana, is rendered easily accessible by a magnificent river system. The only drawback to its development is the corrupt and inefficient government of Caracas—a drawback, judging by the past decades, that seems destined to outlive the century.

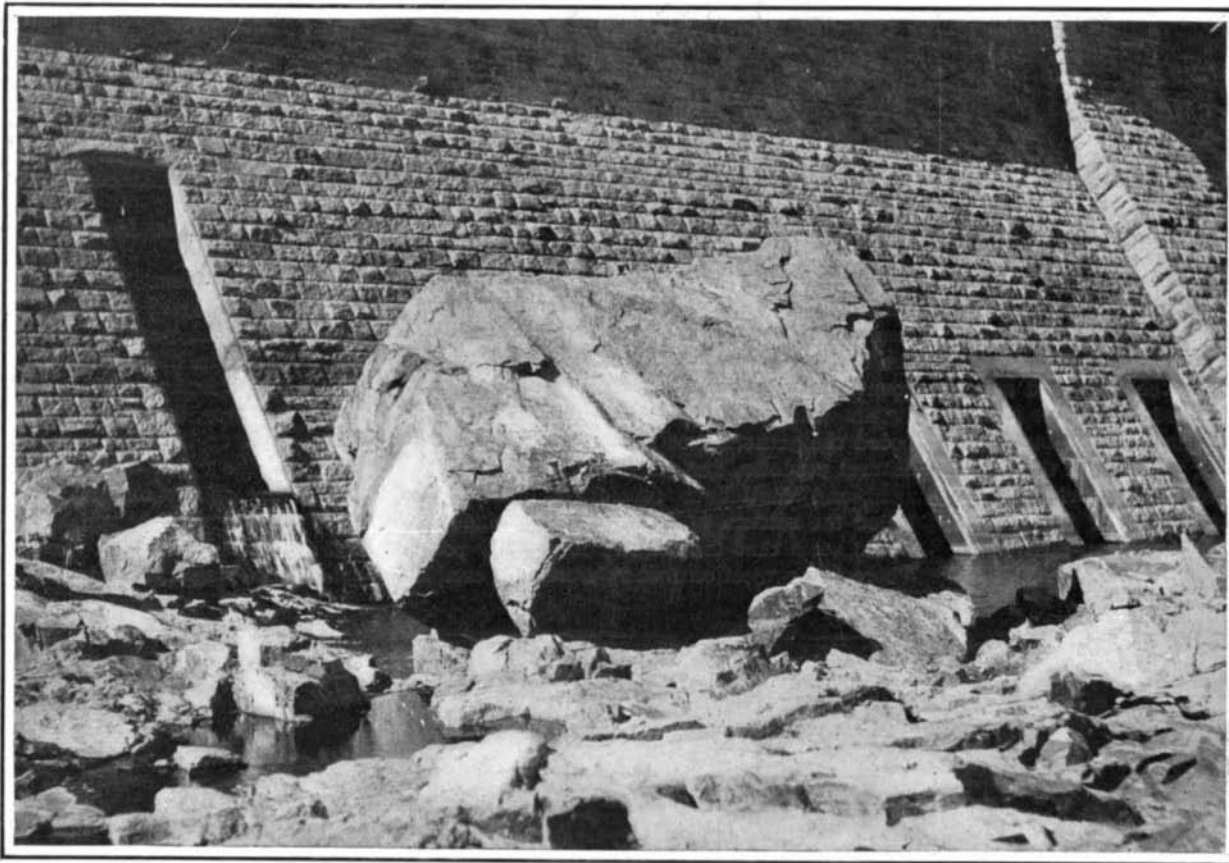
EXTRAORDINARY EFFECT OF WATER EROSION CAUSED BY THE ASSOUAN DAM.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

One of the most perplexing problems to the engineer, when dealing with the control of large masses of water, is the liability of erosion arising from the discharge of the water through a limited space. Occasionally the nature of the surface upon which the released water pours under great pressure and velocity is rugged and broken. Should a crevice exist the checking of the released water thereby is accompanied by a violence almost explosive in character, and the effects of this erosion are often of a remarkable nature.

One of the most extraordinary examples of this action is that shown in the accompanying photograph, kindly loaned to us by Sir Benjamin Baker. In this instance the rush of the water through the sluices of the Assouan dam has dislodged a huge boulder from the rocky bed of the river. As is well known, this barrage extends right across the Nile just above the first cataract, and the flow of the river below Assouan is completely controlled by this dam, the water passing through a series of sluices. At times a huge volume of water is banked up behind the barrage to a height of 60 feet above the level of the downstream. The sluices, however, are built at different levels in the barrage, so that it is possible to control the velocity of the discharge. The maximum head of water allowed is 29.5 feet and this enables the velocity of the released water to be controlled within 36 feet per second.

The bed of the river is solid rock, yet the rush of the water has dislodged this huge piece of rock measuring 17 feet long, 12 feet wide, and 7 feet thick, and has thrown it against the masonry face of the dam. The weight of the boulder Sir Benjamin Baker estimates to approximate 60 tons, yet it has been torn from the rocky bed and hurled backward by the water with the greatest ease.



THE EXTRAORDINARY EFFECT OF WATER EROSION CAUSED BY THE ASSOUAN DAM.

An Inventor's Fantasy.

BY T. A. REEVES.

I have always been fond of inventing. There is no pastime more fascinating and satisfying to my mind. Others may while away tedious hours with books or cards; but I enjoy a stimulating and unending pleasure in fixing my mind on some problem of mechanics, or some of the infinite possibilities of contrivance, and while I am engaged upon it the time speeds away on lightest wings.

Sometimes it is a long railway journey which is thus beguiled and shortened. Sometimes it is one of those irksome half-days of waiting which fall to one's lot in making connections at some cross-country junction, in the midst of a wilderness of scrub-oak; or at some tiresome country tavern, with nothing but the neighboring blacksmith shop to afford relaxation or interest!

Under such circumstances the hours have no horror for me. I seek a quiet corner, and open my design book at some rude sketch of a mechanical idea, and am soon lost to the dullness of the situation, to leaden-footed Time, and to every other annoying circumstance. I have even allowed a slow train to pass the station, while I continued at my problem and awaited a later express.

In the case of sickness, and the necessity of watching and carefully administering medicines, or rendering other attentions to the patients by night, it has been no trouble for me, with an interesting idea re-

volving in my mind, to remain awake, and to care for my loved ones. And often, when wakefulness possessed me, and sleep refused to be wooed, I have composedly resigned myself to the situation, ceased fretting and tossing, and taking up one of my varied inventions, either quieted myself to slumber, or forgot the worry of wakefulness in the delight of its pursuit.

One of the happiest of these devices, over which I spent far more time than the simplicity of the article would seem to demand, was "The Elastic Metal Band." It was intended to replace the rubber band which is so unsatisfactory from its rapid deterioration. The lawyer, author, or business man takes from pigeon-hole or desk a package of papers, or the lady a dainty bundle of letters from her secretary, only to find its rubber band as brittle as clay, and perhaps stuck fast by warmth and moisture to the documents or missives which it bound.

My problem was to create a strap or band which should be perfectly flexible, and at the same time reasonably elastic. If it would stretch one-third its length and return, it would answer every practical demand. Its links must freely move, and there must be no rough ends or open joints to mar the appearance of the strip. It must be flat and neat, and then, when nicked or plated, it would be an attractive and desirable article.

The attainment of all these features gave me no end of trouble. The pesky thing would tangle and hitch in the most unexpected and contrary ways! When adjusted around a bundle and automatically clasped to one's great satisfaction, on turning the bundle over there would be half a dozen links fouled and

crinkled into an obstinate knot, that tried patience almost to the parting point.

I am myself a man of correct language. I do not swear, never having practised, or even learned the rudiments of that accomplishment. When my temper is tried to the last notch, and the expletives seem bound to come as a relief to the pressure within, I simply assure myself that there is need of more thought. Another difficulty has shown itself which must be overcome. If it had been easy to construct this article, it would not have waited for me, but would have been on the market, doubtless, long ago; and some other man, of less patience than myself, would be enjoying the fruits of it. With these philosophic and moral reflections I usually put the article away until with fresh mind it can be taken up again; or, as indeed sometimes happens, until at some unexpected moment the mind, dwelling unconsciously upon the difficulty, flashes out its solution in a moment of inspiration and almost superhuman insight.

Such was the point reached in designing "The Elastic Metal Band." It had been laid aside for a considerable time, as presenting almost insuperable difficulties; when one night I seemed to awake from a refreshing slumber. Never was my mind clearer or keener in grasp of mathematical or mechanical problems than in that hour. I glanced at my clock upon the wall, which I had designed, showing in phosphorescent figures the time, 2:45 A. M. Immediately the elastic band came into my thought, and was pictured before my imagination as vividly as if I held it in my hands. And what is still more to the point, the solution of the difficulty of the entangling links presented

itself to my attention. I could join them so that the crinkling would be avoided absolutely; and the band was in one moment perfected, practical, and complete.

It would be difficult to describe the exultant feelings and triumph of that hour! It was almost a wild joy to have won the victory over all the perplexing obstacles which had arisen, and to see the pretty band of steel, with its ingenious curves, lying like a lady's bracelet, so artistic and beautiful before me! I felt that it would mean fame for me. And there was the genuine usefulness of the invention! It would fill a real want, and obviate the inconveniences of the imperfect article which it was intended to supplant. I saw the windows of the stationers filled with varied and exquisite designs of the elastic metal band; and offices equipped with an abundant supply, on the tables and desks and in the filing cabinets of lawyers, bankers, shippers, merchants, and manufacturers. The government would undoubtedly require immense quantities of these bands in all its offices. And I thought of the vast market for this indispensable novelty in the great cities and in every town and home in our broad land.

I will not deny, also, that golden visions came into my mind of rich pecuniary reward to myself from this important invention. I had before, when the article seemed ready to be patented and manufactured, consulted with a friend who was in the novelty line; and he had named a figure which seemed to me to be very conservative and safe on his side for the invention, and a very modest royalty after the manufacturers had reimbursed themselves for their outlay. But after all, it was a very snug sum in my circumstances; and

there was the certainty that the royalty would surprise my friend when the orders from the whole country began to tax the capacity of his works! In the meantime there was an investment right at hand, in a neat row of cottages, suitable for the skilled mechanics of our city, which would bring a good 10 per cent on the whole sum, while I would have an unexpended part of it still in hand for personal use.

These golden visions filled my imagination with intense satisfaction, until my silent alarm, which was my own invention, awakened me by blowing a current of cool air upon my face; and with returning consciousness I realized that the difficulties were not yet fully solved, which barred

from completion "The Elastic Metal Band."

Violet and Ultra-violet Rays Given Off by Metals at Ordinary Temperatures.

Those who have seen a winter night in the North will probably remember the brightness of the landscape even though the sky be covered with thick clouds. This phenomenon suggests the hypothesis that the snow has some luminosity of its own, and this problem is treated by Prof. Melander, of Helsingfors, in a recent paper published in *Annalen der Physik*.

After experiments made with a photographic camera imbedded in the snow failed to give any satisfactory results, the author eventually observed a very striking photographic effect of the snow cover. As, however, the photographic plates were covered with metal plates, Mr. Melander thought it necessary, first of all, to ascertain whether these did not exert any effect of their own.

Experiments made in this direction showed all metals to give off violet and even ultra-violet rays even at ordinary temperatures, though these rays are too weak to be noted by our eyes. As the temperature increases, this radiation becomes more and more intense until even our eyes are affected by it at a white heat. This radiation is possibly produced by certain chemical processes which occur at the surface of the metal, though the effect on sensitive plates seems to be due immediately to the surface rather than to any emanation.

The ionizing power of these rays may play an unthought-of part in nature, and the author suggests that such animals as see in the dark may have eyes especially sensitive to them.