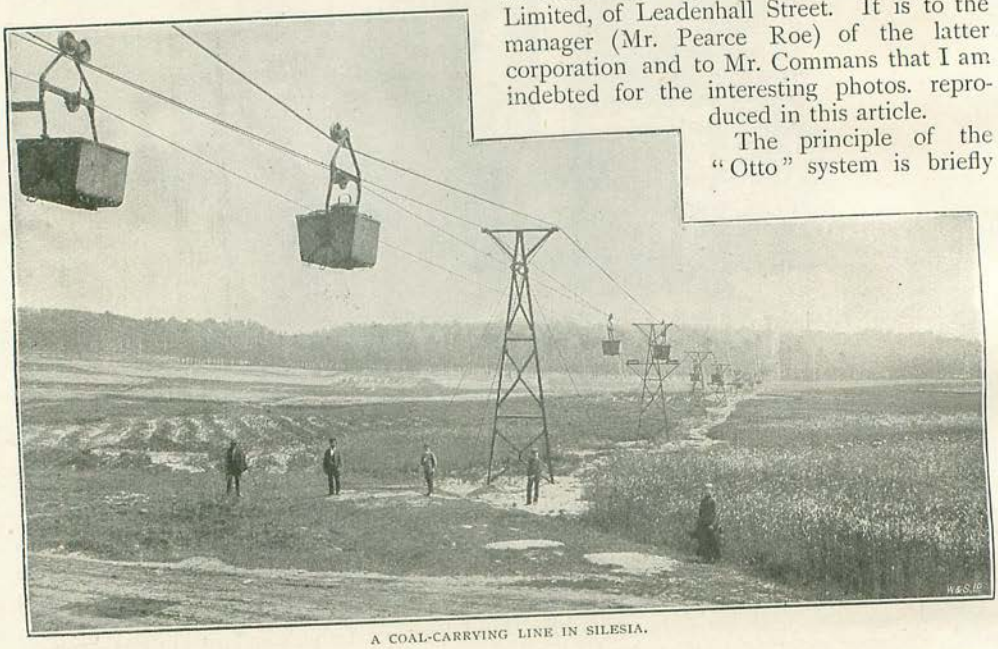
Railways in the Air.

By Corrie Sefton.

TO speak of a "railway in the air" is not Jules Vernese; indeed, either of the two able engineers in London, who would build you one in a few months, "see nothing in it," to use Sir Charles Coldstream's words as he stood disappointed on the crater of Vesuvius.

But where and how are they built—propelled—manned? What are they used for? And what do they look like? Gently, gently; you will presently know all about these triumphs of modern engineering. Well, then, here is the clue to a seeming mystery. The cars or buckets hang on pulleys from wire ropes, instead of running on rails laid on the ground. As a fact, the correct designation of these marvellous lines is "aerial ropeways." One glance at the photograph reproduced on this page will tell you all about these things.



A COAL-CARRYING LINE IN SILESIA.

This line belongs to Count Hugo Henckel von Donnersmarck, and is used at his Antonienhütte Coal Mines, in Silesia. Constructed in 1886–87, it is 2,900yds. long and carries daily from 12,000 to 14,000cwt. of coal; the capacity of each bucket is half a ton. There are three stations, connected with each other by electric signalling apparatus (bells chiefly) and by telephone. One is a little staggered to learn that the total daily working expenses only amount to two-and-twenty shillings! No wonder that in some cases where wire ropeways have been introduced they have paid for themselves in less than three months.

Aerial ropeways may be divided into two broad types. The first is the "Otto" system, exploited by Herr J. Pohlig, of Cologne, whose London representative is Mr. R. E. Commans, of 6, Queen Street Place. The second system is that of Roe and Bedlington, as constructed by the Ropeways Syndicate, Limited, of Leadenhall Street. It is to the manager (Mr. Pearce Roe) of the latter corporation and to Mr. Commans that I am indebted for the interesting photos. reproduced in this article.

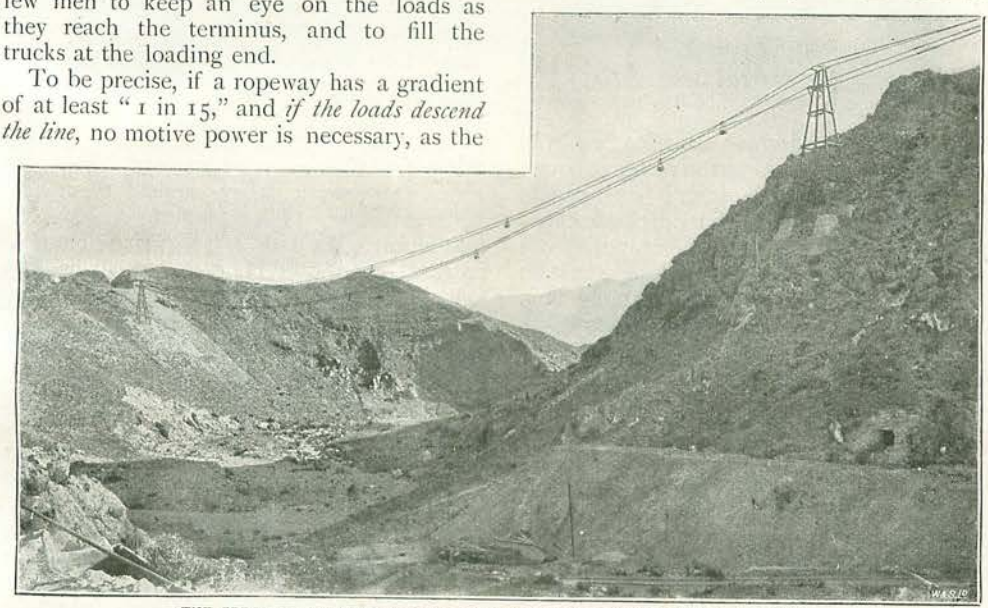
The principle of the "Otto" system is briefly as follows: Two stout wire carrying ropes are laid parallel on standards of wood or iron, and then stretched tightly *in a straight line* between two stations. Aerial ropeways can't run round corners, therefore the longer lines are split up into straight sections with intermediate angle stations. Even when a very long line is quite straight, however, it is usual to place stations at every 5,000–6,000 yards.

On one of the carrying ropes, or aerial rails, the *loaded* trucks run in one direction, while the "empties" return on the other rope; wherefore the latter is rather thinner than its colleague. The carrying ropes are fixed at one end, whilst at the other is established the tightening gear.

The supporting standards are placed at intervals varying from 40 to 100yds., except in crossing rivers and deep valleys, when spans up to 1,600ft. can be adopted. Notice, by the way, in several of the photos. the terrific dip in the aerial track. One marvels how the rope stands the strain; the carrying rope, by the way, has a breaking strain of 38·76 tons per square inch. The trucks or cars are moved (in the "Otto" system) by a special rope of small diameter, running beneath the carrying ropes. This is the endless hauling-rope, which passes round horizontal pulleys at the terminal stations.

But perhaps the most striking thing about aerial ropeways is that many of them—most of them, in fact—are automatic. They can be got to work themselves, and only want a few men to keep an eye on the loads as they reach the terminus, and to fill the trucks at the loading end.

To be precise, if a ropeway has a gradient of at least "1 in 15," and *if the loads descend the line*, no motive power is necessary, as the loaded trucks, running down on one rope, draw up their empty fellows on the other. More, some of these ropeways, far from wanting engines and things to drive them, actually give power away, and graciously consent to work other machinery.



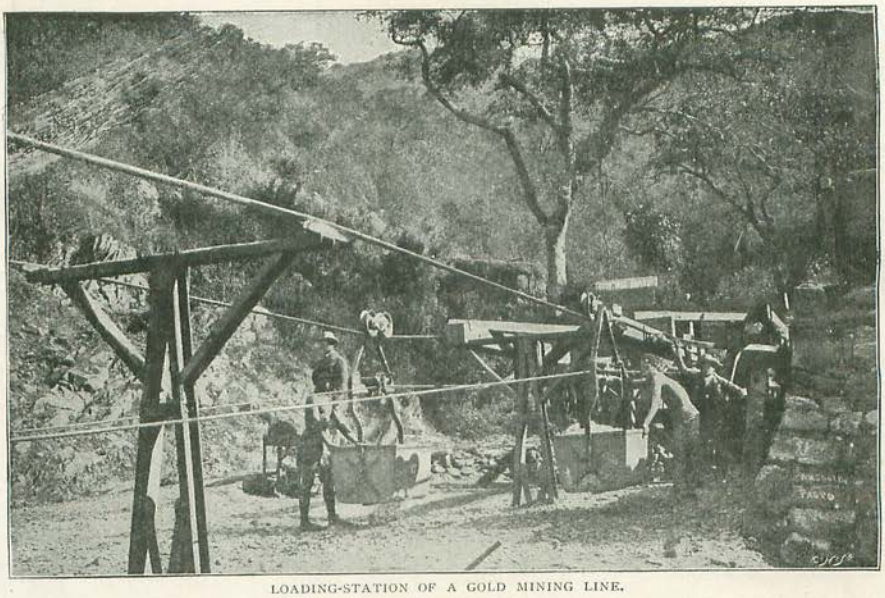
THE GREAT VILLA RIFORMA SPAN OF THE BEDAR-GARRUCHA AERIAL ROPEWAY.

The first photo. gave little or no idea of the appalling country covered by these aerial ropeways. But look at the second illustration reproduced here. It shows a span of 920ft. on the Bedar-Garrucha Wire Ropeway in the province of Almeria (South of Spain). This is one of the most important aerial ropeways in existence, and carries iron ore from the Sierra de Bedar mines to the seashore near Garrucha, on the Mediterranean. The line is 9¾ miles long, and is divided into four sections. At one point it crosses a mountain ridge 1,175ft. above sea-level. An ordinary light railway would have cost £100,000, whereas the aerial ropeway was put up in ten months at a cost of only £26,000.

This line presents a truly magnificent spectacle when viewed from the mountain pass lying between Bedar and Serena. From this spot the whole track can be seen, with the 660 carriers or buckets at regular intervals along the swaying ropes. Half the buckets are descending and half ascending with a velocity of about 5ft. per second. They seem to grow smaller as they approach the sea, until they dwindle gradually to mere black specks, and finally leave visible only the traces of the ropes, which form two white threads in the sunlight, connecting the glittering sea with the mountains at one's feet.

This is not an automatic line, so two engines are needed—one of 30 and the other of 70 horse-power. At the loading-station, the buckets are filled from ore bins, each of 800 tons capacity. Our third photograph, next reproduced, shows us what a loading-station is like.

This photo. shows part of the ropeway owned by the Oriental and Sheba Valley Gold Mining Company—a three-mile line in the De Kaap district of the Transvaal. The fall from the loading-station at the mine to the stamp-battery at the Kaap River is



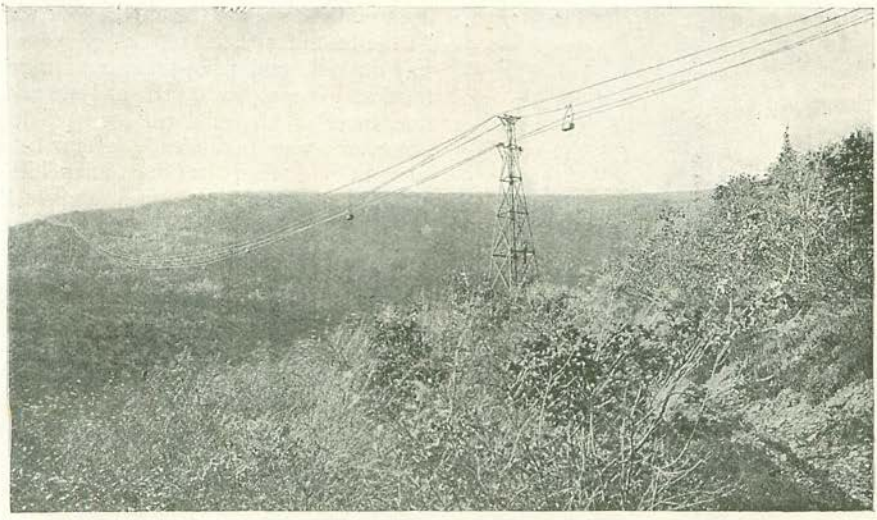
LOADING-STATION OF A GOLD MINING LINE.

about 950ft. Kaffirs are seen loading gold quartz into the buckets as the material comes from the mine. On the right is seen part of one of the huge bins which feed the buckets. Mr. Commans tells me that this ropeway was constructed under great difficulties. It passes over two tremendous ridges with gradients in places of *one in one* (or an angle of 45deg.), and it cost £30 a ton to transport the material up country from the coast. By adopting this ropeway, the cost of transport was reduced from 25s. to about 5s. a ton.

The aerial ropeway can follow a bird anywhere — a "tall order" apparently, but literally true. There are lines across awful ravines and over rock-encumbered country, where even a common road is an utter impossibility. The "silver strands" run up precipices and over mountain peaks, railways, and buildings. Moreover, no great purchase of land is necessary for their construction, but merely the lease of a 10ft. strip, giving the right to walk along and inspect the line. Actual *terra-firma*, however, is only required at the points of support, so that the land can otherwise be cultivated as usual. The question of "way-leaves," by-the-bye, has so far hindered the general adoption of aerial ropeways in England, where cantankerous landlords, approached on the subject, suddenly manifest the keenest appreciation of every square inch. "That's splendid building land," they will say, and therefore demand a prohibitive rental. Our "railways in the air" have peculiar advantages. What if the country is flooded for miles, or rendered impassable with snow to mere groundlings? These things in no way interfere with the ropeways; rather do they assist them by baffling thieves. This is an interesting point, by the way. In parts of Mexico the cunning natives lie in wait beneath big spans and actually intercept buckets full of gold quartz. These enterprising gentry have special poles made for the purpose of "holding up" the loads. To obviate, or at least trace, this pilfering *en route* (remember, the line is practically staffless) the tops of the loads are whitewashed, and a watch is kept at that part of the ropeway where it is evident that thieves operate.

Our next photo. speaks for itself as to the wild, trackless country covered by these aerial lines. It is a view of part of the Gebhardshain Line, near Siegen, which is used for carrying iron ore, and rock for road metal. This ropeway is between five and six miles long, and is divided into three sections. There is a maximum incline in places of 1 in 4, and 260 tons of basalt and ore are carried daily. The unloading station is situated alongside the main line of a great railway, so that the material can be shot direct from the aerial hoppers into the prosaic railway trucks.

In the fifties, wire ropes were used in mountain districts for the conveyance of big logs, stones, and things over rivers and gorges; but the first real practical steps were taken by Charles Hodgson in England, about 1863. Theodore Otto and Adolph Bleichert having dissolved partnership in 1876, Herr Pohlig took up the construction of the "Otto"

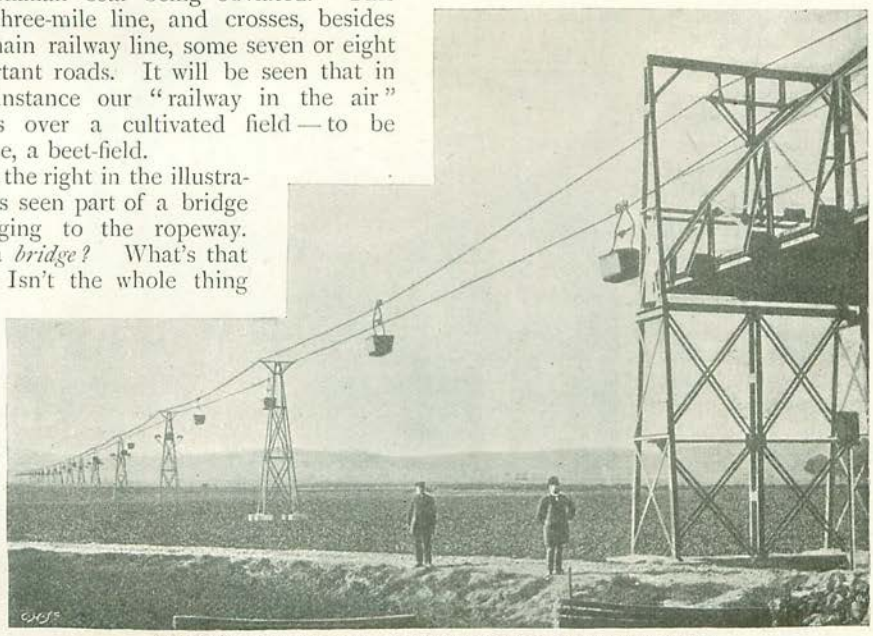


PART OF THE GEBHARDSHAIN ROPEWAY, SHOWING WILD COUNTRY COVERED.

ropeways; and their success is in great measure due to the improvements introduced by him.

The illustration next shown gives an excellent notion of an "Otto" ropeway. This line is situated at Brühl, and crosses the railway from Cologne to Bonn. It is used for the transportation of lignite fuel from a mine in the neighbourhood to the boiler-house of a great sugar mill which works up the beet in the surrounding country. In this way an enormous saving was effected, the use of Westphalian coal being obviated. This is a three-mile line, and crosses, besides the main railway line, some seven or eight important roads. It will be seen that in this instance our "railway in the air" passes over a cultivated field — to be precise, a beet-field.

On the right in the illustration is seen part of a bridge belonging to the ropeway. But a *bridge?* What's that for? Isn't the whole thing one huge bridge? Never mind; ropeways must have bridges just like ordinary railway systems. But, why? Well, suppose the carrying ropes cross a much-used road, and that big chunks of ore, slag, or any other substance much harder than the human head, occasionally fall out of the buckets as *they* pass over; what then? How about unsuspecting foot passengers, to say nothing about mere horses? And then in the case of railways—how about blocks of ore falling on the metals, or damaging the rolling stock?



THE BRÜHL LINE CROSSING A BEET-FIELD, PART OF BRIDGE ON RIGHT.

HOW THE INSPECTOR GOES HIS ROUNDS.

Mr. Commans frequently receives curious requests from people who conceive strange notions as to the use of the ropeways. Passenger lines are often suggested, but the truth is, the ordinary man wouldn't care about whirling over mountain gorges and raging torrents, merely hanging from a wire rope. Mr. Imré Kiralfy thought that an aerial ropeway to the axle of his Big Wheel would be a good and paying thing, but it was found that the risk would be too great. 'Arry would be certain to get gesticulating *en route* to his friends below, and would in all probability rejoin them prematurely—far too prematurely. And yet loaded buckets pass through and above the clouds on some ropeways in the Caucasus!

The cost of ropeways varies enormously; it may be £800 per mile, or it may be treble that sum. Locality, capacity, and transport have to be considered, among many other things. The ropes, properly looked after, last a lengthy period, and to aid their life they are periodically treated with a preparation that is more of a weather protector than a lubricant.

Our next photo. shows how the inspector proceeds along the line. The bucket seen is in reality the truck belonging to a light railway (hence the four wheels). At the terminus of the ropeway, it pursues its way on rails and *terra-firma* until it joins a third and incomparably bigger system. As a rule, there is a special car arranged for the inspector, who periodically examines every part of the line, trailing after him the lubricating apparatus. The endless hauling rope can, of course, be greased at any point as it runs along. It is an interesting fact that the carrying ropes always give warning before actually breaking, after years of wear; the warning usually consists in the snapping of some of the outer wires.

Both Mr. Roe and Mr. Commans have been frequently approached on the subject of an aerial ropeway from ships to the shore. The idea is that, suppose the surf breaks upon the coast in a terrific manner, the vessel can lie out in comparatively smooth water and unload easily and without delay. Of course, the

A TREMENDOUS DIP.

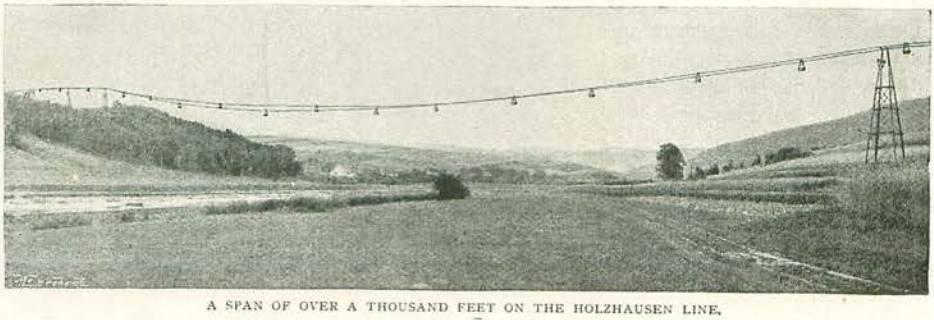
A REFUSE REMOVING ROPEWAY: SHOWING HOW THE BUCKET IS AUTOMATICALLY TIPPED.

difficulty is to moor the carrying ropes. They can't very well be made fast to a pontoon, because the strain would pull it in, and even the strongest anchors are not to be trusted for this purpose.

Perhaps no photograph reproduced in this article gives a better idea of the wild country covered by these aerial lines than the one shown opposite. This is an impressive view. The standard in the foreground is strengthened by means of "tie-rods" and stays. We notice an amazing dip into the valley, and after that the carrying ropes rise boldly up the face of the adjacent mountain. And yet many of the workmen employed at the mines and factories connected by these lines frequently travel in the buckets! Truly, an awe-inspiring "short cut."

The line seen in the accompanying photo. is one that is used to remove daily about 60 tons of refuse and waste from an adjacent colliery to a large piece of waste ground; this is the unloading end of the line. The photo. shows the method employed for automatically tipping the buckets and discharging the dirt. In time, it is obvious that the aerial station (seen on the left) will be completely buried, by reason of the constant accumulation of refuse, and yet this station is 70ft. high. It is proposed to erect coke ovens on the ground that is being filled up. Four-legged supports are used when the strain on the ropes is very great—as, for example, at the place shown in the next illustration. Here we see sixteen buckets passing backwards and forwards, the line crossing a high ridge on the left. This ropeway is established at Holzhausen, near Cassel. It carries lignite fuel—about 150 tons in a day of ten hours. Our photograph was taken at a point where the line crosses the River Fulda, and shows a span of no less than 1,050ft.

At the outset I explained that aerial ropeways might be divided into two classes. Of these—having dealt with the "Otto" system—there remains the Roe and Bedlington type. In the "Otto" system, the buckets are drawn along a fixed carrying rope by means of a separate hauling rope; whereas in the Roe-Bedlington lines, a plain



A SPAN OF OVER A THOUSAND FEET ON THE HOLZHAUSEN LINE.

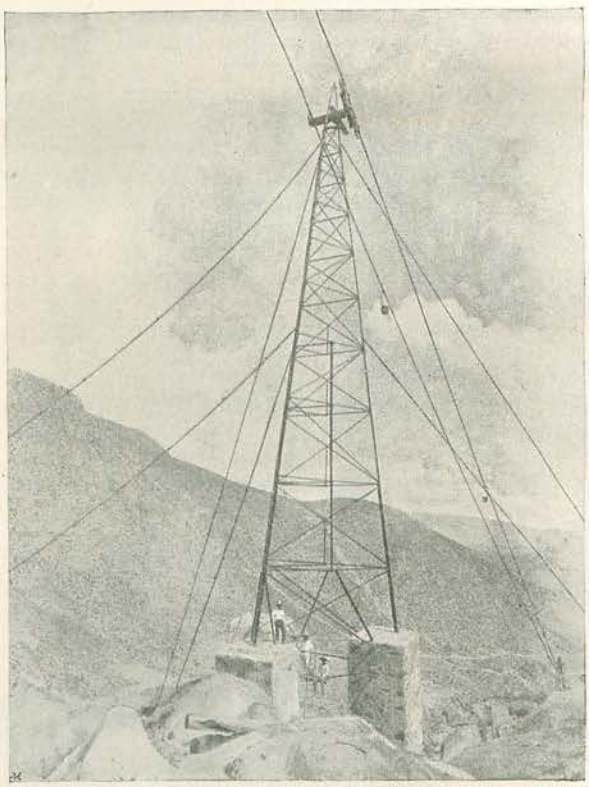
THE ENDLESS ROPE SYSTEM.

carrying daily 350 tons of material. To convey an idea of what can now be successfully accomplished by aerial ropeways, Mr. Roe states that one of his lines, 4,000 yards long, is covered by only seventeen supports of moderate height, and the spans run up to 650 yards, or considerably more than a third of a mile.

endless rope not only suspends the loads, but also moves them along, the buckets being made fast to the rope by means of "saddles."

The next illustration shows at once the principle of this system. The whole double rope is continuously travelling round and round over the pulleys, taking the affixed buckets along with it. This particular ropeway is in connection with the Los Baños Iron Mines in Spain; and it has been shown that the cost of transport by it is only 1½d. per ton per mile. This includes stores, maintenance, labour, and renewal of rope. It should be mentioned, however, that this line is self-working.

The last photo. reproduced shows part of the ropeway, erected at Concepcion del Oro, Mexico, for the Marzapil Copper Company. The great standard depicted is nearly 100ft. high, and the span to the next support is about 1,200ft. As one may judge, it is an arid and desolate country, growing no timber; therefore the supports are all of iron. There are on this line such extraordinarily steep gradients as "1 in 2½." The ropeway is, however, automatic, and actually contributes 35 or 40 horse-power over and above out of its own exuberance and power; and this, too, after



A HIGH SUPPORT ON A MEXICAN LINE.