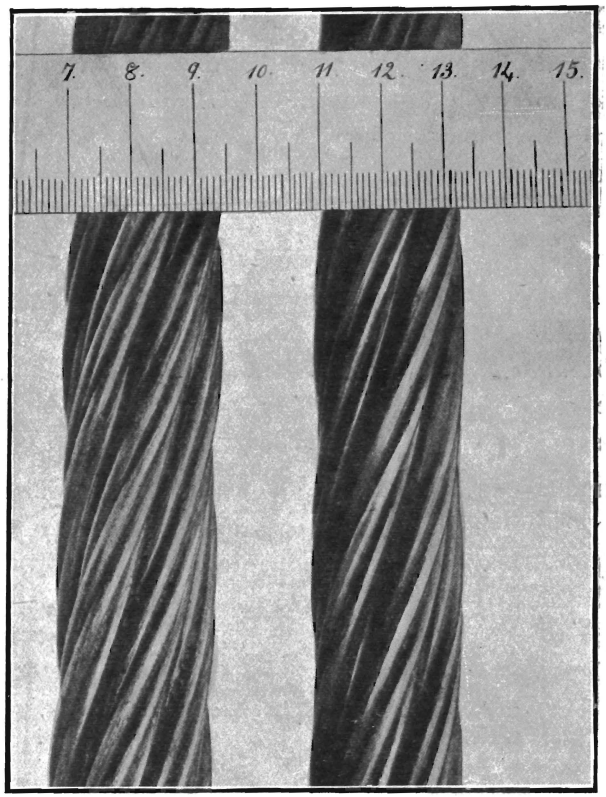

Fig. 13

blondin ropeway, and is used mostly on the construction of dams, bridges and open quarrying work. Plate No. 14 gives a very good idea as to its construction. It will be noticed that this type is distinct from the ordinary ropeway in that the load can only be transported between the two supports. The advantage, however, lies in the fact that the load can be raised from and lowered at any desired point along the span.

Cableways for loads up to 12½ tons, and over spans of 1,000 feet, are now at work in many parts of the world,

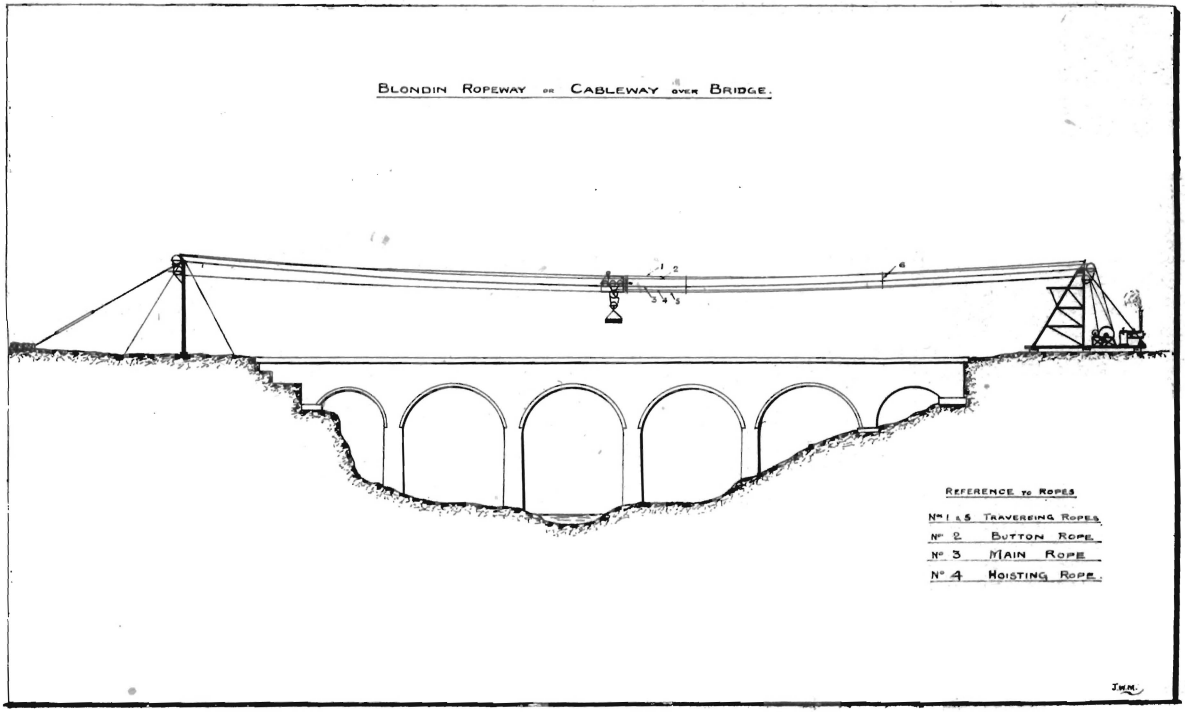
BLONDIN ROPEWAY OR CABLEWAY OVER BRIDGE.
REFERENCE TO ROPES
Nos 1 & 5 TRAVEREING ROPES.
No 2 BUTTON ROPE.
No 3 MAIN ROPE
No 4 HOISTING ROPE.
J.W.M.

Fig. 14.

and for all classes of work. The construction of some of the well known engineering works have been greatly simplified by the use of cableways. For instance, the famous bridge over the gorge, below the Victoria Falls, Zambesi River, the Malta and Gibraltar dockyards, and our Burrenjuck Dam on the Murrumbidgee River. In this type five ropes actually cross between the two supports. The main cable, a lock coil rope, forms the track, and is in the largest plants often as large as 8in. circumference. The other ropes are the traversing ropes, hoisting rope, and button rope. The button rope, as its name implies, has a number of studs or buttons attached to it for the purpose of arresting the hoisting rope carriers which are dropped on to the main rope as the carriage runs out. These rope carriers become very necessary over long spans, as when the lead is released and the carriage is at some distance from home tower, the weight of hoisting rope would overcome the weight of the empty skip or bucket, and would prevent same from being lowered at will from engine house.

The engines and winches for these cableways are usually very powerful. Loads up to five tons are frequently raised at the rate of 300ft. per minute, and traversed at 900ft. per minute and over. As in all other types of ropeways, this system has been greatly elaborated as the special requirements necessitated, but I do not wish to enlarge further here. My main point in referring to this type is that the first two types of ropeways are frequently confused with this machine, and are expected to have the same variety of actions.

General Remarks.—The conveying of material above ground by means of ropes has seldom been given the close study or serious thought it merits by the average engineer, and the consequence is that ropeways of all

types are looked upon with a certain amount of suspicion. This is unfortunate, both for the works which really require a first-class and cheap method of transport, and to the Ropeway Companies who are faced daily with much opposition, due mostly to consulting engineers who are ignorant of the fine work carried out all over the world in this class of engineering.

A practice much to be regretted, however, is where engineers and others get hold of some ropeway catalogue and, thinking a ropeway is simply the stretching of a rope over a few intermediate posts, proceed to order the various parts from the cheapest market with a view to assembling them on the ground themselves. A mix-up invariably follows, and then, of course, ropeways suffer a set-back, at least in that district, and so also do the works for which they were to be installed.

Like all other machines, ropeways have taken years to evolve to their present state of perfection, and any Company is well repaid, when contemplating the installing of a ropeway, to consult with and practically hand the whole contract into an expert's hands.

Discussion.

MR. DEBENHAM (in moving a vote of thanks to Mr. Mackie for his paper) said:

It gives me great pleasure in moving a vote of thanks to Mr. Mackie. Ropeways is a subject I have been very much interested in, although I do not claim in any way to be an expert. As Mr. Mackie points out, it is really very astonishing that ropeways are not more widely used in this country. There are countless installations in foreign countries; but out here, somehow, they do not seem to have made the headway they should have made. I remember hearing many years ago a very interesting and enthu-

siastic description of a cableway on a mine somewhere in South America—South America, by the way, seems to be rather famous for its cableways—which, at that time, must have been pretty nearly a record. It ran from the top of the Andes to the coast. The height was 1600 feet, and the length something like 30 miles to the plains below. It was a very interesting ride to the top of the mountains—although there was the disadvantage of mountain sickness when you got to the top. One of the most spectacular rides, in this connection, would be the Table Mountain, South Africa. Out here we do not seem to have done much. I think the installation at Mt. Lyell must have been pretty well the pioneer. That is used to convey the ore from the Blow over to the smelters. Previous to that installation, they used to bring the ore over by means of trucks—one running up the hill while the other went down—by gravity. The installation at Mt. Lyell has, I know, proved very successful.

With regard to Irvinebank, to which Mr. Mackie referred, anyone who visited that place before the ropeway installation must have been at once struck by the fact that the mine was on a rise about two miles away from the smelting works. The ore used to be transferred by horse and cart—a very primitive way of handling.

I am very glad to see that ropeways have been put in at Kandos. I think the Commonwealth Portland Cement Co. also has a short line. The Broken Hill Co. had three when I was up there last, although they are smaller plants.

The problem of stacking tipped rubbish troubled the Broken Hill Companies very considerably some years ago. At the time I was there the only attempt they had made to handle it was either with trucks on the top of an incline, or dumping by means of a belt swinging on a boom. But

this cableway appears to me to be a much simpler method, and, of course, it is much cheaper. I take it the plant at Mt. Morgan is used for that purpose. In Australia, and, I think, everywhere else, cableways have been principally installed by mining companies, which seem to have been the pioneers in pushing out into the wilds. The country they have to negotiate is of such a nature that very often ropeways are the only efficient way of handling the material. I am very much surprised that more companies have not taken advantage of this system, especially in the more mountainous parts of Australia. Mr. Mackie says he wonders at the fewness of the installations, and he puts it down to the ignorance of engineers of the way these ropeways should be run. That is so. I do not think the majority of the men in the districts where they are required really know how very useful they are. I may be wrong, but I have not yet come across any treatise that could really be said to deal in any way exhaustively with the subject. It seems one has to rely on catalogues, for the most part, for his knowledge. It sounds simple enough to design a cableway; but when you start to tackle it, you find yourself running up against little points that are apt to floor you time after time. The small jobs I have put up I have had to work out from basic principles. It is possible there are works dealing with the matter; but I have not come across them. It seems to be very largely a question—as Mr. Mackie hinted—of the ropeway companies jealously guarding private formulae—that is to say, they are very much in the nature of experts with sole knowledge of the details required for putting in a successful plant, at any rate, for a large proposition. I am sure, if the information were available, and if engineers knew where it could be obtained, it would be much more generally availed of.

I was very much pleased to hear that the single rope cableways could negotiate grades so steep as one in two.

It had always been my idea that they could not tackle grades anything like that. The plate shown of the clip makes it difficult for me to understand how sufficient adhesion can be obtained to enable a load of any weight to run up such a severe grade as one in two.

The question of single versus double ropeways has been a very vexed one in the past. It was always urged, as Mr. Mackie pointed out, that the single ropeway could only be applied where the grades would permit of it. I noticed on one of the plates that on the loaded side there were four pulleys, and on the empty side only two. I should like to know whether all those four pulleys would be in action all the time, or whether the outside pulleys were only put in to ease the grade as the bucket came up to the tower. If that number of pulleys were put in simply to distribute the weight, it seems to me it could have been done by increasing the size of the bearing; but I have no doubt it has something to do with easing the load as the load reached the standard.

I thoroughly enjoyed listening to the paper, and I should very much like to hear a similar paper dealing more in detail with the mathematical and mechanical side of the question. It gives me very much pleasure indeed in moving a vote of thanks to Mr. Mackie for his very valuable and interesting paper.

Mr. McEwin: I listened with very great pleasure to Mr. Mackie's paper. I am not an expert on aerial ropeways—I have had nothing to do with them personally; at the same time I enjoyed the paper very much, and I am sure the Association is indebted to Mr. Mackie for all the particulars he has brought before the Members. The paper dealt simply with the single rope system, a system in which Ropeways Limited have specialised, to which they have apparently devoted more attention than anybody else, and it is only natural that they should win from us credit for pos-

sessing ideas equal to anything produced anywhere. It is a pity there is not likely to be anyone present to-night whose firm has specialised in any of the other types of ropeway, in order that we might be able to discuss it fully; but, as Mr. Mackie says, it is a very large subject, and perhaps it is not possible to go into matters connected with the other kinds. The system of single ropeways in which Ropeways Limited has specialised has certainly been brought to a very high state of perfection, and provided the new clip—if I may call it so—that is used in connection with the single ropeway is all that Mr. Mackie claims for it, there is very little in that system, I am sure, that we can criticise. The methods adopted for taking off the tension, for easing the loads on and off the ropeway, and for using the strains at the various trestles, are all very ingenious, and are not likely to be improved upon very much.

I take it the reason there are four pulleys on the loaded side of the trestle, spoken of by Mr. Debenham, is to ease the strain on the rope that would be caused by any sudden flexure which would take place if the load came on a single pulley or pair of pulleys only.

As has been mentioned, it is a matter for wonderment that aerial ropeways are not more extensively used in this country. I do not blame the consulting engineers so much as I blame the engineers who are dealing with the ropeways. It is up to them, I think, Sir, to bring the matter more sharply before the profession than they do, and I will suggest, personally, a means whereby we may be able to do that, so far as Sydney is concerned, at any rate.

I have seen the operation of the ropeways at Broken Hill—the fixed ropeways with the loads being lifted at the open cut, and it is possible that that vast open cut could not have been worked in any other way. They struck me as being wonderfully effective at the time I saw them, although it may not be considered the best means available.

It might seem irrelevant to consider the North Shore Bridge in discussing this question, but as reference has been made in the papers to the passenger ropeways in the Alps in Switzerland, the same method of transportation, both for passengers and merchandise, suggests itself, for the time being, at any rate, instead of a bridge across the harbor. I understand the station is to be on Flagstaff Hill, and a straight line made from that station to the Wollstonecraft station, over pretty open country, where there would be no obstructions of any serious kind. Such a ropeway could be carried on trestles at Miller's Point and on the eastern ends of Goat Island and Ball's Head, and could run in a straight line to Wollstonecraft station, where passenger traffic could easily be dealt with.

If necessary, a similar system could be installed for handling the tramway traffic, which could be handled in a straight line from Circular Quay to a point 100ft. above the water in the neighbourhood of McMahon's Point, from which point a great part of the North Shore traffic could be managed without running any new line. If the lines that now run from Ridge-street to Milson's Point were brought down to meet the terminus of the aerial ropeway, in the neighbourhood of McMahon's Point, it would only be necessary to make use of a crossing in Mount-street, which, I believe, is already in position.

Then, again, Cockatoo Island, which we hope will one day be the great Naval Dockyard of the Commonwealth, could be indirectly in connection, at least with the railway. The Railway Commissioners have in view the construction of a railway along the western side of Balmain down to the neighbourhood of Cockatoo Island. Goods could easily be transported from that railway to Cockatoo Island, and back again, by means of an aerial ropeway, which could also be used, if required, for the carriage of passengers—that is to say, for convenience of the workmen to and from the Island at various times during the day.

In a humbler way, the aerial ropeway might be used much more extensively than it is by big stores for the handling of cash. In many works the handling of light goods, that have to be passed to and fro a great many times, could be dealt with in a somewhat similar manner.

A small device, which I have just seen installed, is a wireway arrangement for carrying a solder box to and from the soldering shed, which has to be some distance away from the goods that are being soldered. It seemed to me a very easy and effective means of transit to and fro.

Many waterside works and factories in Sydney Harbour, where the ground is very heavy, could, with advantage, make use of similar devices on a larger scale than the wireway arrangement I have just referred to.

At the works where I am employed we are proposing to put in an aerial ropeway for the carriage of goods from the waterside to the roadway above. Such a strain is put on the horses which take goods by the municipal roadway that they are absolutely fit for nothing at the end of the day's carting. The introduction of the aerial ropeway will mean a great saving in cartage costs.

In the works adjoining ours there is a small ropeway in use—it was not laid out by an expert, but by an engineer attached to the work—for carrying ashes from the waterside to the top of the hill, and I am sure there are a great many other works outside of Sydney which could with advantage adopt similar devices.

If the possibilities of ropeways were brought sharply before the controlling engineers of Sydney and elsewhere, especially as regards the conveyance of passengers and goods across the Harbour, there is no doubt the progress of the systems would proceed more rapidly than they have done in the past.

I thank Mr. Mackie very much for the very interesting paper he has read to us.

MR. POOLE: I have very much pleasure in supporting the vote of thanks to Mr. Mackie for his excellent paper.

With reference to the ropeway at Mt. Lyell, the mines there are on the opposite side of the range from the smelting works. Before the installation of this ropeway there was an inclined tramway. A comparison of the working costs of the two systems is interesting. The operating cost of the ropeway is 8.8d. per ton; the inclined tramway used to cost 1/5 per ton.

I also had a look at the North Lyell ropeway when I was in that district. At the time of my visit it was not very much in favour on account of some trouble experienced in operating. After rain, or cold weather, the water used to freeze on the rope, making it very hard and slippery, and going up over a certain pinch occasionally a jolt would start a skip sliding, and it then bumped all the other skips down to the bottom of the incline.

The term "flying fox" originated, if I mistake not, at Broken Hill, and not in connection with a jib back ropeway for hoisting conveyors. I think it is considerably over 20 years since hoist conveyors were introduced at the open cut. The operating costs of these hoist conveyors was between 2d. and 2½d. per ton, including cost of labour and unloading—but not for loading the skips.

The most primitive forms of jig back trams or ropeways are seen in operation in a large number of our inland rivers, especially in Chinamen's gardens, where wire ropes are fixed to snags in the river, and large buckets or casks are operated for irrigating their gardens.

Another somewhat primitive method of availing of this system of conveyance is seen in the handling of ore in flat stopes, where the incline is not sufficient for the ore to run by gravity. Two ropes are stretched—usually discarded mine ropes—and two large buckets are operated—

usually round a small brake—the loaded one pulling up the empty one.

The information given to us by Mr. Mackie is very useful, and I hope it will be the means of bringing the value of aerial ropeways more prominently before engineers.

MR. SINCLAIR (in supporting the vote of thanks) said: I should like to ask Mr. Mackie a question regarding Fig. 3. I am not quite sure how the clip gets hold of the rope —the illustration does not make it too clear.

Another question: Is it possible, with a ropeway, to go round a curve, or must you always run on a straight line? How is it all the figures show straight lines, except at the terminal switch?

MR. HARRICKS: I desire to heartily support the vote of thanks to Mr. Mackie for his interesting paper.

With regard to the case of a ropeway 3½ miles long, with a special clip with ball bearings, requiring an engine developing 7 horsepower to drive, I would like to know the grade of the rope. It seems to me, by the time you allowed for loss of efficiency, even with ball bearings, it would take almost the balance of power left in the engine to move the rope under some circumstances—especially in unfavourable weather. Probably the ropeway had an inclination, as Mr. Mackie described in another case, with the load, in which case it could easily be explained.

Mr. Mackie will be only too ready to agree, I am sure, that ropeways of every form and device have their limitations. I should like to mention one instance which may be of interest at the present time: Some years ago the Colonial Sugar Company had to transport about 12 tons of cane an hour, for six months of the year, over undulating country for about 4 miles. They had practically decided to adopt the ordinary light-gauge tramway, when a representative of the German firm of Bleichert came along and

simply implored them to give him an opportunity of proving the infinite superiority of ropeways. With the object of introducing Bleichert's ropeways into Australia, he worked very hard to get an order for an installation, and cut his prices to the absolute irreducible minimum. But notwithstanding that, it was found that the actual cost of handling, according to Bleichert's quotation, was 50 per cent. greater than the ordinary narrow-gauge tramway.

MR. MCEWIN: First cost?

MR. HARRICKS: Including running cost, maintenance, and first cost. Of course, there are cases where no one would dream of suggesting a competitor for the ropeway. That, I think, we can all accept without question.

I had one or two other things to ask Mr. Mackie, but I think the questions asked by Mr. McEwin and Mr. Sinclair really cover them. Therefore I conclude my remarks by supporting very keenly the vote of thanks that has been proposed to Mr. Mackie.

MR. ORAMS: I noticed Mr. Mackie's reference to a 15ft. diameter terminal wheel. On Plate 5 there is a terminal shown with a wheel, and if we can take it that the photograph is anything to scale, it looks about 10ft. in diameter. I should like Mr. Mackie to give me an idea of the average diameter of the terminal wheels. Most of the conveyors shown are apparently types which lie in a straight line between the terminals, but I believe there are systems where these cables change direction—if I remember rightly they were in the bi-cable system. I should like to know how the single rope system would compare with those systems that change direction.

Mr. Mackie referred to stresses and strains. I should think some difficulty would be experienced, when designing a ropeway, to find out the range of tensile strength in the rope. There must be some means they work on, because in one particular part it is very low, and in others, high,