The President read a letter from Mr. L. Brennan in reference to the "Monorail" railway.

On the motion of Mr. J. T. N. Anderson, seconded by Mr. C. Hatton, it was decided to submit those portions of the letter suitable for record to the Publication Committee.

The discussion on Major H. V. Champion's paper on the "Recent Tunnelling Operations for the Sewerage of the City of Melbourne" was the next business. In the absence of the author and of further contribution, the discussion was closed.

Discussion on Professor W. C. Kernot's paper on "The Quebec Bridge Disaster" was continued and closed.

Major J. Monash's paper on "Building Construction" was then dealt with. A suggestion by Mr. J. A. Smith, that in view of the importance of the question it should be resumed next session, was adopted.

Mr. J. T. Noble Anderson read his "Notes on Current Engineering Development," illustrating the subject by the exhibition of plans and photographs.

Mr. T. W. Fowler said he thought it would be right before they separated that they should tender their hearty thanks to Mr. Anderson for the trouble he had taken and for his interesting address; seconded by Major J. Monash, and carried by acclamation.

The President said that closed the work of the session. He wished members a happy new year and trusted that they would all meet again in March for another prosperous session.

The meeting closed at 10.20 p.m.

MONORAIL RAILWAYS.

Extracts read by Professor Kernot from letters from Mr. L. Brennan.

After describing initial difficulties and experiments, Mr. Brennan wrote:

"The design of these machines, however, showed me that they would be far too cumbersome for practical use, and again I allowed the matter to drop, perhaps for a year or two before it pressed upon me to such an extent that I was obliged to go on.

At last, about twelve years ago, the idea first occurred to me of utilising gyroscopic action for the purpose, and I purchased some gyroscopes and studied the matter very hard, but it was about two years before I really saw how to use them. The solution came at last, when I recognised that in order to recover from a position of unstable equilibrium all that was necessary was to accelerate the precession of the gyroscope wheel by means of power drawn from the rotating wheel itself, or from any other source of energy carried in the car."
As in all such matters, however, it is a long distance between actually recognising a principle, and putting it into practical form, and it required a very long and patient series of experiments to arrive at a thoroughly reliable method of doing it.

This I have now done, and really, the performance of the model which I have made, and lately exhibited before the Royal Society, would surprise you, although it falls very far short of what I expect to attain on the full sized machine. This model, which is to one-eighth scale, has been designed to represent a military vehicle twelve feet wide by forty-five long, and to weigh when fully loaded somewhere about forty tons. It is designed to take extraordinarily sharp curves, for it turns on a radius of 3 feet 6 inches, and ascends an incline when fully loaded of 1 in 5. If tested for stability it easily recovers a condition of equilibrium, although weights equivalent to three tons, or 45 to 50 persons, are suddenly dropped upon its extreme edge. It is also geared so as to run at two rates of speed, and free wheel down inclines. While travelling on the straight it runs with perfect steadiness, absolute freedom from oscillation, and on curves it heels inwards to the correct angle counteracting centrifugal force, so that if passengers were seated in it they would be perfectly undisturbed and not thrown outwards as they are by centrifugal action on vehicles of other kinds.

It is curious to see the model run with a basin full of water standing in it, for the water does not overflow, although the vehicle in going round a curve leans inwards to an angle of 30 degrees or more.

When I tell you that the model, with its accumulator cells, which I use in lieu of a petrol electric set for the supply of current for the road motors, weighs 173 pounds, which would be equivalent to 40 tons on the big machine, and that it carries a man of 10 stone weight, which is equivalent to 32 tons, you will admit that this is a good result to obtain by means of two gyroscopic wheels five inches in diameter, and weighing 63 pounds each, this being a little over 4 per cent. of the entire weight.

In my big machine I fully expect to obtain similar results with wheels weighing not more than 1 per cent. of the entire load, and I look to saving this weight in other portions of the structure, which may be considerably lighter owing to the fact that there is no racking stress upon it, and that wheels, axles, and other parts may be of less weight. It will be an achievement, I think, if it turns out that the tare of the vehicle will be less on the monorail system than on the dual rail.

As with all new things it is difficult to get away from ideas associated with things with which we have been long familiar, and I find considerable difficulty in getting people to understand that with this system of transport, in order to make it pay, we must face the fact that the dimensions of the vehicles must be altogether changed, and that instead of small carriages, capable of only carrying a few tons apiece, we must be prepared to
adopt vehicles of huge dimensions capable of carrying hundreds of tons and great numbers of passengers. By doing this the additional complication due to the introduction of the gyroscopic mechanism will become relatively a small matter, whereas the advantages of carrying materials such as ores, grain, and other commodities in bulk, and passengers in great numbers and with every comfort, will ensure at the same time more economical conditions and increased inducements to people to travel. I look, in fact, to make a journey on land quite as pleasant as one on water, without the drawbacks of rough weather, for the vehicles will run without either oscillation or vibration, and with great smoothness and absence of noise.

When you come to think of it, you will admit that it is about time that some departure was made from existing methods. Now that we have railway journeys occupying from a week to a fortnight, it is about time that people got something like proper accommodation, and I propose, therefore, to provide carriages for entertainment and exercise in addition to those already in use. But you will say, how can all this be done without greatly increasing the cost of the permanent way? My reply is that by packing the rail with wheels from one end of the carriages to the other, the increased load can be carried without necessitating a heavier rail than one of the two in ordinary use, and that the sleepers need only be of half the length of those used at present. The possibility of distributing the weight over such a number of wheels is achieved by means of a system of compound bogies which are so contrived as to admit of complete flexibility of under-carriage at the same time that the effect of both vertical and lateral inaccuracies of the rail are decreased in the inverse ratio of the number of wheels. The result will be that each carriage in a train will follow the general trend of the line without being disturbed by small local irregularities.

With regard to motive power. This may be either steam, petrol, or electricity. All that is required in addition to power for propelling the vehicles being the provision of a small supply of current for rotating the gyroscopes—from one-half to one per cent. of the total power—which can be easily derived from a small auxiliary engine, petrol set, or accumulator, as may be convenient.

If steam is used, as it no doubt would be on transcontinental lines in Australia, the trains would be drawn by locomotives provided with their own gyroscopic stability mechanism, and each carriage would be similarly equipped, the current for the gyroscopes on the entire train being supplied from one source, i.e., a small steam engine and dynamo on the locomotive. It is not necessary that this auxiliary engine should be kept constantly running, as the stored up energy in the gyroscopic wheels is so great that they will run on for two or three days without any current whatever, and be able to impart sufficient stability to the carriages for several hours. This is a very providential fact, as
it altogether avoids the possibility of accidents through the sudden cessation of the driving force, owing to anything going wrong with the engine or dynamo. In such a case the wheels simply spin on, and there is no perceptible change in the action of the mechanism until, as the speed decreases, the carriages begin to get slightly unsteady and roll from side to side, gradually increasing in the amplitude of their oscillations until at last they are unable to recover their upright position. Long before this condition could be reached, the driver would take every necessary precaution by stopping his train, and lowering the legs with which each carriage is provided in order to maintain its upright position when the gyroscopes are not in use. The legs mentioned can all be lowered simultaneously by the movement of a lever in the driver's cab.

While on this question of safety, I should like to emphasise my belief that by the monorail system travelling on railways, especially at high speeds, will be much safer than by any other means, as anything which could possibly go wrong with the gyroscopic mechanism is provided for, so as to make it practically speaking infallible in its action. There is, in fact, no more danger of a gyroscope going wrong than of a boiler bursting on an ordinary train, a circumstance which is, generally speaking, left out of consideration altogether, especially by the travelling public."

Prof. Kernot said he had submitted the letters to the most capable body of men, and he did not know that anything further could be done in the matter. The fact that the money had been contributed by the Indian Government, facilities supplied by the Imperial Government, and the thing recognised by the Royal Society in England proved there must be a basis of practicability. It was a most remarkable invention, and they might well feel proud that an old Melbourne man had astonished the whole engineering world.

Mr. Jas. Alex. Smith submitted a gyroscope, which had been constructed wholly or in part by Mr. Brennan when an apprentice in Melbourne to the late Mr. Alex. K. Smith.

Mr. Smith briefly explained the fundamental principle, viz., that if a mass possessed energy of motion the expenditure of external energy was required to deviate it from its initial course, and that if the mass existed as any particle in a revolving body, any effort to deflect the axis, for instance by tendency to motion of a supporting platform, would be resisted without diminution of the energy of rotation except by axle and air friction.
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