1910.

NEW ZEALAND.

AUCKLAND CITY AND SUBURBAN ELECTRIC TRAMWAYS.

(REPORT OF THE ROYAL COMMISSION APPOINTED TO INQUIRE INTO THE EFFICIENCY OF THE BRAKES, AND SUITABILITY OF THE BRAKE SYSTEMS, ADOPTED ON THE AUCKLAND CITY AND SUBURBAN ELECTRIC TRAMWAYS.)

Presented to both Houses of the General Assembly by Command of His Excellency.

REPORT.

To His Excellency the Right Honourable William Lee, Baron Plunket, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Knight Commander of the Royal Victorian Order, Governor and Commander-in-Chief in and over His Majesty's Dominion of New Zealand and its Dependencies.

MAY IT PLEASE YOUR EXCELLENCY—

By the Commission intrusted to us by Your Excellency we were directed,—

(*a.*) To ascertain whether, having regard to the grades of the Auckland City and suburban electric tramways, to the speeds at which cars travelled thereon, to the congested street traffic, to the safety of the public, and also to the provisions of clause 48, Part III, of the Second Schedule of the Tramways Act, 1908, the systems of brakes already adopted, or any of them, are suitable, efficient, and sufficient for use on the said tramways:

(*b.*) If, in our opinion, the said brakes were not suitable and sufficient, to state what other form of brake we would recommend, having regard to all the circumstances and conditions under which the said tramways are operated, for adoption on the said tramways:

(*c.*) To generally make inquiry into any matter or thing arising out of or connected with the subjects of inquiry hereinbefore mentioned, and into the working of the existing law, or regarding the necessity or expediency of any new legislation in respect thereof.

Our attention was also directed to the fact that the Auckland Tramway Company had, by the consent of the Minister of Public Works, installed for experimental purposes on two of its cars a pneumatic wheel-brake.

The great diversity of practice, the widely differing opinions held by tramway authorities, and the admitted difficulty of obtaining a single satisfactory solution of this complicated problem, rendered it evident to us that a full and searching investigation must precede the report which we have now the honour to make.

Types of brakes in general use.

The following types of tramway-brakes are in common use :—

1. The hand-applied wheel-brake.
2. The mechanical slipper, or track-brake.
3. The pneumatic wheel-brake.
4. The pneumatic track-brake.
5. The rheostatic brake.
6. The electro-magnetic track-brake.
7. The Newell electro-magnetic combined track and wheel brake.
8. The electric emergency brakes.

Shortly described,—

1. *The hand-applied wheel-brake* arrests the motion of the car by the forcible application of cast-iron blocks to the wheels. Since this application is effected by the manual effort of the motorman, this brake is only suitable for the control of comparatively light cars.

2. *The mechanical slipper or track-brake* is applied by hand, and, when in action, a portion of the weight of the car is transferred from the wheels to the slipper-blocks, which press directly on the rails. This brake is chiefly used for keeping the speed of the car within safe limits when descending steep gradients, its function being to compensate for the effect of gravity.

3. *The pneumatic wheel-brake.*—Here air under pressure is admitted to a cylinder, where it acts upon a piston connected by levers and rigging with brake-blocks, which are thus forced upon the wheels. A reservoir capable of storing sufficient air for many applications of the brake is attached to the car. The supply is maintained by an air-compressor, usually motor-driven.

4. *The pneumatic track-brake* differs from the pneumatic wheel-brake in that the brake-blocks are applied to the track instead of to the wheels.

5. *The rheostatic brake* is applied by moving the handle of a suitably arranged controller in the opposite direction to that which is required for the application of power. The retarding effect is obtained by the use of the motors as generators, in parallel, with resistances in circuit which are gradually taken out, until at the last notch the generators are short-circuited upon themselves. This method of braking, by throwing the duty of retarding the car upon the motors, in addition to that of accelerating it, calls for the use of larger motors than would be fitted for propulsion alone, especially in hilly districts.

6. *The electro-magnetic track-brake.*—The mode of operation of the electro-magnetic track-brake is similar to that used in rheostatic braking; but instead of current-energy being dissipated in "resistances," it is utilised to energise electro-magnets suspended over the rails, to which the magnet pole-pieces are forcibly attracted, thus forming powerful track-brakes, the retarding effect of which is added to that produced by the motors acting as generators.

7. *The Newell electro-magnetic combined track and wheel brake.*—The arrangements for actuating this brake are similar to those of the electro-magnetic track-brake; but, in addition to the braking action previously described, the drag of the track-magnets is, by means of a system of levers, utilised to apply blocks to the wheels, the total retarding effect being that due to—(1) the retardation arising from the motors being used as generators; (2) the retardation due to the drag of the track-magnets; (3) the retardation accomplished by the pressure of the brake-blocks upon the wheels. This combination constitutes the most powerful brake known.

8. *The electric emergency brakes.*—What is known as the "first electric emergency" is applied by pulling the reversing-key (with the power-lever at the "off" point) into an extreme backward position, only to be found on some controllers. This has the effect of short-circuiting each motor upon itself. The "second electric emergency brake," which can be applied with all controllers, is brought into action by pulling the reversing-key into the "backward" position, and then giving one or two notches of power. The "third electric emergency brake" is applied after the "second" by opening the canopy switch (or the coming-out of the automatic cut-out), and the placing of the power-handle at full parallel. This short-

circuits the motors upon one another in reverse, and results in one taking up the function of a generator and driving the other in the opposite direction. All these three electric emergency brakes tend to bring up the motors suddenly and skid the wheels. They are uncertain in action, and destructive to the equipment, and should only be brought into use when all other methods available for stopping the car have failed.

Brakes in use at Auckland.

The brakes on the cars of the Auckland tramway system are the hand-applied wheel-brake, which is used for all service stops, and the Spencer track-brake, which is applied as a steadying brake when descending gradients. Motormen are also instructed in the use of No. 2 and No. 3 electric emergency brakes.

Two cars, Nos. 75 and 48, have been equipped with pneumatic wheel-brakes. These cars have been in service for about twelve months.

Brakes in use at other centres.

On the Wellington and on the Dunedin systems the cars are fitted with the hand-applied wheel-brake, and the Newell electro-magnetic combined track and wheel brake.

On the Christchurch tramways the hand-applied wheel-brake and the pneumatic wheel-brake are installed upon all the electric cars, and the second and third electric emergency brakes are available.

Proceedings at Auckland.

The Commissioners held their first sitting at Auckland on the 18th April, 1910, when it was stated on behalf of the Auckland Tramway Company that the company was prepared to equip the whole of its rolling-stock with pneumatic wheel-brakes, in addition to the existing hand and track brakes, but objected to the adoption of an electro-magnetic track and wheel brake recommended by a previous Commission, on the grounds that this brake was unsuitable for use in hilly districts, and also that its application would necessitate the complete reconstruction of the running and electric gear of the cars. Evidence was led to support these contentions.

The representative of the Auckland Tramways Employees' Union produced evidence with a view of showing that the pneumatic wheel-brake was reliable at all speeds and under all conditions, whilst the electro-magnetic brake was liable to failure, especially at high velocities.

Evidence was also led to the effect that the existing hand-brake equipment was insufficient, and entailed very severe stress on the motormen.

The Commissioners investigated the condition and working of the existing brake gear, and carried out tests of the pneumatic wheel-brake equipment of car No. 75.

Car fails to stop.

As a preliminary, this car was taken over the most severe gradients on the system, and stops attempted on College Hill (grade, 1 in 11·74) and Parnell Rise (grade, 1 in 8·77), but it was found that, whilst stops could just be made on College Hill with either track or air brake, on Parnell Rise neither of the brakes could arrest the car, although the rail was in good condition.

Car weighed.

In order that the mass dealt with might be accurately known, the Commissioners had decided not to accept manufacturers' weights, but to accurately weigh all cars experimented on; and on car No. 75 being placed on the scales it was found to weigh no less than 52 per cent. in excess of the previously stated weight.

Auckland cars underbraked.

Further, it was found that with the hardest possible application it was not possible to carry more than 26 per cent. of the weight of the loaded car upon the slippers of the track-brake. The combined errors of underestimation of the weight of the cars, and overestimation of the mechanical advantage of the brake gear (the efficiency of which, according to the drawings supplied, had been taken at unity),

had resulted in the cars upon the Auckland system being distinctly underbraked, and much of the trouble which has arisen in connection with the brakes was immediately accounted for.

It was decided that before further trials were made the brake-leverages on car No. 75 should, as a temporary expedient, be increased to an extent which would give block-pressures more comparable with the weight of the car. This was done, and, although the full benefit which should have been derived therefrom was not, on account of the structural weakness of the gear, obtained, a vastly improved control resulted.

Proceedings at Wellington.

After completing the brake-tests at Auckland, the Commissioners adjourned to Wellington, where evidence was brought forward by the Wellington City Council to show that the magnetic brake was a safe and suitable type of brake for use in hilly districts.

The Commissioners inspected the brake-equipment and repair-returns; they also witnessed a demonstration of the efficiency of the magnetic brake, which was not altogether convincing.

At this stage of the proceedings a request was received from the Tramways Committee of the Dunedin City Council for the Commission to sit in Dunedin, and examine there the working of the magnetic brake. No extended experiments were therefore conducted in Wellington.

Proceedings at Christchurch and at Dunedin.

The Commissioners sat in Christchurch to hear evidence as to the results which had been obtained in the working there of the pneumatic brake over a period of some years. They also conducted a series of experiments, and subsequently proceeded to Dunedin, where evidence was led by the tramway authorities with a view of showing that the magnetic brake was a satisfactory arrangement for the control of cars on steep gradients, and was not liable to failure.

The Commissioners here conducted a series of tests of this brake.

The Evidence.

For convenience of revision, the evidence given before the Commission may be divided into four sections:—

Section 1: Evidence relating to the efficiency and reliability of the existing hand-brakes on the Auckland cars.

Section 2: Evidence relating to the electro-magnetic combined wheel and track brake.

Section 3: Evidence relating to the pneumatic wheel-brake.

Section 4: General evidence.

Evidence relating to the Existing Hand-brakes.

A large amount of evidence was given by motormen before the Royal Commission which sat in July, 1908, as to the bad condition and difficulty of application of the brakes on the Auckland tram-cars. It was then stated that several men had been severely injured by the great physical effort entailed in their use, and also that the cars were not properly under control.

Brakes hard to apply.

The evidence of motormen before the present Commission was generally to the effect that though a great improvement in the upkeep of the brakes was noticeable, they were still hard to apply, and very severe upon the man.

An independent expert witness (L. Birks, pages 35 and 36 A) agreed that the brakes entailed a good deal of hard work on the men; and it was stated that the company recognised the exertion required, and were prepared to meet the point (F. E. de Guerrier, pages 40 and 41 A).

Mechanical track-brake.

The use of a mechanical track-brake for the Auckland service was supported by the officers, motormen, and several expert witnesses (J. H. Brennand, page 37 A; W. Rockland, page 41 A; W. G. T. Goodman, page 44 A).

Evidence relating to the Newell Electro-magnetic Combined Track and Wheel Brake.

A number of motormen now in the employ of the Auckland Electric Tramway Company who had previously worked with the magnetic brake in Glasgow stated that they found it to be liable to failure—often to partial failure and skidding—and that they had little confidence in the brake. Further, that its use as a service brake had been prohibited, being confined to "coasting" and to emergency stops.

Evidence was also given that the equipment of the Auckland stock with this brake would involve an expenditure of from £50,000 to £60,000, and occupy a period of two years (J. H. Brennand, page 37 A; W. G. T. Goodman, page 44 A).

Magnetic brake unsuitable for Auckland.

Mr. W. G. T. Goodman, electrical engineer and general manager, Adelaide tramways, called on behalf of the Auckland Tramway Company, stated that he had considerable experience with the magnetic brake, and was responsible for its installation on the Dunedin and on the Adelaide tramways. He had a very high opinion of the magnetic brake, but did not consider it to be the proper brake for use under all conditions. He found that at a high rate of speed very heavy currents were generated, the equipment suffered, and the brake might fail to act. If it were used for "coasting," motors of greater capacity than that required for the propulsion of the car must be provided. He considered the brake unsuitable for Auckland conditions. At Adelaide he had restricted its use to stops from below fifteen miles per hour, and had prohibited its use when "coasting."

Wellington evidence.

The officials of the Wellington tramways gave evidence that they were satisfied with the magnetic brake (M. Cable, page 49 W), and considered it suitable for Wellington conditions, but admitted (M. Cable, page 50 W) that instructions had been given to motormen to use this brake as little as possible, though the making of service stops with it was not prohibited.

Cases had been known of field magnets refusing to excite after car had been standing in shed, and recently there had been a good deal of flashing round commutators (H. Leah, page 54 W).

Three to twenty miles per hour was considered to be the speed-range over which the brake is effective (S. Richardson, pages 52 and 53, W).

Dunedin evidence.

At Dunedin evidence was to the effect that the magnetic brake was used for all stops, that complete failure was practically unknown, though partial failure or failure to act on the earlier notches was not uncommon; this was attributed to the motormen misjudging the speed.

It had not been found that the motor commutators or armature windings suffered from the use of the brake.

From three to twenty miles per hour was considered to be the range of speed of effective control.

Accidents to cars.

Evidence as to accidents to cars fitted with the magnetic brake was given by F. E. de Guerrier (page 40), J. H. Brennand (page 36), M. Cable (pages 49 and 50), and E. E. Stark (page 68).

Evidence relating to Pneumatic Wheel-brake.

The evidence of the motormen who had been in charge of the two Auckland cars fitted with the pneumatic wheel-brake was that no trouble of any kind had been experienced by them in handling these cars. They had complete confidence in the brake, and considered that, in conjunction with the track-brake, it was eminently fitted for the Auckland service.

Motormen called at Christchurch were equally emphatic as to the reliability of and the confidence they had in this description of brake.

The expert evidence called on behalf of the company was all to the effect that the pneumatic wheel-brake was efficient and reliable, and would form, in conjunction with a mechanical track-brake, a most reliable system of brakes for the Auckland cars.

The engineer and the manager of the Christchurch tramways gave evidence to the effect that no failures had occurred with the pneumatic brakes since their installation some five years ago.

General Evidence.

The following matters which were mentioned in evidence are deserving of notice :—

(1.) That in some cases one or more trailers provided only with hand wheel-brakes are drawn by electric cars.

(2.) That, with some cars, sanding can only be effected on one of the rails.

Tests conducted by the Commissioners.

The Commissioners advance no claim to scientific accuracy for these tests ; such could only have been attained by the use of elaborate automatically recording apparatus, which was not available, and by an exhaustive series of experiments.

Every care has, however, been taken to insure the tests being sufficiently accurate for the practical purposes of this report, and for the information of those engaged in tramway operation and control.

Weighing of cars.

As a preliminary, all cars experimented on were carefully weighed, with somewhat surprising results.

At Auckland, car No. 75 was found to weigh, when empty, 36,736 lb., as against 24,080 lb., its reputed weight, an excess of 52 per cent.

At Christchurch, car No. 9 weighed, when empty, 33,992 lb., as against a reputed weight of 26,096 lb., an excess of 30 per cent.

At Dunedin, car No. 20 scaled 23,072 lb., instead of 21,504 lb., the excess in this case being $7\frac{1}{4}$ per cent. of the nominal weight.

"Coasting" trials.

To enable the different brakes to be directly compared, the car-resistance was in each case obtained by a series of "coasting" trials; but these resistances have turned out to be so nearly the same that the relative results are practically unaffected thereby. The corrected values are, however, included in the tables.

Measurement of grades.

The inclinations of the grades operated upon were taken from authentic sections of the track, or were directly measured.

Observations.

The speeds were obtained by at least two observers from readings of carefully calibrated speed-indicators. All observations were reduced to true mean-value before being inserted in the results tables.

The times were in all cases taken by three observers with stop-watches beating $\frac{1}{5}$ sec., and were subject to careful scrutiny before being used.

The distances from the stations (previously marked) at which the stop signals were given to the ends of the runs were carefully measured.

In all cases a preparatory signal was given.

Retardations.

The retardation by time works out in every case to a greater value than that calculated on the length of stop. This is due to the time lost between the giving of the signal and the actual coming into action of the brakes.

The true retardation is from this moment greater than that calculated from either observation.

It may readily be computed; but since the distance travelled from the point of observation of danger is an essential factor in the estimation of an emergency stop, and the promptness of action of the brake is involved, all retardations have been calculated from the length of stop alone.

The retardations effected have been stated in feet per second^2. This method renders stops made on different grades directly comparable, and the corresponding length of stop on the level can be calculated therefrom. A table (Appendix I, Table I) is provided to facilitate such conversion.

Tests at Auckland.

In all, eighty-five stops were made, with the following results:—

(a.) *With the Mechanical Track-brake alone.*

Three stops down Parnell Rise (grade, 1 in 8·77), with a mean total retardation of 4·49 feet per second^2. (Appendix I, Table 2.)

Six stops on College Hill (grade, 1 in 11·74), with a mean total retardation of 3·79 feet per second^2. (Appendix I, Table 3.)

Five stops down Wellesley Street East (grade, 1 in 14·19), with a mean total retardation of 3·80 feet per second^2. (Appendix I, Table 4.)

(b.) *With the Pneumatic Wheel-brake alone.*

Ten stops down Parnell Rise (grade, 1 in 8·77), with a mean total retardation of 4·82 feet per second^2. (Appendix I, Table 5.)

Eight stops down College Hill (grade, 1 in 11·74), with a mean total retardation of 4·31 feet per second^2. (Appendix I, Table 6.)

Seven stops down Wellesley Street East (grade 1 in 14·19), with a mean total retardation of 4·27 feet per second^2. (Appendix I, Table 7.)

Six stops various gradients; mean total retardation, 3·85 feet per second^2. (Appendix I, Table 8.)

(c.) *With Hand Wheel-brake and Mechanical Track-brake.*

Five stops were made down Wellesley Street East (grade, 1 in 14·19), with a mean total retardation of 3·06 feet per second^2. (Appendix I, Table 9.)

(d.) *With Pneumatic Wheel-brake and Mechanical Track-brake.*

Seven stops down Parnell Rise (grade, 1 in 8·77), with a mean total retardation of 6·14 feet per second^2. (Appendix I, Table 10.)

Ten stops were made down College Hill (grade, 1 in 11·74), with a mean total retardation of 5·53 feet per second^2. (Appendix I, Table 11.)

Fourteen stops down Wellesley Street East (grade, 1 in 14·19), with a mean total retardation of 5·42 feet per second^2. (Appendix I, Tables 12 and 13.)

Experiments at Wellington.

The experiments at Wellington were confined to testing the behaviour of the magnetic brake when "coasting," and making stops from the higher velocities.

The behaviour of the brake when "coasting" on the Brooklyn grade (1 in 12), and when making stops from speeds below eighteen miles per hour, was satisfactory, and the stops were exceedingly good; but above the speed of nineteen miles per hour the current flashed round the commutators, inducing skidding and lurching, with uncertain stops. The commutators were found on inspection at the conclusion of the run to be badly burnt at the edges.

Tests at Christchurch.

Pneumatic brake.

At Christchurch eighteen emergency stops were made with the pneumatic wheel-brake fitted on car No. 9. The grade was practically level, being 1 in 2,200 down. The rail was muddy. The mean total retardation obtained was 3·96 ft. per second^2. (Appendix I, Table 14.)

Tests at Dunedin.

Magnetic brake.

A series of tests of the Newell electro-magnetic combined track and wheel brake (old-pattern magnets) was made at Dunedin. In all, thirty-seven "stops" were made with car No. 20, fitted with this brake, viz. :—

Fifteeen stops down Caversham grade (1 in 18·7), with a mean total retardation of 5·84 feet per second^2. (Appendix I, Tables 15 and 16.)

Four stops down Anderson's Bay Hill (1 in 14), with a mean total retardation of 6·34 feet per second^2. (Appendix I, Table 17.)

Eight stops down Anderson's Bay Rise (1 in 155·25), with a mean total retardation of 6·22 feet per second^2. (Appendix I, Table 18.)

Ten stops on the level, with a mean total retardation of 4·75 feet per second^2. (Appendix I, Table 19.)

Electric emergency stops.

Two electric emergency stops, one with No. 2 and one with No. 3 electric emergency brake, were made with satisfactory results, and a demonstration of the retaining-power of the magnetic brake on a gradient of 1 in 14 was given in the following manner :—

Control on grade.

The controller-handle having been placed in the last magnetic-brake notch, the hand-brake was released, and the car allowed to proceed from rest down the grade. The car gathered way up to about five miles per hour, and was then automatically stopped by the brake. After a short period of rest it again gathered way, and was again automatically stopped, and so on indefinitely.

Critical speed.

In the Dunedin trials the critical speed-limit of the magnetic brake was on the first day, with perfectly clean commutators, about twenty-two miles per hour on the level, and towards the conclusion of the trials, when upwards of thirty emergency stops had been made, it was about eighteen miles per hour down a gradient of 1 in 14. Above this speed, flashing round the commutators, with accompanying skidding and lurching, occurred, though in every case fairly satisfactory stops were accomplished.

The commutators were inspected after the first day's tests, and found to be in good order. They were not interfered with, and on reinspection at the conclusion of the trials were found to be only slightly affected.

Stopping-power of the Brakes compared.

The average mean retardation obtained is a measure of the stopping-power of a brake. The average mean retardations obtained with the different brakes tested were as follows :—

	Feet per Second^2.
Mechanical track-brake	4·02
Hand wheel-brake and mechanical track-brake	3·06
Pneumatic wheel and mechanical track brake	5·63
Pneumatic wheel-brake alone	4·24
Newell electro-magnetic track and wheel brake	5·80

The average distances in which the cars experimented upon can, under the conditions of test, be arrested on the level, and on various gradients at ten and at fifteen miles per hour are clearly shown on the set of curves marked Curve sheets 1 and 2, Appendix II, and also in tabular form in Table 5, Appendix II.

The stopping power of the pneumatic wheel with track-brake is directly compared with that of the Newell magnetic brake on curve sheet 3, and the length of "stops" made by the pneumatic brake alone and by the Newell magnetic brake on the level at all speeds are shown by curve sheet 4.

To facilitate comparison the following extracts are given :—

The average length of stop made would be : Down—

	Ft.
The Parnell Rise (1 in 8·77),—	
At ten miles per hour,—	
Pneumatic wheel-brake with track-brake	45
Newell magnetic brake	40
At fifteen miles per hour,—	
Pneumatic wheel-brake with track-brake	104
Newell magnetic brake	90½
The Wellesley Street Grade (1 in 14),—	
At ten miles per hour,—	
Pneumatic wheel-brake with track-brake	31
Newell magnetic brake	26
At fifteen miles per hour,—	
Pneumatic wheel-brake with track-brake	77
Newell magnetic brake	60
On the level,—	
At ten miles per hour,—	
Pneumatic wheel-brake alone	28
Newell magnetic brake	23
At fifteen miles per hour,—	
Pneumatic wheel-brake alone	61
Newell magnetic brake	51

Limits of magnetic brake.

During the tests it was found that the limits of effective operation for the magnetic brake lay between three and twenty miles per hour, but that there were no limits to the speed at which the pneumatic wheel-brake might be applied.

General Conclusions.

From the results of their tests, a consideration of the evidence, an inspection of the lines, cars, and equipment of the tramways of the Dominion, and a general investigation of the subject of tramway-braking, the Commissioners have come to certain conclusions, and are of opinion,—

Hand wheel-brake.

(1.) That the hand wheel-brake is not a suitable appliance for the everyday control of cars exceeding 15 tons gross weight, for the action of this brake is dependent on the muscular effort of the motorman, who should not be called upon to repeatedly exert a greater force than 100 lb. on the handle.

If used on cars heavier than the weight stated, either excessive force has to be applied by the motorman or the leverage has to be made so great that promptness of action is seriously interfered with.

Pneumatic wheel-brake.

(2.) That the pneumatic wheel-brake is a reliable and efficient brake for cars of any weight, run at any practicable speed, on the level or on moderate gradients.

It gives rapid retardation, its action is independent of the condition of the electrical equipment, the pressure-gauge indicates the braking-power available, and stops can be graduated from "easy" to "emergency" by the movement of a single handle. The complete control of the brake-pressure which exists renders it possible for quick stops to be made with the minimum of inconvenience to the passengers. It is simple in construction, easily understood, and not liable to get out of order.

Track-brake required on steep grades.

(3.) That where gradients exceed 1 in 20 it is desirable, and where gradients exceed 1 in 15 it is imperative, that some form of track-brake should be used.

Where the track-brake is an auxiliary to an efficient wheel-brake, its function being to compensate for the effect of gravity, slowness of application is not a serious

defect. The brake is then applied at the summit of a grade, and kept on until the descent has been accomplished, any stops required in the interval being effected by means of the wheel-brake, the car being restarted if necessary by the use of power, the track-brake not being interfered with.

The great simplicity of the mechanical or hand-worked track-brake, and its complete independence of all other brakes, renders the combination of this brake with an effective wheel-brake one of the most reliable arrangements for the control of tram-cars on steep gradients.

Rheostatic brake.

(4.) That rheostatic braking, throwing, as it does, the work of retarding the car on to the motor-equipment, and controlling only the motor-driven wheels, is an undesirable arrangement for level or undulating districts, but with carefully designed motor-equipment of ample capacity constitutes a valuable auxiliary for use in descending long grades, such as are to be met with on mountain rail and tram ways.

Magnetic brake.

(5.) That the Newell electro-magnetic combined track and wheel brake is exceedingly effective as a brake, and in careful hands, and within certain speed-limits, is reliable. The necessity for avoiding the too rapid reduction of the resistance in circuit renders it, in the hands of a not absolutely cool motorman, liable to flashing-over, skidding, and failure, especially in the case of sudden emergency, when the motorman would probably put the controller-handle hard round, instead of dwelling on the intervening brake-notches.

The magnetic-brake windings form, when in use, a portion of the external circuit of a pair of powerful series generators, running in parallel; consequently it is imperative that in the design of these generators (the car-motors) the nature of this circuit should be considered.

The more satisfactory results obtained in Dunedin as compared with Wellington are probably largely due to the whole of the car-equipment at the former place having been supplied by the manufacturers of the brake, and the motors having been designed with a view to its use.

Limitation of effective speed a danger.

The limitation of speed at which this brake is effective constitutes a very real source of danger when steep gradients are worked, especially when "coasting" on some other form of brake is permitted. Should the brake in use fail, the lapse of only a few seconds will permit the car to attain a speed above that at which the magnetic brake will operate.

A car travelling at ten miles per hour down a grade of 1 in 8·77 will, on the removal of control, attain a speed of twenty miles per hour in $4\frac{1}{2}$ seconds, or down 1 in 12 in $6\frac{1}{2}$ seconds. It is thus possible for a car on which the magnetic brake is fitted, but not in use, to get completely out of hand before the danger is realised.

Skid-proof attachment.

The Westinghouse Company, who are the manufacturers of the magnetic brake, have introduced improvements intended to overcome the drawbacks mentioned. They have devised what they term a "skid-proof attachment," in which, on the current in the braking-circuit reaching a predetermined value, solenoid-controlled switches shunt the motor field-windings, and so further increase in excitation, voltage, and current is prevented. It is claimed by the manufacturers, and experiments in traffic appear to substantiate their claim, that this simple and easily applied device renders the brake absolutely skid-proof up to thirty-five miles per hour, no matter how suddenly it may be applied, all flashing-over and injury to the motor-equipment being prevented.

Mechanical attachment.

A second improvement consists in the addition of hand gear to the magnetic-brake rigging; this enables that brake to be applied altogether independently of the electrical equipment.

The application for "coasting" can be made by hand, all heating of the motors due to this work being avoided, and the magnetic action is still available for service or emergency stops.

Skid-proof attachment to be tested.

It is desirable that the skid-proof attachment should be tested in the Dominion, with a view to its ultimate adoption by the tramway systems on which the magnetic brake is used.

Mechanical attachment to be fitted.

Also, that on such systems all cars running on gradients of 1 in 15, or steeper, should be fitted with the mechanical attachment (hand gear).

On cars fitted with the magnetic and with hand wheel-brakes all "coasting" should be done on the former (electric or hand application), and its use should be compulsory for both service and emergency stops.

Emergency and service stops to be made by same appliance.

It is necessary, in order to insure the emergency brake being in working-condition, and its application instinctive, that both emergency and service stops should be made with the same appliance, and differ only in the degree of force used.

Standard Tramway Brake Gear.

(6.) That the standard both of design and construction of tramway-brake gear is, as a whole, below that dictated by railway practice.

Sanding-gear.

(7.) That efficient sanding is necessary for efficient control.

The majority of sanding-gears in use on tram-cars are crude and unsatisfactory; the hopper arrangements are poor, and the method of delivery on the track bad, the terminations of the sand-pipes being in some cases 6 ft. in advance of the wheels: the sand is thus delivered far away from the rail on the curves, and even on the straight the greater portion may be blown away in windy weather.

In other cases only one rail is sanded (involving a very severe stress on the axles), and again in others only some of the wheels receive any benefit from the sand.

The sand-hoppers should be provided with lids, the valves be designed to work freely, and the pipes so arranged that the sand is delivered immediately in front of the leading wheel on each rail. Fan-shaped terminations should be fitted to the pipes.

Air-sanding should be adopted on cars fitted with the pneumatic brake.

Trailers.

(8.) That where "trailers" are used they should be fitted with brakes actuated by the motorman of the electric car.

Speed-indicators.

(9.) That a few cars on each system should be fitted with speed-indicators, in order that the motormen may become accustomed to correctly judging the speed at which car is travelling. Low speeds are invariably under- and high speeds over-estimated by untrained men.

Having narrated the course of their investigations, and expressed in general terms the conclusions to which these investigations have led them, Your Excellency's Commissioners have now the honour to state with regard to the matters specifically referred to them,—

(*a.*) That they are of opinion that, having regard to the grades of the Auckland tramways and the conditions under which traffic is there conducted, the brakes already adopted are not suitable, efficient, nor sufficient for use on these tramways. Underestimation of the weight of the cars has led to their being equipped with brakes of insufficient power and capacity. A far larger amount of physical force than was apparently anticipated is required for their application. The brake-gear is too light in scantling and too insecure in anchorage to safely and effectively transmit this larger force. That the cars are too heavy, speeds too high, and gradients too severe for hand-power to be alone relied on for actuating the brakes.

(*b.*) That, having regard to the following matters—The reliability, independence of traction equipment, smoothness of working, and efficiency at all attainable speeds of the pneumatic wheel-brake; the simplicity, reliability, and complete independence of the mechanical track-brake; the capacity of a combination of these two brakes; the comparative ease with which an installation of such can be made: and, on the other hand, to the limit in the speed at which the magnetic brake is effective; the want of experience of the devices now introduced to overcome this disability; the unsuitability of the electrical equipment and undergear of the Auckland cars for the application of the magnetic brake, and the estimated excessive cost thereof; and also to the comparatively small difference in the stopping-power of the two systems —they are of opinion that the safety and convenience of the public will be insured, the necessary relief to the motormen be given, and the vested interests fairly dealt with by the company being requested to fit on the Auckland cars an approved type of pneumatic wheel-brake, of ample cylinder-capacity, and substantial rigging, together with pneumatic sanding-gear arranged to deliver the sand under the leading wheels at each end of the cars; and to reconstruct the existing track-brakes so that it may be possible by a strong application to transfer 45 per cent. of the weight of a loaded car to the slipper-blocks without undue stress on or deflection of any portion of the gear.

(*c.*) That other matters arising out of this inquiry have already been dealt with under the heading of "General Conclusions."

The Commissioners have also considered the working of the existing law, and the necessity or expediency of any new legislation in respect thereto. They have found that at Wellington, Christchurch, and Dunedin a high standard of upkeep and efficiency of equipment is maintained. The standard attained on the Auckland tramways is below that of the other lines, but there is evidence that a great improvement has been effected by the present officials, who appear to be desirous of using all means at their disposal to place their equipment in a more satisfactory condition. In this connection it may be stated that a pleasing feature in the work of the Commission has been the capacity, zeal, and interest in all that pertains to tramways shown by the officers of the systems visited.

In these circumstances, the Commissioners are of opinion that if further legislation, necessitating closer inspection, be introduced it is desirable that any inspector appointed should be an electrical engineer of high qualifications and extended experience of tramway-working, whose professional status should be such that his assistance would be welcomed by executive tramway engineers.

The Commissioners also consider it to be desirable for the Government to take powers to be able, if necessary, to insist on any tramway system being equipped and worked with due regard to the safety and convenience of the public.

In conclusion, they desire to acknowledge their indebtedness to the tramway authorities of the Dominion for the many facilities given for investigation, and their ready assistance in experimental work.

The Commissioners have the honour to be,

Your Excellency's most obedient servants,

ROBT. J. SCOTT, M.Inst.C.E., M.Inst.M.E., M.A.I.E.E., Chairman.
A. L. BEATTIE, M.A.R.M.M.Assocn.

30th May, 1910.

ACCOMPANYING this report are the following enclosures :—

Appendix I.

Conversion Table.
Results of experiments.

Appendix II.

Four sheets of curves, showing some results of experiments.
Table 5, Length of Stops.
Table 6, Weight of Cars.

Appendix III.

Evidence given before the Commission.

APPENDICES.

APPENDIX I.

TABLE 1.—TABLE OF LENGTH OF STOP IN FEET FOR VARIOUS RETARDATIONS.

Retardation: Feet per Second.	Corresponding Length of Stop on Level, in Feet.			
	At 5 Miles per Hour.	At 10 Miles per Hour.	At 15 Miles per Hour.	At 20 Miles per Hour.
1	26·9	107·3	242·0	430·1
2	13·45	53·7	121·0	215·0
3	8·96	35·9	80·65	143·4
4	6·72	26·9	60·5	107·3
5	5·38	21·5	48·4	86·0
6	4·48	17·9	40·3	71·7
7	3·84	15·3	34·57	61·45
8	3·36	13·44	30·25	53·8

Results of Tests.

No. of Test.	Speed of Car.		Elapsed Time: Seconds.	Length of Stop: Feet.	Mean Retardation.		Grade, 1 in	Acceleration due to Gravity: Feet per Second².	Total Retardation of Car: Feet per Second².	Retardation due to Car-resistance: Feet per Second².	Total Retardation due to Brakes: Feet per Second².	Mean Retarding-force of Brakes: per Cent. Car-weight.	Sand.	Remarks.
	Miles per Hour.	Feet per Second.			By Time: Feet per Second².	By Distance: Feet per Second².								

Table 2.

Brake-test at Auckland. Dates: No. 13, 26th April, 1910; Nos. 46 and 47, 28th April, 1910. Location: Parnell Rise. Type of brake used: Mechanical track brake. Type of car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Coasting on track brake; track brake applied hard on signal.

13	11·7	17·2	14·5	178·6	1·18	0·83	8·77	3·67	4·50	0·36	4·14	13·0	No	Good rail.
46	11·2	16·4	12·1	144·7	1·36	0·93	8·77	3·67	4·60	0·36	4·24	13·3	,,	,,
47	10·7	15·7	15·1	178·1	1·04	0·69	8·77	3·67	4·36	0·36	4·00	12·6	Yes	,,
Mean	..	..	..	..	..	..	..	..	4·49	..	4·13	12·9		

Table 3.

Brake-test at Auckland. Date: 26th April, 1910. Location: College Hill. Type of brake used: Mechanical track brake. Type of car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Coasting on track brake; track brake applied hard on signal.

5	9·2	13·5	11·4	126·6	1·18	0·72	11·74	2·75	3·47	0·36	3·11	9·80	Yes	Rail good.
6	9·7	14·2	12·1	126·4	1·17	0·797	11·74	2·75	3·547	0·36	3·187	10·00	No	,,
7	11·2	16·4	11·4	128·1	1·44	1·05	11·74	2·75	3·80	0·36	3·44	10·80	,,	,,
8	11·7	17·2	10·5	128·3	1·64	1·16	11·74	2·75	3·91	0·36	3·55	11·20	,,	,,
9	13·9	20·4	13·4	179·5	1·52	1·16	11·74	2·75	3·91	0·36	3·55	11·20	,,	,,
10	14·9	21·9	14·6	215·8	1·50	1·34	11·74	2·75	4·09	0·36	3·73	11·75	,,	,,
Mean	..	..	..	..	..	..	..	..	3·79	..	3·43	10·70		

Table 4.

Brake-test at Auckland. Date: 1st May, 1910. Location: Wellesley Street East. Type of brake used: Mechanical track brake. Type of car: Double bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Coasting on track brake; track brake applied hard on signal.

54	10·6	15·5	8·7	101·0	1·78	1·19	14·19	2·27	3·46	0·36	3·10	9·72	No	Dew on rail.
55	14·1	20·6	9·5	140·3	2·168	1·512	14·19	2·27	3·782	0·36	3·422	10·80	,,	Sanded going up grade.
56	13·1	19·2	9·1	127·3	2·110	1·448	14·19	2·27	3·718	0·36	3·358	10·60	,,	Sand still on rail.
57	15·9	23·2	9·9	154·1	2·343	1·746	14·19	2·27	4·016	0·36	3·656	11·50	,,	,,
58	19·3	28·2	11·7	225·1	2·410	1·766	14·19	2·27	4·036	0·36	3·676	11·60	,,	,,
Mean	..	..	..	..	..	..	..	..	3·80	..	3·44	10·70		

TABLE 5.

Brake-test at Auckland. Dates: 37–45, 28th April, 1910; 15, 26th April, 1910. Location: Parnell Rise. Type of brake used: Pneumatic wheel brake. Type of Car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Coasting on air brake; air brake applied hard on signal.

37	9·0	13·2	6·3	53·4	2·09	1·63	8·77	3·67	5·30	0·36	4·94	15·50	Yes	Good rail.
38	9·2	13·5	6·3	57·5	2·14	1·58	8·77	3·67	5·25	0·36	4·89	15·40	,,	,,
39	14·4	21·2	25·1	442·3	0·84	0·51	8·77	..	..	0·36	..	..	,,	Ran to flat.
40	9·1	13·3	11·7	125·0	1·14	0·71	8·77	3·67	3·38	0·36	3·02	9·45	,,	Eliminated from mean.
41	9·2	13·5	8·0	77·8	1·69	1·17	8·77	3·67	4·84	0·36	4·48	14·10	No	Good rail.
42	10·2	15·0	8·9	103·1	1·68	1·09	8·77	3·67	4·76	0·36	4·40	13·80	,,	,,
43	13·1	19·2	13·5	193·7	1·42	0·95	8·77	3·67	4·62	0·36	4·26	13·40	Yes	,,
44	14·5	21·3	23·5	365·4	0·91	0·62	8·77	3·67	4·29	0·36	3·93	12·40	No	Slight skid.
45	16·0	23·5	24·4	503·5	0·96	0·55	8·77	..	..	0·36	..	..	,,	Ran to flat.
15	9·2	13·4	8·4	90·0	1·59	0·99	8·77	3·67	4·66	0·36	4·30	13·50	Yes	..
Means of Nos. 37, 38, 41–44, and 15				..	..	..	..	..	4·82	..	4·46	13·90		

TABLE 6.

Brake-test at Auckland. Date: 1–4, 26th April, 1910; 17–20, 27th April, 1910. Location: College Hill. Type of brake used: Pneumatic wheel brake. Type of car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Emergency; air brake applied at signal.

1	18·0	26·4	19·5	347·5	1·35	1·003	11·74	2·75	3·75	0·36	3·39	10·50	Yes	First of series eliminated in mean.
2	10·4	15·3	7·5	80·7	2·04	1·450	11·74	2·75	4·20	0·36	3·84	11·90	,,	Rail good.
3	9·0	13·2	5·6	53·6	2·36	1·625	11·74	2·75	4·37	0·36	4·01	12·42	,,	,,
4	14·1	20·7	9·2	147·9	2·25	1·449	11·74	2·75	4·20	0·36	3·84	11·90	,,	,,
17	18·0	26·4	12·7	238·5	2·08	1·461	11·74	2·75	4·21	0·36	3·85	11·92	,,	Rail slightly greasy.
18	19·8	29·0	13·5	263·2	2·15	1·597	11·74	2·75	4·35	0·36	3·99	12·40	No	,,
19	14·1	20·7	9·7	140·2	2·13	1·528	11·74	2·75	4·28	0·36	3·92	12·20	Yes	,,
20	12·2	17·9	6·7	87·2	2·67	1·837	11·74	2·75	4·59	0·36	4·23	13·13	,,	,,
Means of Nos. 1–20		..	..	..	..	..	..	..	4·24	..	3·88	12·04		
Means of Nos. 2–20		..	..	..	..	..	..	..	4·31	..	3·95	12·26		

RESULTS OF TESTS—*continued.*

No. of Test.	Speed of Car.		Elapsed Time: Seconds.	Length of Stop: Feet.	Mean Retardation.		Grade, 1 in	Acceleration due to Gravity: Feet per Second².	Total Retardation of Car: Feet per Second².	Retardation due to Car-resistance: Feet per Second².	Total Retardation due to Brakes: Feet per Second².	Mean Retarding-force of Brakes: per Cent. Car-weight.	Sand.	Remarks.
	Miles per Hour.	Feet per Second.			By Time: Feet per Second².	By Distance: Feet per Second².								

TABLE 7.

Brake-test at Auckland. Date: 1st May, 1910. Location: Wellesley Street East. Type of brake used: Pneumatic wheel brake. Type of car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Emergency; air brake applied on signal.

71	12·1	17·7	5·8	80·0	3·050	1·957	14·19	2·27	4·227	0·36	3·867	12·18	Yes	Good rail.
72	12·7	18·6	5·7	80·3	3·263	2·154	14·19	2·27	4·424	0·36	4·064	12·80	No	,,
73	10·1	14·8	4·7	59·6	3·150	1·830	14·19	2·27	4·100	0·36	3·740	11·78	,,	,,
74	15·1	22·1	7·0	115·5	3·157	2·114	14·19	2·27	4·384	0·36	4·024	12·60	,,	,,
75	15·8	23·1	6·9	111·2	3·348	2·390	14·19	2·27	4·660	0·36	4·300	13·50	,,	,,
76	19·7	28·8	10·4	200·5	2·769	2·018	14·19	2·27	4·288	0·36	3·928	12·55	,,	Slight skid (1 ft.).
77	19·9	29·1	14·1	279·4	2·064	1·515	14·19	2·27	3·785	0·36	3·425	10·80	Yes	,, ,,
Mean	..	..	..	..	..	..	..	..	4·270	..	3·910	12·20		

TABLE 8.

Brake-test at Auckland. Dates: 16, 26th April, 1910; 49–53, 28th April, 1910. Location: No. 16, Parnell Road; Nos. 49–51, Newmarket–Epsom; Nos. 52, 53, Greenwood's Corner. Type of brake used: Pneumatic wheel brake. Type of car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Emergency; air-brake applied on signal.

16	18·4	27·0	6·5	116·0	4·15	3·15	Level	..	3·15	0·36	2·79	8·67	Yes	Rail slightly greasy.
49	14·1	20·8	4·5	61·2	4·63	3·54	269·38 up	− ·12	3·42	0·36	3·06	9·50	,,	Fair rail.
50	14·2	20·9	4·3	45·2	4·87	4·84	155·91 up	− ·21	4·63	0·36	4·27	13·25	,,	,,
51	19·1	28·0	5·4	79·0	5·20	4·97	68·39 up	− ·47	4·50	0·36	4·14	12·85	,,	,,
52	19·1	28·0	8·1	122·0	3·46	3·22	39·5 down	+ ·81	4·03	0·36	3·67	11·40	,,	,,
53	13·1	19·2	6·1	72·7	3·15	2·55	39·5 down	+ ·81	3·36	0·36	3·00	9·30	,,	,,
Mean	..	..	..	..	..	..	..	..	3·85	..	3·49	10·83		

TABLE 9.

Brake-test at Auckland. Date: 1st May, 1910. Location: Wellesley Street East. Type of brake used: Hand-wheel and mechanical track brakes. Type of car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Coasting on track brake; hand-wheel brake applied on signal.

59	14·2	20·8	26·7	369·2	0·78	0·58	14·19	2·27	2·85	0·36	2·49	7·85	No	Rail slightly greasy.
60	12·5	18·3	15·7	228·8	1·16	0·73	14·19	2·27	3·00	0·36	2·64	8·30	Yes	,,
61	14·9	21·8	15·7	270·7	1·39	0·88	14·19	2·27	3·15	0·36	2·79	8·80	,,	,,
62	11·6	17·0	12·9	177·4	1·32	0·81	14·19	2·27	3·08	0·36	2·72	8·55	No	Rail sandy.
63	17·0	24·8	16·9	331·2	1·47	0·93	14·19	2·27	3·20	0·36	2·84	8·93	,,	,,
Mean	..	..	..	..	..	..	..	..	3·06	..	2·70	8·40		

Table 10.

Brake-test at Auckland. Dates: No. 14, 26th April, 1910; Nos. 31–36, 28th April, 1910. Location: Parnell Rise. Type of brake used: Pneumatic wheel and mechanical track brakes. Type of car: double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Track brake in use; pneumatic emergency applied on signal.

14	7·1	10·4	3·4	25·8	3·05	2·10	8·77	3·67	5·77	0·36	5·41	17·0	No	Rail good.
31	11·1	16·3	6·1	75·4	2·67	1·76	8·77	3·67	5·43	0·36	5·07	16·0	Yes	,,
32	16·0	23·4	7·8	124·8	3·00	2·19	8·77	3·67	5·86	0·36	5·50	17·3	,,	,,
33	16·8	24·4	8·1	126·2	3·01	2·36	8·77	3·67	6·03	0·36	5·67	17·8	,,	,,
34	11·4	16·7	4·8	53·0	3·48	2·63	8·77	3·67	6·30	0·36	5·94	18·6	,,	,,
35	9·2	13·5	3·5	32·4	3·85	2·82	8·77	3·67	6·49	0·36	6·13	19·2	,,	,,
36	11·0	17·6	4·5	45·6	3·90	3·40	8·77	3·67	7·07	0·36	6·71	22·3	,,	,,
Mean	..	..	..	..	..	..	..	..	6·14	..	5·78	18·0		

Table 11.

Brake-test at Auckland. Dates: 11, 12, 26th April, 1910; 21–25 and 27–29, 27th April, 1910. Location: College Hill. Type of brake used: Pneumatic wheel and mechanical track brakes. Type of car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Track brake in action; emergency air applied on signal.

11	13·2	19·4	6·2	85·3	3·13	2·21	11·74	2·75	4·96	0·36	4·60	14·45	Yes	Rail good.
12	16·2	23·7	5·7	98·3	4·15	2·86	11·74	2·75	5·61	0·36	5·25	16·50	,,	,,
21	13·4	19·7	4·3	46·7	4·58	4·15	11·74	2·75	6·90	0·36	6·54	20·60	,,	,,
22	8·6	12·6	3·0	25·3	4·20	3·15	11·74	2·75	5·90	0·36	5·54	17·40	,,	,,
23	11·6	17·0	4·6	57·8	3·70	2·51	11·74	2·75	5·26	0·36	4·90	15·40	,,	,,
24	13·8	20·3	5·3	69·6	3·83	2·96	11·74	2·75	5·71	0·36	5·35	16·80	,,	,,
25	11·2	16·4	4·0	43·2	4·10	3·11	11·74	2·75	5·86	0·36	5·50	17·30	,,	,,
27	15·2	22·3	6·9	112·6	3·22	2·21	11·74	2·75	4·96	0·36	4·60	14·45	,,	,,
28	15·2	22·3	6·5	111·3	3·42	2·24	11·74	2·75	4·99	0·36	4·63	14·50	,,	,,
29	15·8	23·2	6·9	113·0	3·36	2·38	11·74	2·75	5·13	0·36	4·77	15·00	,,	,,
Mean	..	..	..	..	..	..	..	..	5·53	..	5·17	16·10		

Table 12.

Brake-test at Auckland. Date: 1st May, 1910. Location: Wellesley Street East. Type of brake used: Pneumatic wheel and mechanical track brake. Type of car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Track brake in use; then emergency air applied on signal.

64	18·1	26·5	8·3	154·1	3·20	2·27	14·19	2·27	4·54	0·36	4·18	13·00	Yes	First of series eliminated from mean.
65	13·6	19·9	4·7	65·2	4·23	3·04	14·19	2·27	5·31	0·36	4·95	15·34	No	Rail good.
66	13·1	19·2	4·5	59·7	4·27	3·08	14·19	2·27	5·35	0·36	4·99	15·50	,,	,,
67	9.0	13·2	2·8	26·0	5·07	3·36	14·19	2·27	5·63	0·36	5·27	16·40	,,	,,
68	11·2	16·4	4·0	43·7	4·10	3·08	14·19	2·27	5·35	0·36	4·99	15·50	,,	,,
69	15·9	23·3	5·4	76·3	4·32	3·56	14·19	2·27	5·83	0·36	5·47	17·10	,,	,,
70	18·0	26·3	6·7	112·8	3·93	3·06	14·19	2·27	5·33	0·36	4·97	15·50	,,	,,
Mean of Nos. 65–70	..	..	..	..	..	..	..	..	5·47	..	5·11	15·87		

RESULTS OF TESTS—*continued*.

No. of Test.	Speed of Car.		Elapsed Time: Seconds.	Length of Stop: Feet.	Mean Retardation.		Grade, 1 in	Acceleration due to Gravity: Feet per Second².	Total Retardation of Car: Feet per Second².	Retardation due to Car-resistance: Feet per Second².	Total Retardation due to Brakes: Feet per Second².	Mean Retarding-force of Brakes: per Cent. Car-weight.	Sand.	Remarks.
	Miles per Hour.	Feet per Second.			By Time: Feet per Second².	By Distance: Feet per Second².								

TABLE 13.

Brake-test at Auckland. Date: 1st May, 1910. Location: Wellesley Street East. Type of brake used: Pneumatic wheel and mechanical track brakes. Type of car: Double-bogie single-deck, No. 75. Weight of car (total): 48,888 lb. Description of test: Coasting on track brake; emergency air applied on signal, and track brake put down harder.

78	12·5	18·3	3·9	57·7	4·692	2·900	14·19	2·27	5·17	0·36	4·81	15·10	No	Rail good.
79	14·2	20·8	4·8	72·0	4·330	3·004	14·19	2·27	5·27	0·36	4·91	15·20	,,	,,
80	16·8	24·6	5·5	97·6	4·472	3·100	14·19	2·27	5·37	0·36	5·01	15·70	,,	,,
81	17·3	25·3	5·7	98·0	4·438	3·270	14·19	2·27	5·47	0·36	5·11	16·00	,,	,,
83	23·6	34·5	7·5	189·2	4·600	3·145	14·19	2·27	5·41	0·36	5·05	15·80	,,	,,
84	22·0	32·3	7·3	160·2	4·424	3·256	14·19	2·27	5·83	0·36	5·47	17·10	,,	Rear free wheel skidded nearly 1 chain.
85	19·9	29·2	7·1	146·3	4·112	2·914	14·19	2·27	5·18	0·36	4·82	15·15	,,	Ditto.
Mean	..	..	..	..	..	..	..	..	5·39	..	5·03	15·62		

TABLE 14.

Brake-test at Christchurch. Date: 11th May, 1910. Location: Moorhouse Avenue. Type of brake used: Pneumatic wheel. Type of car: Double combination, No. 9. Weight of car (total): 42,714 lb. Description of test: Emergency.

1	16·30	23·80	4·6	75·50	5·17	3·750	2,200	— ·0146	3·735	0·32	3·415	10·60	Yes	Rail wet and mull
2	14·50	21·25	3·6	48·67	5·90	4·630	2,200	— ·0146	4·615	0·32	4·295	13·30	,,	,,
3	10·50	15·40	3·0	28·00	5·13	4·125	2,200	— ·0146	4·110	0·32	3·790	11·80	,,	,,
4	10·25	15·00	2·8	28·67	5·35	3·930	2,200	— ·0146	3·915	0·32	3·595	11·20	,,	,,
5	7·25	10·61	2·4	16·42	4·42	3·430	2,200	— ·0146	3·415	0·32	3·095	9·61	,,	,,
6	7·50	11·00	2·2	18·17	5·00	3·330	2,200	— ·0146	3·315	0·32	2·995	9·30	,,	,,
7	17·60	25·75	5·0	80·50	5·15	4·125	2,200	— ·0146	4·110	0·32	3·790	11·80	,,	,,
8	17·80	26·15	4·8	82·00	5·44	4·175	2,200	— ·0146	4·160	0·32	3·840	11·90	,,	,,
9	19·30	28·25	5·8	100·67	4·87	3·970	2,200	— ·0146	3·955	0·32	3·635	11·30	,,	,,
10	19·10	28·00	5·6	100·00	5·00	3·920	2,200	— ·0146	3·905	0·32	3·585	11·10	,,	,,
11	20·08	29·37	6·0	103·00	4·89	4·190	2,200	— ·0146	4·175	0·32	3·855	12·00	,,	,,
12	20·08	29·37	5·6	99·50	5·24	4·350	2,200	— ·0146	4·335	0·32	4·015	12·40	,,	,,
13	20·80	30·50	6·4	113·50	4·76	4·100	2,200	— ·0146	4·085	0·32	3·765	11·70	,,	,,
14	20·80	30·50	6·0	110·50	5·10	4·210	2,200	— ·0146	4·195	0·32	3·875	12·00	,,	,,
15	21·78	31·90	6·6	128·50	4·83	3·970	2,200	— ·0146	3·955	0·32	3·635	11·30	,,	,,
16	22·00	32·25	6·6	129·50	4·88	4·020	2,200	— ·0146	4·000	0·32	3·680	14·40	,,	,,
17	22·80	33·50	7·8	155·50	4·30	3·610	2,200	— ·0146	3·595	0·32	3·275	10·15	No	,,
18	22·90	33·60	7·4	144·00	4·54	3·925	2,200	— ·0146	3·910	0·32	3·590	11·15	,,	,,
Mean	..	..	..	..	..	..	..	..	3·960	..	3·700	11·33		

TABLE 15.

Brake-test at Dunedin. Date: 17th May, 1910. Location: Caversham Grade. Type of brake used: Newell magnetic. Type of car: Combination, No. 20. Weight of car (total): 30,422 lb.
Description of test: Emergency.

1	14·00	20·50	4·0	58·0	5·13	3·62	18·7	1·71	5·33	0·32	5·01	15·60	Yes	Drizzling rain. Rail damp.
2	13·50	19·80	3·8	57·0	5·20	3·44	18·7	1·71	5·15	0·32	4·83	15·10	,,	Ditto.
3	13·75	20·20	2·8	40·5	7·20	4·48	18·7	1·71	6·19	0·32	5·87	18·35	,,	,,
4	14·75	21·65	3·0	48·5	7·22	4·83	18·7	1·71	6·54	0·32	6·22	19·40	,,	Rail damp.
5	14·00	20·50	4·0	51·0	5·13	4·12	18·7	1·71	5·83	0·32	5·51	17·20	,,	,,
6	16·50	24·20	4·2	73·5	5·75	3·99	18·7	1·71	5·70	0·32	5·38	16·80	,,	Rail good.
7	17·80	26·10	4·0	74·5	6·53	4·57	18·7	1·71	6·28	0·32	5·96	18·70	,,	,,
8	17·20	25·20	3·6	65·0	7·00	4·88	18·7	1·71	6·59	0·32	6·27	19·60	,,	,,
Mean	..	..	..	..	..	..	..	..	5·95	..	5·63	17·50		

TABLE 16.

Brake-test at Dunedin. Date: 18th May, 1910. Location: Caversham Grade. Type of brake used: Newell magnetic. Type of car: Combination, No. 20. Weight of car (total): 30,422 lb.
Description of test: Emergency.

24	15·2	22·25	3·4	51·50	6·55	4·80	18·7	1·71	6·510	0·32	6·190	19·32	Yes	Rail good.
25	17·2	25·20	4·0	76·50	6·30	4·15	18·7	1·71	5·860	0·32	5·540	17·40	No	,,
26	18·3	26·80	4·4	79·25	6·10	4·53	18·7	1·71	6·240	0·32	5·920	18·50	,,	,,
27	19·5	28·60	4·6	86·50	6·20	4·725	18·7	1·71	6·435	0·32	6·115	19·10	,,	,,
28	19·5	28·60	7·0	114·50	4·10	3·56	18·7	1·71	5·270	0·32	4·950	15·45	Yes	Flash and skid. Rail good.
29	20·4	30·00	8·2	148·00	3·66	3·04	18·7	1·71	4·750	0·32	4·430	13·85	,,	Ditto.
30	20·2	29·50	6·4	127·00	4·61	3·42	18·7	1·71	5·130	0·32	4·810	15·00	No	Rail good.
Mean	..	..	..	..	..	..	..	..	5·740	..	5·420	16·90		

TABLE 17.

Brake-test at Dunedin. Date: 18th May, 1910. Location: Anderson's Bay Terminus. Type of brake used: Newell magnetic. Type of car: Combination, No. 20. Weight of car (total): 30,422 lb. Description of test: Emergency.

34	17·20	25·20	4·8	75·00	5·25	4·225	14	2·275	6·500	0·32	6·180	19·30	Yes	Rail good.
35	19·10	28·00	5·2	102·50	5·38	3·82	14	2·275	6·100	0·32	5·780	18·04	,,	Flash. Rail good.
36	21·30	31·25	6·0	116·00	5·20	4·20	14	2·275	6·475	0·32	6·155	19·20	,,	Flash and skid. Rail good.
37	20·05	29·3	6·0	106·67	4·88	4·025	14	2·275	6·300	0·32	5·980	18·70	,,	Ditto.
Mean	..	..	..	..	..	..	..	..	6·340	..	6·020	18·70	..	

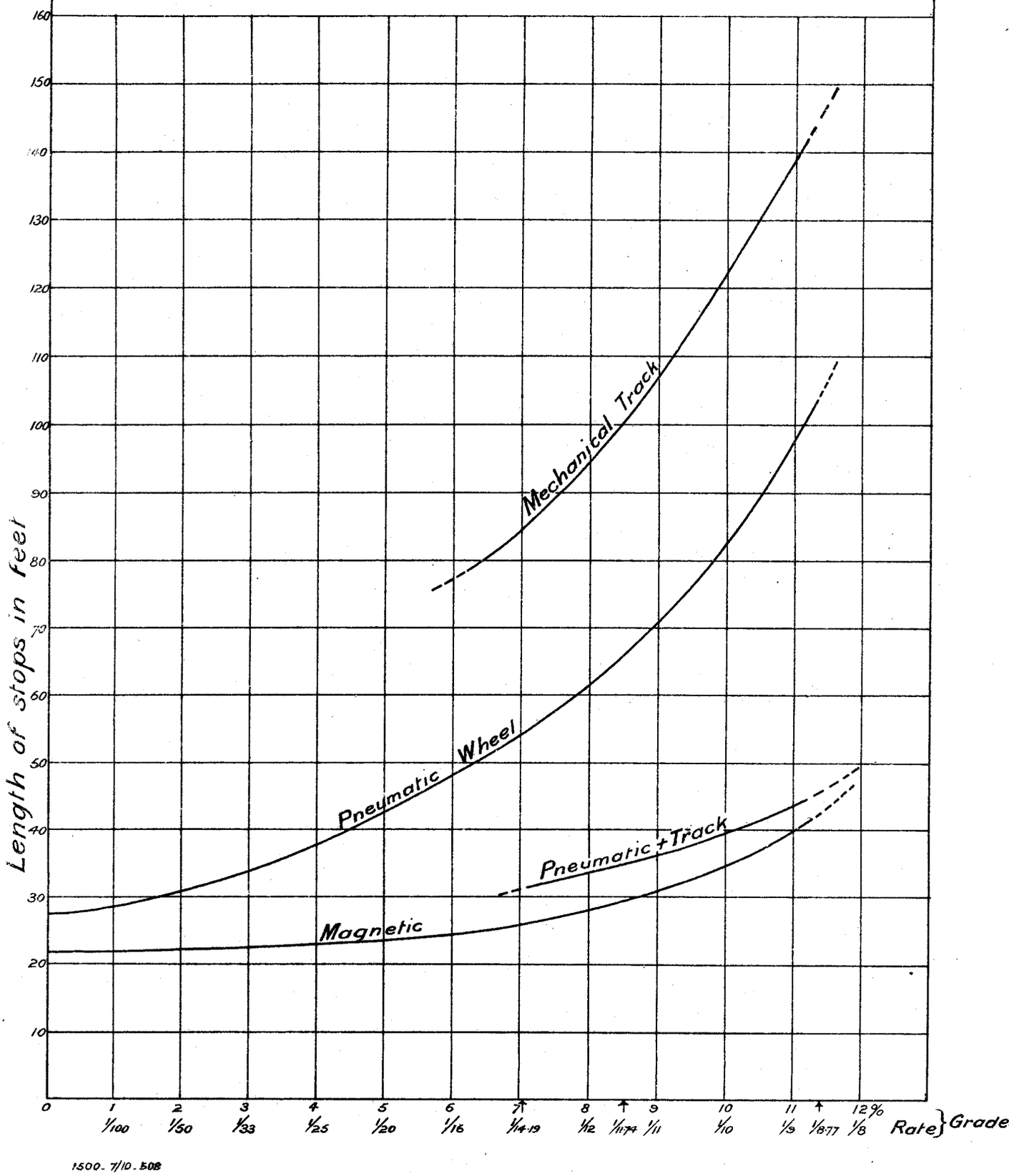
RESULTS OF TESTS—*continued.*

No. of Test.	Speed of Car.		Elapsed Time: Seconds.	Length of Stop: Feet.	Mean Retardation.		Grade, 1 in	Acceleration due to Gravity: Feet per Second².	Total Retardation of Car: Feet per Second².	Retardation due to Car-resistance: Feet per Second².	Total Retardation due to Brakes: Feet per Second².	Mean Retarding-force of Brakes: per Cent. Car-weight.	Sand.	Remarks.
	Miles per Hour.	Feet per Second.			By Time: Feet per Second².	By Distance: Feet per Second².								
TABLE 18.														
Brake-test at Dunedin. Dates: Nos. 9–13, 17th May, 1910; Nos. 31–33, 18th May, 1910. Location: Anderson's Bay Road. Type of brake used: Newell magnetic. Type of car: Combination, No. 20. Weight of car (total): 30,422 lb. Description of test: Emergency.														
9	20·6	30·15	4·2	81·0	7·17	5·62	155·3	0·206	5·826	0·32	5·506	17·20	Yes	Rail good.
10	22·5	33·00	4·8	83·0	6·88	6·55	155·3	0·206	6·756	0·32	6·436	20·15	,,	,,
11	24·0	35·20	5·2	101·0	6·76	6·13	155·3	0·206	6·336	0·32	6·016	18·80	,,	,,
12	22·1	32·40	4·6	83·0	7·05	6·33	155·3	0·206	6·536	0·32	6·216	19·43	,,	,,
13	23·2	34·00	4·6	91·0	7·40	6·35	155·3	0·206	6·556	0·32	6·236	19·50	,,	Slight skid.
31	23·2	34·00	5·4	121·5	6·30	4·75	155·3	0·206	4·956	0·32	4·636	14·50	No	Flash and skid.
32	22·6	33·10	4·4	85·5	7·52	6·40	155·3	0·206	6·606	0·32	6·286	19·60	Yes	Rail good.
33	22·7	33·25	4·6	92·5	7·23	5·95	155·3	0·206	6·156	0·32	5·836	18·20	,,	,,
Mean	..	..	..	..	..	..	..	..	6·220	..	5·890	18·42		
TABLE 19.														
Brake-test at Dunedin. Date: 18th May, 1910. Location: St. Kilda Road. Type of brake used: Newell magnetic. Type of car: Combination, No. 20. Weight of car (total): 30,422 lb. Description of test: Emergency.														
14	16·8	24·60	3·8	61·42	6·46	4·93	3,121	+ ·01	4·94	0·32	4·62	14·40	Yes	Rail good.
15	16·1	23·60	3·8	58·00	6·20	4·80	3,121	+ ·01	4·81	0·32	4·59	14·30	,,	,,
16	12·0	17·60	3·4	41·75	5·17	3·72	3,121	+ ·01	3·73	0·32	3·41	10·68	No.	,,
17	19·1	28·00	4·8	80·50	5·84	4·87	3,121	− ·01	4·86	0·32	4·54	14·20	,,	,,
18	14·5	21·25	3·4	43·50	6·24	5·18	3,121	− ·01	5·17	0·32	4·85	15·20	Yes	,,
19	15·0	22·00	3·4	39·50	6·45	6·14	3,121	− ·01	6·13	0·32	5·81	18·20	,,	,,
20	16·8	24·65	3·8	53·75	6·48	5·64	3,121	+ ·01	5·65	0·32	3·33	16·60	,,	,,
21	7·0	10·28	2·8	16·25	3·66	3·17	3,121	+ ·01	3·18	0·32	2·86	8·95	,,	,,
22	6·0	8·80	2·0	9·75	4·40	3·97	3,121	+ ·01	3·98	0·32	3·66	11·40	,,	,,
23	17·0	24·90	4·4	61·50	5·66	5·04	Level ..	..	5·04	0·32	4·72	14·72	,,	,,
Mean	..	..	..	..	..	..	..	..	4·75	..	4·44	13·80		
TABLE 20.														
Brake-test at Dunedin. Date: 18th May, 1910. Location: Anderson's Bay Road. Type of brake used: Newell magnetic. Type of car: Combination, No. 20. Weight of car (total): 30,422 lb. Description of test: Emergency.														
38	17·0	24·9	6·4	77·0	3·89	4·30	50·30	− ·636	3·664	0·32	3·344	10·42	No	Second emergency.
39	17·2	25·2	7·6	111·0	3·32	2·86	155·35	− ·206	2·654	0·32	2·334	7·30	Yes	Third emergency.

— Curve sheet 1 —

Curves shewing average results of experiments at 10 M.P.H. on various Gradients with

Mechanical Track
Pneumatic Wheel
Pneumatic Wheel + Mech. Track
Newell Combined Magnetic Brake

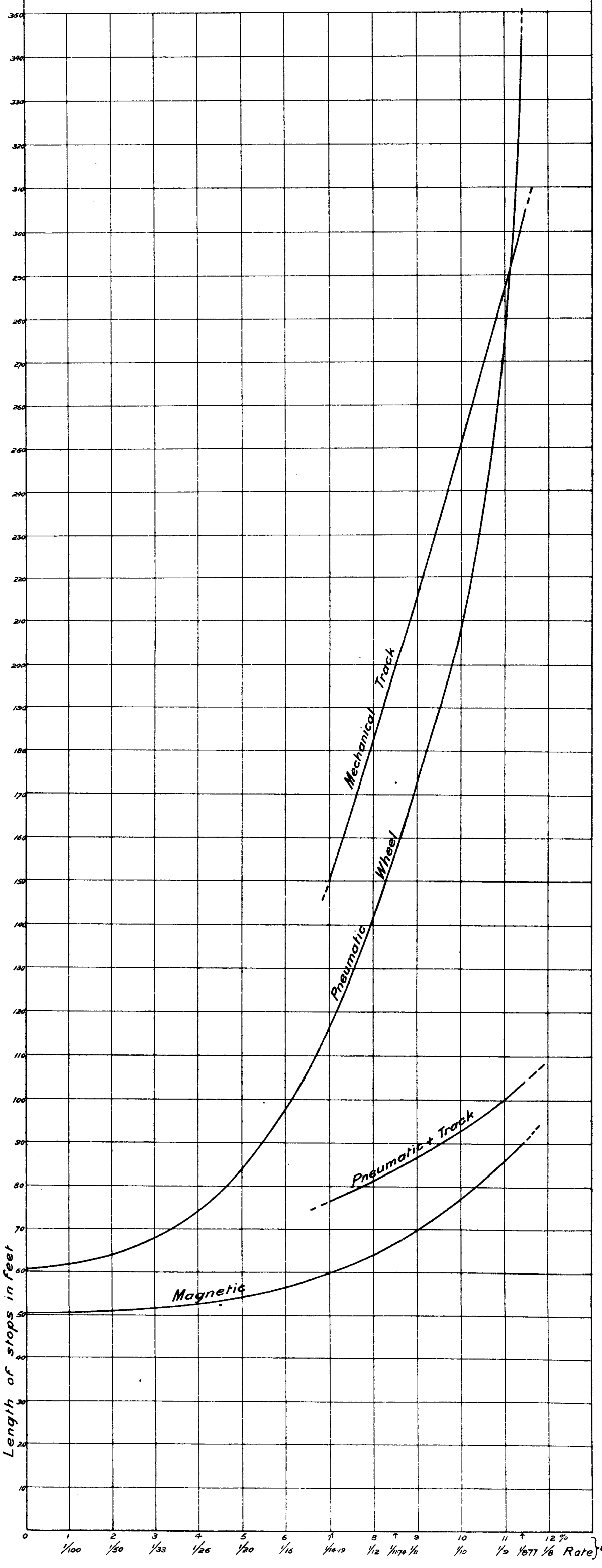


1500. 7/10. 508

— Curve sheet 2 —

Curves shewing average results of experiments on various Gradients with

Mechanical Track
Pneumatic Wheel
Pneumatic Wheel + Track
Newell Combined Magnetic Brakes

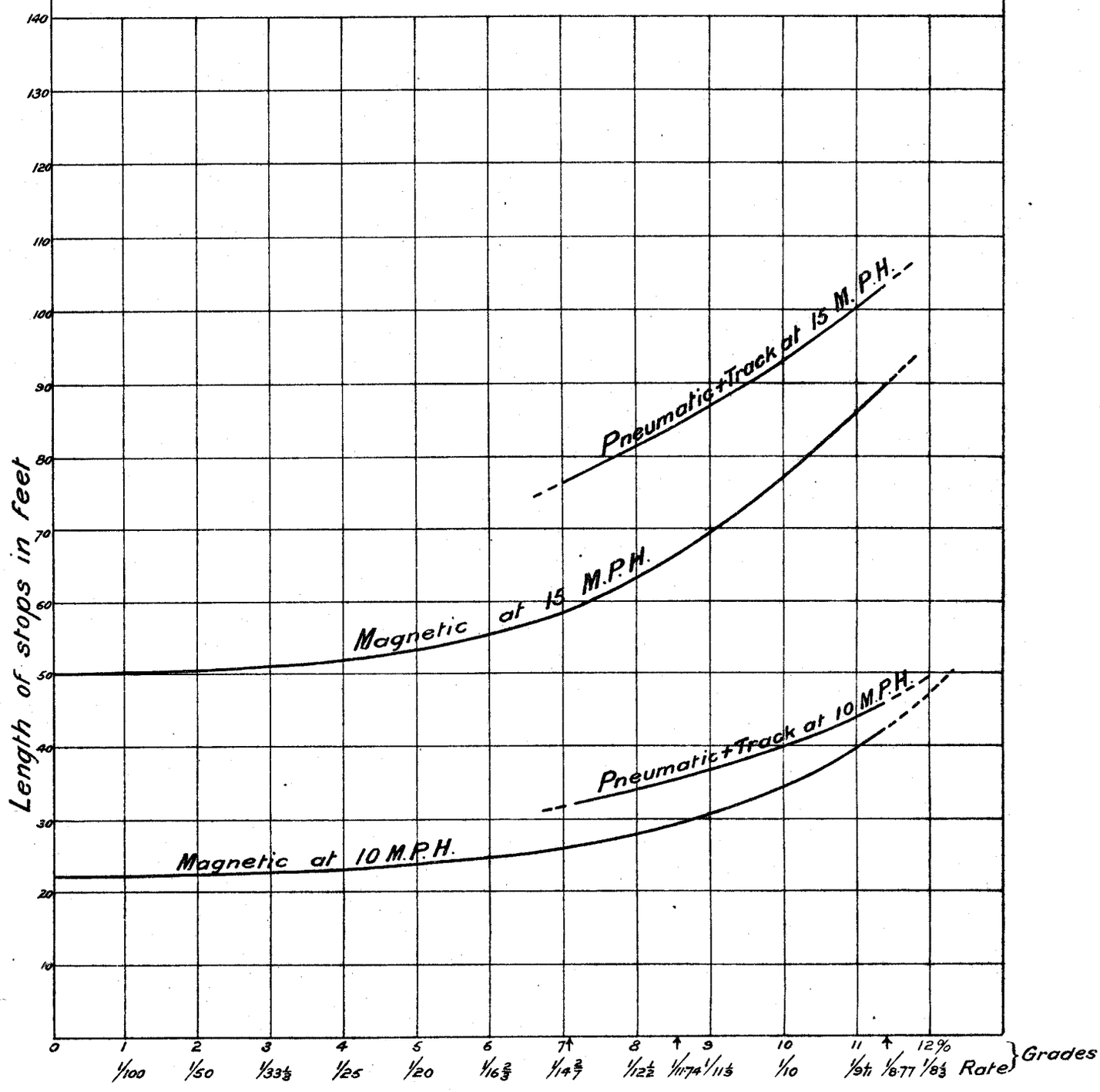


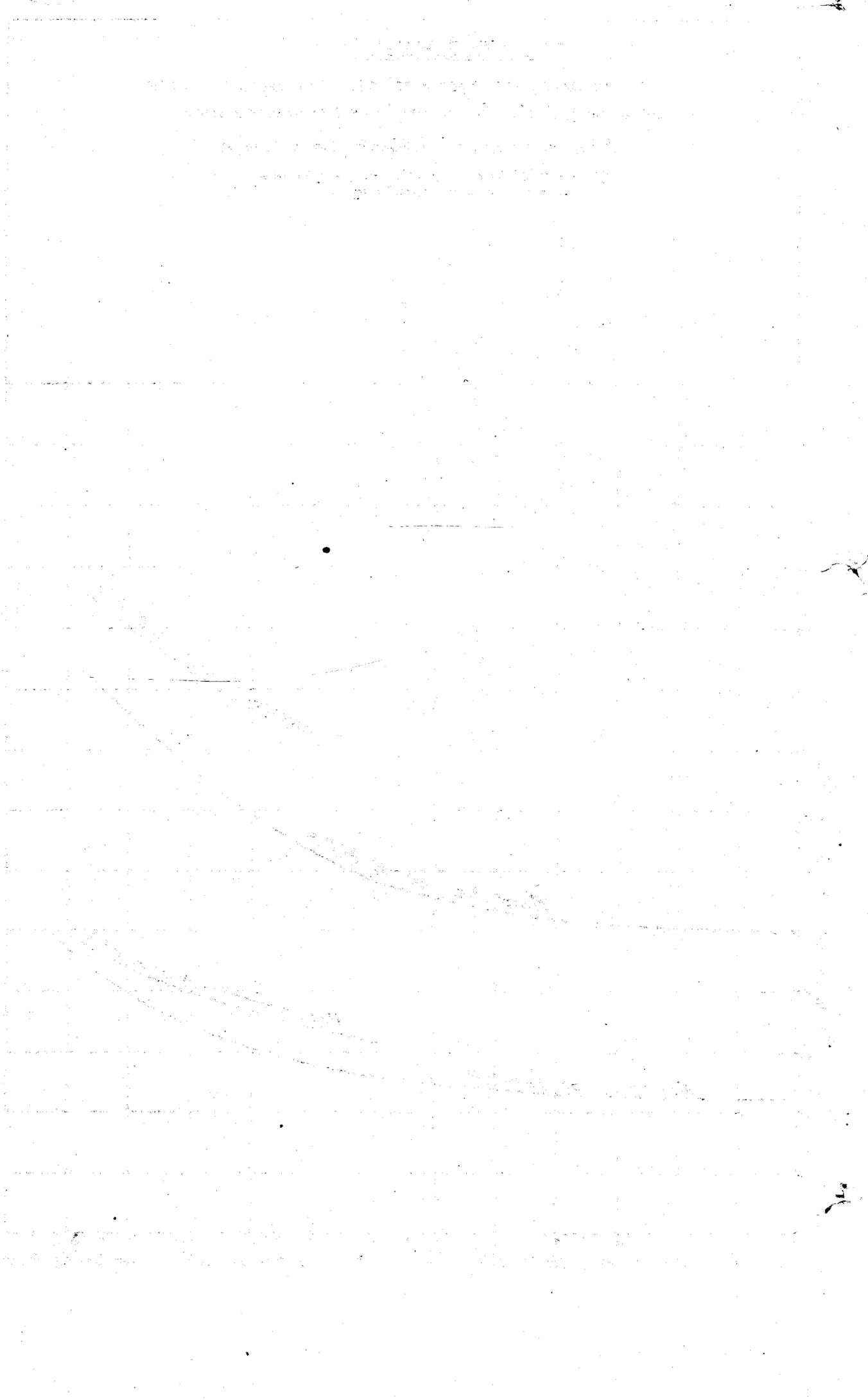
— Curve sheet 3 —

Curves shewing average results of experiments at 10 and 15 M.P.H. on various Gradients with

Pneumatic Wheel + Mech. Track Brake

Newell Combined Magnetic Brake

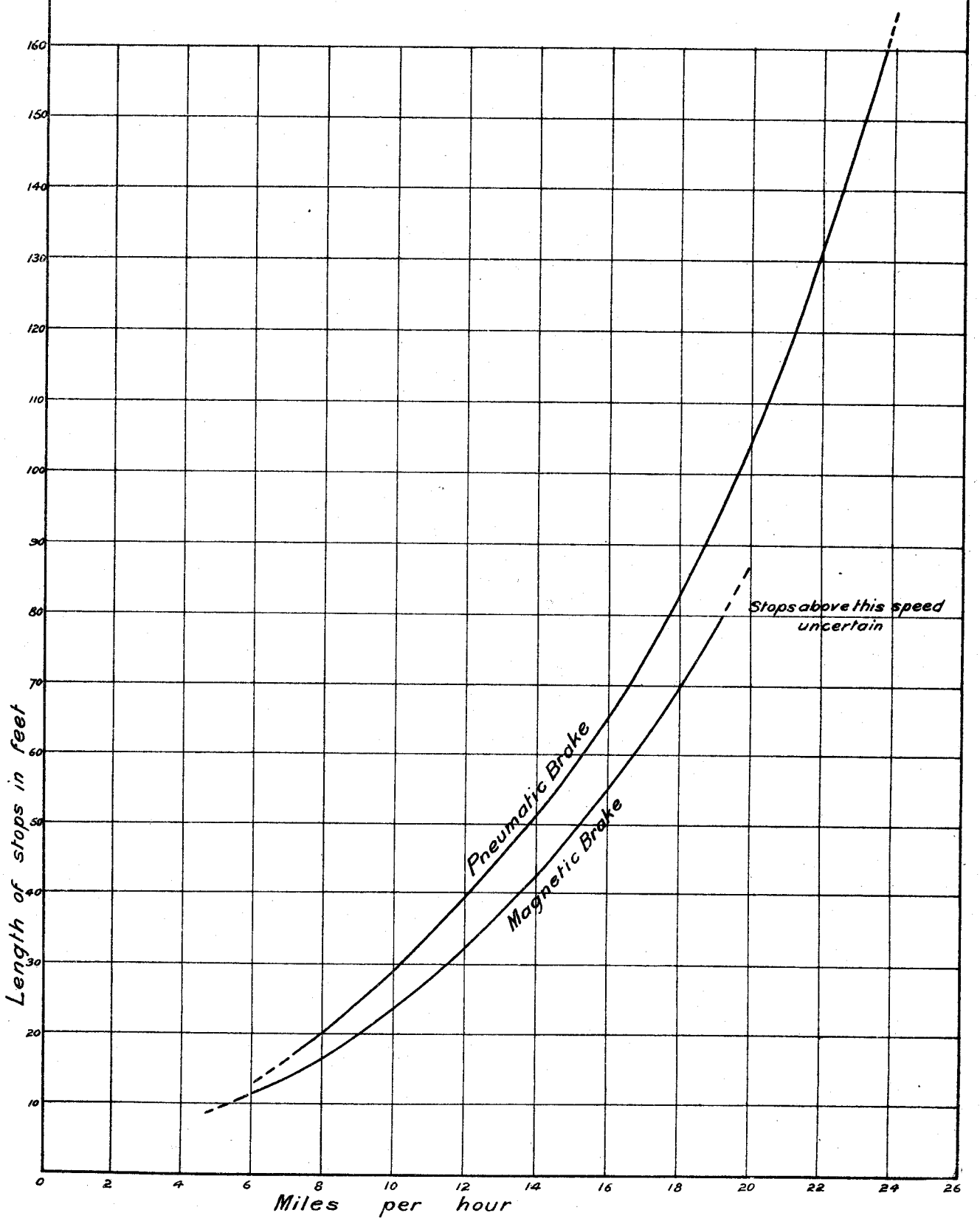




— Curve sheet 4 —

Curves shewing average results of experiments on

Pneumatic Wheel Brake
and
Newell Magnetic Combined Track and Wheel Brake



APPENDIX II.

TABLE 5.—AVERAGE DISTANCES, computed from Tests, in which a Car can be brought to Rest on the Gradients of Parnell Rise, College Hill, and Wellesley Street East, Auckland, and on the Level, from Speeds of Ten and Fifteen Miles per Hour, by the various Braking Arrangements tested. Rail in Good Condition.

Description of Brake.	Length of Stop from 10 Miles per Hour.			
	Down, 1 in 8·77.	Down, 1 in 11·74.	Down, 1 in 14·19.	On Level.
	Feet.	Feet.	Feet.	Feet.
Mechanical track	145	100·5	86	..
Hand-wheel, coasting on track ..	Would not stop	347	136	..
Pneumatic wheel, coasting on track ..	45	36	31	..
Pneumatic wheel only	100	66	55	27·4
Newell electro-magnetic	40·27	29·7	26·4	22·6
	Length of Stop from 15 Miles per Hour.			
Mechanical track	310	203	153	..
Hand-wheel, coasting on track ..	Would not stop	781	306·3	..
Pneumatic wheel, coasting on track ..	104	84	77	..
Pneumatic wheel only	345	15·9	120	61
Newell electro-magnetic	90·6	67·4	60	50·9

TABLE 6.—WEIGHT OF CARS USED IN BRAKE-TESTS.

Car No.	Location.	Estimated Weight, Empty.		Actual Weight, Empty.		Excess percentage of Estimated Weight.	Seating Capacity.	Weight of Passengers and Two Officials at 11 stone each.	Gross Weight Fully Loaded.	Actual Weight on Tests, including Observers.	Overload.	
		Tons.	Pounds.	Tons.	Pounds.						Per Cent. of Normal Load.	Per Cent. of Normal Gross Weight.
								lb.	lb.	lb.		
75	Auckland ..	10·75	24,080	16·4	36,736	52	52	8,316	45,052	48,888	46	8½
9	Christchurch	11·65	26,096	15·2	33,992	30	52	8,316	42,308	42,714	4·9	1
20	Dunedin ..	9·6	21,504	10·3	23,072	7¼	35	5,698	28,770	30,422	29	5¾

APPENDIX III.

MINUTES OF EVIDENCE.

AUCKLAND, MONDAY, 18TH APRIL, 1910.

The Chairman.—I will first ask the Secretary to read the commission.

Commission read.

The Chairman.—Who is represented here?

Mr. Myers.—The Auckland Electric Tramways Company is represented here. I appear on behalf of the company.

Mr. Rosser.—As secretary of the Auckland Tramways Union I am authorised to represent the union at this inquiry, and along with me are three motormen, Paul Richardson, Henry Carter, and John Willis.

Mr. Wyllie.—I represent the Auckland City Council.

The Chairman.—As the commission states, some doubts have arisen as to the efficiency of the brakes on the Auckland tramways. A previous Commission sat on the subject, and a certain amount of evidence was given before a Committee of the House of Representatives. I have to call on Mr. Myers to explain the position he will now take up.

Mr. Myers.—I would first say a word as to the procedure I suggest should be adopted. I have mentioned the matter to Mr. Rosser. I propose first of all to outline the history of this matter, relating to the Auckland brakes. Mr. Rosser, after I have done, would like to say a few words to the Commission, and suggest that he would then like to call certain evidence before the company calls its evidence. I think that is the most suitable course to adopt.

The Chairman.—I see no objection to the course.

Mr. Myers.—Then I will briefly outline the position, and in doing so I will indicate the position that the Auckland Tramways Company takes up. I do not propose to go into matters in detail now, because I assume that if necessary the opportunity will be given to me later on, after evidence has been given, to address the Commissioners with regard to that evidence.

Now, so far as the terms of the commission are concerned, I suggest that the proceedings may be shortened to some extent. I notice that one of the questions the Commissioners are asked to answer is this: "Whether, having regard to the grades of the said tramways, to the speeds at which cars travel thereon, to the congested street traffic, to the safety of the public, and also to the provisions of clause 48, Part III, of the Second Schedule of the Tramways Act, 1908, the system of brakes already adopted or any of them are suitable, efficient, and sufficient for use on the said tramways." It is necessary that I should say a few words with regard to that particular question. To clear away any misunderstanding that may exist in the minds of the Commissioners or in the minds of the public generally, I may say that the Auckland Electric Tramways Company commenced business here about eight years ago. It installed upon its cars a certain system of brakes, which were approved, and which had to be approved under the Government Orders in Council by the Engineer of the Public Works Department. With that system of brakes there was a hand-brake operating on the wheels; a track brake, also operated by hand, and an electric emergency brake. The company has always consistently taken up the position, and it still says, that those brakes are perfectly safe and efficient; but it is unnecessary, I think, if I may respectfully make the suggestion, that the Commissioners should enter into an inquiry with regard to that first question, because, for reasons I will indicate, although the company is satisfied that those brakes are efficient and safe, the company, ever since this brake question has arisen, was always prepared, and is now prepared, to do what it considers the right thing. In other words, it has been prepared to alter its braking system, because, while it considers that that system is perfectly safe, it recognises that, for reasons I will indicate, it is desirable, if not necessary, in order to work harmoniously with the Government and with the employees of the Tramway Company, to alter the system. It is important to bear in mind the origin of this difficulty in regard to the brakes. I may say that the objection to the brakes did not arise in the first place from the Government Department. It arose in consequence of the complaints made by the motormen; and the reason of the complaints was that the application of this brake operating on the wheels involved a considerable amount of hard work. That is the origin of the whole difficulty. The company admits that that hand-brake does involve a considerable amount of hard work, and, as I have stated, it recognises that it is necessary, in order to work harmoniously with the men and the Government, to alter the system, and it is prepared to do so when necessary. I suggest, therefore, that it would be sufficient not to take any evidence with regard to the present position at all, because we are prepared to alter our brake system in the direction I will mention. I suggest that it will be sufficient, therefore, not to answer that question, but to point out in the report that it is unnecessary to do so because of the position the company takes up—namely, that it is prepared and has been always prepared to install a different system of brakes. This is a question that may be at issue. We are prepared to put in a system of brakes, though perhaps we may say that the system is not more safe and efficient than the system we have in vogue now. Still, we are prepared to put in a different system of brakes if necessary, and therefore suggest that there is no necessity to waste time in taking evidence in regard to the first question.

Now, two years ago complaints were first made by the men, and in consequence of those complaints a Commission was set up by the Governor in Council; and Mr. Holmes, Engineer-in-Chief, and Mr. Richardson, Engineer of Tramways, were appointed Commissioners. They took a mass of evidence, consisting almost entirely of the evidence of the motormen and conductors, who were making the complaints, and they duly made a report to the Governor. It is common ground that at the present time, and ever since that report was made, the brakes which are now installed, and have been installed on the Auckland cars, have been kept in good order and condition, and they are efficient, as far as such brakes can be efficient. We say that they are absolutely efficient and safe, but, as I have indicated more than once, because I do not want any misunderstanding on this matter, we are prepared to alter the braking system.

I will refer a little later to the terms of the report of that Commission. After the Commission reported, the company was in communication with the Public Works Department with regard to the different system that was to be installed on the Auckland cars, and, after a certain amount of communication and conversation between the representatives of the company and the representative of the Public Works Department, it was arranged that two sets of air brakes should be installed upon two of the Auckland cars for experimental purposes. I may say that for over a year these two air brakes have been in use on the cars on which they were originally installed, and this Commission will have an opportunity of seeing those brakes working in Auckland upon the hills here. In conjunction with that air-brake there has been in use on those two cars the same Spencer track brake as before. Now, towards the end of last year, after these two air brakes had been installed, Mr. Walklate, the manager of the Tramway Company, had a conversation in Auckland with Mr. Holmes, the Chief Engineer of the Public Works Department. At that time the company had actually on order a sufficient number of sets of air brakes to install the whole of the cars here. Mr. Holmes, however, told Mr. Walklate that, so far as he was concerned, and considering himself bound by the report of the Commission, of which he was a member, he would not agree to the air brakes being installed on all the cars. A serious difficulty then arose. The company's point of view was that the very best system of brakes that it could install on the Auckland cars was the system of air brake operating on the wheels, in conjunction with the track brake. The company has considered, and still considers, that it is the best and the most efficient, the safest and most convenient braking appliance that is installed here in Auckland under the existing conditions, and I understand from the evidence that was given before a Select Committee of the House last year, the motormen are satisfied with the brakes that the company propose to install. However, I have said that Mr. Holmes, assuming that he was bound by that report, was not prepared to agree to the installation of the air brakes, and there was something of a deadlock.

Then there was introduced into Parliament a somewhat drastic form of Bill, which was calculated to effect not only the Auckland trams, but all the tramways throughout New Zealand. That Bill was referred by Parliament to a Select Committee. Evidence was taken by that Committee, and the Committee was addressed by representatives of the different bodies concerned, and I think that the Commission has before it copies of the proceedings before that Committee. It will be noticed that while that Committee was sitting the Minister of Public Works expressed a view that the company ought not to have accepted the Chief Engineer's dictum on the matter, and ought to have communicated with the head of the Public Works Department, presumably the Minister himself. Immediately after that Select Committee reported, the company wrote to the Minister saying that they were prepared to install the air brake, and to order a sufficient number of sets at once, but they wanted the approval of the Department, and then would go ahead.

The Minister, in view of the position taken up by the Chief Engineer, considered it advisable and proper then to set up this Royal Commission, in order to go further into the difficulty that had arisen; and that is briefly the history of this brake question.

There is just one thing that at this stage I want to emphasize—that is, that this Commission is not really reviewing the report of the previous Commission; and I will tell you why. It is true that the previous Commission had before it pretty much the same questions as are before this Commission, but when the previous Commission sat the company was not represented by counsel, and no independent testimony was called by either the men, who were complainants, or the company, which was in the position of respondent, as to what really was the best system of brakes that could be applied under the Auckland conditions. If you read the evidence, as I have no doubt you will, that was taken before that Commission (I am sorry to say it is very voluminous), you will find that nearly the whole of that evidence was addressed not to the subject of what was the best brake to be used on the Auckland tramways, but the evidence was given for the purpose of condemning the system of brakes then in operation. No independent testimony was called, no outside expert evidence was called, and the consequence was that these two gentlemen that formed the Commission had to make their report not really upon the evidence, because there was little or none. I am referring to the question of what was the best braking system, but they had to express their opinion practically upon their own experience. I want to say one word about the Commissioners, and I do not want to be misunderstood on that point. Mr. Holmes and Mr. Richardson are both gentlemen for whom I have the highest regard.

The Chairman.—Is it desirable to discuss the previous Commission?

Mr. Myers.—I think we must, sir, because I am bound to show this is not a review of the report made then.

The Chairman.—We do not take up that position.

Mr. Myers.—I am quite satisfied then. All I want to emphasize is that, assuming that the present Commission comes to a different conclusion on this point from the report of the previous Commission, that cannot be taken as in any sense a reflection on the previous Commission. That is really what I was coming to, and it is important that that should be so. I do not mean to say because the present Commissioners may take exactly the same view, but because it is a matter of considerable public interest and importance, and it ought not to go forth to the public, as it

appears to have done, that this is a review of the report of the previous Commission, and that a different report to theirs might involve a reflection on them. That is all I wish to say on that point.

It is desirable, however, to say a few words with regard to the position taken up by the Engineer of the Public Works Department here in connection with the tests of the air brake. I have already said that two sets of air brakes were installed, and have been in use for a considerable time. It is not suggested, and it has never been contended by the company, that the air brake alone, good, efficient, and powerful as it may be, is sufficient by itself as a braking appliance on which cars would have to negotiate the hills that exist in Auckland. It is common knowledge that a form of track brake is necessary as well as the air brake, and the company contends—and we shall call a considerable body of evidence on the point— that the present track brake is a perfectly efficient track brake; but what happened when the tests were made of the air brake was that only one brake was applied at a time. I should have thought that if a proper test was to have been made of the braking appliances of a car coming down a hill, all the brakes should be applied; but, as a matter of fact, when the air brake was being tested on those two cars, the cars were sent down the hill at something like twenty to thirty miles an hour, and the track brake was not allowed to be used at all; only the air brake was allowed to be used. And I am instructed that the tests that were made were exceedingly good tests, but that is no test of the braking appliances on those cars, because, as the Commissioners will know, the track brake is put down, under service conditions, before the car commences to descend a hill, and the consequence is that the motorman has available the air brake and the track brake as well; and if a test is to be made, I suggest that the test should be made on the whole of the braking appliances which are installed on the car, and not merely a test of one particular brake.

Without criticizing the report of the previous Commission, there are just two portions of that report to which I think it desirable to make a brief reference. I am referring to the bottom of page 4 and page 5 of the printed report: "The hand-brake will skid the wheels on a bad rail. The opinion was expressed by witnesses that the Christensen air brake was suitable for use on the Auckland tramways; but, as this only acts on the wheel-shoes, and as the present hand-brake is powerful enough to skid the wheels, no material advantage can be gained by the use of the air wheel-brake, which can only be considered as a means to lighten the labour of application and provide for quicker action. The wheel-brake alone, no matter how applied, would not be sufficient to properly control the car. It is therefore necessary to use a track brake on the Auckland tramways, and we consider that if an air brake were installed it should be in the direction of applying it to the track brake, so as to make it an effective emergency brake." It would appear that the fact was ignored that there was a track brake in existence at that time. Then, at the bottom of page 2 and top of page 3 of the report it is stated as follows: "The Commission, having had extended personal experience in the use of the Newell magnetic combined track and wheel brake, whilst not wishing to unduly advance its claims against competitors, consider it a suitable brake for use on steep grades such as occur on the Auckland tramways. We are led to this conclusion by the very satisfactory results obtained in practice, by its reliability, and by its low cost of maintenance, and because this brake may be used as a service brake, only requiring, to convert it into an emergency brake, a quicker application, which would be the instinctive action of a motorman in the event of a sudden emergency arising; and also because the brake is applied by the use of the same handle on the controller as is used to apply power to the motors. The motorman's hand is always on this handle, so that he has nothing to do in applying his emergency brake but to turn it quickly. The use of the brake in service keeps the motorman practised in its use."

One more observation may be made with regard to that part of the report where it says the magnetic brakes are used for a number of different systems of tramways in different parts of the world. I understand that in most cases the motormen are not permitted to use the magnetic brake as a service brake at all, but they have to use the hand-brake operating on the wheels. Now, if that is so, and it is a matter which depends upon the decision of the owner of the tramway in each particular case, one of the main reasons urged for the installation of the magnetic brake falls to the ground.

We propose to call a number of witnesses who have had experience of both the magnetic brake and the air brake such as we propose to install here in Auckland, and the evidence of those witnesses will be strong in the direction of an expression of preference for the brakes we propose to install. It is not my intention, nor is it the desire of this company, or anybody connected with or appearing before the present Commissioners, to say an unnecessary word in condemnation of any particular form of brake. All we are concerned with is the question as to what is the best brake to suit the Auckland conditions, and I propose to call a mass of evidence in the direction of showing that the most suitable and most efficient brake for the Auckland conditions is that class of brake which we propose to install.

There is one other matter to which I desire to refer at this stage. If we are permitted to install the air brake, I may say that we have made arrangements which will enable us, barring unforeseen accidents, to install the whole of the Auckland cars with the air brake by February of next year. If the cars had to be fitted with the magnetic brake, it would be something like three years before that could be done, because it would involve complete alterations, or rather, a complete reconstruction of the whole of the cars that are running in Auckland. We are prepared to spend on air brakes something like ten or twelve thousand pounds. To install the magnetic brake would cost I do not know what, but it would be something enormous, but the delay would be very great indeed, and the question I put to the Commission is this: If we are able to show that the brakes that we propose to install are as serviceable, having regard to the Auckland conditions, as the magnetic brake, the question of expense ought then to be taken into consideration. I propose to go further, and to show that the brakes that we propose to install are as safe and as efficient as the magnetic brakes in regard to the Auckland conditions, and I propose to show, as

I have implied, that they are more efficient, having regard to the conditions existing in the city and suburbs of Auckland. I do not think I need trouble the Commission any further at this stage. I had nothing more to do than to indicate the general outline of the matter which led up to the present position.

There is just one other matter I wish to refer to: We have endeavoured to obtain independent evidence outside New Zealand, in addition to certain independent evidence which will be called in New Zealand. By "independent evidence" I mean evidence of witnesses who have no connection whatever with the Auckland tramways. Some evidence will be called in New Zealand, and at least one witness from beyond New Zealand. We endeavoured to obtain evidence from Sydney, where they have been using the air brake on most of their cars and the magnetic brake on a few of their cars. The conditions in North Sydney are very similar to the conditions in Auckland. There they have the air brake without the track brake. In Auckland the air brake which we propose to install is the National Air Brake, and in addition we shall have a track brake, which is one more than they have in Sydney. We endeavoured to arrange for one or two witnesses to come over from Sydney to give evidence here, but, unfortunately, a Mr. Brain, their Chief Engineer, has left New South Wales quite recently, in order to attend some important conference in Europe, and was unable to come over. It makes them short-handed in their service, and the Sydney Government has been unable to spare any officer to come over here. When we ascertained that, a cable was sent from here, asking, if possible, for one of their officers to make a report—one who knew something of the Auckland conditions—declare it before a notary public, and forwarded it here, so that we might hand it to the Commission. It is, I submit, of some value, because it is a report of a gentleman of experience and independence. He is a gentleman perhaps known to the Commissioners, as I understand he was for many years employed in the New Zealand Railways Department, Mr. John Kneeshaw. I have a declaration made and drafted by him, and in no sense dictated or drafted by any one connected with the Auckland Tramway Company. I ask leave to read the declaration and to hand it in as evidence, of such value as the Commission may think it worth, considering the circumstance that Mr. Kneeshaw is not himself available for examination by the Commission. He is a Traffic Superintendent in New South Wales, and says he has had considerable experience there for a number of years.

Declaration of John Kneeshaw.

"I, John Kneeshaw, of Sydney, in the State of New South Wales, do solemnly and sincerely declare,—

"I am the Traffic Superintendent of the New South Wales Government Tramways, which position I have held for the last fourteen and a half years. Prior to taking up the present position I had had twenty-one years' railway experience in New Zealand and New South Wales.

"I have had considerable experience in connection with brakes on tramway rolling-stock, and it is one of the questions I gave attention to when visiting the United States of America and Canada.

"When the Ocean Street, Sydney, cable line was first opened for traffic in 1894 it was operated by track and wheel brakes, actuated by levers operated by hand. With a view to relieving the strain on the gripmen air brakes operated by axle-driven compressors were installed on both the grip cars and trail cars attached thereto. As these air brakes proved so satisfactory, they were subsequently adopted on the cable line at North Sydney. On both these lines there are exceptionally severe grades—in some cases up to 10 per cent. (1 in 10). When electric trams were first operated in the City of Sydney, in 1899, four-wheeled motor-cars, each hauling a four-wheeled trail car, were used, and similar air brakes to those in operation on the cable lines were adopted—that is, "Standard" air brakes, operated by axle-driven compressors, with brakes being actuated on the wheels of both motor and trail car by one operation from the air-brake controller, manipulated by the driver. Numbers of these cars, with the original brakes, are still in use. As additional rolling-stock was introduced on lines it was decided to adopt an improved type of air brake, then known as the "Christensen," by which the air-pressure is obtained by means of a compressor operated by an independent electric motor worked by current obtained from the overhead wire, and in connection with which there is an auxilliary reservoir, with which provision was made for a sufficiency of air to operate the brakes for a number of stops after the failure of current, in the event of such a contingency arising; and the great majority of cars now operated on the Sydney tramways are fitted with brakes of this description, and give very satisfactory results.

"From time to time experiments have been made with various other types of brakes; but the only other type that was continued in service was the Newell-Westinghouse magnetic brake, of which eighty-eight equipments were fitted to cars—namely, forty-four on vehicles of the four-wheeled type, and forty-four on vehicles of the bogie type.

"Shortly after the introduction of this type of brake there was considerable dissatisfaction on the part of the staff in connection with it, as a result of which investigations were made, and from the evidence it was found that the principal grievance on the part of drivers was that they had not the same confidence in the magnetic brake as they had in the air brake. While in the case of the air brake drivers could always ascertain what air-pressure they had available, there was nothing on cars fitted with the magnetic brake to indicate whether the brake was operative or otherwise, and, owing to instances occurring in which the brake failed through various causes, the drivers evinced considerable dissatisfaction. Later the staff became more accustomed to the magnetic brake, but they are still strongly in favour of the motor-driven air brake in preference. After careful consideration it has been decided in Sydney to discontinue the use of magnetic brakes on all rolling-stock; and the brakes previously in use are now being removed, and replaced with air brakes operated by motor-driven compressors.

"The magnetic brake is, when properly handled, very effective; but considerable care is necessary in training men, as otherwise there is a great liability of them giving too strong an application of current, and thereby occasioning very severe stops, causing inconvenience to passengers.

"In connection with the use of the magnetic brake it must be explained that when the brake is being operated for retardation purposes the motors by which the car is operated are in service for braking purposes; hence it arises that these motors are no sooner out of use for propelling the car than they are called upon for use in connection with controlling or stopping the car, consequently the motors are in almost constant use. This necessitates more powerful motors being installed on cars operated by the magnetic brake than would otherwise be required for propelling the car.

"One of the objects in installing magnetic brakes in Sydney was with a view of obtaining a more economical brake for maintenance purposes than the air brake; but subsequent experience showed that, owing to the difficulty indicated in connection with the motors, no such saving was apparent. This is, of course, a difficulty that might be overcome by installing larger motors in the first instance; but the cost of the additional motors would be a fair charge against the cost of the brake, and it is doubtful, therefore, if it would show as good results as the air brake in the first cost and subsequent maintenance.

"One great advantage in connection with compressors operated by independent motors is that brakes on trail cars can be operated from the controller used by the driver in front of the tram; and up to the present I am not aware of any satisfactory method of operating the magnetic brake on trail cars.

"From my knowledge of the Auckland tramways I am of opinion that an air brake operated by an independent motor-driven compressor would satisfactorily meet all requirements on the rolling-stock now in operation, and I am further of opinion that such a type of brake would command the confidence of the drivers operating the cars, and I should have no hesitation in recommending a recognised type of air brake of the description indicated in preference to the magnetic brake.

"At the present time 900 electric motor-cars are being operated in connection with the Sydney electric tramways. Of this number, some eighty are still fitted with the magnetic brake. The remainder of these cars are operated by air brakes, the majority of the cars being fitted with independent motor-driven air-compressors. As previously stated, the balance of the magnetic brakes will shortly be replaced by air brakes.

"And I make this solemn declaration conscientiously believing the same to be true, and by virtue of the provisions of the Oaths Act, 1900. JOHN KNEESHAW.

"Declared at Sydney, this 13th day of April, 1910, before me—A. Wigram Allen, Notary Public, Sydney, N.S.W."

Some suggestion has been made that there may be skidding of the cars on these hills if the air brake were used; but the evidence which will be called from those men who have been working these two cars in Auckland on which the air brake has been installed for the last twelve or fourteen months, will go to negative that. They say there has been practically no skidding and no flat wheels. They say that in every respect this air brake has been thoroughly satisfactory. They also say that, even if there should be a little skidding, the brake can be applied so rapidly, and they have such confidence in the brake, that they are able instantaneously to release the brake in case of skidding, and to apply it again before it is reasonably possible for the car to have skidded any distance.

The Chairman.—I think it would be convenient at this stage, since the question of equipment is before us, that Mr. Walklate would give us a few particulars as to the brakes at present in use. I am simply asking for a statement as to the methods in use. I should like to ask him one or two questions in elucidation of one or two points that cropped up in counsel's address.

Mr. Walklate (duly sworn and examined by the Chairman).—The systems we have in use are the hand-brake operating on the wheels, also the slipper or track brake operated by hand—that is known as the Spencer brake. In addition to that we have a method of reversing the current of the motors, or what is known as the emergency brake. The emergency brake is by connecting the motors up so that one motor is working as a generator intended to drive the other motor. That is put in action by a movement of the reversing-lever on the controller. It is put into operation by moving the same levers as the ordinary reversing-brake, but by different movements, of course. I cannot tell you what percentage of the weight of the cars is carried on the slipper blocks, as I have not got the calculations. We will give you full particulars later on.

Mr. Rosser.—I do not propose to take up very much time in opening, but I may have something to say afterwards before the inquiry closes. My friend Mr. Myers has outlined the position from the company's standpoint, and I think it is just as well to state definitely the position of the union in this second inquiry. Mr. Myers stated that the company had taken up the position that the brakes are efficient and safe. I may say that the union does not propose to recede one iota from the position taken up by them on the previous Commission, that they considered that it was not an effective brake system. Our position is the same to-day as it was then, but the company has altered its position, and, whether from conviction or otherwise, they are prepared to admit the decision of the previous Commission that a more effective brake was needed on the Auckland system, and that being the position taken up by the company also modified our position. A mass of evidence was taken before the other Commission, and the bulk of it is union evidence, and when the commission was issued empowering you gentlemen to go over the whole system again, we were afraid that we should have to go over the same ground once more. I have to say this: Although I do not suppose there is any set of employees which has been more in antagonism with its employers than the Auckland Tramway Employees' Union, I am very pleased to say that at the present time the position is very much altered indeed, and the relationship existing between the employers and employees at present is the best condition, I think, since the establishment of

the service, and we should regret to cause friction again by going over that evidence. Now that the position is taken up by the company as already stated, I assume that practically this evidence will be taken as read, because we have to take up a new position to show the difference between the air brake and the magnetic brake. The company have practically told us that they do not propose to contest our position that there is a more effective brake—indeed, they bow to the report of the previous Commission. That modifies our position a great deal.

Mr. Myers said there was no independent evidence taken at that previous Commission. We were in this position: The men made the complaints, and indirectly the condition of the brakes was one of the causes of the last strike; and in putting the proposition to Dr. McArthur's Commission the brakes were referred to, and also the glass fronts, and Dr. McArthur threw those two points out. The result was that the first Commission was appointed, and we were brought forward and made our complaints. Now, I understand that, while we do not alter our position, the union does not propose to call evidence complaining of the hand brakes, but we still hold the position that they are obsolete, and that a more efficient brake should be provided. Now, it is our place to show that the air brake is a more efficient brake, in our opinion, than the magnetic brake. We have men working here who have worked on both systems, and the union proposes to call several of these men as witnesses. We have an argument in favour of the air brake that does not appeal to the company the same as it does to the union—that is, the physical effect on the men. The air brake is used as a service brake. I only know of two systems where the magnetic brake is used for service stops—one is in Dunedin and the other in Wellington. We have men here who have driven in Glasgow for six or eight years, and the magnetic brake is not in use for a service stop there—it is merely used for emergencies, and for coasting down certain grades. We submit that a brake, to be efficient as a service brake, should be constantly in use, because a man flies by instinct to the brake he uses mostly, and if a magnetic brake were not allowed to be used for a service brake the fraction of a second would determine the magnitude of an accident, and we submit that the brake to be installed should be a service brake.

Then, again, the union has taken up this stand in favour of the air brake because it is the most speedy installation. Mr. Myers mentioned this morning that the air brake could be fitted on ninety-two cars in Auckland by next February, but the magnetic brake would take up to three years to install, because there would have to be an entire renewal of the trucks and under-gear. The men want some relief, and the quicker relief will come by the air brake, which is a most effective brake. You are conserving the interests of the general public, and our contention is that those interests are best conserved by the installation of an air brake. We shall bring evidence to show the effectiveness of it. The evils of the present hand-brake system exist to-day as much as they ever did, as since November last we have had four motormen who have been through the hospital for rupture, appendicitis, or abdominal strain. We could not admit that the present circuit is an effective brake. We contend that the air brake is a more effective brake because it is used for service stops, and the magnetic brake, if only used for emergency, merely perpetuates the hand-brake system. I shall be prepared to bring forward evidence in Wellington that the magnetic brake used there is for service stops, but the hand-brake is used to retain the car after it has stopped. It is a strain on the motormen, and they are leaving the service. With the air brake in Christchurch I know of cases similar in that respect.

With these remarks I do not propose to take up the time of the Commission any longer, but I shall be prepared to call evidence from the employees in relation to the working of the air brakes on the cars at present in the Auckland system. Also as to the working of the magnetic and air brakes elsewhere. There are two classes of evidence I propose to bring forward, unless it is proposed to review the present condition of the hand-brakes on the Auckland cars—and I presume the Commission does not propose to go over the ground already traversed by the previous Commission.

The Chairman.—I certainly think that at this stage it may be as well for me to state that the efficiency of the existing slipper brake will be called in question. In the first place, the company propose to retain the existing slipper brake; in the second place they contend that the brakes are efficient, and it is an act of grace on their part to substitute an air brake. The question as to the stopping-power of the trams under ordinary service stops, not to stop the cars by hand-brake, I think need hardly be discussed.

I think now we will hear any evidence which Mr. Rosser has to call.

THOMAS TROY duly sworn.

Examined by Mr. Rosser: My name is Thomas Troy. I am a motorman in the employ of the Auckland Tramways Company, and have been in their employ about seven years, all the time as motorman. I drove cars installed with the hand-brake. Air brakes were installed on certain cars, Nos. 48 and 75, last year. I have driven No. 75. Comparing my experience with the old brakes and the air brakes, it is very much in favour of the latter. I have had no experience of the magnetic brake, but I have seen it worked both in Wellington and Sydney. I think the air brake is a good brake for the fast service and the grades in Auckland. They are heavy cars on the Auckland service. I am able to make quick stops with the air brake. I have had occasion to use the air brake quickly because of an impending collision, and I found it reliable. Comparing my work as motorman with the air brake and hand-brake, I have been able to make much better stops with the former. Car No. 75 has the electric emergency brake just the same as an ordinary hand-brake car. When using the air brake I have never had occasion to fall back on the electric brake for any emergency that might arise—I depended solely on the air brake. I have found it equal to every emergency. Comparing the physical effort required by the two brakes, I feel fairly fresh at the end of the shift with the air brake. I have never had any failures with that brake. There is the sand gear on the car. It is intermittent. I could not express an opinion on the relative merits of continuous or intermittent sand gear. The gear is working efficiently on my car at present.

Cross-examined by Mr. Myers: I am quite satisfied with the present sand gear. There is a track brake on Car 75 as well as the air brake. I apply the track brake on every steep grade. There is no particular effort required to use that brake. If well oiled it is easily applied. I was in the company's employ at the time of the previous Commission. I think the brakes are in better order since that Commission. Speaking from my own experience, the efficiency of the track brake in conjunction with the air brake is very good. I am honestly able to say that I am absolutely satisfied with the braking appliances on my car. I think they are efficient from the view of the public safety, apart from the question of convenience to the motormen themselves. I have had no breakdown or trouble on Car No. 75 since the air brake was installed. I have used it as an ordinary service stop in all weathers and all conditions of the rail. I have had no trouble arising from skidding. With ordinary care I consider trouble should not arise from skidding, speaking as a practical motorman. If I applied the brake rather too harshly, I would release and apply again. That can be done quickly, and in time to prevent a continuance of the skidding.

By the Chairman: On service we always use the track brake. It would not hold the car on the steepest grade in the most greasy weather, not by itself, but with the air brake it would. With the air brake it holds; without the air brake it does not hold. I have been over the Wellesley Street grades. I understand that grade is 1 in 14. The steepest grade, I understand, is 1 in 9.

Mr. Rosser.—The regulations state that the motormen must use the track brake on top of the hill.

Mr. Frank Fitt.—I am here on behalf of the Parnell Borough Council. We have some very steep grades in that locality.

WALTER ROGERS duly sworn.

Examined by Mr. Rosser: My name is Walter Rogers. I am a motorman in the employ of the Auckland Electric Tramways Company. I have been driving for seven years. I am Mr. Troy's relief mate. The two of us work car 75 for sixteen hours a day. I have been driving the car from the 5th September, when the car was first put on traffic. I have driven her ever since. My opinion is that the air brake, as compared with the hand-brake, is a big improvement. I am able to make quick stops with the air brake—much quicker than with the old hand-brake. I have had occasion to congratulate myself on having the air brake for an emergency a good few times. On one occasion there were two little children near Franklin Road—it was the first day I was on the car. By applying the air brake I did stop, but could put my hand over in front and touch them. I had another experience near Howe Street: Two boys were playing, and came round in front of another car. It was somewhat similar to the other experience. It was just like on the top of the grade. The rail was not too good. The Auckland service is a fast service. No. 75 is on the Parnell grade. I think it is 1 in 8·7. That is the steepest grade in the service, I think. I have been down College Hill also—that is 1 in 12. I have had no trouble with the air brake on those grades. In the regular run I also come down Wellesley Street West—that is 1 in 14. I could come down on a greasy rail. I have had no trouble with the cars skidding with the air brake. If I had trouble I would apply the sand first, release right away, and put the brake up again. It is done instantly. The sand gear works well on the car. The regulation with regard to the track brake is to apply it on all steep grades. I have never tested the air brake by itself, because it would be a breach of the regulations. I have never had any failures with the brakes since September, nor any trouble with flat wheels on that car.

By Mr. Myers: I know that at the time of the last Commission there was a great deal of dissatisfaction expressed by the men with regard to the condition of the brakes. Speaking entirely of car 75, as the motorman, I desire nothing more satisfactory than the brakes on that car. My experience is that I have never had any trouble with her. I have never had any trouble, and am thoroughly satisfied with those brakes. I should be satisfied to drive any car similarly fitted in Auckland or suburbs, taking any part—that is, the air brake and the track brake. The track brake is a very good brake on grades. We use it on down grades. It would stop the car anywhere; you have command of her all the time. There is a big improvement in the condition of the track brakes since the last Commission. I have not heard any complaints. I am speaking of the period that has elapsed since the last Commission.

By the Chairman: I am perfectly satisfied with the air brake used in conjunction with the track brake. I have never tried the track brake to hold the car in greasy weather by itself on Parnell Rise. By putting the track brake on on the greasy rails and giving her plenty of sand it all helps, but I have not tried the track brake alone. The air brake will control it. Supposing we were travelling four miles an hour, I could pull up the car with the track brake alone, but you must apply sand. You can come down in greasy weather on the Parnell Rise on the air brake alone. We are supposed to put the track brake down on the top of the grades. It takes a few revolutions. It is not much of a strain on you. I have always found the track brake act.

By Mr. Fitt: I am aware that the Parnell Rise is the steepest grade in the service. I could stop the car in any part by means of the air brake. I have not stopped her, but I could do so. I have only come down that grade at slow pace. I could not say how many times I have driven down that Parnell Rise. The car I drive is the usual bogie car, and I have brought it down with a full load. I feel confident I could control it.

FRANK TAYLOR duly sworn.

Examined by Mr. Rosser: My name is Frank Taylor. I am a motorman in the employ of the Tramway Company, and have been with them for about seven years. I have driven the cars fitted with the air brake. They are Nos. 75 and 48. No. 75 is a bogie car, and No. 48 is a small car, commonly called a dinghy car. I consider the air brake on those two cars is efficient. My

opinion of the track brake on No. 75 is that it is certainly a very good brake, but I believe that it could be made to work freer. It has not got ball bearings. I think that would be a great improvement. The time occupied in putting on the track brake varies considerably according to what you have to take up. The general method is to take up the slack at the top of the hill until you start, and as soon as you start you put it down as hard as necessary. From my experience on the Auckland system, with the fast time-tables and steep grades, I consider the air brake an eminently satisfactory one. There is room for improvement in the sand gear. In some cars the sand is applied to both rails. I consider it should be on both rails. Taken all through, it is better than it was previously. I consider the best type of track brake is the type that is on No. 75, and also the 80's and 90's cars. I have had occasion to use the air brake in emergency once. I do not think it is possible to throw people off their feet by the application of the air brake. I approve of the air brake that I am working on the Auckland system.

By Mr. Myers: The occasion I referred to was when going down Eden Terrace. The grade is somewhere near equal to Wellesley Street. I made a quick stop, quite satisfactory, in my opinion. I have driven the cars on various routes—in fact, on all runs with the exception of Parnell Rise. I should be prepared to drive down that Rise. I consider it would operate satisfactorily there. I have not noticed whether the sand applies to both rails on all cars. The sand gear may be effective, but on some cars it only works on one rail, I think; though I grant you that on the majority of them it applies to both rails. There has undoubtedly been a great improvement in the sand gear lately, also in the upkeep of the track brakes. In some cases there is an improvement in the hand-brake as well. There is still room for improvement in the track brake. Speaking of my car, I am satisfied with the air brake and track brake. It is the same type that is installed on the 80's and 90's. That type is superior in working, and is more reliable. I suppose the mechanism has chiefly to do with it. I can only speak as to results; I am not an engineer.

By the Chairman: I have had experience on College Hill grades. In Car No. 75 we can bring the car down College Hill or Wellesley Street on the track brake, but a great deal turns on the condition of the rail. I believe that in greasy weather I could successfully bring down the car on that grade with the track brake alone. I am not going as far as saying I could stop. There is a great improvement in the condition of the track brake since the last Commission. I think I can say they are well kept up. I could not say exactly the time it takes to put down that brake. You might be able to do it in a minute, but I could not say for certain. In greasy weather it all depends on the adjustment of the brake—in some cases it is easy and in other cases it is not so. I should be quite prepared to come down College Hill in a heavy car on the air brake alone. I believe that on a greasy line I could stop at a speed of ten miles an hour with sand. I should have most confidence in using the air brake by itself rather than the track brake. I have no idea of the relative stopping-power of these two brakes, but I should feel more confident with the air brake.

By Mr. Fitt: My experience of the value of the different brakes on Parnell Rise is that the air and track brakes are no doubt the best.

By Mr. Rosser: The track brake is not a brake used for stopping. It would be merely an experiment to try and stop with the track brake. It is used for coming down grades. If coming down College Hill or Wellesley Street I should put it down hard, but I would not rely on the track brake entirely to stop the car. With reference to the type of track brake, it is a vertical wheel, not a horizontal. You can apply it quicker in some cases. You can apply it with one hand, but in bad weather on steep grades you have to use two. Occasionally we can do it with one.

HARRY MARSHALL WHITE duly sworn.

Examined by Mr. Rosser: My name is Harry Marshall White. I am a motorman in the employ of the Auckland Electric Tramways Company, and have been in their employ since 1904. I started as a conductor. I have been two and a half years driving. I have driven the cars with the air brake—No. 48. I have driven on the Herne Bay line, in which College Hill occurs every trip. My experience of the air brake on that grade is that it is very good. I have never had any failure to act. It has always been reliable. I had some narrow escapes with vehicular traffic on No. 48. Once in Pitt Street two ladies were crossing a road. It was a drizzly sort of night, with a greasy rail. I made an efficient stop. My opinion is that the air brake is suitable for the Auckland service and grades. I have had the current cut off on the Wellesley Street grade, but I found the car retained its position securely, although the current was cut off two or three minutes. I was going up at the time. If the current goes off, we are instructed to stop at once.

By Mr. Myers: I am satisfied with the vertical track brake. They are mostly vertical—all the new cars are.

By the Chairman: I had to get new blocks on the track brakes, and had to run the car into the barn. The car had the blocks worn a bit. It was not a complete failure, as it held the car. I never had a failure with a track brake on the road.

The Chairman.—I should like to say that the Commissioners desire particulars as to the track brakes fitted on the various cars, and also plans showing the section of the line, with grades and curves, especially the grades which are known to be the heaviest.

Commission adjourned.

Commission resumed at 2.15 p.m.

GEORGE ABERDEEN duly sworn.

Examined by Mr. Rosser: My name is George Aberdeen. I am a motorman in the employ of the Auckland Tramway Company, and have been with them over three years. I was a tramwayman before coming to the Dominion, in Glasgow, in the employment of the Glasgow Corporation Tramway Company, as motorman. We used the magnetic brake there. I used it for four years. We used the hand-brake to make service stops, similar to the one on these cars at present. We only used the magnetic brakes when coasting down grades and for emergencies. It was a good brake, and a good brake for coasting down hill with. You never could depend upon it for emergency stops; it gave no warning as to when it could be depended upon. We were required to try the brake occasionally, by testing it before entering on a grade. We tested it in the mornings when taking over the car, but we were not required to test it when we left the terminus to see whether it was acting all right. When the grades were not so steep we used the hand-brake. If you rushed too fast it would not act properly; the magnetic brake required a certain amount of time to do it justice. It was liable to get out through contacts being wrong. I have driven the air brake on the Auckland system. In comparing the two brakes I would rather use the air brake in Auckland. We have some pretty steep grades in Glasgow. There are more grades here, but some of those in Glasgow are just as steep. I had a brake-failure with the magnetic brake in Glasgow, and had to fall back on the hand-brake. There was no inquiry that I know of. The instructions to try the magnetic brake on entering grades was brought about by an accident. I find I can make as quick stops with the air brake as with the magnetic. With the latter you have to give it time. If going twenty miles an hour it would bring up the car at that speed. As motorman in both services, in Auckland and Glasgow, I would say the service is a bit faster here. I believe it has a more strenuous effect on the men. A blistered finger would prevent contact and affect the magnetic brake acting; it would affect the working of the brake. I have had to use the hand-brake to retain the car after stopping. I always did that.

By Mr. Myers: In giving my evidence I am comparing my personal experience with the air brake here with my experience with the magnetic brake in Glasgow. I think from my experience that the air brake and track brake here are better than the hand-brake and magnetic brake in Glasgow.

By the Chairman: I was in Glasgow for six years. They had meal-hours there, and we worked in two shifts; we do it in one here. Taking into consideration the winter weather, the crowded nature of the streets, &c., I think you have more to contend with in Glasgow than here. The magnetic brake was all the same type, but it had different controllers.. It was a track brake, wheel-brake, and axle-brake. It actuated the blocks on the wheels. At one time when I was using the magnetic brake when coasting down a hill, I came to stop the car, but found it defective on the last notch, though it was good on all the rest. The car went away. I had no serious accidents, but it failed several times on the first stop. I never had any confidence in it. It was ordinary weather at the time. In one case the failure was due to bad contact, in another case to a bad finger, and in another case the current was not generated, as I had not the distance to travel. I have worked the slipper brake here, and found it successful, and have had no trouble with it. I always put it down on the top of the hill. It does not take long—from about half a minute.

By Mr. Rosser: The magnetic brake will act best when the car is going at moderate speed. At the very slow speed it does not act easily.

ARTHUR LESLIE BRAISBY duly sworn.

Examined by Mr. Rosser: My name is Arthur Leslie Braisby. I am a motorman in the employ of the company, and have been in their employ for three years and four months. I have worked in New York City, U.S.A., for the Metropolitan Street Railway Company and the Subway Company. On the Metropolitan Company we had the hand-brake and the air brake. Some cars had no air brake, but those that had had the hand-brake too. Some cars had the air brake alone. The air brake gave the best satisfaction to every one. On the faster lines they used the air brakes. It was on certain lines where there were crossings, and the distance in between they wanted done as quickly as possible. When working air-brake cars they had a better effect physically on the men than the others. The shift was ten hours, relieved in the middle sometimes. Occasionally there was an extra trip. The grades are not so numerous, but they have just as steep grades there as here. The cars stop at every block, and certain cross streets are fire stops, and we kept at the inner side of the street. It was because further along that street there was a fire-house, and any moment the engine might come along, and if you crossed them there would be an accident. We had greasy rails there, worse than here. There was snow, sudden thaws, then more snow on top, and that would give you a very bad rail. If you had a greasy rail you made sure the sand was working well. I have had no experience of magnetic brakes. I have been all over the United States, though I have not worked as motorman in every city. There were no magnetic brakes or track brakes in the States. I have been in New Orleans. I went right through the car system. They had the air brakes, but the first cars still had the hand-brakes. A lot of cars were equipped with the air brake, and hand-brake in addition.

By Mr. Myers: There was no track brake in New York. I know the track brake here, and find it effective on the grades to hold the car, and help you to make a stop. I have not worked the cars with the air brake here.

By the Chairman: We were using the straight air system, not the automatic. They had no brake-failures. You would have plenty of warning, and if you had sand you must stop; that is recognised. There are grades in New York City as great as any here, except the Parnell Rise; but I could not tell you how steep they were. You see the run of the grade, and you know what it is. Amsterdam Avenue was the steepest. Then the Madison Avenue and San Juan Hill: That is the steepest in the New York State.

WILLIAM DIXON duly sworn.

Examined by Mr. Rosser: My name is William Dixon. I am a motorman employed by the Auckland Electric Tramways Company, and have been in their employ for two years. I was previously in the Glasgow Corporation Tramways for about six years and nine months. I have had experience in driving cars with a magnetic brake for about six years. I drove the first car fitted with the brake, the test car. I know of several failures of the magnetic brake, and accidents as the result. I do not consider the brake is a reliable one on heavy grades and greasy rails, as it needs plenty of time to act. It would have a severe effect on the passengers if it were pulled up quickly. There was a woman in one of the suburbs got knocked out through the window. She got compensation of £400. The orders issued after that accident were only to use the magnetic brake on emergency stops and heavy grades. Practically they prohibited the magnetic brake from being used as a service brake. I can place more reliance on the hand-brake than on the magnetic brake on a big grade. I think the Auckland service faster than the Glasgow, and therefore the more need for a more reliable brake. I have known the magnetic brake to fail without giving any warning on several occasions. It skidded the wheels a long distance. I would call it a partial failure. I have not driven a car with the air brake.

By the Chairman: The magnetic brake locks the wheels on heavy grades. If the wheels skid, the current does not cease: the magnetic brake generates its own current. I still believe, if the wheels skidded the magnetic brake would hold—that is, if the wheels did not revolve.

JOHN MCCORMICK duly sworn.

Examined by Mr. Rosser: My name is John McCormick. I am a conductor in the employ of the Auckland Electric Tramways Company. I worked in Glasgow as a motorman, and used the magnetic brake for four years. I consider if the brake skids it is ineffective, but that does not say it is no good. I had a case of wheels skidding in Glasgow on a greasy rail. I had not sufficient distance to stop. There was no Board of Trade inquiry. I know of a fatal accident that happened on a steep grade, where the motorman was killed, and the brake was found to be full on to the full braking notch. The reversing-handle was in the opposite direction to that in which the car was going, at the other end, and the controller was locked, and you could not get the reversing-handle in the proper position. The effect of the brake is to put metal blocks down on the rail. I know these blocks are liable to catch. They had bogie cars there. I have heard of the magnetic brakes failing when tested, and afterwards they would be all right; but not of my own knowledge.

By Mr. Myers: I am a conductor here. No matter how long a man may have been motorman on any other service, he has to serve as a conductor before being taken on as a motorman here.

By the Chairman: I was a motorman in Glasgow, and had experience of the magnetic brake there. It did not actually fail with me, but it failed to stop the car; it skidded the wheels for about 10 yards or more. There was no hand-brake. We were not allowed to use the hand-brake at the same time. The wheels skidded pretty often. In one case I had an accident by collision with a cart. It was not my fault; I had not sufficient distance to stop the car in. The grades are not so many, but there are some grades just as bad as here. They are not so long as Parnell, but almost as steep. They are some distance out of town. We worked nine hours a day. The work is easier here, and the traffic is busier there. I do not think we had to travel so fast there.

By Mr. Fitt: I have had experience of pulling up a car on a steep grade. With the magnetic brake I could pull it up in about 20 yards, but it would depend upon the speed we were travelling. The regulation speed was about nine miles an hour. I could stop in about 12 to 14 yards; but it depended on the state of the rails. If wet rails, about 8 yards; if greasy rails, about 14 yards. It was a wet rail at the time the accident happened. It is very severe on the passengers. One passenger broke the window in the front door. I do not think it would have any effect on the motorman; he is ready for it, and knows what is coming.

WILLIAM CAMPBELL duly sworn.

Examined by Mr. Rosser: My name is William Campbell. I am a motorman in the employ of the Auckland Electric Tramways Company, and have been there for over two years. I have driven trams in Glasgow for ten years. The magnetic brake was not installed to begin with, but I drove from the start of the magnetic installation. The effect on the passengers is pretty severe sometimes. It has no effect on the motorman whatever: he knows what is coming, but the passenger does not. I have known of passengers being thrown through the window on a quick stop. There is a difference in the application of the magnetic brake in the speed the car is going. If you are going at a high speed the magnetic brake has a tendency to skid a certain distance. If down-hill it would go all the farther. If going twenty miles an hour down-hill and a greasy rail, my own experience would be to check the speed with the hand-brake, and then apply the magnetic. If going at only three miles an hour, the magnetic brake would make a good stop then. I believe the half-way speed is the best for the application of the magnetic brake. In Glasgow the motorman shifts the points himself, and it was a source of annoyance. We only had about ten cars at first, when taken over from the horse-cars. I did not find the brake-blocks interfered with the special points when going down-hill. The grade in High Street in Glasgow is pretty bad; there is one part as bad as College Hill, but not so long. Generally speaking it is a fairly level system, but from start to the finish from Glasgow Cross I think it is a worse grade than here. On one occasion I had a magnetic-brake failure. I was coasting down an incline on Creaston Hill. I found it was ineffective, absolutely useless, and I had to use the hand-brake. Although I applied the magnetic brake down to the second notch or so, the car had gained considerable speed, so I reversed the motors; but the wheels locked and started skidding; then there came a collision with

a lorry, which disabled the hand-brake. I came to a collision with three lorries before the car stopped. I certainly believe an emergency brake, to be effective, should be used as a service brake. The magnetic brake is a very effective brake when in good working-order and the rail in good condition. I have made hundreds of good stops, yet I found it failed me. The air brake is more consistent, according to my experience of it. When you see the pressure of the air-gauge in front of you, you know how much air you have on.

By Mr. Myres: As far as I have seen of it, the air brake is effective. I have used the track brake here since I started driving about two years ago. Some of them vary a bit. I have driven a car with the air brake. As to the failure of the magnetic brake in Glasgow, I say it was a total failure. Sometimes when there is an accident there is a certain amount of recrimination—the motorman blames the brakes, and the proprietors blame the motorman. There was no charge of blame made against me. I was able to satisfy those in authority that it was the brakes that failed. I remained in the service of the Corporation for some two or three years after that. It was not suggested that the fault was mine. I had to give the insurance agents a statement, otherwise I should have been censured by the officials. I found the brake took no effect, and I called on the Inspector to try and see him. There was a partial failure on another occasion. I had the car running all right, tried the brakes, which would not act, probably go along the road a few yards, and then found they would act all right.

PETER KNOWLES duly sworn.

Examined by Mr. Rosser: My name is Peter Knowles. I am a conductor in the employ of the Auckland Tramways Company, and have been with them for about twelve months. I was formerly employed in Glasgow as motorman for about nine years and eight months. I was four or five years on the magnetic brakes. I have had no experience with air brakes, but I have conducted the Auckland car with the air brakes on. From my experience as conductor I am satisfied the motorman could make as quick stops as with the magnetic brakes. I had one direct failure with the magnetic brake, something the same as Campbell was talking of. I was coasting down an incline on the second or third notch, and when putting the controller on the third notch it had no effect. I gave it four or five, and then put on the top notch: it took no effect whatever, but skidded all the time. I stopped the car with the hand-brake. It so happened that everything was clear. It was the first time it happened with me, but I heard that others had the same failure. The car worked all right before and after that particular time, and when I handed the car over to the man who was relieving me it worked all right. I told him about it, and told him to watch the car, but he said he knew, and that it had done the same thing with him before. I would say the magnetic brake was of a very erratic character; you did not know whether you had got it or it had got you. The High Street in Glasgow was the steepest grade. High Street and Duke Street are both together.

By the Chairman: There was no skidding of the wheels; there was no effect at all.

OWEN MCGRATH duly sworn.

Examined by Mr. Rosser: My name is Owen McGrath. I am a conductor with the Auckland Electric Tramways Company, and have been with them for over twelve months. I was previously in the employ of the Glasgow Corporation Tramway Board for about seven years, five years as motorman. I have not used the air brake. I have been on Car No. 75 in Auckland. I have been conducting. The magnetic brake is only used for emergency stops and coasting in Glasgow. I once had a magnetic-brake failure on a down grade, but I stopped the car with the hand-brake. It gave me no warning whatever. I have found after failure that the brake will suddenly become good again. I do not know much about the air brake. Improper contact with the finger and loose lead will sometimes upset the magnetic brake. While working on Car No. 75 I considered the air brake very effective, and made good stops. Every one has first to go through the conductor's service in this company, and that is the reason I am conducting now. The magnetic brake will skid on a dirty greasy rail, and dirt on the rail will prevent it acting.

HENRY CARTER duly sworn.

Examined by Mr. Rosser: My name is Henry Carter. I am a motorman in the employ of the Auckland Electric Tramways Company, and have been with them since the inauguration of the system, seven years last January. I have had good experience as a motorman, and worked in North Sydney before that—principally in North Sydney, although I have worked over the whole system. We had the Standard Air Brake and the Christensen Brake. There was no track brake, but sand gear. There were pretty good grades on that system. The steepest is about 1 in 8 and 1 in 10; but in North Sydney there is 1 in 7½ at Balmain, while at Malison Point there is 1 in 13. I found the air brake effective on those grades, and never had a failure. I assisted you in representing the union at the last Commission. I have trained a good many of the motormen in the service here. As a practised driver, I consider the air brake is efficient on the Auckland system. I have used both the cars. The type is the same as the Sydney brake, but the valve operates in the opposite direction—that is the only thing. I am at present an invalid, suffering from the effects of the hand-brakes. I have abdominal strain. I never had any experience of the same thing in Sydney when using the brakes there. There was no strain at all with the air brakes. I had a little experience with magnetic brakes in Sydney, and have driven one a short distance in Wellington. If the magnetic brake were installed in Auckland I consider the danger of strain would be lessened. On College Hill, coming down, you would have to fall back on the hand-brake if you wanted to make a dead stop. If you had the magnetic brake you have to use the hand-brake to make a dead stop also. The condition of the track brakes has improved since

the last Commission, but there is still room for improvement. I consider they might be improved by having ball bearings. The track brake is governed by the weather. It may be working splendidly in the morning, then, after a shower, the blocks get cut right down; and the wet on the straps makes the application much more difficult after rain. They did not use the brake blocks in Australia, though I think they put on a couple for trial. The track brake and air brake acted well in Sydney—that is my experience. The sand gear has improved since the last Commission, but there is still room for further improvement. I drive on the College Hill route. The sand goes down to both rails on my car. It is intermittent, but the pedals do not work so well here as they do in Wellington.

By Mr. Myers: In my opinion the air brake and the present track brake would be an effective braking apparatus for use in Auckland.

By the Chairman: I worked in Sydney on grades 1 in 7½. It was by Darling Street extension, in Balmain. It is the opposite side to Mossman's Bay. We had straight air brakes there, on trailers, not automatic. There were dead trailers on the North Sydney line, but now they have coupled cars there. I had no trouble in handling my car on that steep grading—none whatever. In greasy weather I would use the sand. I say the track brake worked all right, and it would go down as well after rain as it did before, but it would require much more effort to put it down fast; but it would act so long as the track-block is not worn right down. I have worn it down in less than a day, and had to have new track-blocks. When the blocks are right down the brake is practically useless. There are facilities for fitting the blocks on in Queen Street. With regard to the application of the track-block, I have had many of them very easy. It has certainly improved since the last Commission, and, as a rule, they work fairly well; but there are times when it is a difficult matter to put it on, and I should say a 200 lb. pressure is required sometimes. I consider the air brake alone will pull up the car on the Parnell Rise, if under control. At ten miles an hour, with a full load on, I could stop the car with the air brake alone with greasy rails.

By the Chairman: Yes, without the track brake being down.

By Mr. Fitt: Ten miles an hour or any other speed on that Rise would be governed by the condition of the rail. I am not prepared to make a definite statement as to the yards. I could not give my opinion upon that, as I do not consider it is a question I can answer honestly. It would only be a shot at random. I applied the emergency brake to pull the car up on College Hill, and also near Herne Bay. It was a very good stop, sufficient to move the people inside. I could not make a statement as to the number of yards; I do not know for certain.

DAVID TAYLOR duly sworn.

Examined by Mr. Rosser: My name is David Taylor. I am a conductor on the Auckland tramways, and have been so for fourteen months past. I was a tramway employee in the Burnley Corporation Tramway Company in England, and worked as motorman there. I had experience there of the magnetic brake. It was an experiment. They installed two. There was a failure of that brake. It was on a falling grade, about 1 in 17. They discarded them altogether; they would not put them on the heaviest grades, as the test was a failure. They shifted it on to the scrap-heap. They used only the hand-brake the same as you have here now, but they had very good sanders. There was also a patent ratchet back-preventer, put on to prevent the car from slipping back. It was worked automatically. You switched it on in the direction in which the car was travelling, and if the car tried to get back, a part went into the groove of the wheel and prevented the car from going back; it is not possible to go back. The reason of the brakes being discarded was that they were effective enough sometimes, but would stop the car very suddenly, knocking the people about, and at other times skidding the wheels, while still again they would not take effect for a long, long way. On one occasion I saw the brake fail. It was in Shakespeare Street, for a matter of a quarter of a mile, and afterwards it worked all right. The brake had been working all day. I have worked air-brake cars and one on a locomotive. I have never had any failures with the air brake, and I have done speed at thirty miles an hour. I should not like to try the magnetic brake, as I could not place sufficient confidence in it.

By Mr. Myers: The brake would skid the wheels. It would have a severe application occasionally, and skid the wheels, or lock the wheels and skid on a greasy rail. In Burnley we have a good many hills, something like Auckland. In Burnley the hand-brake was considered sufficient. It was something like what you had here, with a cast block, not a wooden block. The track brake here is as good as the one in Burnley, and is a very good brake. I certainly cannot call it a bad brake. The hand-brake here is pretty much the same, but I cannot say it is as effective, though it is on the same principle. In Burnley the hand-brake is considered perfectly good, and was effective, with a good sand gear operating on all four wheels. As to being easier on the man, the man is paid for his work. I say the air brake and the present track brake would do well for Auckland. I have a great idea myself for the vacuum brake. You can read it as it is working. I am perfectly well satisfied with the present air brake and track brake. If you give me the same gear as in Burnley, then I am all right; but if I have no confidence in it, then I should want something better, and that I shall find in the air brake, I think, as I am quite satisfied with that.

By the Chairman: If you have something good to stop a car, that is all that is required. I consider the arrangements in Burnley were effective. We had equally heavy grades in Burnley, 1 in 9—that is about the same as here. There is also a grade of 1 in 14.

JOHN WILLIS duly sworn.

Examined by Mr. Rosser: My name is John Willis. I am a motorman in the employ of the Auckland Tramways Company, and have been there about two years. I worked for the Christchurch Tramway Board for about three years prior to that. I worked the air brake there. They

had the McGhennier brake there. They had trailers to New Brighton, Sumner, &c. I never had any complaints to make about the air brake—none whatever. When the air brake was installed on No. 75 and No. 48, I worked those cars for about five months in traffic, and I have trained a couple of men on them. I consider, in my opinion, the National Air Brake compares very favourably with the McGhennier Air Brake. It has better compression, and is not so noisy. I found I could make just as quick stops. We had sand gear on the Christchurch cars. There was no track brake, but there were trailers to make up for it. I think the air brake, in conjunction with the track brake, is the best you can get. I have only worked the magnetic brake for a short run. It was on the sly. I was getting initiated. I was on board a car when it failed to operate. It was in the King Street route in Sydney. I have no knowledge of the Wellington system, as I was only there two days. There is a danger of skidding the wheels with any brake, but you can release and bring it together again. The release is mostly instantaneous.

Mr. Rosser.—The only evidence I have to call now is corroborative evidence as to the condition of the sand gear and the track brake, and that has already been established by the witnesses. We are prepared to admit that the sand gear is better than it was, and is in very good condition, while there is still room for improvement; and the track brakes are much better adjusted than prior to two years ago. I would like to say I have written to the Tramways Unions in other centres, and I shall be prepared to call evidence there. I have been appointed by the union to accompany the Commission to other centres. In Wellington I have evidence that I can bring forward, and also in Christchurch and Dunedin. With reference to Wellington, I have not got the names, and the witnesses would have to be subpœnaed. Our witnesses here were prepared to come forward, and the company and the union are practically on the same road, although we have arrived on that road by different routes, and it is by mutual arrangement that the witnesses have come here to-day. In Wellington there would be no arrangement, and I should have to subpœna the men there. There have been several accidents there—in Cuba Street, for instance. There was an appeal in that case, and evidence was given by the men before that inquiry, and I should like to avail myself of that—in fact, I understand the report could be obtained by this Commission before this case is completed. These men I would subpœna, seeing that their evidence is against the magnetic brake. I therefore have to protect them under subpœna. In Christchurch they would be acting against their superior officers. If the Commissioners could let me know where they propose to sit, I could arrange to get evidence accordingly.

The Chairman.—The Commission proposes to sit in Wellington and Christchurch only.

Mr. Myers.—I apprehend the evidence will be in favour of the air-brake system, so far as the suitability of brakes is concerned. The only question you have to answer is as to the brake appliances for Auckland. I say at once I have no desire to call evidence in any other centre for the purpose of condemning any particular brake in that centre or elsewhere. I am going to confine myself as far as I can to the question of the most suitable brake for Auckland, without offering any comment or evidence as to the brake system in other places.

The Chairman.—It is the most advisable manner of treating the thing, I think. The question may be opened as to braking on all the New Zealand systems. We are asked to recommend legislation if necessary, and that legislation will, of course, be general—that is a portion of the commission. You have no more evidence to call, Mr. Rosser, then?

Mr. Rosser.—I was only going to call a witness to show that since the recommendation of that previous Commission the brake appliances have received proper attention. With regard to the sand gear, the track brake, and the hand-brake, these are also in a better condition, but we consider the hand-brake is obsolete, though it is certainly better looked after.

The Chairman.—I think it would be better to call one or two witnesses to establish these facts.

WALTER McDONALD duly sworn.

Examined by Mr. Rosser: My name is Walter McDonald. I am a motorman in the employ of the Auckland Electric Tramways Company. I gave evidence before the previous Commission. I think the track brake and the sand gear have been improved since the Commission gave its report. I drive Car No. 77. There is a good track brake on that car. I remember showing you how I stopped the car with the track brake alone, and I did it again this morning. It was on the Kingsland route, where the car ran back and caused a fatal accident. My opinion is altered since I gave evidence before the Commission two years ago. The track brake and sand gear are now in good condition. Mine has the horizontal wheel. I prefer the sand-hopper. The sand runs all right, but it is sometimes hard to work. It runs all the time; it is a continuous flow.

By the Chairman: I consider the track brake as we have it now is efficient. I should not be prepared to bring a loaded car down any of the grades with the track brake alone in greasy weather; it is bound to slip, but with the sand gear it would be all right. I have not driven on the Parnell Rise circuit much. I consider the brakes are in good condition now.

By Mr. Myers: If coming down a hill and the air brake failed, we could still work the hand-brake.

PATRICK CODY BUCKLEY duly sworn.

Examined by Mr. Rosser: My name is Patrick Cody Buckley. I am a motorman in the employ of the Auckland Electric Tramways Company. I gave evidence before the last Commission. I consider things have been bettered since that Commission—considerably so. I am using the vertical-wheel track brake now. It has vertical cogs. I am running Car No. 73. It is an exceptionally good track brake on that car. The brakes are better adjusted. I think it is a better brake than the one I complained of before. I consider I should be quite satisfied with that brake in addition to the air brake. I have not driven an air-brake car. As a motorman I often pass Nos. 75 and 48.

By Mr. Myers: At the time of the last Commission there was a good deal of friction. The men certainly thought they had grievances, and they naturally made the most of them. At any rate, some of them would have an inclination that way.

By the Chairman: The car I am driving now I can hold steady down Wellesley Street or down College Hill without the assistance of another brake. Under ordinary conditions I have stopped at Princes Street, near the Police Barracks, without using another brake, providing the brake was in good order. I have no cause to complain of the brakes on my car. When I gave evidence before the last Commission I used a variety of cars, five or six a day. My experience is more limited now. I was on the College Hill line, and we got any car from there.

By the Chairman: I had wider experience before the last Commission than since, as I have been chiefly driving one car lately, and the brakes are in fairly satisfactory order.

Mr. Rosser.—That is practically the type of the witnesses that I have here for the secondary evidence—that is, those who have given previous evidence on the last Commission.

The Chairman.—If the tramway authorities can arrange it conveniently, the Commissioners will pay a visit to the system, making themselves acquainted with the track, the cars, and the brakes in use. Then, the following day they will take the evidence of the company.

Mr. Myers.—May not the course the Commissioners adopt depend much on the weather? There is one witness whom I think it would be very important to take to-morrow. It is Mr. Birks, the Government Engineer at Rotorua, and he has telegraphed from Rotorua that he can only be in town to-morrow.

The Chairman.—Then we will take his evidence first, and then go round the system.

Commission adjourned.

AUCKLAND, TUESDAY, 19TH APRIL, 1910.

LAWRENCE BIRKS duly sworn.

Examined by Mr. Myers: My name is Lawrence Birks. I am an electrical engineer employed by the New Zealand Government at Rotorua. I have had fifteen years' experience as electrical engineer and in connection with electrical works, and my experience has included the construction and working of tramways. I have been connected with tramways in Sydney, the operation and equipment, and at Christchurch, in construction and equipment. I was not working in any special district in Sydney; I was at the head office at the power-house. I was in touch with a great deal of work done, particularly the tests in the North Sydney District, and I have a knowledge of the working of that portion of the tramways. It was in 1902, and I have no knowledge of later developments. At that time the brake equipment was all air brakes, the majority with axle compressors. The cars were not equipped with any track brake, but, of course, they had the electrical brake. The type of air brake in use was the Christensen. They gave satisfaction on that line and on the other lines in Sydney. The grades on portions of the North Sydney line are extraordinary; particularly at Mossman's Bay the grades are considerable, as 1 in 12, and on one section 1 in 8. They may have been modified since I left. The North Sydney grades are very much more severe than any grade I know of in Auckland. I have only been up and down the Parnell Rise twice. The Sydney grades are particularly severe—sharp corners, view obstructed, running close to the bank with no view more than a few chains to be seen. I consider that an air brake fitted to the Auckland cars would be suitable to this service. I have this morning paid a somewhat lengthy visit to the depot at Ponsonby, to ascertain whether the under-gear of the cars would be suitable to carry the brake if fitted in Auckland here. It was also part of my object to have a look at the track brake. The cars are quite suitable for carrying the air brake. I have heard that it is proposed to fit the National air brake on the cars. I say that the cars are suitable for the installation of that brake. I wish to preface any remarks I make with reference to the Newell magnetic brake by saying that I have never equipped a car with it. If that brake were introduced in Auckland I can say it would practically involve a reconstruction of the carriage, on account of the very small space which is available for the mechanism. On course, there would be new controllers too. I consider the air brake is equally efficient, possibly more so than the Newell magnetic brake, for all circumstances in Auckland, and if I were responsible for the system I would not go to the expense of new controllers, new under-gear, and new trucks for the purpose of installing the Newell magnetic brake, when, in my opinion, the air brake would be suitable. The expense is not only unnecessary, but would bring no corresponding advantage whatever. The track brake is apparently an Auckland device for checking the cars, either when coasting or for emergency purposes. I think the Auckland cars fitted with the air brake and track brake would be better equipped than the cars that were running in my time in North Sydney, as they had no track brake. I have had no personal experience of working the magnetic brake, though I have seen systems where it has been in operation, and taken an interest in those systems to a certain extent. Supposing a new system were about to be installed, I think I would specify the air brake with the track brake for steep hills, because I consider and believe the air brake would be the cheapest. Safety is the first consideration. I certainly say, in my opinion, the air brake with the track brake is as effective or more effective than the magnetic brake. On the North Sydney lines there was very little skidding, because those cars had to be handled very carefully. Of course, the human element is the main factor on such grades as that. It is an element that comes in, no matter what kind of brake you have.

By Mr. Rosser: I have had no experience of the magnetic brake, and I do not profess to have made any closer inspection. As to the physical effect of the men, that is an opinion one could give only after a long experience. I never had any complaints of men wishing to leave the service because of the physical effects on them when working the air brakes in Sydney.

By Mr. Myers: As to the effectiveness of the present braking appliances, that is a general question, practically asking me to go into the whole system of the tram brakes, which would be a long matter. Given a first-class driver, I would not wish a better equipment than the present—a man who can keep his head under all circumstances; but that is not a practical condition. As braking appliances in the hands of a good driver they are good. Without saying anything derogatory to the drivers generally, there are great differences in the quickness of a man's comprehension of circumstances under emergencies. It is common ground that the brakes do entail a good deal of hard work on the men. You want a brake that wants less thought, and the least consideration.

By Mr. Rosser: I had no experience on the Sydney cars with the hand-brake alone. I did not give a general reply to Mr. Myers's question as to the effectiveness of the brakes, as a general reply would involve a description of the whole question of brakage. The air brake is a quicker method of putting on a brake than the hand-brake.

By Mr. Wyllie: I would not suggest under any circumstances the dispensing with the hand-brake—certainly not. There are occasional circumstances with the air brake when a car might be brought home with no pressure in the reservoir. There are cases known of that, but very occasional.

By the Chairman: The majority of the cars in Sydney had the axle compressors and the air power brake, relying on the electrical reverser in special cases. It was both the reversal of the car and also short circuit of the motors. For an emergency you could work the motors against each other, but that, of course, is purely an emergency brake. The emergency brakes were not then in use. The cars could make the stops under the air brake alone, even on greasy days, with the sand gear, which is an important part of the mechanism. None of those cars were fitted with slipper brakes. The magnetic brake was not in use in Sydney when I was there. I have had no experience of that brake. As an electrical engineer I understand the construction. The action of any magnetic brake depends on the electrical current passing, and the motor being in continuous rotation somewhere, in order to get the magnetic effect; but when the motor stops the brake is not effective for the moment; but I certainly cannot understand the continuous skidding of the wheels as explained by you. I have had no experience of the working of any form of track brake, but, judging from my Sydney experience, I consider that an air-brake equipment would be perfectly satisfactory—as satisfactory as any form of brake in the market. As to the track brake, I think its promptness of action might be improved by pneumatic pressure, suggested by you; but when one is considering such sudden applications, you must rely on one brake only, as a man cannot do two things at once on an emergency. Regarding it as a brake which is put down on coming over the crest of the hill so as to steady a car, in that case a driver has several seconds in which to prepare. It is not a circumstance met with frequently on the line, but I do not see that there is any great advantage to be obtained in being able to clap the brake on suddenly, if you regard it as a coasting brake.

The Chairman.—It has been arranged that the Commissioners should now pay a visit to the stations, and view the track, &c., and we should like some official of the tramway service to accompany us.

Commission adjourned until Wednesday morning.

AUCKLAND, WEDNESDAY, 20TH APRIL, 1910.

Commission resumed at 10 a.m.

JAMES HAMPDEN BRENNAND duly sworn.

Examined by Mr. Myers: My name is James Hampden Brennand. I am superintendent of the rolling-stock of the Auckland Electric Tramways Company. I have been in their employ about two years and eight months. Prior to that I was general foreman at North Sydney for six years and a half, employed by the New South Wales Government. I had full charge there. My official designation there was "Electrical Inspector." Prior to that I was putting in power for the Leeds Tramway Company in the Old Country, and saw a good bit of the equipment there. At North Sydney I had about seventy cars under my charge, of various kinds and descriptions, which were altered from time to time as the service grew. I had a good opportunity of watching the working of the Sydney cars. The air-brake equipment is generally used in Sydney. They have tried the magnetic brake, also the Electric Dissel brake, but that was condemned very shortly afterwards. I think they tried the magnetic brake for about two years. None of the North Sydney cars had the magnetic brake at that time. The results of the working of the magnetic brake on the Sydney cars was brought under my notice as we had a conference each month, and the faults of each depot were brought down and discussed, and we thus got a good idea as to the best thing to be done. I have seen the magnetic brake fail. It was on King Street Hill, in Sydney. I understand it was the fault of the controller solenoids. The failures were not under my personal knowledge, but they were brought up in conference. The Neutral Bay car had the track brake as well as the air brake, very much the same as ours. It was the Spencer brake. There are very similar grades on the North Sydney line to ours here in Auckland. The air brakes on the North Sydney cars gave entire satisfaction. The reason for fitting the Neutral Bay cars with the track brake was because it was a dangerous line, 1 in 9 grade. It was considered a particularly dangerous line, with the water at the end of it. It is a series of hills and hollows, bad to come down, with short sharp hills. I consider it is more dangerous than the Parnell Rise, where you have a good landing-place at the bottom of the hill, and you do not have a water frontage; but Neutral Bay is rather shorter. The North Sydney cars were fitted with Christensen—that is, twelve coupled sections, or twenty-four cars; the others were fitted with axle brakes. They were

originally fitted with the Standard air brake, and this was changed by one designed by the department. I have had experience with the air brake in Auckland. I am satisfied that the National air brake is as good as the Christensen. I have no doubt about it that I should prefer to have the air brake on the Auckland cars. Of course, I mean with the assistance of the track brake. We can make very satisfactory stops on the Auckland hills with the air brake. We have made tests of the working of the air brake apart from the ordinary work. If the air brake were worked without the track brake I consider that the leverages would require to be lengthened. We have made tests with the air brake on the cars coming down hills here with lengthened leverages. We have records of those tests that were made, and of the condition, and adjustment, and so on. Those tests were taken by the Public Works Department when the air brake was first installed. We altered the leverages in various ways, so as to give an increased leverage, to compensate for the extra weight of the car, and speed. The rail at the time of the tests being made was very bad. Some of the tests were taken with the air brake in conjunction with the track brake, but the majority of the tests were taken with the air brake alone. I consider the tests were satisfactory when made by the air brake alone, when the leverages were lengthened—that is, as far as the tests went. I consider the tests were not fair tests, seeing the state of the rail and the overloaded car. The car was loaded 50 per cent. overload—that is, over its carrying-capacity. The car was travelling at the rate of seventeen miles an hour on a 1-in-14 grade, with the air brake alone operated for the purpose of making stops. The track brake here is a good one, but it took some considerable time to get the men to find out the efficiency of it. My personal opinion is that it is a good track brake, slightly better than the one we had at North Sydney. It would be scarcely possible for me to fit the Auckland cars with the magnetic brake at the present time. There are sixty bogie cars here, and I do not consider we could get the magnetic brake applied to them very well. There would be ninety-five cars in all fitted with that brake, and they would require new cross-bundles, the wiring of the car, new rheostats, and also to be equipped with a new controller, in addition to ninety-five sets of magnetic brakes. I have estimated the cost of that to be about £40,000, apart from anything being done to the motors. I should say the total cost would be about £50,000 approximately. The fitting of the cars with the National air brake would cost between £10,000 and £12,000. I think I could fit about five cars per week with the air brake—that is, after the arrival of the materials. The company made preliminary arrangements for the purchase and installation of these brakes if they were approved, and I estimated the quantity of material required. I cannot state definitely that provisional orders were given; that would be a head office matter, and I am hardly conversant with that. The installation of the air brake could be completed, I think, by about next February. If the magnetic brake were to be installed it means pretty well the rebuilding of the cars. The body remains the same, but the whole of the rest, as to cutting off the wiring and controllers, &c., would mean a reconstruction. I am afraid that I could not do more than one or two cars each week at the most. It would be a pretty slow process, and would take over two years. It would not disorganize the traffic, but we could only lay up a few cars at a time. From my knowledge of electric tramways, there would be practically no advantage in the magnetic brake to justify the increased cost. My contention for the air brake is that to all intents and purposes it is a sure brake. The man has the gauge in front of him, and can see that he can apply same, whereas you are rather in the dark as to whether the magnetic brake is going to apply. If the man's air has ceased pumping, or anything of that kind, the man has time to stop his car, but with the magnetic brake he has none whatever. Assuming the position of two cars coming down the Parnell Rise, one fitted with the air brake and the other with the magnetic brake, assuming the necessity for a fairly good stop, and assuming that something goes wrong with the magnetic brake on the one car and something wrong with the air brake on the other car, you would be in a safer position on the car fitted with the air brake—that is, if it had installed upon it the braking equipment which the company propose to put in. The two cars upon which we have fitted the air brake and track brake have worked entirely satisfactorily. Car No. 75 has been running one year and four days, and No. 48 a slightly shorter time. Since the installation of the compressor on No. 75 car, I opened it to see the effect of the wear, and the way the compressors have behaved, and have found nothing wrong. These cars have never been into the barn in consequence of complaint. There has been no trouble with skidding of the wheels, but the wheels were flattened once by the application of the electric brake. It was to prevent a collision at Mount Eden, and the collision was prevented. That is the only occasion on which these cars have been into the barn. Car No. 48 was fitted with the air brake on the 15th May last. No. 75 was fitted on the 15th April. Up to date No. 75 has approximately run 35,000 miles, and No. 48 3,500 miles. I made this up a few days ago. In 1907 I went on an extended trip to America and Canada, to study the latest developments, working, and treatment of tramways, under credentials of the New South Wales Government. I visited New York, Chicago, Toledo, Detroit, Buffalo—in fact, had a general cruise all round. I spent pretty well the whole of my time, and took a keen interest in the tram-works. The brakes were air brakes almost entirely. I came across many places where the conditions were similar to those here. From Buffalo to Niagara they had steep grades; in Toronto and in Vancouver also. They had the air brakes in those places, but not in conjunction with the track brake. In those places the leverage would be lengthened to a greater extent than under service conditions in Auckland, as they had very big brakes in most of them; but that is a mechanical detail. The speed averages about ten miles an hour, but in the urban service from town to town—say, from Toledo to Detroit, or from Buffalo to Niagara—they go up to forty or fifty miles an hour. I can say the air-brake equipment has been satisfactory on those systems. I discussed with the officers controlling the systems the Christensen brake equipment, and the opinion seemed to be entirely in favour of the air brake as against the magnetic brake. The reason of my doing so was because at that time Sydney was having trouble with the magnetic brake, and because of this it was one of the points to which I particularly directed my

attention. I asked which was the best brake, what were the good and bad points about the braking system; and got an unbiassed opinion on it. I can say that the advisability of installing the magnetic brake had been considered. It was not installed, but the air brake was. As a practical man I have given a practical opinion, after taking into consideration all the necessary factors as to public safety, &c. The air brake is a brake in which motormen, as a rule, have big confidence. They are confident because they know they have the pressure, and the means of applying that brake, and they can hold the car at any time. The man can try his brakes before leaving the depot. The braking effect is not dependent upon the car-equipment. That is a very big consideration if anything goes wrong—that the force which controls the brake can be depended upon. The air brake is easily learnt by the average motorman. The faults that occur on the road are very simply and quickly remedied. You can see any defect and hear it, and act. Now, with the magnetic brake you do not know whether she is going to go right or not, and that brake is almost entirely disused for service stops, on account of the injury likely to be done. I would not allow the men to use the magnetic brake for service stops. I would not like them to use it, because I know the work in the depots would be much increased.

By Mr. Rosser: The Sydney drivers had a grievance against the magnetic brake, and there was a Royal Commission appointed to inquire into it just before I left for America. That was one of the reasons I took such a personal interest in it. I took service with this company in September, 1907, about two years and seven months ago. Since that time we have increased the staff considerably, and the cars receive more attention than formerly; but, of course, there are other reasons—we have more cars to attend to, and we are able to draw a car out of traffic without it being missed. I say the magnetic brake is more severe on the equipment of the cars and more severe on the passengers. We have six double-deckers here, and the severity on the passengers on the top of those deckers would be more severe. As to the magnetic brake being more severe on the men than the air brake, that depends on whether the men are allowed to use the magnetic brake for service stops. They have to rely on the hand-brake for a stop. As far as I know, all services which have been equipped with the magnetic brakes have started out to prevent the men from using that brake for service stops, but it has generally worked round that they have been allowed to use it. The hand-brake has the same application as the Auckland hand-brake, and it would be severe on the men. As to the air in the compressor lasting, should the trolly leave the wire, it would depend on the number of stops. You would have a sufficiency of air there to control the car down a very big grade. Should the current be off for some time, that would give the driver ample warning to use the ordinary appliances. In the tests made by the Public Works Department I think Motorman Troy drove, also Barker, but he has left the service now. I did not know he was in the Adelaide service at present.

By the Chairman: I cannot speak definitely as to the equipment of the cars on the Leeds tramway. I was working for John Fowler and Co., who put in the plans. At the North Shore in Sydney the Milson's Point is 1 in 12. On the Spit line and the Mossman line the grades are 1 in 10, with very bad curves. Neutral Bay varies, but averages about 1 in 9. On that section the track brake was used. On the stiff grades the track brake was not used. I had very few cars equipped with that. The braking arrangements on the cars of the other lines—the methods of retardation—were the air brake, the hand-brake, and the emergency on the controller. There were two brakes on the controller. The first motion was to reverse the car, then, if the main switch came out, the hand was brought round with full power. The emergency brake in the car was the first, the emergency reverser of the motors was the second, and the complete cutting-off of the power was the third emergency. I could not say the electrical emergencies were very often brought into use—not as the usual thing; I think the men relied on their air. They were able to completely control the cars by the air alone on those heavier grades. They had coupled cars; they controlled two. The two cars were exactly the same. If the first one failed, the other one controlled it. The weight of the cars would be as much as 10 tons, but they varied somewhat. The brake-cylinders were 9 in., as far as I remember. The working-pressure on the axle-driver compressors was about 35 lb., and on the Christensen brakes from 75 lb. to 85 lb. We sealed up the brakes of the car. With the air brake we ran that car three shifts, for eighteen hours, with one adjustment. I think Mr. Carter was with me at that time. The magnetic-brake failure at King Street was due to the man using the brake constantly for service stops. It was a controller failure brought about by the magnetic brake solenoids. We have five types of controllers here, but really only two in use. There are two kinds of manipulation, the ordinary emergency controller and the rheostatic. I will arrange for your inspection of the cars fitted with these different types of controllers. The different modes of retardation in use here are the hand-brake, the track brake, and what is called the third emergency. That is, to reverse your motors, and, if the switch blows out, cut into the power. I am satisfied with the sand gear here. There are four sand-pipes, and, except on very big curves, they always deliver the sand on the rails of the curves. The pipes are between two wheels of bogie cars, and on the single cars about 6 in. or 8 in. in front. The general thing is, the bogie cars are fitted between the two bogie wheels. That particular car you had yesterday was an exception. The leverage required for the air brake is more if used without the slipper brake: that is my experience. On the air-brake car alone you would rely more on the air brake and more on the shoes, but on the car fitted with the track brake you would rely on the track brake. Supposing we are going to rely entirely on the air brake, we should require a larger leverage than if relying on the air brake plus the track brake. When a car is fitted with the track brake, the leverage could be left within a safer limit as far as skidding is concerned, the reason being that the weight of the wheels is reduced by the track brake. With a magnetic track brake the shoe is attracted to the rail, and the action of the car is to overshoot that shoe, which pulls on the wheel brake—that is, the Newell magnetic brake, which is considered the best. I have no personal experience of it, though I have seen it illustrated. I could form no idea as to the relative cost of fitting that brake as against the Newell brake. The bolster

on the cars comes up too far, and there is very little room to put anything on the side of the tram. Controller-modifications and wire-modifications would be required as before. Our controllers are absolutely unsuitable, and you must have new controllers for it. Speaking of electrical emergency brake having been used on Car No. 75, and the result being a flattening of the wheels, the air brake did not fail, but the man, who had never seen an air brake before, and had been used to a certain thing, did it from mere force of habit more than anything else. He did not know the possibilities of the air brake. The traffic manager has his report; it will no doubt be produced. As to the question of the relative safety of two cars fitted with magnetic and air brakes and slipper brakes, I still consider that the latter would be the safer, because the slipper brake would also be available. I know the magnetic brake is also made with hand-attachments. Supposing the car fitted with the magnetic brake had the hand-attachments, I still believe in the car with the slipper brake. Personally I should feel safest with it. In America the steepest grade was about 1 in 14, running between Niagara Falls Bridge and the bottom of the Gorge: that struck me as being particularly steep. They had the air brake alone there—no track brakes. I am aware that in Dunedin and Wellington the magnetic track brake appears to be in daily use, but I am not aware as to the cost of the upkeep and the work done. The motorman can vary the leverages of the air brake when applying same. He can apply the service and emergency stops by using the service or full application. The only objection I see to the brake leverages being so worked out as to give the motorman the maximum holding-power when required in an emergency is that it would give him too much power, and it would increase the likelihood of skidding. The date of the Royal Commission held in New South Wales to which I refer was, I think, in 1905 or 1906. The Commission was brought about by the men being asked to use the magnetic brake for emergency purposes only, and they asked to have it used for service stops as well.

WILLIAM ALLWOOD DUTTON duly sworn.

Examined by Mr. Myers: My name is William Allwood Dutton. I am an electrical engineer employed by the Brush Electrical Engineering Company. I am the resident engineer in the Auckland District. The company have been building cars for twenty years, and I have been employed in their works for about eleven years. They completely equip the cars if necessary. They are not manufacturers of brakes, and have no interest in any particular brake. They simply equip the cars in accordance with the specifications. I have had experience in the different types of brake, the electric brake, the rheostat generative brake, also the hand-brakes and air brakes. We have not fitted air brakes to tram-cars except for Canada and for foreign companies. But we have fitted the Newell magnetic brake on several systems. I have had experience of the designing, equipment, and construction of tramways, and also experimenting on our own private track before delivering, in the early days of electric traction. I cannot say I have studied the best form of brake for Auckland conditions, but I have travelled on the cars a good deal, and have seen no signs of inefficiency on the existing brakes. I have been to the depot and seen the appliances there. By the permission of the company I was allowed to witness the tests of the air-brake cars. I know the Parnell Rise. I think the track brake is a very suitable brake. I have seen the cars equipped with the air brake and the track brake. I think it is more efficient than both brakes being hand-operated, inasmuch as the driver has not to exert any great physical exertion with the air brake, and is more likely to be fresh at the end of his shift. I think the air brake and track brake is a very excellent combination of brakes, and particularly efficient. I should be satisfied if all the cars were equipped with the air brake and track brake, most certainly. I should certainly prefer the air brake and track brake in preference to the Newell magnetic brake. The main reason is that when using the magnetic brake you are heating up your motors, otherwise the motors would be cooling down through not acting, and radiation would be taking place, instead of the machine being heated up by energizing electricity. Another reason is that the magnets are depending on the revolving wheels to excite them, and you cannot hold up the car at rest on a down grade; and the extra wear-and-tear thrown on the motors and controllers, which are a very important part of the cars. I have known of accidents in Great Britain on cars fitted with magnetic brakes, but cannot give you date or place. I have no personal knowledge, but only by repute. From my own knowledge of magnetic brakes I can conceive a possibility of sudden failure of that brake. There are many things that might occur, the coil might be burnt out and rendered useless, it may ground-earth, or it may short-circuit. If those things were to happen, breakdowns would occur without any warning whatever. Provided the earth-indicators were attached, the motorman would know prior to actually applying the brake; but with a short curcuit, or a burnt-out coil, he possibly would not know. I cannot suggest any combination of brakes preferable to the track brake and air brake in conjunction.

By Mr. Rosser: I stated that I did not observe any signs of inefficiency on the part of the hand-brake in the Auckland service. I travel in the fore part of the car as much as possible. I would pit my opinion against those twenty-seven motormen that you speak of, because if the car is required to stop it depends on the speed that you approach the grade. I have not been on any runaway cars in Auckland, as I have only been here nine months. I have driven a car with a hand-brake, but not in Auckland. It was on the private track, specially constructed, and consisting of all the worst features you would be likely to meet. We had to imagine traffic crossing the line.

By the Chairman: I served my time with P. and R. Jackson's, at Manchester, and then took up the position with the Brush Company, and have been with them ever since. I was first of all designing electrical machinery, working out the parts, providing drawings for the office, with particulars and calculations, &c. I am an Associate of the Electrical Engineers. We have fitted the Newell magnetic brake to our cars, with ground-detectors.

FRANK ERNEST DE GUERRIER duly sworn.

Examined by Mr. Myers: My name is Frank Ernest de Guerrier. I am an electrical engineer, and a member of the Institute of Engineers. I have been practising about twenty years. For about twelve years I specialised in tramway-working. I have been on the Auckland system for more than two years. Prior to that I was a short time at Home, five years in Calcutta, India, and previous to that with the Brush Electrical Traction Company, in their head office at Swansea, also at Tynemouth and Gateshead. At Swansea I was Resident Engineer. They had horse tramways there, and we electrified them. We had hand-brakes there operating on the wheels, also hand-operated slipper. On the majority of cars we had no slipper brakes, just the hand-brake and an electric emergency brake. The district was not as hilly as this, but there was a grade of 1 in 13, which was the worst. The next place was in Tynemouth. They had the air brake and slipper brake, operated by hand. There was one particularly dangerous gradient which had the sea at the bottom, and a bad curve; and if you missed the curve you went into the sea. I could not give you the grade: it is pretty severe—about 1 in 11, I think. At Gateshead there was one very bad gradient, in West Street, and at the bottom of this was a railway-bridge with five roads coming across, and further on a bridge going to Newcastle, and if you had a runaway it was certain to mean a collision. We never had a collision. We had the hand-operated slipper brake and wheel brake, also the emergency brake. In Calcutta it is a flat district, and we ran trailers attached, but only fitted with the hand-operated wheel brake and no track brake. In this place the same braking appliances were used as you have here, with the exception of the two cars fitted with the air brake. The appliances were considered sufficient. As to the Auckland system, the brakes can control the car. The hand-brake cannot be applied so rapidly as by air, but once they are applied they are efficient. The company recognised the exertion entailed on the men, and are prepared to meet that point. I have had no personal experience of working trams fitted with the air brake, excepting in Auckland. I have no personal knowledge of the magnetic brake, but I lived in London where the cars were fitted with them, and I have knowledge from personal observation and from reading about the brakes. I have not considered the air-brake system very much until lately. I have gone into the question of the air brake or the magnetic brake for Auckland. In spite of the different Commissions at Home, they have not been able to make up their minds as to the best brake for general use, and therefore no legislation has been made at Home; there is nothing arrived at yet. I consider the best form of brake is the hand-operated track brake as the first consideration; because I think, the district being so hilly, we must first of all consider the best way of coasting. And the hand-operated track brake is very simple, it practically never gets out of order, and when the car stops on its journey the motorman can feel he has it under his control. In combination with that wheel brake, there should be an air brake by means of which he can adjust the speed of the car, and I think, with all brake systems at present on the market, that that particular combination cannot possibly be beaten. As regards the air brake, it is very simple, the great point being that there is an indicator in front of the motorman's eyes by which the pressure of air at his disposal is seen, and that would, of course, give him confidence. He knows there is a brake to put on, and that it is in good working-order. I say emphatically that it is from the result of my observation and consideration I should prefer the track plus the wheel-operated air brake to any form of magnetic brake. As regards the magnetic brake, there are so many possible ways for it to get out of order. If the coil gets burnt out, if any connection is loose, or anything goes wrong with the controller—any one of these things will throw it out of action. Then, of course, there is the excessive heating of the motors, which in this particular case would be a most important point. The motors could not stand the magnetic brake; they would burn out, and the service would be disorganized. I consider the track brake and air brake on the two cars in Auckland very satisfactory. The cars have never been into the depot for repairs. The motormen were keen on having those cars out. I may say that when in Madrid they had the electrical system of cars there, but I do not remember any form of cars better than these two. I have never heard of a failure on the two cars here. I know of the failures of the magnetic brake in England through reading the reports from time to time in technical papers. They were total failures, I think, in Sunderland, Birmingham, and Bournemouth; but I cannot give the dates from memory. You have the dates there. In Sunderland it was on the 27th July, 1907; in Birmingham, the 1st October, 1907; and in Bournemouth, 1908. In the latter case they had to pay £10,000 damages, which means that several got killed.

By Mr. Rosser: The Auckland service is faster than the service in the Old Country where they had hand-brakes. It is too long ago to recollect whether the cars had single or double purchase. I am satisfied that the air brake is an efficient brake, and can be used with greater efficiency by the motorman than the hand-brake. With reference to the Swansea line, it is really not a tramway, as it is run by steam. It is really a train; but it is owned by the same company—namely, the Swansea Improvements and Tram Company. The reason it is steam is financial. If they started again it would be electricity. I do not know whether it is a Westinghouse air brake, but it is possible. We have shoes on the wheels operated by air instead of by hand. I do not admit that the former brakes were inefficient, but the advantage of the air brake over the hand is the rapidity of application, which is a point. The magnetic brake at Home is very commonly used—on several systems. As an emergency brake, provided that everything is in tip-top order, and you have a decent rail, it is a very powerful brake, and can shoot passengers through the windows.

By the Chairman: The company have experimented with the hand-brake operating on the wheel, and the track brake, as well as the brake operated by air. We have not experimented with the magnetic brake. With the magnetic brake our motors would be of insufficient capacity—that is, in the majority of cases. They are fully loaded now. I have had experience of the rheostatic brake here. As to the relative amount of current taken by the magnetic brake as compared with the rheostat brake, I have never taken the actual figures, as it depends on the speed to a certain

extent. I could not be quite certain as to the actual current required to fully energize the brake. It might be very much smaller than the current required in rheostat braking, as it is simply a question of energizing the magnet, and, in addition to any small retardation, there is the effect of skidding the wheels at any time. I am still of opinion that the amount of current required for the magnetic brake as against the rheostat brake would be more. The Bournemouth accident I am referring to was due to the magnetic brake, not to the skidding of the wheels.

WILLIAM ROCKLAND duly sworn.

Examined by Mr. Myers: My name is William Rockland. I am motor-inspector employed by the Auckland Tramways Company, and have been in that position for about eighteen months. Prior to that I was motorman for five years. I was one of the men who gave evidence about two years ago as to the equipment of the trams. The brakes are looked after much better now—the motormen have called my attention to it many a time; and the general equipment is better also. For instance, the sand gear is inspected in the depot every night, and if any defect is found it is remedied at once. I think the vertical track brake is the best, and nearly all the cars are equipped with that brake. I am satisfied with the track brake in its present condition. During the last two years the *personnel* of the officers looking after the equipment has been altered. I have driven both the cars fitted with the air brake, and consider it the most suitable brake, combined with the track brake, for Auckland. I have never driven a car fitted with the magnetic brake. I should be quite satisfied with the air brake and track brake combined.

By Mr. Rosser: I consider the brakes are better looked after now. As a motorman I certainly prefer the air brake, and I think there should be a power brake installed.

Commission adjourned.

Commission resumed at 2.15 p.m.

CHARLES BAYLEY duly sworn.

Examined by Mr. Myers: My name is Charles Bayley. I am night foreman of the Epsom depot, in the employ of the Tramway Company, and have been in their employ for nearly eight years. I was driver for about two years, on the freight for about two years, and motor-inspector for three years, and have been night foreman for over a year. The equipment of the cars is in better condition now than it has ever been during the last two years, and it is working satisfactorily. We have had trouble with the sand gear, but it is working very well at present. We have about forty cars at Epsom, and the sand gear is working well on all of them. We inspect the equipment every night at Epsom, and if any defect is noticeable it is remedied at once. Since I have been in the Epsom shed we have had, of course, various cars booked up for bad brakes, but they are remedied immediately. In bad weather we get more reports. I find the air brake on cars 75 and 48 very satisfactory. If all the cars were equipped similarly I consider they would give every satisfaction, having, first, regard to the safety of the public, and, secondly, to the requirements of the motormen.

By the Chairman: It is possible to skid the wheels with the hand-brake by hard application. Under certain conditions of adjustment you could not skid them. It depends on the condition of the rails.

JAMES HAMPDEN BRENNAND recalled.

This morning I stated that in the majority of bogie cars the sand gear operated between the wheels. That is not correct. There are thirty-three bogie cars in which the sand gear leads the wheels, and thirty bogie cars in which the sand gear is between the wheels. There are thirty atached to the car-frame and thirty-three to the body itself. We duplicate the propeller-box, and we could easily remedy the sand gear if required. I should like to say that any test taken by the air brake must be alone on the merits of that brake, as you cannot alter the efficiency from time to time—you cannot "ready" the brake. With the magnetic brake it is possible to have the motor in good order, the commutator is good, and the controller is good, and you may make a far better stop than under ordinary running conditions. I am speaking about general service conditions.

By the Chairman: I could not tell how much current is required to fully energize the magnets of the magnetic brake.

JOSEPH JOHN WALKLATE recalled.

Examined by Mr. Myers: My name is Joseph John Walklate. I am general manager and attorney of the Tramway Company. I am an electrical engineer by profession, and have been so for twenty-three years. My energies have been applied principally to tram-work for practically the whole of that time, principally in Birmingham, the Isle of Man, Australia, and Brisbane, and prior to coming to Auckland I was in the North Staffordshire District. I was in Auckland when the last Commission sat, and personally represented the company. At that Commission no evidence was given as to the suitability of brakes for the Auckland conditions, excepting such as was elicited by the questions of the Chairman; there was no outside evidence. We had had no experience in Auckland with the air brakes at that time. The two cars, Nos. 75 and 48, have been installed since then. I had had experience with the air brake, axle-driven compressor, and also one or two cars with the Christensen air brake, which is practically the same as the National. The district was a similar country to Auckland so far as grades and hills are concerned, excepting that the roads were much narrower, traffic more congested, and the rails were much more liable to be greasy, owing to the nature of the pottery industries in the district. The Christensen air brake worked very well. On the car with the Christensen brake we had no track brake, but a hand-brake. I have had no personal experience of the working of the magnetic brake. I have a full knowledge of the mechanism of the brake and the methods of its

working. The two sets of air brakes in Auckland were put on for experimental purposes, with a view to the equipping of the whole of the cars. We did not proceed with this owing to a conversation with Mr. Holmes. So far as the Auckland conditions are concerned, my experience here with the air brake in conjunction with the track brake has satisfied me that it would be a very efficient—in fact, the most efficient—combination for Auckland. I remember on the former Commission saying something about the pneumatic track brake. At the time of the Commission I contended that the existing brakes were quite satisfactory. We are now prepared to install the air brake. We have considered the advisability of applying a pneumatic slipper brake, in conjunction with the pneumatic wheel brake, and the disadvantages would be that both would rely on one source of operation. The space underneath the tram-cars is very limited, and there is a difficulty in getting in the ordinary hand-brakes. If you had the wheel brake operated by air, and the slipper brake operated by air, and by any chance it went wrong, you would only have the hand-brake to rely upon. It is a possible failure. The air brake may go wrong at times, as accidents will happen, but it would be very infrequently. I certainly think that the air-operating wheel brake and the present track brake would be the best to use here. As far as I am able to form an opinion, I consider that the risks of the magnetic brake failing without warning are too great. As has been mentioned by Mr. Brennand, the air brake is always ready, regardless of the working of the car, but the magnetic brake is liable, owing to the dirty contacts between the comutator and the crushers, to go wrong without warning. I do not condemn that brake. It is largely used in England, but not so largely outside of England. The air brake is coming into more general use in America and on the Continent. We did think of the possibility of installing the Freund brake, but at present it has been merely experimental on two cars; beyond that I do not think it has progressed. The result of our inquiries was to find that the patentee, Mr. Freund, had not completed his design. And I think that the brakes were manufactured in England. We were not able to get them. The difficulty about it is that in equipping the whole of the cars we should be having too much of an experiment, and how long it would take I could not answer. It would be necessary to re-equip the cars electrically if we had to install the magnetic brake. The cost would be £10,000 or £12,000 for an air brake, and £50,000 for the magnetic brake—that is, including any additions. Supposing we were starting *de novo*, we should be satisfied with the air brake and track brake. As an electrical engineer, having had experience in tramways, I consider it a perfectly safe combination. Referring to the answers I made to the Chairman at the last Commission as to the difficulty with the wheel air brake skidding, my experience of the air brake equipped on the Auckland cars has altered my views as to the skidding. In the potteries district which I have referred to there were peculiar conditions. They had to take off the brakes there owing to the potteries dealing in clay and coal, and the whole of that material is carted through the streets, and makes a suprising greasy combination of mud, which renders braking extremely difficult in the potteries district, hence the skidding of the wheels there. We have had no such difficulty in Auckland with the air brake. The tests made with the air brake by the officials were not fair ones—first, because the cars were overloaded by more than 50 per cent. I can safely say we do not carry overloads to that extent, nor approaching it. And, secondly, as I characterized the arrangement, it started on the assumption that we had a madman at the wheel, because no one but a madman would bring a car to the brow of College Hill with no brakes on and with the current full on. They started from rest at the top of the hill under the most exaggerated conditions, and that is not fair. Even if all the brakes failed, a man would not be found with his current on. The track brake was not used at all on that test, and it is supposed to be put down before descending the more important hills. That is rigidly enforced; and if a man is noticed not to have his track brake on sufficiently hard he is reported. I think the time mentioned for applying the track brake is somewhat ridiculous. It would take from about an eighth to a quarter of a minute; but, of course, that varies on different types of cars somewhat, but it certainly does not require anything like a minute.

By the Chairman: I am not a member of any Institution of Engineers. When in the potteries district it was the original intention to run trailer cars, consequently the first twenty cars were fitted with axle-driven compressors, and twenty other cars were trailers, no motors; the idea being to connect up the air brake and work on the trailer cars. But the Board of Trade refused to have trailer cars. The company already had twenty sets of axle-driven compressors, and the motors were made for others. We started the forty cars with wheel brakes and compressors. Great trouble was experienced with the compressors, and when I assumed control we got more cars. Then I "scrapped" all the compressors and the wheel brake, with a view of putting on the Hewitt and Rhodes brake, operating with an auxiliary tank. My experience of the working of the slipper brake under those conditions was that it worked very well. We had wheel hand-brakes there. The grades were severe, some short ones 1 in 8—canal bridges—and some long ones, three-quarters of a mile, 1 in 12 to 16. As to introducing magnetic brakes here, the report of the Commission was sent Home and the matter discussed. The Public Works officers were interviewed, and it was arranged that two sets of air brakes should be put on the cars. We have correspondence as to that. The Chief Engineer was doubtful, and the suggestion was never made that we should experiment with the magnetic brake. I cannot give details as to the magnetic brake, but I am informed they get to a pretty high temperature after a day's work, and that is one of the reasons why we assumed that the magnetic brake would be the last straw. I am afraid it is not possible to work the Parnell Rise with special appliances for that road, not required for other parts, without interfering with the general working. We are rather awkwardly situated in Auckland, as all the lines come to Queen Street, and at times there is very heavy traffic to the races or shows, to the Remuera or Epsom districts. We have a large number of cars and a large number of people, and it is necessary to send the cars back and forth by that route. We aim at standardisation as much as possible, so as to make the cars interchangeable

throughout the system. I therefore consider that any special car for working that route is not feasible. The Parnell Rise never troubles me: it is short and straight, and there is a landing-place. We have never had any trouble on that line. It happens to be an exceptionally severe gradient. In the potteries the hand-brake is used as a service brake, and the pneumatic slipper brake is exclusively used as an emergency brake.

The Chairman.—We should like the evidence of the motormen in charge of the car when this skidding eventuated, and the emergency had to be used. I think it was a car fitted with an air brake the first day out.

Commission adjourned till Thursday.

AUCKLAND, THURSDAY, 21ST APRIL, 1910.

Commission resumed at 2.15 p.m.

Mr. Myers stated that the man who had driven the car was not now in the company's service, and had left Auckland, so they understood, but that the company would do its best to trace him.

WILLIAM GEORGE TOOP GOODMAN, M. Inst. C.E., M.I.E.E., M. Amer. E.E., duly sworn.

Examined by Mr. Myers: My name is William George Toop Goodman. I am a civil and electrical engineer. I am at present Chief Engineer and General Manager of the Adelaide tramways, and came for the purpose of giving evidence on this Commission. I have been an engineer for twenty years. I have had special experience in tramway-construction and the working of electric tramways—that is my specialty I have had considerable experience in tramways, and have constructed a portion of the Sydney trams, the Dunedin tramways, and now the Adelaide tramways. I have been responsible for the design and the whole undertaking of the electric trams in Dunedin and Adelaide, and a considerable portion of it in Sydney. I have had very considerable experience in the working of the magnetic brake, I suppose more than any other man in Australia. I was the first to adopt the magnetic brake. I have had some experience in the working of the air brake in Sydney. I had experience in the working of the tram system in Sydney during the construction that was going on on other portions of the line, and I paid close attention to the working. After the construction of that portion in Sydney was finished I resigned the service. My experience of the actual working of the air brake is limited to Sydney, with the exception of severe and extensive tests which I made in America. I had similar tests with the magnetic brake there in Pittsburg. I did not have to do the designing or construction there. My reason for making the experiments was in order to enable me to arrive at a decision as to what was the best brake to adopt for those tramways; and we adopted the magnetic brakes. I have an exceedingly good opinion of the Newell magnetic brake—in fact, I am known as the "magnetic-brake man." That does not imply that I consider the Newell magnetic brake is the proper brake under all conditions. The Adelaide district and the Dunedin district, having regard to the gradients and general conditions, are not in any way comparable with the Auckland district. The principal reason is that the topographical conditions in Adelaide and Dunedin are different from what they are in Auckland—that is to say, they have very severe gradients here that do not obtain in either of those two places. I carried out very extensive experiments in Glasgow in order to see if I got the same results as I obtained in Pittsburg. I think the Newell magnetic brake, under suitable conditions, is the very best form of brake I know of. You want conditions where you have not to negotiate heavy grades. Where you have heavy grades it is necessary to have a brake which you can use on the down grade continuously; and with the magnetic brake, by continual coasting thereon, it throws very excessive and heavy stresses on the motors. Now, where you have the down gradients you also have to climb the up grade, and when climbing the up grades the work done by the motors is exceedingly heavy and severe, and consequently that heavy work causes the motors to heat to a large extent, and unless the capacity of the motor is such that the heat generated can be easily dissipated, then you want the motors free on the down grades in order to allow the motors to cool. In other words, I mean by that, that with the magnetic brakes, unless you have sufficient capacity in the motors, it is inadvisable to coast on the down grades, because you are throwing extra work on the motors which they are not designed to carry. And the conditions which really govern the use of the magnetic brake are such that you must limit the speed at which the brake is applied, you must limit the coasting on the magnetic brake, and you must limit its use, and when you have to make any sudden stop on steep gradients, especially at a high rate of speed, the brake may not act. I have carried out a great number of experiments in order to see really what amount of work there is on the motors, and though we have been told that it is not necessary to provide any capacity in the motors to provide for the magnetic brake, I have found you get some disastrous results unless you put in motors with a larger capacity than is necessary for traction purposes only. The experiments I have carried out recently show that the current occasionally generated by the motors when operating the magnetic brake is momentarily greater than the motors take when doing the work of hauling the cars. You see from that that with a hilly country and the magnetic brake, the brake, if used for coasting, is doing work on the down grade as well as the up grade, consequently the motor has no time to dissipate that heat which is generated. The result of the continuous working of the magnetic brake on steep gradients would be that unless the motors were properly designed to carry the loading, you would have severe trouble with the commutation of the motors, and you would get a complication that would render the brake inoperative. That also applies to the great necessity of limiting the speed at which the magnetic brake is applied. Although I have adopted the magnetic brake in Adelaide, I have had to give strict instructions that the magnetic brake is not to be used at a speed greater than fifteen miles per hour. Neither is the magnetic brake to be used for coasting on down gradients. In Adelaide we have no gradients to speak of, and it was that

fact which made me decide on and put my trust in the magnetic brake, because where you have gradients it is necessary that the man who is to operate the cars should be able to utilise his brake on the down grade for coasting and for ordinary or emergency stops. Another feature is that with heavy down grades the motorman cannot hold his car at rest with the magnetic brake, unless he applies the hand-brake. The reason of that is, of course, that the magnetic brake is energized by the current generated by the motors, which current cannot be generated unless the motors are rotating. We also find that with the grades in Adelaide we do not get the excessive speed due to gravity on down grades. If a car has stopped on a down gradient, you must attain the speed of two miles an hour, which is a critical speed, before the motors will excite and give the necessary current to energize the magnetic brake. Under those conditions it is inadvisable to adopt a brake that you cannot depend on to hold the cars stationary on a down grade. If travelling at a speed higher than fifteen miles per hour, my instructions to my men are to slow down the car to that speed by the hand-brake, after which the motorman can apply the magnetic brake. The reason of that limit being made is because the brake is designed to act under normal conditions, and not at very high speeds, and you cannot provide for the brake acting readily under abnormal conditions, and at the same time work properly under normal conditions. In other words, we should have to have a brake which had more resistance and a greater series of brake-notches, which would only be used occasionally, as they would be of no use when working under normal conditions. Another reason for limiting the application of the magnetic brake to speeds of fifteen miles an hour is that I find it advisable to save the stress put on the motors. I particularly designed the motors with 10 per cent. greater capacity than was necessary for traction purposes, so as to meet the stress put on those motors by the brake; but even with that precaution, I find it necessary to fix the limit of speed. I want you to bear in mind that if I were redesigning the trams in Adelaide I would still use the magnetic brake, as our conditions are entirley different from Auckland. We have practically a level country. Our speeds are entirely dependent on the motors, whereas in Auckland you have the gradients, and the gravity would enable you to get up a far greater speed than the horse-power of the motors would on level country. In designing rolling-stock you have to carefully consider the conditions, and that is most essential in deciding what type of brake should be adopted. I should say from what I know of Auckland—and my knowledge is fairly extensive—it should be imperative that the cars should be equipped with a mechanically operated track brake, and if the cars are provided with that apparatus, then it is practically an impossibility to apply the magnetic brake. I should say that if you have the cars thoroughly fitted with the hand-operated track brake, and the hand-operated wheel brake, you have done everything in reason, because as well as these two brakes you also have two emergency brakes, by making use of the motors themselves either by reversing the motors, or making them work against each other. So that, as far as Auckland is concerned, they have the hand-brake, the mechanically operated track brake, the reversal of the motors, and the third emergency, which is the letting of one motor work as generator and the other as a motor, working against each other. I think the present system is effective with regard to the facilities of the men handling the car. Of course, you must admit that they had a fair amount of work to do in applying the hand-brake and the mechanically operated track brake. The installation of the air brake would, of course, enable the motorman to do his work much more easily and quickly, and you would relieve the motorman of the necessity of operating the hand wheel brake. It would, of course, be necessary for them to still apply the hand-operated track brake, which should be imperative, and irrespective of whatever type of brake is decided upon, to put it in in addition to the track brake. The track brake should be imperative, and always used on down grades. I have been over the whole system of the Auckland tramways, and I went to the Ponsonby depot this morning and inspected the various types of rolling-stock, also cars 75 and 48. It would be possible to install the magnetic brake on the single-track cars, but you would have to sacrifice the mechanically operated track brake. On the double-bogie cars it would be impossible to install the magnetic brake unless you had new trucks throughout, and trucks specially designed to provide the necessary room for the magnetic brake. You would also require new controllers, and, in my opinion, it would be imperative to put in new motors. I do not think, from what I have seen, and the close inspection I have made this morning of the apparatus, that the motors at present in use would hold up the work of the magnetic brake, and you would have to sacrifice that very necessary provision, the hand-operated track brake. That applies to both types of cars. I have calculated it would cost to install the magnetic brake about £60,000, and to fit the cars with the air brake about £12,000. I do not think that expenditure is warranted, having regard to the Auckland conditions. I think the provision made by the company is all that is reasonable. It should be remembered that the company have to carry the risk and have to pay for any trouble, and I think they have entered into this question very carefully indeed, and I doubt whether the British Board of Trade in England would allow the cars such as we have in Adelaide, without insisting on the provisions of the mechanically operated track brake. I want to lay great stress on this point, and I do not wish to be misunderstood: On a very steep gradient, where a man stops his car and then applies the magnetic brake he has got at the same time to go through the work of applying the hand wheel brake, to hold this car. I maintain that this is not desirable, as a man should be able to handle his car by the application of one lever; he should be able to stop and hold the car at any one point. If you tell him he has to pull one lever to slow the car down, and then operate another lever to stop it, you are bringing in a risk which it is not desirable to bring in. I understand the company in Auckland have agreed to install all its cars with the air brake, and retain the track brake, and I think they are doing really more than they should do—in other words, they are going out of their way, spending a lot of money, in order to provide the men with extra facilities. At the same time an extra brake is an extra safeguard. If you apply the air brake to the cars, you have five means of stopping the car. I do not think the company could

do more than that, having regard to the safety of the public and the convenience of the men. I think the combination of the air brake and the track brake is the best and safest system that can be adopted in Auckland. In my opinion they are sufficient to meet all the service conditions in Auckland. I do not think—a car travelling down College Hill at thirty miles per hour, and the air brake alone being allowed to be used—that you could expect the car to be pulled up in less than ten car-lengths. It was an abnormal condition, and absolutely unlikely to occur in ordinary working, unless the motorman had lost his head, and then you never know what a man might do. The track brake has to be applied before negotiating the down grades, and under ordinary circumstances it is unlikely that the car would ever attain such a speed on such a grade, and I say it is unreasonable to expect the brakes on the car to hold it. The track brake should be used: it was unreasonable to call on the air brake to attempt to hold the car. The magnetic brake under ordinary conditions would not work at such a test for the reasons given, necessitating the restrictions as to limiting the speed before the magnetic brake is used. I should like to explain the necessity for limiting the speed: the reason is, the voltage generated by the motors is proportional to the current that is passing through the fields, and the speed of the car; consequently, to limit excessive current it would be necessary to provide more resistance in the magnetic-brake circuit. The magnetic-brake shoes of the latest pattern are saturated with a current of 20 amperes. At a high rate of speed, if the magnetic brake is suddenly applied, it is possible to get up to 350 amperes on the brake circuits. No motor would stand that, as, with the sudden application and the sudden generation, the current, instead of taking the proper path, would flash over the brushes. I know the Thompson-Houston magnetic brake. The general observations I have made apply equally to any other form of magnetic brake.

By Mr. Rosser: The Auckland cars, being equipped with the present hand-brake and the hand track brake, are already sufficiently equipped, in my opinion. I have seen a great many of the cars in operation, and have travelled on them at various time, and have always been satisfied with the manner in which the brakes acted and the way the stops were made. I cannot say I should be surprised if you told me that twenty-seven motormen on the previous inquiry declared the brakes to be inoperative, unless I heard their statement as to the conditions. I should not be surprised if you told me that one man was killed at Karangahape Road on a greasy rail one Saturday night on a slight up grade, and that the car travelled some distance afterwards. I should say that the men you refer to were medically unfit. I should certainly be surprised to know that six men are now suffering from the working of the brakes, by abdominal strain, appendicitis, or rupture. I am not surprised that men ask for a more powerful brake to ease the physical strain. If the men can get out of unnecessary work, they will. I really do not think the application of the hand-brake is likely to be the cause of such serious results unless the men are physically unfit. It may be the case that they have to produce a doctor's certificate before entering the service, but at the same time I do not think the operation of the hand-brake can be held to be responsible for the cause of these strains. I have had no cases like that through the operation of the hand-brake.

By Mr. Wyllie: I have had no experience of the pneumatic-operated track brake, and can give no opinion on it.

By the Chairman: I carried out some experiments at Pittsburg on the ordinary tram-lines. The cars there are equipped with the magnetic brakes. I have the results of those experiments, and can let you have them, also results of those I made at Glasgow. They were made under ordinary service conditions. I had many cars at my disposal, and took them over the various grades, and satisfied myself as to the operation of the magnetic brake. In Pittsburg the conclusion I came to was that, although the brake was an admirable one in ordinary cases, it was inadvisable to use it as a coasting brake. On one line near the river you get a long coast of a mile and a half or so, and I found it was not advisable to coast on the magnetic brake unless the motors were provided with increased capacity. In Adelaide, where there is no grade whatever, I have provided 10 per cent. extra capacity on the motors, and I have prohibited the use of the magnetic brake in coasting down those grades—which rule also applies to Sydney. You suggest that if we took a car fitted with a rheostatic brake, and allowed it to coast, the current generated by the motors would be less than the current required to be supplied to them on the upward grade: that would all depend on what resistance there is in circuit, as it follows that the amount of current is regulated by the amount of resistance in circuit. The result of the experiment I made last week was that the current in some cases exceeded 350 amperes. It appears from a theoretical basis that the current when coasting down-hill should be less than the current taken up-hill. It is a fact that we do get, under ordinary service conditions, much more current than we estimate in our calculations. The magnetic brake would take less current than the rheostatic brake to give the same retardation. With the magnetic brake you have three retarding efforts—firstly, you have the negative torque on the motors; secondly, you have the friction of the shoes on the wheels; and, thirdly, the friction of the shoe on the rails. Yes, I agree with you that the Newell magnetic brake should take less current than the pure magnetic. You ask if it is not accepted that the current taken in coasting, comparing the rheostatic pure magnetic braking and the combined magnetic braking is in the ratio of 1, 3, and 5: that has been found as the result of experiments; but the results of experiments are usually different from those obtained under service conditions, where you have to take into account the human element. We train our men how to use the seven brake notches, and they are told certain speeds for the application of each notch; but they do not follow those instructions, and the current generated is greater than under the conditions of experimental test. We found that by putting ampere-hour meters in the brake circuit there was a difference of 50 per cent. in the current generated by the motors by one man as compared with another man. That shows that the test conditions cannot be compared to service conditions. As to a double-decker coasting down a gradient of 1 in 13, and the consumption being only four

amperes on test, I doubt if I should get that result. The current required for full saturation with the new type of longitudinal shoes in which the pole pieces are parallel, and the flux passes through the rail transversely, is about 25 amperes. On the Dunedin system the motors are 48-horse power, and there the current is often over 200 amperes when starting. We have 46-horse-power motors in Adelaide, and we find the motors often generate up to 160 amperes per motor; but the average is from 40 to 80 amperes for the two motors. It may be that the current should not exceed 20 amperes, but it is not my experience, as in ordinary conditions I get 50 or 60 amperes through the men putting the controllers round to the fourth or fifth notch, when they should not go beyond the first or second. With the magnetic brakes we have eight ohms resistance, and it is divided over the seven panels. We find the resistance of the brake circuits is about 0·125 ohms. Often a man may rush his controller-lever round to the seventh brake-notch, in which case there is only a very low resistance in circuit, and the current would be excessive even with a fair rate of speed. We find that stresses on the motor due to the ill-usage of the brake are very severe indeed. I have put cars on to certain runs, and taken careful records of the temperature, allowing the man to make all his stops during the day with the magnetic brake, and the next day I had sent the same cars out with the same motorman, with limitations as to speed at which the magnetic brake was to be used, and I found very great difference in the temperature of the motors. I can let the Commissioners have the records of those experiments. There is no literature to tell how or why it is necessary to put in a larger capacity of motors than is necessary for traction purposes. We are told that the average current generated by the motors is exceedingly small, but we cannot get those conditions in the service. I have made actual tests on the service which bear out my statement. Only last week I put a recording ammeter in the brake circuit on a car, and sent it out without the man knowing, and the ammeter indicated 350 amperes. I want to impress upon you I am not condemning the Newell magnetic brake. I would use it in Adelaide and Dunedin, but would not use it in Auckland or Sydney. I would not use it as a coasting brake. I know the method of operating the track brakes on the Auckland tramways. To operate the track brakes by means of air, rather than a hand-wheel and a screw, would save the necessity of operating the hand-wheel, but I do not see any special advantage gained by that. The track brake is only operated in coasting down grades. That means that the driver has to turn the hand-wheel when approaching the down grade, and turn it more when he has to make a stop, and to make it operate pneumatically means a considerable expense. You would have to have a motor- or axle-driven compressor, and I do not see what advantage you would gain by applying such a system to the track brake. I think if the company here, as a result of the special conditions in Auckland, agree to put in the air brake, it would provide their cars with everything that is necessary, and they will do all they possibly can do. They are reducing the work of the motorman, and allowing him to give more attention to his other duties. I am aware that the Westinghouse people are having a hand-attachment for coasting. That type of brake in a hilly district would cause extra work on the motors, because with the magnetic slipper brake you have to use the iron shoes. I think the track brake with wooden slippers is most effective. I do not think the magnetic brake plus the hand-attachment is suitable here, because you must provide for extra capacity of the motors if you use that brake, as I have said before. I think it is a good thing to apply where you have the ordinary type of magnetic brake, but you could not apply it here—it would be impossible to do it without "scrapping" very much of the machinery. If you provided the magnetic brake with mechanical attachment as you suggest, the motorman in nine cases out of ten will neglect to use that mechanical attachment, and by neglecting to do so it would throw the work on the motors just the same. They very often disregard the regulations, I find.

The Chairman.—I think the most convenient day to open in Wellington will be on Monday week, but we cannot definitely fix the opening-day at Christchurch yet.

Commission adjourned.

WELLINGTON, TUESDAY, 3RD MAY, 1910.

The Commission sat at 10.30 a.m.

Mr. J. O'Shea appeared for the Wellington City Corporation Tramways, Mr. M. Myers for the Auckland Electric Tramways Company (Limited), Mr. A. Rosser for the Auckland Tramways Employees' Union, and Mr. E. J. Fitzgibbon and Mr. W. L. Jones for the Wellington Tramways Employees' Union.

The Chairman.—This Commission, appointed for investigation as to the efficiency of the Auckland Tramway Company's brakes, will now open here. I think it is desirable that the clause dealing with the scope of the Commission should be recapitulated.

The points set out in the terms of the commission for adjudication were duly read by the Secretary.

The Chairman.—Evidence has been brought forward in Auckland by the Auckland Tramways Company with a view to showing that the magnetic brake is not a suitable brake for use on steep gradients. The magnetic brake is installed in Wellington and Dunedin, and the Commissioners propose to ascertain what have been the results of the practical working of the magnetic brake in both places and of the air brake in Christchurch. As the Commission will not sit in Dunedin the Commissioners will call Dunedin evidence as to magnetic brakes at the Christchurch sitting.

Mr. O'Shea.—I suggest that before taking evidence the Commissioners should have a practical test made of the magnetic brake here. The Council is prepared to put cars at the service of the Commission for this purpose.

The Chairman.—The Commissioners would first like to hear expert evidence as to the efficiency of the brakes in actual service on the Wellington tramways and elsewhere. There have been a large number of tests of the magnetic brake in different portions of the world, and its stopping-power is well known; but what the Commission desires to know is what results have been attained by the use of this brake—as to its durability, efficiency, and reliability.

Mr. O'Shea.—I propose to call Mr. Cable on this point. Mr. Stuart Richardson, being a member of the last Commission which sat in Auckland, would prefer that the Commission see their way to examine Mr. Cable instead of himself. Mr. Cable, who is Assistant Electrical Engineer to the Wellington tramways, is familiar with the working of the magnetic brake in England. If the Commission desire to call Mr. Richardson, I would ask the Commissioners that, in view of the previous Commission, they strictly limit Mr. Richardson's evidence to his general opinion on the magnetic brake as working in Wellington.

The Chairman.—The Commission has decided that it will be necessary to call Mr. Richardson. The Commissioners do not consider the fact that he was a member of the last Commission affects the matter, as he is Engineer of the Wellington tramways, and the engineer of the Auckland Tramways Company has been called; and it is proposed to examine engineers of the other tramway systems of the Dominion. No reference to the finding of the last Commission will be permitted.

Mr. O'Shea.—I am not quite clear as to the attitude which the Wellington Tramways Employees' Union intend to take here, and I thought therefore it might be better if their evidence was given first, as I should like to know what evidence we shall require to call.

Mr. Fitzgibbon.—On behalf of the union I may say that we intend to take up a passive attitude. If there is any evidence called by the Corporation with which we are not in agreement, then we request the right to call rebutting evidence.

The Chairman.—If the union adopts a passive attitude it seems to be a very correct one. I do not think the union is much concerned in the collection of information as to the working of the magnetic brake by the Commissioners, but the union may be able to assist us. I understand, however, that the men here are not bringing forward any particular complaints against this brake.

Mr. O'Shea.—I propose to address the Commission generally on the attitude the Council takes up, and then to call Mr. Cable and other officers, with leave to call such further evidence in rebuttal of any statements made by the union as may be thought necessary. I may say that, as far as I can see, any conflict between us and the union is improbable if side issues are not brought in.

Mr. Myers.—I should like to ascertain what the position of the Auckland Tramway Company is so far as the Wellington evidence is concerned. The evidence called in Auckland, so far as the company is concerned, was confined to the question of what is the best brake, having regard to the conditions existing there, and the Commission had the opportunity after I left Auckland of making very exhaustive tests. The question I wish to put, and which the Commission may see its way to answer, is this: Is the evidence which the Commission desires to call with regard to the Wellington and Dunedin systems limited to those cities, or to the last clause of the scope of the inquiry, or does it have any immediate bearing upon the question as it exists in Auckland? The answer to this question may affect the attitude which may be taken up on behalf of the company here. We do not make any attack upon a particular brake or upon a particular system of tramways, but we desire to confine ourselves to the main question—namely, that of the best brake for the Auckland system.

The Chairman.—The previous Commission reported in favour of the use of the magnetic brake in Auckland. This Commission, when there, heard a considerable amount of evidence, and in the evidence which was led by yourself on behalf of the company statements were made to the effect that the magnetic brake was not a suitable one, having regard to Auckland conditions. Statements were made by witnesses that the magnetic brake had very serious faults when used on steep gradients and at high and low velocities. The Commission listened to the evidence which was led with regard to the superiority of the air brake and of the hand-brake, and also to the evidence which was brought forward against the adoption of the magnetic brake. The latter brake has been in use in both this city and Dunedin for some time, and for their full information the Commissioners are desirous of knowing what have been the practical results of its working, on ascertaining which we shall have before us evidence on which to base the Commission's report. We are asked to recommend legislation accordingly. Legislation will probably be brought down, and therefore Wellington and Dunedin must be affected by that legislation.

Mr. Myers.—I submit it is sufficient for us to show that the air and track brakes are not less efficient than the magnetic brake, and I would ask if the Commission is to give some indication as to whether it is really necessary—I do not mean at this stage—for the Auckland company to call further evidence. We called a considerable amount of evidence before, and I really think there would be no impropriety in the Commission acceding to my request at a later stage.

The Chairman.—All the Commissioners are endeavouring to do is to arrive at a sound basis on which to formulate their report, and the question of calling evidence must be left entirely in your hands. We are quite prepared, however, to hear any evidence which you may bring forward; but to give an intimation as to whether sufficient evidence is called would be practically to indicate the lines upon which the Commission's report is going to be framed. The Commission will, however, consider the point.

Mr. O'Shea.—In making my suggestion that the Commissioners might personally examine the working of the brakes under conditions which they could see for themselves, I was impelled by some of the statements in regard to the magnetic brake, that it cannot be worked on steep

gradients and at very high speeds; but we consider that we are in an absolute position to disprove that by demonstration or tests. I might mention that in the evidence given at Auckland reference was made to accidents in England, especially at Sunderland, Birmingham, and Bournemouth; but I do not think the whole of the facts that gave rise to those accidents were laid before the Commission, as they do not appear in the evidence. The are all explicable, and attributable to factors which in no way affect the inherent value of the magnetic brake. We submit that this brake is by reason of its action alone one of the most powerful brakes installed, and that this is a factor which has to be considered in connection with safety. We consider that no other brake which is put on has the same effect as the magnetic, in which the shoe-action pulls the car to the rails. We do not wish in any way to refer to Auckland conditions, or to say anything directly against the air brake or what is contended for it there, but we wish to justify before the Commission the magnetic brake as used in Wellington, and we wish to state that we have, from our experience of this brake under the conditions prevailing here, a decided preference for it. We therefore ask the Commission, on the strength of such experience and of the views held by our experts, not to interfere with our present tramway system. We consider that we can put a case for this brake before the Commission which, as far as Wellington is concerned, will enable the Commission to say that it is perfectly satisfied with things as they exist here. We submit that we have enough gear on our cars at present to allow a motorman to have the full use and control of each brake, and that to install an additional brake would necessarily complicate the working of the cars and would interfere with the rapidity of action we have at present. We also consider, apart from giving an element of dubiety to a motorman's actions, that there is a danger, if any other brake were put on, that the hand-brake (which within its limits is in our opinion a reliable brake) would possibly be put out of action altogether. We shall put before the Commission the results of tests we have made on the Brooklyn line, and evidence as to our methods of inspection in the car-shed, and we shall also bring before the Commission the evidence of motormen and of officials of the Corporation as to the efficiency of the magnetic brake. I would like to refer to the Commission Mr. Kneeshaw's declaration, which was put in in Auckland, and I would draw your attention to the statement on page 25 of his evidence. You will notice there that Mr. Kneesaw does not give any direct reason for the removal of the magnetic brake; but we consider that there were two reasons for its removal—first, the Sydney people wanted uniformity in their tramway system, as it insures safety in this respect, that a motorman instinctively does the right thing when he is continually using the same type of brake; and, secondly, we have been informed that the reason why the magnetic brake did not please the authorities there was that it is an expensive brake to install and maintain. It was dispensed with not because of any defects therein, but because it was considered that they could obtain all that was required at less cost by the use of the air brake. I have in my hand a report of the inaugural meeting of the Australian Tramway Officers' Association, which contains a paper read by Mr. Brain—a paper read to improve the knowledge of his brother officials throughout Australasia; and I wish to refer you to Mr. Kneeshaw's remarks thereon in 1907, which I consider are much more valuable to the Commission as an indication of what Mr. Kneeshaw's actual views were on the magnetic brake before it was decided to discard it in Sydney for the reasons I have alleged. I merely refer to this in order to remove from the minds of the Commission any idea that Mr. Kneeshaw's statement is a condemnation of the magnetic brake after it was decided to remove it.

The Chairman.—There is a qualifying statement in Mr. Kneeshaw's declaration, that the magnetic brake when properly handled is very effective, but considerable care is required in training men to use it.

Mr. O'Shea.—I would point out to the Commission that it is not proper at this stage of brake-development to do away with the hand-brake, and that we would deprecate any proposal to dispense with it. I would ask the Commission, in consideration of the simplicity of the action of the hand-brake and of its safety (though circumscribed), not to interfere with our braking system in that respect. I would also point out to the Commission that the magnetic brake is used very largely in Britain, and we can quote from the rules of the Manchester Corporation to show that it is used as a service brake. It has been stated in evidence in Auckland that the magnetic brake is not used for service stops under certain conditions; but it is used here as a service brake, and we propose to show that it is so used in other systems. The Council asks the Commission to accept British practice as against American for the following reasons: First, in Britain the care of life and limb is more serious than in America; secondly, in America trailers are largely adopted, and for that reason the air brake is used; and, thirdly, there are no narrow-street difficulties to contend with in America, as in Britain. I also desire to refer you to the reports of the Light Railways and Tramways Association, and, in calling evidence, to refer you to some of the statements therein relating to magnetic brakes. I would draw your attention to the fact that Mr. Fell, who occupies perhaps the highest position in tramway matters, has consistently adopted and still continues this year to adopt in new cars the magnetic brake on the London County system, and I would also bring before your notice the marvellous effects which have been proved to be attained by this brake, in one case retardation amounting to 9 ft. per second per second. To refer more particularly to Wellington, we consider that in our system—especially with the narrow streets, with side streets coming on to the main line at awkward angles, and with our grade limit of about 1 in 12—the magnetic brake is the most efficient one for our service, and that, as far as the Council is concerned, we know of no brake which would give the same results under the conditions prevailing here. At Brooklyn the average grade is 1 in 14, and we have found the magnetic brake to act efficiently on that route even with the high strain that is put on the motors. I will now call Mr. Cable, Assistant Electrical Tramway Engineer, who will give his views on the magnetic brake and its working both here and in Britain.

MATTHEW CABLE sworn.

Examined by Mr. O'Shea: I am Electrical Assistant Engineer to the Wellington Corporation Tramways, and am an Associate of the Electrical Engineers' Institute. I have had eighteen and a half years' engineering experience. I entered Siemens's over eleven years ago, and was there two and a half years. I have had opportunities of inquiring into the working of the London and other large tramway systems, and have made it my business to make myself familiar with them. I am familiar with the working of the London County, Manchester, Bury, Glasgow, Dundee, and other systems. The Glasgow Corporation, London County, London United, and Manchester systems use magnetic brakes, though there are a few air brakes in Manchester. In the *Light Railway and Tramway Journal* of June, 1909, there is a statement that Mr. Fell, Electrical Engineer to the London County Council, has ordered a further 200 brakes. The magnetic is a service brake in London and Manchester, and on steep grades. In London the hand-brake is only used as an emergency. In the Light Railways Report (page 829) there is a summary of the advantages and disadvantages of the magnetic brake. An ordinarily careful man can make himself sufficiently skilful to apply the magnetic brake efficiently. There is a slight tendency to skid, but any kind of brake will skid the wheels. There is a corresponding advantage, that it is not dependent on the current. It is independent of the controller. The mechanism can only be adjusted by skilled labour, and there is a slight tendency to increased temperature; but this has never been increased to such an extent as to render the motor inefficient. I have never known a case where the brake has become ineffective owing to heat if the motorman uses the brake with care. At page 830 of the Light Railways Report it is stated that the magnetic brake is suitable where a high-speed is required and where there are frequent stops. It is also stated there that a retardation of 9 ft. per second per second can be obtained. In some instances the earning-capacity of the line will not warrant the expense of putting in the magnetic brake. My opinion of the magnetic brake is that for the conditions existing in Wellington it is the most suitable type of brake obtainable on the market, and that it is the most powerful brake. I have known of alleged failures and also of failures owing to slight defects taking place. During the last three years there have been only about four failures, and these were due to other causes than a defective brake. I know of several cases where good stops have been made by the magnetic brake and serious accidents averted, and it is necessary to have a powerful brake like this in Wellington. My opinion of the magnetic brake on the Brooklyn line is that it meets all the requirements for coasting down, as it is possible to pull the car up at the second notch. The Brooklyn accident was investigated by experts from the Corporation Tramways and the Public Works Department, and the conclusion they came to in respect of that accident was that they considered the magnetic brake was in good order, all the undergear having been dismantled. In my opinion the cause of the accident was that the motorman overran the points on a loop, and, finding another car on the line, reversed the controller and allowed the other car to pass, his own car then running down by gravity. Owing to the motorman's failure to put the controller back again, when the brake was applied it was found that it was useless. As to the collision in Cuba Street, Mr. Buckley and Mr. Holmes held an inquiry into that, and they both reported that the brakes were in perfect order after the accident. The hand-brake was in exceptionally good order. This is also my opinion, as I was present when the car reached the shed, and I ascertained that there was no interference with the mechanism of the brake. With reference to the accident at Swinton, referred to in Auckland, I was residing there at the time, and am well acquainted with the facts. The car was a new one, and was sent out before the brakes were properly adjusted. It was afterwards found that the braking-gear did not make a proper connection with the wheels, and the evidence clearly points to the fact that it was simply due to the mechanical portion of the brake, and that the traffic manager was aware that the car was not in perfect order. Our practice of inspection and examination in Wellington is sufficient to prevent any such accident occurring, where every night the cars are cleaned and the controllers and equipment examined. If any complaint is made about a car it is taken to the shed and examined carefully in every part. Accidents which have occurred in Wellington have not been due to the failure of the magnetic brake, except the Brooklyn accident, which I understand was due to improper handling of the controller. Originally the magnetic brake was installed in the United States, but it was discarded in favour of the air brake, and, as Mr. Fell has pointed out, the Americans have never tried the latest type of magnetic brake, which is far in advance of the old type. The magnetic brake can be applied to trailers, but it is not satisfactory, the air brake being especially suitable for this purpose. There are eighty-one cars in Wellington, but no trailers. According to our regulations, motormen are allowed to use the magnetic as a service brake as well as an emergency brake. The advantage of this is that the man using it for service stops knows exactly what to do in case of emergency. There have been allegations that the magnetic brake is largely a failure, and goes out of operation suddenly; but there have been no serious breakdowns of the magnetic beyond those mentioned. As to the heating of motors and its effect generally on the braking system, some cars which have been running on steep gradients come back to the shed in practically no warmer condition than a car running on the flat, as some motormen study the cars and others abuse them. We have no instance of the brake becoming defective through such ill-usage. I consider that, under the circumstances in which the Wellington tramways are run, and taking the speeds and narrow streets into consideration, this city has a low rate of accidents. The most serious accidents are due to people falling off or stepping on the car when in motion. The magnetic brake can be safely applied up to twenty-five miles an hour on the flat independently of a hand-brake, this having been done by me with a speed-indicator. My car was in good condition, and the commutators were clean. Mr. Kneeshaw's statement of Mr. Brain's article is generally commendatory of the magnetic brake. The effect of putting another additional brake into our system would probably confuse the motor-

man, owing to multiplicity, in case of emergency, as there would be a lever for each brake. With reference to the hand-brake, I am in favour of its retention, because, although it may go wrong, it is unlikely to do so. This brake is relied on in the smaller systems in England, where the grades are 1 in 16. It is only the large systems which can afford to adopt the magnetic brake. As an engineer I am satisfied that the magnetic brake is suitable for all purposes in Wellington, and I should be very averse to any departure from the present system. An additional brake is always a certain safeguard, but as against that I am inclined to think it would lead to confusion. The instructions issued to motormen are practically that they may use the magnetic brake with discretion as a service brake. As to the car tests made, the general result is that we get about two car-lengths with a speed of eighteen miles, which we consider a fair test for Brooklyn, under ordinary conditions. On the 22nd of last month a test was made, giving 21½ miles an hour according to the speed-indicator, and I consider the stops made were satisfactory. These tests have not yet been submitted to the Council. With reference to the accident at Bournemouth referred to by Mr. de Guerrier, according to the Board of Trade report the cause of the accident was that the controller was out of order, and one of the brakes used disconnected. These were defects which were ascertained by inspection and not remedied, and the car was allowed to run without the magnetic brake being in order; but that was not a defect of the brake. Generally, we prefer English to American practice, as life is considered to a greater extent at Home. I have read Mr. Goodman's evidence, which I agree with, except as regards the speed in using the magnetic brake for coasting. If a car's magnetic brake has been roughly handled, it is not possible to stop above a speed of fifteen miles an hour; but with a car which has been looked after and is in good order, there is no reason why the speed should not be twenty miles an hour or over. If I were going to install a new system in Wellington, I should prefer the latest type of magnetic brake. My conclusion is drawn from my Wellington and Home experience as to its working.

By Mr. Rosser: I have had no experience in the Glasgow tramways, but I had an opportunity of making myself acquainted with their working before I left for New Zealand in December, 1907. In Glasgow the magnetic brake is used solely for emergency purposes. With reference to Wellington, I have only known of four brake-failures in three years. A car that refuses to act I would term a brake-failure; not where a brake is applied and the car does not stop, as the car may have skidded. If the car skids it is not the failure of the brake, but of the application of the brake. The Hancock accident was followed shortly afterwards by more reported brake-failures than there have been since the Wellington trams started to run. Every failure was considered, and it was found to be an alleged failure only. There were five failures reported within twelve days, but I would not infer from that that the failures were wilfully caused by the motormen to secure sympathy with the motorman concerned in the above accident, as the men may have felt justified in reporting them as failures. It is a fact that there are instructions issued that motormen are to use the magnetic brake as little as possible, but that they may use it for service stops. Some motormen simply abuse the brake, but if it were always used properly there would be no objection to its being used continuously; therefore the men have been asked to use it at their discretion to save the motors—that is, to dissipate the heat generated by the motor being used for traction purposes as well as for braking purposes, a larger motor being required for traction purposes to allow for braking; and in the new type of cars we have 40-horse-power motors, which gives sufficient reserve for braking purposes. The smaller cars are 25-horse power, and they run up the Karori grades. It is understood that motormen must try the brakes when taking cars over, and in Manchester they are instructed to do so. Laying a car up for a few days would not affect the magnetic brake, as we have heard of a case where a magnetic brake refused to act from the Newtown depot to the Basin Reserve before the magnet became charged. This statement was made by a motorman some years ago in the Chief Electrical Engineer's office, but was not reported. This difficulty might happen at any time, and we have had cases where the cars have been standing over Sunday and the brake would not act when leaving the shed. I have never heard a motorman complain that the physical effect of using the hand-brake was too much for him, and I thought the complaints made on this matter in Auckland were perhaps due to the sudden stoppage of the car. If a car were going over twenty miles an hour on a down grade (at which speed, by the way, it ought never to travel on such grade), I would apply the magnetic brake. I agree with Mr. Goodman, the magnetic-brake expert, that this brake should not be used at a greater speed than twenty-five miles an hour, but a car ought never to get up that speed. I would, however, at first ease the car down with a hand-brake in order to bring the speed below twenty-five miles.

By Mr. Myers: The grades existing on the tramway systems in which I was engaged in Britain compare very well with both the Auckland and Wellington grades. The steepest grade here is from the despatcher's corner at the Government Railway-station to Mulgrave Street, and the average grade is 1 in 14. I have had experience in the working of a tram system in which the air track brake was installed. There is no tram system in England operated with air brakes acting on the wheels: there the pneumatic track brakes are solely used. I have had no experience in the Australian or American tram systems—my practical experience has been limited to systems where the magnetic brake is used. With reference to the cost of maintaining the magnetic brake, I do not agree with the experts who made estimates that the cost is a disadvantage, as the amount expended in maintenance is compensated for by the effectiveness of this brake. Their reports do not show a comparison between a magnetic and an air brake system, as they are based upon solely English conditions. I do not agree that there may be an intermittent failure of a magnetic brake, though it is possible that through some defect—temporary, if you like—the magnetic brake may not work at one moment and yet may appear to be quite efficient a few minutes afterwards. This is a possible, though improbable, explanation of accidents such as that at Brooklyn and Cuba Street, as nothing was found wrong with the brake afterwards. If I examined the

brake afterwards, when it was acting, I should find evidence of the defect which had prevented its acting a few moments before, and it is impossible for the brake to fail to act except through some defect which would be visible afterwards. Of course there are exceptions—for instance, with a car going at a very low rate of speed the brake would not act, and it might not act on a car which has been standing some time in the depot. If the electric circuit is in order the magnetic brake should not fail, and it is impossible under normal conditions for the brake to fail one moment, when properly applied, and yet be operative a few moments afterwards. Whenever there is an accident here the question is at once raised between the officers and the men whether the cause of the accident was due to brake-failure. Speaking generally, I come to the conclusion that the cause of the accident is due to the men, and not to the brake, when there is no visible evidence of a defect in the brake. This is the test I apply. I am prepared to say that the officers would prefer that the magnetic brake should not be used for general service stops, as the efficient working of it depends upon the manner in which it is used, and, seeing that every motorman cannot be depended upon, the frequent use of it is discouraged. With regard to the heating of the motors, it depends upon how the men drive the cars. Some cars come in from Brooklyn with the motors not heated at all, and these are generally the cars on which motormen do not use the magnetic brake. Others come in overheated; but they may be cars on which the magnetic brake has been used.

Mr. Myers.] That is to say, from a perfectly legitimate use of the magnetic brake on cars running on the Brooklyn line their motors may become overheated—I am speaking of your cars as they now are?—Yes.

Have you made tests with the magnetic brake on cars on the Brooklyn gradient; and at what speed?—The maximum speed at which I sent a car down the Brooklyn hill was about twenty-three miles an hour, according to the speed-indicator. I then used the magnetic brake solely; but I would not advise the use of it, as after one or two of such applications the motors would soon be gone.

In order that a demonstration of the working of the magnetic brake on an ordinary palace car might be made during the afternoon for the benefit of the Commissioners, the Commission at this stage adjourned at 1 p.m. till 10 a.m. on Wednesday, the 4th May, 1910.

WELLINGTON, WEDNESDAY, 4TH MAY, 1910.

The Commission resumed at 10 a.m.

MATTHEW CABLE recalled.

1. *Mr. Fitzgibbon.*] You made a statement yesterday in connection with the Brooklyn accident that the cause thereof was due to the motorman. Is it not true that the inquiry held by the Public Works Department did not arrive at any such finding, and that the finding was practically an open one, the motorman not being blamed at all?—I did not deny that. I was only expressing my opinion.

2. You made reference yesterday to certain alleged failures that were reported. Could you give me some idea of the number?—I cannot make a definite statement as to the number. A large number of men put in reports simply that the magnetic brake had failed.

3. Should I be correct in stating that there have been something like sixteen failures reported since the Cuba Street accident up to the present time?—I think twelve would be nearer the correct number.

4. With reference to these alleged failures, what have you found to be the cause for the most part, if there has not been a defect in the brake?—Skidding. I have examined the cars in every instance, but have questioned only some of the men, as they make a report stating all the facts. A motorman of, say, three years' experience ought to be able to tell when the wheels were skidding or when they were revolving.

5. Do you remember a case that was reported on the 28th July, 1909, of a car on Jervois Quay going about 150 yards after the application of the magnetic brake?—I have no record of it; but according to the Inspector's report the brake was found to be in order, and the alleged failure was due to the too quick an application of the brake, resulting in skidding of the wheels. The motorman's name was Maiden.

6. Then, your view appears to be this: If there is a failure reported, and you find no visible evidence of a defect in the brake, you come to the conclusion that the motorman is to blame?—My opinion is that when a brake is in good working-condition there is no reason for it to fail one moment and act the next, unless there is evidence that some peculiar phenomenon is present.

7. You stated yesterday that you had a thorough system of inspection at the sheds. Have you had any complaints from motormen or from their union as to the system of brake-inspection there?—Not recently. I have no recollection of any particular complaint about the inspection, but I will not make a straight-out denial. In my opinion the system of inspection at the sheds will compare with the very best systems in England—and I am familiar with those systems.

8. *The Chairman.*] Regarding the Brooklyn gradient, what is the practice in working that gradient? Are the cars brought down by the hand-brake, and the magnetic brake used as an emergency brake, or is the magnetic brake used as a coasting brake?—As a rule the magnetic brake is used as a coasting brake. There are a few men who use the hand-brake, but they are given the option.

9. Have you any record of the current taken in coasting down the Brooklyn grade?—We have taken several tests of this on palace cars. When this route was first started it was only intended to use box cars.

10. With the cars now in use, can you, from memory, state what is the approximate amount of current taken for coasting down steadily at seven miles an hour?—I should say about 45 amperes.

11. You mentioned that the temperature of the motors had been taken after running: was this done only in a few instances, or have you made a practice of it?—It was only done for experimental purposes.

12. In what way was the temperature taken, and where were the thermometers put in?—The thermometer was laid on the commutator, and was protected outside.

13. Do you know from your own observation or experiment the saturation current taken by the magnets of the brake?—We have no particulars, but from recollection I estimate the current to be about 35 amperes. This is an old type of magnet, and it has a very long circuit.

14. You say that you have used the magnetic brake up to twenty-five miles an hour on the flat, and have made good stops. Have you had any difficulty in making stops, and have any of them been failures?—There have been failures, but I should not care to make more than one or two stops at that speed, as in a test of twenty-five miles an hour the motors must be in perfect order.

15. You are aware that a failure to stop occurred yesterday when the magnetic brake was applied?—That car had been out all morning, and it may have been handled pretty roughly.

16. To what do you attribute the failure of the brake to act?—To flashing over the commutator. I did not inspect the car afterwards, as it would be inspected in the evening.

17. You did not consider the matter of sufficient moment to inspect the car?—No. The car is still in use, and it was cleaned up last night after it was returned to the shed.

18. You attach no particular moment to the failure of the brake?—Not in a case like that. For ordinary running I consider that twenty-one miles an hour is about the limit at which the magnetic brake will act satisfactorily in practice. The car in question worked well during the remainder of the trip, and there was nothing to indicate that it was in any way out of order. I attribute the failure to stop to flashing over the commutator, and consider that such failures are liable in speeds exceeding twenty-one miles an hour with emergency stops.

19. Your cars are fitted with a hand-brake, which acts upon the wheels. The action of that brake is to a certain extent opposed to the action of the magnetic brake. You are aware that the Westinghouse people have lately introduced an improved attachment to the magnetic brake. If you were equipping a hilly system with magnetic brakes, which would you prefer: to add to the magnetic brake the attachment for coasting or to retain the present ratchet or wheel brake in preference?—I would adopt our present system, together with the improved attachment to the magnetic, which is now being used in the cars working on steep grades in London.

20. Is the speed of twenty miles an hour approached on any of your lines here?—Our Order in Council does not permit us to run over fifteen miles an hour, but the cars are capable of exceeding this limit.

21. Have you heard of any cases of the magnetic brake failing to act when the car has started from the depot after a period of rest?—Three or four cases have been reported.

Mr. O'Shea (to the Chairman): I gather from your question as to the adoption of the new type of magnetic brake that it is proposed to do away with the hand-brake if you apply that attachment.

The Chairman: I think the witness understood my question clearly, that the attachment to the magnetic brake did not mean the abandonment of the present hand-brake.

STUART RICHARDSON sworn and examined.

1. *The Chairman.*] You have had considerable experience with the magnetic brake here?—Yes, the magnetic brake has been installed here since the inception of the service.

2. In evidence given in Auckland certain defects were alleged as being peculiar to the magnetic brake. One was that it was more or less unreliable owing to the fact that some portion of the brake gets out of order, there being no indication to the motorman that such was the case; and the other was that a motorman had not, as a rule, the same confidence in the brake that he had in an air brake, where he had the pressure-gauge before him. Speaking generally of your experience here, do you find the magnetic brake a reliable contrivance?—Yes. The magnetic brake when used as a service brake would show any fault. The brake is used here as a service or emergency brake, and a man must know if his brake is in good order.

3. Is it possible that a man might keep his magnetic brake in reserve, and use the hand-brake, and that the magnetic brake might fail when required?—It might be possible, as much as any other brake might get out of order and fail. The same might be said of the air brake. The magnetic brake is only an optional service brake. It is not a compulsory service brake.

4. Witnesses have stated that the magnetic brake is very liable to failure by skidding. Have you found that to be the case?—That very much depends upon how the brake is applied.

5. It has been stated that the brake is only serviceable at a limited range of speed, and that below three miles an hour it is inoperative, the necessary current not being present, and that at anything much above eighteen miles an hour it is liable to fail by short circuit. Does that tally with your experience?—After a car has been in service for some time I think the limit of speed at which the brake should be applied would be eighteen or twenty miles an hour; but if the commutator is clean and the car has just been taken out of the shed, the speed might be increased and the car would brake well. In ordinary service I consider that practically the speed-limit for the usefulness of the magnetic brake is between three and twenty miles an hour.

6. It has been stated that in hilly districts where the magnetic brake is in use it has been necessary or advisable to provide additional capacity in the motors to compensate for the heating of the braking current. Does your experience tally with this?—It very much depends upon the type of motor that is used. We have had no trouble with the motors that we are using now. There are two types of motors in use—25- and 40-horse power. We have never had any trouble with the motors from overheating, although it is known that they do warm up owing to working the magnetic brake on the grades. To compare Wellington with other places, we only have one man to repair armatures, and you can therefore understand that our motors have not been used much. I believe that any brake is liable to failure, and that the magnetic brake is not more liable to fail than the air brake or any other brake. But the most reliable brake of the whole lot is the hand-brake, which has fewer parts than the others. With regard to the other brakes, I think that the magnetic brake would compare favourably with them.

7. *Mr. O'Shea.*] As Manager of the Wellington Corporation Tramways, are you satisfied with the brakes as they exist?—Yes.

8. Having regard to present-day knowledge of brakes, how would you view any attempt at alteration?—I should have no objection to putting on another attachment to the magnetic brake, but I should not be in favour of any other alteration.

9. Are there any conditions in Wellington which make the retention of the magnetic brake, in your opinion, necessary? The narrow streets, the sharp curves, and the speed at which the cars are run I think make it necessary that we should have a very powerful brake in case of emergency.

10. Do you consider there is any additional factor of safety, as comparing it with other brakes, in the fact that there is a magnetic attraction through the brake used to the rail?—No; I do not think this is an additional factor of safety.

11. Do you know of any means adopted in Wellington to prevent the flashing over the commutators; and as the result of your experience, what steps have been taken?—We have insulated the commutators, but it has not been done in all the cars yet.

12. *Mr. Myers.*] Your actual tramway experience has been limited to Wellington, so that you have had no experience of the working of any brakes other than those used upon your own system?—That is so.

13. You have consequently had no experience of the working of the air brake. Have you ever made any tests with the air brake?—No.

14. *Mr. Rosser.*] The effect of the application of the magnetic brake in an emergency stop is very severe, is it not?—Yes.

15. Is it severe on the car-equipment and also on the passengers?—Yes.

16. Apart from the shock to the feelings of the passengers, have you ever had any complaints from passengers about being injured by the magnetic brake?—Yes. Passengers have been thrown down, and compensation has been paid, but not to any great extent.

HOWARD LEAH sworn and examined.

1. *Mr. O'Shea.*] As Superintendent of the Wellington Tramway Car-sheds, what is your opinion of the magnetic brake as used here, and do you know of any cases of its failure?—My opinion is that it is a very reliable brake. I only know of two cases of failure during the last six years.

2. Statements have been made about intermittent failures—that the brake would fail to act, that subsequently it would operate, and that afterwards there would be no defect discoverable in the brake. Is this correct, in your opinion?—No; unless when coming from the shed in the morning the motors fail to act for a short period could be called a defect.

3. What is your system of inspection of the brakes at the shed?—If a brake is supposed to be faulty, or an alleged failure, the car is not touched by the night shift, but is left for the day shift to overhaul.

4. How do you test the brake?—The shoes are tested by connecting them to the overhead wire, which passes through an armature, to see the amount of current that is taken to compel the shoes to drop on the rail.

5. I understand that you have duplicated the leads in the shoes?—We have made an alteration in the original method by which the lead after going round the coil comes on to the brake-shoe.

6. Have you adopted means to cope with the flashing over the commutators?—Yes. We have insulated the cone, so that the flashing cannot take place over the commutator. The insulation is on a portion of the cars, and we are gradually altering the others.

7. Do you get many allegations of failures of the magnetic brake from time to time which are not correct?—Yes, we do get reports.

8. Do the cars work efficiently afterwards?—Yes, they have done.

9. *Mr. Rosser.*] Reports of anything wrong in the equipment are first of all sent to you?—The sheets are examined by the night foreman, and from him they are sent to me.

10. Have you had much trouble from the commutators arcing—as this is what has to be looked into in case of failures?—Recently we have had.

11. Am I to infer from your answer that the trouble with the commutators is owing to the age of the equipment or to this Commission being held?—It is just the natural order of things. In fact, with the 40-horse-power motors we have had worse trouble in this respect than with the 25-horse-power. The equipment is inspected each night, but the controllers are inspected every other night. I have been present at the investigation of these alleged brake-failures, and have examined the cars, and I attribute most of them to skidding, as I found that the commutators were in good order. I am speaking now of failures, not weaknesses.

12. How would you define the difference between a failure and a weakness?—I should consider that if a brake will not act on the motors it is a failure, but that if a brake will not act with the first or second notch, but with the third, it is a weakness.

13. We have instances in your service where the brake fails to stop the car at the sixth notch. Would that be a failure or a weakness?—It depends upon the speed of the car.

14. *Mr. Fitzgibbon.*] Is it not a fact that there are some motormen whose reports you take notice of and others whose reports you do not notice at all?—No. Of course, one can take more notice of some men than of others, but that does not say that one would not take notice of any one. I do not discriminate. It is natural that one can certainly put more reliance on some men's version of a matter than others, and I do to a certain extent; but one must take notice of every one.

15. If a car failed to stop on the sixth notch, what would be the speed at which it might fail?—I should say about two or three miles an hour.

16. *The Chairman.*] You mentioned that you only knew of two absolute failures of the magnetic brake?—One of them was previously mentioned by Mr. Cable, regarding the reverse bearing coming loose, and the other was when I took out a car myself to test for loss of residual magnetism in the motors.

17. You were on Car 62 yesterday when the brake failed to stop it?—Yes. My opinion is that the wheel skidded, as I could hear it inside. If there was a flashing over the commutators, of course, they would lock. If the wheel skidded I would not class it as an absolute failure. The car in question had been specially insulated on the cone.

18. What do you consider the limits of effectiveness as regards speed?—About three miles to eighteen and twenty miles an hour to be safe, although we have stopped at about twenty miles an hour.

19. If a car were running on a down grade at about twenty-five miles an hour, is there a chance of the brake failing to act?—With the magnetic brake alone it is possible to flash over. It flashed over yesterday, and the wheels skidded. I admit that the flash-over is the primary cause.

20. *Mr. Beattie.*] Touching the admitted failure of the brake to stop the car yesterday, suppose the motorman had attempted to make the same emergency stop in order to avoid running into a vehicle coming from a side street, would you have considered the brake a failure, or would you have blamed the motorman for having failed to properly apply it?—With reference to yesterday's case, the brake was really improperly applied. I asked the motorman the cause of the failure, and he told me that he had some difficulty in applying the brake through one of the Commissioners being on the platform and not giving him enough room. He said, when bringing the controller-handle round his arm was impeded.

21. *The Chairman.*] When the speed-indicator showed twenty-one miles an hour, the motorman came on the first notch and afterwards pretty quickly on to the second. If I had retarded him in any way it would have stopped him from getting on to the second notch as quickly as possible; but, as a matter of fact, he had sufficient room even though I was standing on the platform. There is no doubt that there was a flashing over the commutator, and there may have been subsequent skidding, but that was not from the sudden application of the brake. Do you agree with that?—Yes; I could not see how his application was made.

22. *Mr. Beattie.*] Assuming the incident yesterday to have been an actual emergency, where the car must be stopped in the quickest possible space of time to avoid collision, would you as a tramway expert consider that brake to be reliable under those circumstances?—If he applied the brake too quickly, then it is hardly the fault of the brake; but if he took the first notch and gave it time, and the brake failed to act, then, of course, the brake would not be reliable. Twenty-one miles an hour, however, is hardly the speed that we come down an incline like that, though the speed is safe in ordinary service.

23. If an accident had happened as the result of yesterday's failure of the brake to act—the brake having been put on in an emergency, and having failed to stop the car—would you blame the motorman or the brake?—I should make an examination of the wheels, and if I found that the car had skidded I should naturally consider that the brake was defective.

GEORGE ERNEST JAMES, Traffic Superintendent, Wellington City Tramways, sworn and examined.

Examined by Mr. O'Shea: I have been Traffic Superintendent since the inception of the service, and have had twelve years' railway experience in South Africa. I have seen the operation of the magnetic brake, and am familiar with cases where it has acted as an emergency brake. Having regard to the circumstances, I consider that it is an effective brake for the Wellington service, and as reliable as any other I know of.

1. *Mr. Myers.*] In your opinion, it is as reliable as any other brake. What other brakes have you had experience of?—I have had experience in the working of the vacuum brake on the South African railways. I know of no brake that is infallible. I have had no other tramway experience than that which I have had here, and I have no technical knowledge.

2. *The Chairman.*] Would you put a limit to the range of the magnetic brake's efficiency as regards speed?—I do not think it would be advisable, if a car was going at a very high rate of speed, to apply the magnetic brake to its full extent, as the wheels may then have a tendency to skid; but I have seen it applied up to twenty miles an hour.

3. Would you absolutely trust the brake at twenty and three miles an hour?—Yes, and I should trust it at a speed lower than three miles an hour; but I do not think there would be then any necessity for it.

4. What is the outside limit, as far as high speed is concerned, in which you would give up the magnetic brake and turn to other means for stopping the car?—I do not think I should resort to other means in any case, but I should expect the magnetic brake to act up to any speed.

5. *Mr. O'Shea.*] What emergency do our motormen use under three miles an hour?—The second—that is, reversing the motors; and in my experience it has proved the means of avoiding accident.

Mr. O'Shea.—Mr. Fitzgibbon says the union is generally satisfied with the magnetic brake, and therefore the Council does not consider it necessary to call motormen's evidence on the matter unless the Commission desire it.

Mr. Fitzgibbon.—I appear simply to protect the motormen when evidence is given which we do not think correct, and which may be detrimental to the union.

Mr. O'Shea (to Mr. Fitzgibbon).—I understand the union are generally satisfied with the brakes?

Mr. Myers.—If a statement of this kind is made it should be given in the ordinary course as evidence, as I wish to have an opportunity of cross-examining upon it, as to what the attitude was on a certain date, what it is to-day, and why it has changed in the meantime; and I decline to be bound, as far as I am concerned, by statements made to the Commission in this way—as to what the present circumstances are.

Mr. Fitzgibbon.—The union is taking up a passive attitude in this matter.

The Chairman.—Mr. O'Shea's position is that the Council does not desire to call any further evidence unless the Commission wish to do so.

The Commission adjourned at 11.30 till 2 p.m.

The Commission resumed at 2 p.m.

RICHARD ROGERS HAWLEY, Motorman, called by Mr. O'Shea, and sworn.

1. *The Chairman.*] Do you remember coming down a declivity beyond a tunnel on the way to Seatoun? I was on the platform, and you were taking instructions from me. I signalled you to stop, and what did you do then?—I applied the magnetic brake as instructed. I gave the first notch, and was going to give the second notch when my hand came in contact with you. I then started to take up the hand-brake, and you moved back on to the rail. I did not mention the matter to you at the time.

2. The fact of your arm coming in contact with me retarded your movement in putting on the brake?—It prevented me from striking the notch clean, as I ought to have done. I came on to the second notch afterwards. In my opinion the car skidded slightly until I took up the hand-brake and the magnetic brake was released.

3. You attribute the failure of the magnetic brake on this occasion to the fact that you could not get on to the second notch as quickly as you wished to?—I did not say that the brake failed to act at all.

4. We have evidence before us that the brake did fail to act. You say the brake did not fail to act?—I cannot say that it was a straight-out failure, and under ordinary conditions I would have pulled up the car and could have made a fair stop. I have never before had a brake-failure under similar circumstances, and I have no actual knowledge of any brake-failures having taken place.

5. I thought you mentioned to me on the car that you had known the brake to fail in a similar way in the Brooklyn trials?—I said I had known it to flash. I never mentioned that it had failed. I do not call yesterday's occurrence a failure, seeing that the car took the brake as she ought to have taken it, although she flashed, which I ascertained from the controller.

The Chairman.—The witness's recollection of the incident hardly agrees with mine, as there was another stop that was made before, and he is probably confusing the two. His statement that he came on to the second notch too quickly hardly coincides with his statement just now, that he was retarded in doing so by coming in contact with me, but no doubt he was flurried under the circumstances.

Mr. Beattie.—For the information of the Chairman and others present, I might mention that I was standing in the front smoking-compartment of the car, immediately behind Motorman R. R. Hawley. From time to time Professor Scott gave signals for emergency stops to be made by Motorman Hawley, and I was taking time with a stop-watch. With regard to the incident in question, I saw the whole of the action, and wish to state that Motorman Hawley is under a misapprehension if he thinks his elbow or hand came in contact with Professor Scott, who was standing alongside him. On Professor Scott giving the order to make this stop Motorman Hawley swung the controller-handle round smartly, but neither his arm nor the controller-handle came in contact with Professor Scott.

SAMUEL BLACKLEY sworn.

Examined by Mr. Myers: I am manager for Turnbull and Jones (Limited), and am an electrical engineer of sixteen years' standing. I have lived in Auckland for three years, and am well acquainted with the conditions of and surrounding the Auckland tramway system, and have paid particular attention thereto.

Mr. Myers.] You know that the company has at present a ratchet hand-brake and a track brake apart from the electric brake installed in the cars. Can you express an opinion upon the suitableness of an air brake operating upon the wheels plus the track brake for that system?—For the Auckland conditions I should say that an improved form of air brake in combination with a track brake would be first-class in view of efficiency and safety.

At 2.30 p.m. the Commission decided to formally adjourn till 10 a.m. on the following day, Thursday, 5th May, 1910.

WELLINGTON, THURSDAY, 5TH MAY, 1910.

Mr. Fitzgibbon.—The union has asked me to bring under the notice of the Commission certain considerations which we submit appear from the evidence. We merely make these considerations to bring more prominently under the notice of the Commission certain facts that we submit have been supported by evidence already tendered—that in connection with the brakes there is a strain thrown on the motormen through the constant use of the hand-brake in conjunction with the magnetic brake; that cars are liable to sudden failure, the cause of which may be detected at the time of examination, but that the self-same cars will in a few minutes afterwards act properly, and the fault may not be detected; that the brake will fail on cars leaving the shed, and the car may be out of control for some time; that the brake will or may fail on application of the first notch, and so render the motorman helpless as far as stopping the cars are concerned. We contend also that, with regard to the reference to failure on the part of the brakes through rough usage on the part of motormen, failure may be put down at times to efforts on the part of the motormen to run up to a fast time-table, the equipment being abused through his efforts to keep a fast time-table, and not through any fault on his own part in unnecessarily roughly using the mechanism. These are the only points that we desire to enunciate.

Mr. Myers.—As I find it practically impossible to attend at Christchurch in consequence of this Commission having occupied a longer time than was anticipated originally, and of the fact that there is a long criminal sitting commencing on Monday next in Wellington, where I have to prosecute, I, with your permission, would like to address to the Commission at the present stage such observations as I desire to make upon the evidence which has been tendered up to the present time. I do so for the reasons I have indicated, and also for the further reason that, as far as one can reasonably foresee, no evidence can be given at Christchurch and nothing can happen at Christchurch which can really affect the position of the Auckland tramway in connection with the present inquiry. I think it is due in courtesy to the Commission to explain, as I have done, the reasons why I shall not be appearing, as I have appeared up to the present time, before the Commission in Christchurch. I propose to arrange for the company to be represented by counsel, but it is not anticipated that the counsel who will appear in Christchurch will require to address the Commission in any way. But I do ask that leave be reserved, and I feel sure that the Commission will reserve it, to the company by its counsel to address the Commission in Christchurch if necessary upon any new matter which may be introduced there, though at present I do not see very well how it can affect the position of the Auckland tramway in connection with the subject-matter of this inquiry.

I explained when I was opening in Auckland the attitude which was adopted by the company which I represent, and I have endeavoured throughout to maintain that attitude. As I viewed the position, and from the standpoint taken by the company, there were really two questions which this Commission had to consider. The first question was this: The company being prepared—for reasons which I indicated in Auckland when opening, and which I intend to repeat now—to install a new or different brake, what is the most suitable brake to be adopted, having regard to the Auckland conditions? And the second question had reference to paragraph (*c*) of the matters referred to this Commission, which appears in these words in the Commission itself: "And generally to make inquiry into any matter or thing arising out of or connected with the subjects of inquiry, into the working of the existing law, or regarding the necessity or expediency of any new legislation in respect thereof."

In the evidence that has been led on behalf of the tramway company we have endeavoured to restrict any comparison of brakes to the question of suitableness to the Auckland conditions; but the question seemed almost of necessity to resolve itself into this: viz., whether an approved type of air brake operating upon the wheels in conjunction with a track brake, or the magnetic brake, is the most suitable braking-appliance for the cars upon the Auckland system; and, beyond what may be involved in the necessity of that comparison, the company has not attempted, and I do not now propose to attempt, to in any way condemn the magnetic brake. It is quite sufficient for the purposes of the company to adopt the words which were used by Mr. Goodman when he was giving his evidence in Auckland. I do adopt those words, and therefore I propose to repeat them. Mr. Goodman says, on page 43 of the printed evidence, "I think the Newell magnetic brake, under suitable conditions, is the very best form of brake I know of." The company is not concerned to dispute that statement, and, as I say, the company is quite prepared to adopt it; but the company adopts it with the reservation which Mr. Goodman made, and I again refer to his words. He says, "You want conditions where you have not to negotiate heavy grades. Where you have heavy grades it is necessary to have a brake which you can use on the down grade continuously, and with the magnetic brake to be continually coasting down it throws very heavy and excessive stress on the motors." And he proceeds to give at somewhat greater length the reasons for the statement made by him, and which, as I have said, I am prepared to adopt. However, I do not propose to weary the Commissioners by reading the whole of what Mr. Goodman has said, because the Commissioners have it all before them, and will no doubt give what has been said by Mr. Goodman and by the other witnesses the very fullest consideration. Consequently, from what I have already said we are not concerned—when I say "we" I mean the company—with the question as to whether the magnetic brake has satisfied requirements in other places, nor really is the Wellington Corporation in any way concerned with the question as to what is the best brake for Auckland. Some of the references, therefore, which have been made to Auckland here in Wellington on behalf of the Wellington City Corporation, and as to what happened before the Commission in Auckland, have occasioned me not a little surprise, but fortunately they have not occasioned any injury to the company's cause. I do not propose, having regard to the nature of the tribunal before which these questions came, to address myself as to the technical aspect of the questions involved. I propose to avoid the technical considerations as far as possible, because the Commissioners will have before

them the evidence which has been given by the witnesses who have been called on those technical questions, and the Commissioners have also had the opportunity of making tests in Auckland and here, and will, as we understand, take the opportunity of making further tests in Christchurch. Speaking generally, therefore, with regard to the evidence, I would point out that it may be grouped into three classes: The first class consists of the evidence of the motormen and others who were called by Mr. Rosser in Auckland on behalf of the union. (You will understand that when I say there are three classes of evidence I am speaking only of the evidence which has reference to the principal question with which I am concerned—viz., to the question of the appliances as being best adapted and as most suitable to the Auckland conditions.) The second class consists of that given by the company's officers. And the third class consists of the evidence of persons who are quite independent of the company, and have no interest whatever in the matters in controversy at all, or, at all events, so far as the company is concerned.

With reference to the first class—viz., the evidence of the motormen and others called on behalf of the Auckland Tramways Union—it is not necessary for me to rely upon or adopt without qualification everything that those witnesses have said. It is quite sufficient for my purpose to say that a large number of those witnesses have used the air brake in Auckland on the two best-equipped cars, that some of the witnesses have used the air brake on other systems, and that others have used the magnetic brake on other systems, and that all these witnesses agree as to the suitableness of the combination of the air brake and the track brake which we propose to install in Auckland—or, to be more correct, I should say that they agree with the suitableness of the air brake which we propose to install in conjunction with the track brake which we have at present existing and the other braking appliances; and it must be borne in mind that we do not propose to do away with the present hand-brake either. I refer particularly, in speaking of the motormen and others called by the union, to the evidence of Messrs. Troy, Rodgers, Frank Taylor, White, Campbell, Carter, David Taylor, and Willis. I think my general statement will be borne out—viz., that these men, or a number of them, have had experience with other systems, where other braking appliances have been used, and that they are all prepared to advocate the system which the company proposes for Auckland as the system which is best suited to Auckland conditions. It may perhaps be suggested—I do not suggest it—that the evidence of these witnesses or some of them, should be discounted to a certain extent because they were giving evidence in favour of what they themselves desired. But this must not be lost sight of: viz., that these men have their own safety and that of the public to think of, and therefore the suggestion to which I have referred which may be made against their evidence is really not tenable. Of course it is possible that where men are advocating in evidence a particular thing which they desire they may unconsciously exaggerate the reasons which they are giving in support of their contentions; but the suggestion I have referred to, if it is applicable at all, I would point out applies rather to matters of detail and to collateral matters than to the question which is really the main point at issue—viz., what is the best braking-appliance to be used in Auckland, having regard to the conditions existing there.

With reference to the second class of evidence—viz., the evidence of the company's officers—I refer particularly to the evidence of Mr. Walklate, Mr. Brennand, and Mr. de Guerrier. There are other men who were called on behalf of the company, and who held positions in the company above those of conductor and motorman; but it is not necessary for me to make particular reference to their evidence. These three officers of the company whom I have named are men of considerable experience in connection with the equipment and working of tramways. They have all had experience in other parts of the world, and they all advocate the use of the air brake which the company proposes to install in conjunction with the present track brake. It may be said with regard to the officers of the company that they may be unconsciously biassed in favour of the system which the company proposes to adopt. But there is not very much in that suggestion at all, because presumably these gentlemen have first of all been consulted as to what they think is the best braking-appliance to be installed, and, beyond the statement that they were giving evidence in support of their convictions, I respectfully suggest that there is nothing in any suggestion that might be made that they are unconsciously biassed in favour of the system which we advocate should be adopted on the Auckland tramways.

But, whatever may be said with regard to the first two classes of evidence, no exception can be taken by anybody to the third class, because that class consists of men who have absolutely no interest in the subject-matter of this inquiry at all, and, indeed, as to one of them (Mr. Goodman) one's most preconceived idea would have been that if he had any feeling or bias at all it would be in favour of the magnetic brake, seeing the vast experience comparatively that he has had with that brake, his extensive knowledge of it, and the fact, as he himself puts it, that he is known as the "magnetic-brake man." The persons who have given evidence and whom I place in this third class are Messrs. Birks, Goodman, Kneeshaw, Dutton, and Blackley, and on the evidence of those gentlemen I do most strongly rely. I rely most particularly on the evidence of Mr. Goodman, because of the predilection which he himself says he has for the magnetic brake; but, notwithstanding that predilection, what in effect does he say with regard to the use of the magnetic brake in Auckland—and, as I said before, I am not concerned with the use of the magnetic brake anywhere else. He says that he would be sorry to see the magnetic brake installed in Auckland, because, having regard to the conditions existing there, he does not think it would be a good thing for the reputation of the magnetic brake—and remember that this evidence is given by the expert in magnetic brakes, who reiterates over and over again in his evidence that it must be understood by the Commission and by the public that under suitable conditions he considers that the magnetic brake is the very best brake that can be used. Now, what evidence can possibly be given that is stronger than that? Mr. Goodman appears before the Commission quite disinterested, quite unbiassed, and he says that he has no doubt that the best braking system to be used in Auckland is

the very system which the company proposes to adopt; and what Mr. Goodman has said is borne out and corroborated by each and every of the other gentlemen who have been called and whom I put, in classifying the evidence, in the third class to which I have already alluded. Mr. Goodman has given in detail the reasons for his preference, having regard to the Auckland conditions, for the air and the track brakes. I do not propose to weary you with reading that evidence—it has been taken down in shorthand and typewritten *in extenso*, and is before the Commission; but I do think it proper to say that upon the evidence of Mr. Goodman and of the other independent witnesses that have been called I do strongly rely in respect of my contention that the braking system which we suggest should be installed in Auckland is the very best system that can be installed. Nor is it necessary for me to recapitulate the reasons for preferring the air and track brakes to the magnetic in Auckland, although I propose directly to list very briefly some of the main advantages which we say the air brake possesses.

With regard to the evidence that has been given in Wellington, it is sufficient for me to say that, so far as that evidence can be said to be applicable to Auckland conditions, it is in our favour, because it shows the existence of the very defects in the magnetic brake which have been referred to by the witnesses who were called in Auckland, and because it also shows the existence of the defects which we contend would make the magnetic brake unsuitable to Auckland conditions. I said a moment ago that I would give a list of some of what we consider to be the advantages pertaining to the air brake. In the first place, I may say that the evidence shows that the air brake has been satisfactory wherever it has been tried and used, and we have no evidence of the air brake where it has been installed having been discarded in favour of any other brake. I know of only one instance—North Sydney—where the air brake is in use where the conditions are very similar to those of Auckland; and where the air brake has been operating upon the wheels it has been found, according to the evidence, to be perfectly satisfactory. And it must be remembered that, in comparing North Sydney with Auckland, in the former place, with conditions and gradients very similar, the authorities do not equip the cars except on one run—the Neutral Bay run—with a track brake; whereas in Auckland the proposal is to retain the present track brake in conjunction with the air brake which we propose to install. One very great advantage in favour of the air brake is that the drivers have complete confidence in it, and one of the main reasons for their confidence is that the brake is instantaneous in its action. Again, the risk of failure of the brake is practically eliminated; and it is important perhaps to remark that there is no evidence that there ever occurred in connection with the use of the air brake any intermittent failures—that is to say, there is no suggestion, so far as we can learn from the evidence, that the air brake fails either momentarily or for any length of time, and then operates again afterwards without leaving any evidence of a defect to be afterwards seen. Indeed, there is no evidence that there are any intermittent failures of the air brake at all. Again, where the air brake is installed there is a pressure-indicator also installed upon the cars, so that the motorman can see at a glance when he is using the brake, what he is doing, and to what extent he is applying it. Some objection has been suggested—perhaps not in the evidence before this Commission, but elsewhere—that there is a disadvantage pertaining to the use of the air brake, and that is the possibility or the probability of skidding. But I submit that the evidence which has been adduced before this Commission tends to negative any suggestion which might have been or might be made of the probability of skidding. In other words, there is no real danger of skidding, and if at any time there should be any skidding, the motorman can instantaneously release the brake, which he may have applied with too great a force, and then put it on again more mildly, and the whole thing is done so quickly as to really overcome the suggestion which might have been or which might be made as to any danger that might arise from probable skidding. Again, as far as the layman, at all events, can see from the evidence which has been adduced, there is no suggestion that the air brake is one which can be abused as it is said other brakes may be abused; and that also is an advantage, I submit, in favour of the air brake. And another consideration that appears to me to be applicable is this: that the air brake, where it is installed, is used in all cases for service stops, so that in emergency the motorman intuitively flies to the air brake and uses it. According to the evidence we have heard, in no system—except perhaps Dunedin, of which I know nothing at the present time—can it be said that the use of the magnetic brake for service stops is satisfactory, and if the use of it is made compulsory in any system where there are steep gradients, it appears that a great disadvantage arises owing to the liability of overheating the motors.

Mr. O'Shea.—We do not admit that.

Mr. Myers.—I am only referring to the inferences which I draw from the evidence that has been adduced. I am not saying a word against the use of the magnetic brake in Wellington. All I am saying is this: that the evidence shows what might happen and what does happen on hilly systems of tramways—and Auckland's is a hilly system.

I do not claim to have given an exhaustive list of the advantages which pertain to the use of the air brake. I have gone through those which appear to me to be the chief advantages, although the Commission may find that there may be other advantages which have been deposed to in the evidence of the witnesses who have been called.

There is one observation that I desire to make with regard to the air brakes which have been installed for experimental purposes in Auckland, and that is, it must be borne in mind that they were installed solely for experimental purposes, and, for all I know, good as those air brakes may be, according to the evidence which was given by the men and by others called in Auckland, they may be capable of improvement in adjustment and in other directions. Those are matters upon which I am not competent to speak or to make any suggestions to the Commission; but the Commission, I understand, made exhaustive tests up there, and will be in a position to make recommendations as to improvements and adjustments or otherwise if they think such recommendations are necessary.

I come now to the question of the track brake which is in use in Auckland. There, again, the Commissioners have made their own inspection and their own trials, but I submit that the evidence which has been called before this Commission shows—subject, of course, to the results of the inspection that the Commissioners have made, of which I know nothing—that the track brake is a perfectly effective and proper brake, and that, in conjunction with the air brake which we propose to install, it will be the very best breaking-equipment that could be used, having regard to Auckland conditions.

No doubt the Commission will have been struck with the difference in the nature of the evidence given by the men in Auckland on this occasion and of the evidence which was given on a former occasion about two years ago, and which is before this Commission. The Commission will remember that one witness said with frankness and candour that at the time when the former Commission sat there was very great friction existing in Auckland; that the men had (I suggested to him) "fancied" grievances, but he would not accept that word, and said that the men on that occasion made the very most of their grievances.

Some questions were asked during the taking of evidence in Auckland with regard to the suggestion of using a pneumatic slipper brake on the Auckland cars; but an independent witness, who had been called, corroborated the evidence given by the officers of the company, that a pneumatic slipper brake could not very well be applied, and would not be the best form of brake, having regard to the conditions existing in Auckland. In the first place the pneumatic slipper brake could not be applied to the cars at present in use, and I think there are over ninety cars in use there at present. The next point against the pneumatic slipper brake is that it is not suitable for a service brake, particularly inasmuch as the wooden blocks wear out too quickly. And a further objection against the pneumatic slipper brake, if the air brake operating on the wheels is installed, is that the motorman would be dependent for both brakes on one source of power, which we suggest is a very decided disadvantage; and, apart from all these considerations, the pneumatic slipper brake would be more or less an experiment.

I referred before to paragraph (*c*) of the matters referred to this Commission by the Governor. Up to the present time no general evidence with regard to paragraph (*c*) has been given, though no doubt the Commissioners, from the evidence which has been given, and from the trials which they have made in Wellington and which they propose to make in Christchurch, may be able to come to certain conclusions which will enable them to make recommendations in regard to paragraph (*c*). I assume from the wording of the commission and from the attitude which has been adopted by the Commission throughout that it is common ground on which the Commissioners agree that paragraph (*c*), although it is in general terms, applies only to the question of braking generally. In other words, I apprehend that nobody will suggest that paragraph (*c*) has any reference to tramway matters *generally*, apart from the question of braking-appliances, though the Commissioners may presumably deal with the question of braking-appliances in a general way, apart from the question of the braking system to be adopted in Auckland. I apprehend, however, that the Commission would in no case recommend that any particular form or any particular type of brake should be brought into universal use; because, from the reports of various Commissions, Committees, and experts that have considered the question of braking-appliances, and, indeed, from the evidence which has been adduced before the present Commission, it appears to a layman to be quite plain that it would be impossible to say that any particular form of brake or any particular type of brake should be brought into universal use. as we have heard that one brake may be the very best form of brake under suitable conditions and yet under other conditions might not be serviceable and might not work at all efficiently. The only question which has been submmitted to the Commissioners, and which affects Auckland particularly, is the question of the braking-appliances for Auckland, with which I have already dealt at some length. Any other question which comes under paragraph (*c*) of the commission is, I take it, a question which affects tramway systems generally, and does not apply specially to any particular tramway system in the Dominion.

When I opened in Auckland I referred to two matters to which, so far in my present address, I have made no reference. One of those matters was the question of the time that it would take to install in Auckland any particular form of brake, and the other matter was the question of cost. I pointed out, and I repeat now, that the air brake could be installed in Auckland on all the cars within a very few months, and, as far as the company can see from the inquiries that it has made, it could obtain a sufficient number of sets of air brakes, and could install those sets on all its cars—barring, of course, unforeseen accidents—by February next. To install the magnetic brake there on all the cars, which for the reasons I gave in Auckland, would occupy anything up to three years—that is a matter which I suggest deserves consideration at the hands of the Commissioners.

When opening for the company in Auckland I also stated that to install the air brakes would cost from £10,000 to £12,000. I was not then in a position to say what it would cost to install the magnetic brake, but I am instructed that it would cost a great deal more than £10,000 or £12,000. The Commissioners may remember that in giving his evidence in Auckland Mr. Brennand said that from calculations he had made it would cost from £40,000 to £50,000 to install the magnetic brake, because of the new controller that would be required, and new brakes, and undergear, and wiring, and so on. Mr. Birks, if I remember rightly, also gave evidence on that point, and Mr. Goodman also. Mr. Goodman's estimate of the cast of installing magnetic brakes in Auckland was from £50,000 to £60,000.

I quite agree that the first consideration in the working of braking-appliances is public safety. I also agree that the question of the convenient working of a braking system by the men also comes into consideration; and I submit that the question of cost ought also to be taken into consideration—though I say again that the first and primary consideration is the question of

the public safety. Supposing, therefore, that the company had been able to prove to this Commission that the system of brakes which we propose to install is as good and efficient as any other system that is known of at the present time that might be installed, or even nearly as good as that other system, I submit that the question of cost should be taken into consideration, and that the Commission should make a recommendation in favour of the air and track brakes. But I go further, and I submit that not only if it were proved that the system we propose to install is no less efficient than any other system—we have proved that the system we propose to install is better, safer, and more efficient than any other system which is known at the present time and which could possibly be installed, having regard to the general conditions which exist in the city and suburbs of Auckland.

The Chairman.—The Commissioners propose to arrange with the officers of the Wellington City Council to make a further inspection of the cars and equipment this afternoon. This concludes the public sitting of the Commission in Wellington. The next sitting of the Commission for the purpose of taking evidence will be held at the Provincial Council Chambers, Christchurch, on Monday, the 9th May instant, at 10.30 a.m.

The Commission rose at noon.

CHRISTCHURCH, MONDAY, 9TH MAY, 1910.

The Commission resumed at the Provincial Council Chamber, Christchurch, at 10.30 a.m.

Present: The Commissioners, Professor R. J. Scott and Mr. A. L. Beattie; Messrs. A. K. S. Mackenzie, counsel, Auckland Electric Tramways Company; J. H. Walklate, manager, Auckland Electric Tramways Company; J. B. Brennand, rolling-stock superintendent; A. Rosser, on behalf of the Auckland Tramway Employees' Union; J. O'Shea, counsel, Wellington City Corporation; M. Cable, Assistant Engineer, Wellington City Corporation; T. G. Russell, counsel, Christchurch Tramway Board; F. Thompson, Secretary, Christchurch Tramway Board; H. Pearce, Chairman, Christchurch Tramway Board; Scott Symington, Engineer, Christchurch Tramway Board.

The Chairman.—The Royal Commission on the Auckland Tramway Brakes is now opened in Christchurch, but out of respect to our late King we will adjourn until 10 o'clock to-morrow morning. The Commission now stands adjourned till 10 o'clock to-morrow morning.

The Commission adjourned at 10.35 a.m.

CHRISTCHURCH, TUESDAY, 10TH MAY, 1910.

The Commission resumed at 10 a.m.

The Chairman.—It will not be necessary at this stage of the proceedings to read the whole of the commission, but for the information of counsel who are joined in this case I think it would be well if the clauses which set out the scope of the Commission were read. I would therefore ask the Secretary to read clauses (*a*), (*b*), and (*c*).

Clauses read.

In reply to the Chairman,—

Mr. T. G. Russell said he appeared on behalf of the Christchurch Tramway District Board.

Mr. A. K. S. Mackenzie said he appeared on behalf of the Auckland Electric Tramways instead of Mr. Myers, who was unable to attend.

Mr. A. Rosser said he represented the Auckland Electric Tramway Employees' Union.

Mr. J. O'Shea said he represented the Wellington City Corporation.

Mr. T. G. Russell said that the Christchurch Tramway Board had considered that it would be calling evidence of the greatest assistance to the Commission if it called men able to depose to facts. The Board did not intend to bring witnesses to express opinions, but men who had been connected with the working of the brakes since the inception of the Christchurch system. The most experienced motormen had been selected, together with the Engineer and the Traffic Manager; but the Board was willing to make arrangements for the production of any other evidence the Commission desired to have. The brakes installed on the Christchurch system were the air brakes, and in no single instance had they proved unreliable; on the contrary, in emergencies they had proved most reliable, as his witnesses would testify. On many occasions the trams had been promptly pulled up, thereby saving life. An instance of this on the Sumner line would be referred to in evidence.

Mr. Russell then called the following evidence:—

EDGAR CRESPIN sworn.

Examined by Mr. Russell: He was a motor-driver in the service of the Christchurch Tramway Board, and had been employed for the past five years. During that time the present air brakes had been on the cars; and from first to last he had had no single experience of the brakes proving unreliable. He had often been called upon in an emergency to bring up the car in a very short distance, and had never had the brakes fail him in any degree; many times their reliability had enabled him to avert serious accidents. He did not desire any change of brake, the present brake was so reliable and so easy to work. The gauge showed when the compressor was not quite right, and they had always a certain amount of air to depend on. Directly they were unable to exercise the maximum pressure, there was the indication of that fact staring the motormen in the face. He had not heard from any other driver of any defect in the brake; so far as he knew from first to last they had acted exceedingly well.

By Mr. Rosser: They had a hand-brake as well as an air brake. He only used the hand-brake to bring the car into the shed; the air brake had always answered for all other purposes. He would not like to have to use the hand-brake all the time, on account of the great physical effort involved. The air brake was very much easier to work, and very much safer. He had every confidence in the air brake. He would still have confidence in the air brake if the compressor got down to 60 lb. Until it got down to 50 lb. he would still have 10 lb. pressure, and he would also have the hand-brake to fall back on.

By the Chairman: He had never had a serious accident; had run into a cart at one time as it approached from a side street without warning. He had had no failure at all, nor even any difficulty, in effecting a stop with the air brake; the brakes had always responded. There was the ordinary service position and the emergency position, and in ordinary service he used the service stop, and the emergency only in cases of emergency. He had personally had no failure of the brake to act, and had no knowledge of any such failure in the Christchurch system.

GEORGE LOMAS sworn.

Examined by Mr. Russell: He was a motorman in the service of the Christchurch Tramway Board, and had been in the service for over four years and a half, joining some six months after the service began. The service was equipped with air brakes, and the cars he had been driving were so equipped. In no instance had the brake failed to respond when he required it, either in ordinary service or in emergency. He had had to use the brake in case of emergency scores of times, to avert collisions and so forth. He found the brake very prompt and very easy to work, for service occasions as well as on emergency. He had never heard other motormen complain of failure of brake; in his experience and to his knowledge there had been no single failure in the four years and a half. He was driving the 4 o'clock Sumner tram to the Cathedral Square last Sunday, and when between Fitzgerald Avenue and Barbadoes Street two girls were riding on horseback alongside the track—a little girl on a big horse, and a big girl on a very small pony (Mrs. General Mite's pony) next the track. The big horse pushed the pony on the track. When within a pole-length he applied the emergency brake, and had pulled up the car and the trailer well within the pole-length. There was a big load on both the car and the trailer; and he was within 4 ft. of the girl when the car was arrested. Had the brakes not been excellent the girl would have been killed.

By the Chairman: He should think he was going about fifteen miles an hour at the time. He thought the poles were about 25 yards apart.

Mr. Russell.—They are 100 ft. apart.

By Mr. O'Shea: The car went a car-length from the time he applied the brake—about 35 ft. He thought there would be a collision, and therefore applied the brake.

Mr. O'Shea.—I understood the witness to say he was a pole-length away when he applied the brake.

Mr. Russell.] How far were they from you when you put the brake on?—A car-length.

Mr. O'Shea.] And you saw the girl go on the line when you were a pole-length away?—Yes.

Mr. Russell.] Did you apply the brake when you saw them on the line?—Yes, soon after.

Mr. O'Shea.] You were only a car-length away when you applied the brake?—Yes. And you put on the brake and pulled up within a car-length?—Yes, that is so.

By Mr. Rosser: He had seen the girls further down the road, and they had passed and re-passed the tram, but the horses had not taken fright; and he did not, therefore, expect them to do so at all; it was an unlooked for contingency. He usually had two trailers—that was the rule.

FREDERICK SHORT sworn.

Examined by Mr. Russell: He was a tram-driver in the service of the Christchurch Tramway Board, and had been in the service since it started, but driving only for the last three years. The cars he drove were fitted with air brakes. On no occasion had they failed; he had many times had to use the emergency brake, and had many times averted an accident thereby. He had heard no complaints of the failure of the brakes at all. The general feeling of the motormen was that these brakes were good brakes.

By Mr. O'Shea: In his service stops he would cut off current sometimes a pole-length, sometimes two or three pole-lengths, beforehand, according to the speed. The former would be at slow speed, when he had just started and got the whistle to stop; he would put on the air brake when he started to shut off the current. At high speed he would "coast" along at times. If he were going at, say, twenty miles an hour, he would cut off the current about ten pole-lengths away when approaching a stopping-place. He would put on the air brake about three pole-lengths away, to make a nice gradual stop; he could do that at less than three pole-lengths.

By Mr. Rosser: The condition of the rails would also have to be taken into consideration.

By the Chairman: At fifteen miles an hour, a pole and a half would be the average length taken to make a stop when applying the brake. A stop could be effected in a pole-length or less; perhaps half a pole-length was the shortest distance.

WILLIAM LEWIS sworn.

Examined by Mr. Russell: He was a tram-driver in the service of the Christchurch Tramway Board, and had been so employed for four years and eight months—almost the whole period of the service. He had been continually driving the trams, and had the air brake on his cars. He had never found the brakes fail; both service and emergency brakes were perfect. He had many times had to use the emergency brake to avert accidents. There had never been any failure or even partial failure of this on any occasion. He would like to keep on with the air brake. He could pull up a heavily laden car within one and a half car-lengths or two car-lengths. He had done that on many occasions when fully laden.

By Mr. Rosser: His experience of tramway matters was not confined to Christchurch; he had had experience in Auckland previously. He was twelve months there as a motorman; he had got through the spare list and was on a regular run—Onehunga and Parnell. He had some knowledge of descending the Parnell rises. Speaking from his own knowledge of the Auckland trams, he thought the air brake would be a suitable brake. He knew the steepness of the Parnell rises, and he would feel confident driving a car there if he had an air brake. There was no track brake on the Christchurch cars. They found here that on the level, even with trailers, they could make effective stops without the aid of a track brake. On most of the cars the sand-pipes led down to both rails; in some cars, only to one rail. The flow of sand had to be pumped out.

By Mr. O'Shea: He had had experience only of the hand-brake and the air brake; he had never used a magnetic brake.

ARTHUR ROSSER sworn.

Examined by Mr. Russell: He was the secretary of the Auckland Electric Tramway Employees' Union. He was a carpenter and joiner by trade, but had had four years' experience of tramway matters as secretary of the union. He was on the 4 o'clock tram from Sumner to the Cathedral Square last Sunday, and saw that tram pulled up very shortly. He was on top of a double-decker. He saw two horsewomen—a big girl on a small pony, and a small girl on a big horse. The tram passed the girls, then made a stop, and they passed it again. When the tram got to a narrow part of Ferry Road, going, he thought, about eighteen miles an hour, an unlooked-for contingency arose. The big horse shied, and threw the pony in front of the car. He thought the tram would be then about one or one and a half car-lengths away. All the passengers rose to their feet, believing there would be a collision. The motorman applied the brake and brought up the car within 3 ft. or 4 ft. of the pony. If the brake had failed to respond, there would would have been an inquest. The horse was wholly on the track, hind legs as well, and there would not have been time for it to get away. He had made only a cursory examination of the brakes himself; but from his knowledge and experience of hand-brakes, air brakes, and latterly of magnetic brakes, he considered it would be difficult to beat the stop made on that occasion. The driver acted promptly and the brake responded promptly, and a very serious accident was averted. He was satisfied that had this happened on the Auckland tramways, with the hand-brakes in use there, there would have been trouble.

THOMAS WILLIAM RICHARDSON sworn.

Examined by Mr. Russell: He was a motor-inspector in the service of the Christchurch Tramway Board, and it was a part of his duties to see that the brakes were in order. If any brakes were found unreliable the matter would be reported to him; he would get the information, and it would be his duty to investigate the matter. He had been motor-inspector for about fifteen months. Previous to this he was a motorman in the service in the Auckland Tramways Company. Fifteen months was the whole of his service here. In not one single instance, from first to last, had he had any complaints from the drivers with regard to the brakes.

By Mr. Rosser: He had had experience of the Auckland tramways on two occasions, twelve months the first time and three months the second time. He thought the air brake would be very suitable for the Auckland system. As motor-inspector he had to examine the whole equipment, including the brake-equipment, of the cars; he took complaints from the motormen, and saw that the rolling-stock was in perfect order. On the average he saw about three hundred stops made per day: in no single instance had he experienced any failure of the brakes. Of course, some stops were made better than others, according to the condition of the road, the load, and the handling of the motorman. On no occasion had he seen the passengers all huddled up in one corner of the tram as a result of the use of the brake. He had seen the emergency stops used, and had had to report the motormen for good stops. Even the emergency stop was a gradual stop; there was no "stopping dead," and causing the passengers to shift from one end of the car to the other in a hurry. Yes, he considered the air brake would be suitable for the Auckland system.

By the Chairman: He also inspected the sand brake. A few of the cars had sand on one rail only—about nine cars in the whole service, he thought, speaking from memory. The sand was all dried before it was put into the lockers. There had been no failures with the brakes when they were required to be used. The men had to try them before bringing out the car, and if they failed the car was not taken out of the shed. He had not seen one failure in service. They had some trouble with flat wheels, occasionally only.

JOHN WOOD sworn.

Examined by Mr. Russell: He was Traffic Manager to the Christchurch Tramway Board, and had been in the Board's service since the system was started. Assuming that the compressors were right, he had had no complaints at all from the motormen as to the brakes. Sometimes the compressors got out of order, but these would give the men warning at once. Assuming that the compressors were sound, he had not had a single case come under his notice of the failure of the brakes. He had seen cars pulled up suddenly to avert accidents, and on these occasions they appeared to respond to all the functions required.

SCOTT SYMINGTON sworn.

Examined by Mr. Russell: He was an engineer by profession, and at the present time was in the service of the Christchurch Tramway Board, but had taken an engagement with the Invercargill Borough Council. He had been Engineer to the Christchurch Tramway Board for nearly

seven years—from the time the Board started to install the system. The trams are arranged so that sand falls on both lines (it is a mistake to say, only on one line); each car has two separate conduit-pipes to the rails. He had no reason to believe that the air brakes had not responded amply to all the demands made on them; he had heard no complaints from anybody connected with the trams as to the brakes. Even assuming the compressor was right, the brakes *could* fail to act, but they had not done so. There could be a failure of the mechanism. Assuming that the mechanism was right, there was no reason why they should fail to act. He had seen the trams pulled up suddenly, and had never seen any failure at all. In his opinion the present system of brakes was the best system—so far as Christchurch was concerned, at any rate.

By Mr. Mackenzie: He had been in Auckland. In his opinion the air brake, plus the track brake, would be very suitable for Auckland.

By Mr. O'Shea: Oh, yes! they had instances of the failure of the compressor, and of the compressor-motor getting out of order; but they had had no cases of brake-failure. They had never had any failure of the brake-equipment throughout; they had always had something to fall back upon. Yes, in case of the compressor failing, they had had to rely on the hand-brake, but there had always been due warning, because there was always a certain amount of reserve power in the reservoir, which would give ten stops, say, before there would be a failure. There would always be compressed air sufficient to make, probably, ten stops after the warning. He had seen the trams in Wellington, but had no actual experience of the system there. Nor had he had any experience of the use of the magnetic brake.

By the Chairman: The air brake was used in service and in emergency. The trailers were fitted with hand-brakes, and these could be used when required. Oh, yes! the motormen were instructed in the use of the electric emergency brake; they were instructed how to make stops with the motors, in case of the brake-rigging carrying away—a very remote chance. They were instructed how to make the first emergency stop with the air brakes, the second emergency by reversing the controller and putting the controller on to the first notch; and then the third by putting the controller right round on to the last position. They are instructed to make these three emergency stops, but instructed to make the air-brake stop first, and only in the failure of the brake-riggings are the others used, or supposed to be used. They are not used in the service at all, but only in emergencies. Yes, sand was delivered on both rails, in the front portion of the car—in front of the two front wheels. There were four sand-boxes on the cars, the two forward ones dropping sand in front of the car, so that all the wheels had the benefit of it; the sand was not dropped between the wheels. The sand was dropped from 6 in. to 10 in. in advance, almost immediately in front of the wheel. There was no difficulty in bringing the sand-pipes down there; the pipes were flexible pipes, and were brought immediately over the rail. His experience of the working of the air brake had been very satisfactory. The principal expense was the upkeep of the compressors: there were men constantly repairing the compressors—*i.e.*, the compressors, the valve-gear, and the connecting-rods of the compressors. The motors themselves gave very little trouble except an occasional burn-out. No, the adoption of the air brake had not loaded up the system to any great extent; he thought it was as cheap a brake as they could put in, except the hand-brake. From the commercial standpoint as well as from the engineering standpoint, he was satisfied that the air brake was the best brake available. The compressors might be improved, and the later types were certainly better than the original ones put in by the Board. Up to the present time any defect in the brake had always been discovered before the brake was required.

By Mr. Russell: There had never been any failure of pressure which had caused an accident. If the compressor was not normal, indication was given to the men by the dial immediately. The driver can always see if he has the maximum pressure in the compressor or not.

By the Chairman: At present there were forty-three electric cars on the Christchurch tramway system. There were eighteen trailers fitted with air brakes, and from forty to fifty not so equipped. The trailers were used in conjunction with electric cars; those not equipped with air brakes were used merely for holiday traffic.

Mr. Russell said this was all the evidence he proposed to call, unless the Commission could suggest any one else whom they would like to hear.

The Chairman said he considered the evidence brought by Mr. Russell was full and complete, and very consistent, and would be of value to the Commission.

At 11 a.m. the Commission adjourned till Monday, 16th May, at Dunedin.

DEAR SIR,— Christchurch Tramway Board, Christchurch, N.Z., 30th May, 1910.

In reference to evidence given by me at the Christchurch sitting of the above Commission, I have to inform you that one portion of same was incorrect—that relating to the depositing of sand on the tracks.

My statement was that the sanding-gear was fitted on all the cars on both sides at the forward end, whereas only twenty-one of the cars at present running are so fitted; the remaining twenty-two cars have sanding-gear on one track only at each end. All the new cars we are building are being fitted with sand at both sides.

Yours, &c.,
S. SYMINGTON, Engineer.

L. M. Shera, Esq., Secretary, Auckland Brakes Royal Commission,
Canterbury College, Christchurch.

DUNEDIN, MONDAY, 16TH MAY, 1910.

The Chairman: The Royal Commission appointed to inquire into the effectiveness of the Auckland tramway brakes will now open. As I mentioned at Wellington, the Commission intended to conclude its sitting at Christchurch; but evidence having been adduced that the magnetic brake was not a suitable brake if used at high velocities and steep grades, the Dunedin City Corporation requested that the Commission should meet at Dunedin to give them an opportunity of bringing forward witnesses as to the suitability of this brake for this particular locality. In compliance with their request the Commission now sits here. It will not be necessary, but I think it will be desirable that the Secretary should read the clauses which state the matters referred to the Commissioners.

Clauses read.

Mr. C. F. Alexander said he appeared for the Dunedin City Corporation.

Mr. O'Shea said he appeared for the Wellington City Corporation

Mr. Mackenzie said he appeared as counsel for the Auckland Electric Tramway Company.

Mr. Rosser said he appeared on behalf of the Auckland Tramway Employees' Union.

Mr. R. Breen said he appeared for the Tramways Industrial Union of Workers.

MATTHEW COCHRANE HENDERSON sworn and examined.

1. *Mr. Alexander.*] What is your name?—Matthew Cochrane Henderson.

2. You are Assistant City Electrical Engineer for the Dunedin City Corporation?—Yes.

3. In conjunction with Mr. Stark you act as Consulting Engineer to the Tramways Department of the Dunedin City Corporation?—That is so.

4. You are frequently consulted in regard to equipment of electric cars?—Yes.

5. What brakes are used in the Dunedin City Corporation?—The Standard hand-brake and the Westinghouse magnetic brake.

6. The Westinghouse magnetic is a new patent?—Yes.

7. What is the horse-power of the motors in each of our cars?—40-horse power.

I find from the evidence given by Mr. Goodman that he states the horse-power of the motors is 48, while until a few days ago it has always been taken that the Corporation tramway motors were 35-horse-power motors. Inquiries were made, and the only evidence we can get at short notice reveals a 42-horse-power motor.

8. *The Chairman* (to witness).] 42, you said?—Well, from 40 to 42.

9. That is, each motor?—Each motor, yes.

10. What is the weight of the cars in Dunedin?—The saloon cars and the open cars are 9 tons 2 cwt., and the combination cars are 9 tons 12 cwt. very nearly, I think. The chief grades are—Anderson's Bay grade (total length, 12 chains)——

11. What is that grade?—1 in 14. And the Caversham grade—that is going from Maitland Street to Eglinton Road.

12. Do you know the average?—1 in 16; steepest, 1 in 13, from Eglinton Road to Glen Road.

13. Do you know the average?—1 in 20, I think.

14. Do you know the steepest?—1 in 16.

15–6. As regards motors—the capacity of motors, what bearing has that on a magnetic brake?—If the motors are simply designed for traction purposes, and these motors are used in braking and coasting and other purposes, the motors are likely to get overheated. Have you had such trouble in Dunedin?—Not to my knowledge.

17. Do you know if motors in Dunedin are capable of performing the duty expected of them?—Absolutely.

18. The other day certain tests were made in connection with the magnetic brake. What was the highest speed at which it was effective?—We found that if properly applied the brake was effective up to twenty-two miles an hour.

19. Of course a brake might be ineffective at eight miles an hour?—That is true.

20. What is the lowest speed at which it is effective?—We have tried it at three miles an hour, and found it operative at that speed.

21. At what speed would it be usual to stop a car with the hand-brake?—Below that speed.

22. What, in your opinion, are the present advantages in the magnetic brake as being actually applied?—The outward pull of the magnet on the rails, the locks to the wheels, and also the effect of the slippers on the rail.

23. Is that an important point—that with the application of a brake it cleans a greasy rail?—Certainly.

24. Is a greasy rail a danger?—A greasy rail is a danger. Anything that will clean a greasy rail helps.

25. Is there any effect on the motors?—In the Westinghouse magnetic brake the current which operates its magnets is generated to the car by the revolution of the armature, which also has a braking effect on the car. When a car is travelling at a fair rate of speed—say, anything from three miles an hour—with a magnetic brake, is it powerful enough?—It is sufficient.

27. What is the result when a car starts to skid?—When a car skids it means the wheels are stopped. The brake is automatically released to a certain extent.

28. Is the magnetic brake dependent on any outside forces?—It is entirely independent of the current used for power purposes.

29. Evidence has been given in Wellington that a magnetic brake failed to act: what is your experience in Dunedin?—To my knowledge there has never been a report of anything of that sort.

30. Further evidence was given that the magnetic brake was severe on the equipment and severe on the passengers. Of course I take it that this was only in the case of an emergency stop—to indicate that it was a very powerful brake. Why is a magnetic brake severe on passengers?—Any emergency brake on a car will be severe on equipment and passengers. Any brake, in my opinion, must be severe—any brake that is effective must be severe on equipment and passengers. We use the magnetic brake for several stops in Dunedin.

31. What is the effect of the magnetic brake on equipment and passengers when used for service stops?—In Dunedin the magnetic brake is used for ordinary stops, and it is not severe on the car and passengers if properly operated.

32. *Mr. Alexander.*] In your actual experience of our motormen, what kind of stops do you find them make—that is, the average stop with the magnetic brake?—An easy, gradual stop.

33. If the magnetic brake was not used in Dunedin for service stops, is it likely that the motormen would be able to apply it directly in case of emergency?—In my opinion the use of the magnetic brake under all conditions makes it more automatic on the part of the motorman to operate it in any case of emergency.

34. Of course rules and regulations have an important part in the proper operation of brakes?—That is so.

35. Do you consider the rules and regulations in Dunedin are sound and reliable?—Yes.

36. What are those rules?—[Reads Rule 109A; Rule 99, page 35; Rule 100, page 35.]

Mr. Rosser mentions Rule 101; Rule 109A, page 40; Rules 99, 100, 101, page 35; Rules 102, 103, 104, page 36; Rules 105, 106, 107, page 37; Rule 108, page 38; Rule 62, page 25; Rule 76, page 28; Rule 78, page 29.

37. Have you any knowledge about Glasgow as regards what kind of cars they have got?—With regard to some of the Glasgow cars, they have cars similar to our own. In every case they have double-decked cars.

38. Are the cars heavier or lighter than ours?—I should think they were heavier than ours.

39. You do not know the seating-capacity?—No. The seating-capacity must be great, because they have double-decked cars.

40. Do you know the condition of the rails in Glasgow?—From my knowledge of Glasgow, I should say that the condition of traffic on the rails must make them greasy.

41. Have you seen that slimy stuff on the rails? Have you been in Glasgow?—I have been in Glasgow. I know Glasgow fairly well, and I have no hesitation in saying that the rails must be very dirty.

42. You have seen the report by Mr. Ferguson under date of the 22nd March, 1910. What brakes are used in the Glasgow trams?—The standard hand-brake, and the magnetic brake such as is used in the Dunedin City Corporation trams.

43. *Mr. O'Shea.*] Mr. Henderson, one factor of safety in the magnetic brake in its application on the controller is that it is impossible for a motorman to put on his brake with power at the same time?—That is so. It is impossible to do that, because the controller is used under power, and has to be reversed.

44. Now, I think Mr. Goodman in his evidence in Auckland said he drew up rules and regulations? You do not know about that?—I have never seen these rules.

45. I want to ask you a few questions about his evidence. He says in talking of the magnetic brake, "I think the magnetic brake is the very best I know of." Could you get a better brake?—I have had no experience of any other brake, but from the experience I have had of Dunedin I would hesitate before making any change.

46. Is there any possibility in Dunedin of the magnetic brake not acting?—Not in my opinion.

47. Mr. Goodman said nothing about Dunedin in the matter.

48. Do you use this brake for coasting?—Always.

49. You are not instructed in the matter?—That does not come under my department.

50–1. You are Consulting Engineer with Mr. Stark?—Yes.

52. Mr. Goodman goes on to discuss the Auckland brake. He says the track brake has to be applied before negotiating down grades. Do you consider a brake that has to be put on when descending a grade an emergency brake?—No.

53. Do you think that if you have to apply the air brake and the track brake with a heavy car, that would be considered an emergency brake?—I have had no experience of other brakes, air brakes or others. I do not know the conditions. I have not seen Auckland or Wellington, so could not give an opinion.

54. If a tram is going down a grade of 1 in 12 with a magnetic brake at a speed of 22½ miles an hour, and the motorman wished to stop the car, and the brake flashed over and the car subsequently took a curve, would you say that that was a failure of the magnetic brake?—Not an absolute failure of the magnetic brake.

55. Are there brakes which are effective—absolutely effective—on all occasions? Do you know of any?—Not to my knowledge.

56. Do you find the magnetic brake in Dunedin specially satisfactory for emergency stops at an average speed of, say, eight to fifteen miles an hour in the town?—So far as my knowledge goes, there has never been any question of the brake being defective.

57. Has it been impossible to avoid serious accidents on numerous occasions?—That is a question which the Tramway Manager will be able to answer.

58. I want your answer?—I have no knowledge of any accidents having happened under these conditions.

59. *Mr. Mackenzie.*] Well, sir, I might have a question to ask, but I think I should be permitted to wait till the last.

60. *Mr. O'Shea.*] Do you have any great trouble with armature here?—No.

61. How many armature-winders here?—One.

62. Is he fully employed?—No.

63. *Mr. Rosser.*] I understand you are Consulting Engineer—are you, Mr. Henderson?—Yes.

64. Do you consider there have been any failures of the magnetic brake here in your term of office?—Not to my knowledge.

65. Have you had any alleged brake-failures reported to you?—They are not reported to me—they go to Mr. Alexander.

66. Then, supposing a failure is reported, whose business is it to look after and investigate the matter? Is it yours?—No—not unless consulted by Mr. Alexander.

67. Have you ever gone in company with Mr. Ross to investigate cases of brake-failure?—Yes.

68. And what was the result?—The only case that I have had was an accident near Manor Place. In that case the brake was tried next morning on the car, and at all the tests the brake acted perfectly.

69. In your wide experience have you ever found that the magnetic brake failed to act, and gives no trace of failure afterwards?—My experience of the magnetic brake is confined to Dunedin.

70. Have you found that to be so in Dunedin? Have you found an instance where the brake might fail and leave no discoverable defect afterwards?—Not to my knowledge.

71. Do you consider it possible for the magnetic brake to fail?—If the magnetic current is out of order it certainly will fail.

72. Did you have Car No. 20 out a few days ago trying it? What was the result of that trial—Thursday or Friday it was?—We had a car out, and that was possibly the number of it. We tried it on speed. As far as the emergency stop is concerned, it was a good stop. That was going down the Glen Road. The next was in Main South Road, and was a good stop. The next one, from the terminus down to David Street, the motor flashed over.

73. And you had to run the car into the shed?—No.

74. Was that a very steep grade?—I should imagine it was 1 in 16.

75. The speed was over twenty miles here, was it?—Over twenty—we judged, about twenty-two miles.

76. I notice Mr. Alexander did not bring out what sand-gear you have. Have you an effective sand-gear on the Dunedin cars?—A sand-gear that operates on one track only.

77. How far in advance of the wheels?—3 ft. 6 in., I should say.

78. On each pipe on car, is that?—I can hardly give you this.

79. Though it was the Sabbath day yesterday, I made some observations. On Car No. 26 the pipe was 6 ft. ahead of the wheels, and on 20, 25, 24, 29, 17, 22, and 32. Would you be in a position to contradict this, and say that on 6, 4, and 1 the pipe leads out 2 ft. 6 in. ahead of the wheel? That would be the type you are thinking of?—I cannot say.

80. It is obvious that with the pipe leading 6 ft. ahead of the wheel the sand would be very little use in rounding a curve. And some of the cars run over curves on which sand is necessary?—Yes.

81. Do you consider that it is an effective sand-gear?—No.

82. Is it an intermittent or continuous flow of sand?—Intermittent.

83. Do you remember a case where a car skidded through some operations in which tar was used a little while ago, I think, in Princes or George Streets?—I remember a car being brought up, but it did not come under my notice.

84. Do you remember an alleged failure of the brake about six weeks ago on Car No. 6? It was a motorman named McTagg, I think. Was that reported to you?—Not to me.

85. Did you notice that in the rules as read by Mr. Alexander, Rule 100, page 35, provides that if the magnetic brake fails, the hand-brake is to be used?—Yes.

86. That admits the possibility of a failure?—Yes.

87. Then you do not take up the strong position that the magnetic brake cannot fail?—If there is anything wrong with the magnetic circuit the brake must fail.

88. How long were you in Glasgow?—I have only been in Glasgow many times as a visitor.

89. Then, your evidence is not the result of active connection with the Glasgow service?—No, not at all.

Mr. Reid.—No; no questions.

90. *Mr. Mackenzie.*] You said, Mr. Henderson, your practical experience is confined to Dunedin, so that your opinion of the suitability of the magnetic brake is based on its use in Dunedin, under Dunedin conditions?—Yes, to Dunedin conditions, and the results we have had.

91. *The Chairman.*] I am not quite clear as to how tramway matters are arranged. You are in the service of the Dunedin City Corporation?—Yes. I am entirely under Mr. Stark. Mr. Stark is Consulting Engineer to the Tramway Department. I am consulted as Mr. Alexander desires.

92. Are you a member of any Institute?—I am a member of the English Institute of Electrical Engineers and an Associate of the American Institute.

93. You have had no former experience before coming here? So that, although you have had no knowledge of them, it does not mean that these failures have not taken place?—That is true.

94. You have no knowledge of the magnetic brake having failed on going out of the shed in the morning?—None.

95. You mentioned that the current flashed round the commutator: that produces an immediate skid?—I do not recollect that I said I had no knowledge of a car skidding, because if the magnetic brake is applied improperly it certainly will skid.

96. If the current flashes round the commutator, does not that produce a skid?—That locks the wheels, and may affect the action of the brake and produce a skid.

97. Is this particular case you mentioned just now the only case that has come under your notice of the current flashing round the commutator?—So far as my recollection goes, it is.

98. You have not seen commutators that have been burnt?—No; these matters are not brought under my notice.

99. You have not been consulted?—I have not been consulted on them.

100. Have you been consulted with reference to any defects of the armature or in the magnetic brake?—No.

101. You stated, I think, that you found the magnetic current 200 amperes. Have you a voltmeter?—No.

102. You noticed by Mr. Goodman's evidence he states that on certain experiments he got voltage as high as 700. Mr. Cable, in his evidence, showed us that he got a voltage of as high as 1,000. Also, I think, the Westinghouse Company have admitted that voltages as high as 1,100 occur with the same application of the magnetic brake. In your experience have you seen anything to lead you to suppose that such high voltage is common?—Not in my experience.

103. Are you aware that the Westinghouse Company are fitting an anti-skidding device to these brakes?—I am not aware of that. I cannot say that I have seen that.

104. From your personal experience, do you consider this desirable?—No; I should prefer to keep the hand-brake, and should judge that it would make it more awkward for the motorman to use them.

105. It has been stated in evidence that the motormen of Glasgow are prohibited from using the magnetic brake on service stops. I gathered that you were acquainted with the Glasgow tramway system. Are you aware that the magnetic brake is used in Glasgow only as an emergency brake?—Yes.

106. Not as a service brake?—Not as a service brake.

107. Have you any knowledge of the fact, which has been stated before in your evidence, that motormen are prohibited from using the magnetic brake except as an emergency brake?—From my reading, I think that is the case.

108. You said, Mr. Henderson, that the weight of the cars here was from 9 tons to 9½ tons. How was that weight arrived at, by actual weighing, or by estimate?—I could hardly tell you how it is arrived at, but that is the weight we have as the weight of the car. It may possibly be taken from the makers. Of course, we have all the weights of the different parts.

109. The cars have not been weighed in their complete form?—Not to my knowledge.

110. In connection with that test that you made on the South Road, what was the condition of the track?—It was a fairly greasy track.

111. On the occasion of the power flashing over, do you consider the magnetic brake was properly applied?—No; the brake was not properly applied.

112. On the same day, under the same conditions, you made a test: what was the result?—The car was brought to a good stop, because the magnetic brake was then applied better than it had been before.

113. Did you notice that the Inspector driving the car did not rest on the notches?—I did not notice that.

114. You would know that from the two tests?—Yes.

The Chairman.—I have a Glasgow rule-book here stating that the magnetic brake must be used on all down grades. We have had the evidence of five or six motormen who have been on the Glasgow trams, and the motormen had received instructions that the magnetic brake only was to be used on emergency stops.

115. Why do you say the brake was improperly applied?—It was brought round too quickly; the notches were cut out too quickly. I should judge from the fact of the skid that that was the case.

116. I take it you consider him a good motorman?—He is a good motorman, but not now in ordinary work as an every-day motorman.

117. You were out for the purpose of making trials, and you would select a capable man?—I should judge, in my opinion, that an Inspector would not be taken if we are going to get tests under ordinary conditions.

118. If you take a car out for trial and put on it a man you consider a good motorman, and he does improperly employ the brake, does it not appear to you that a motorman in traffic is very likely to do the same thing?—I should say that if a motorman is not careful the wheels would be skidded.

119. Would you be surprised at a motorman making the same mistake in an emergency stop?—I cannot say that. A motorman who is operating this every day is likely to know the conditions better than one operating on very few cases.

The Chairman.—I take it you propose to call Mr. Ross and Mr. Stark.

Mr. Alexander.—If you wish to do so.

EDGAR EVERETT STARK sworn and examined.

1. *Mr. Alexander.*] What is your name?—Edgar Everett Stark.

2. You are City Electrical Engineer for the Dunedin City Corporation. What is your position as regards the Tramways Department?—I am Consulting Engineer for the Tramways Department, and am consulted on questions of a technical nature or any work requiring special instructions.

3. You also go down and examine cars?—I have been called a number of times to make an examination of cars in conjunction with yourself and the Chief Engineer of Public Works Department in any case where there has been any special accident or anything of a technical nature. I think you have invariably called either myself or my assistant in.

4. You heard the evidence given by Mr. Henderson *re* tests. You were on the car?—I was on the car. I was reading the meters.

5. And you know that the figures as regards those tests are correct?—There was only one time it did reach 200 amperes. The meter went up to 180 coming down the Caversham grade. We made two tests.

6. What was the result of the first test?—The result was that the motor flashed over, and the car-wheels skidded slightly.

7. What was the cause of that?—The cause was evidently the too sudden turning of the controller-handle.

8. You heard Mr. Henderson's evidence: are you in agreement with what he stated there as regards the magnetic brake being suitable? Would you care to adopt any brake but the magnetic brake in Dunedin?—It is not necessary. We have had no trouble with our motors. In fact, the armature troubles that we have had are less than in any place I have been in. Indeed, our armature repairer is not employed half his time.

9. How many cars have you got?—Forty-three altogether.

10. In Wellington they have eighty-one. Do you know the Wellington system?—Not very well.

11. Do you know Wellington at all?—I have been in Wellington, but I have not made a study of the system at all.

12. You have been on the cars and seen the narrow streets. Do you consider the magnetic brake suitable, as far as you have seen?—I should put on a magnetic brake.

13. *Mr. Rosser.*] I do not quite gather what experience you have had in Dunedin?—Three years.

14. Have you had any previous experience in tramway matters in America?—I have.

15. Do you know of any magnetic brakes installed in the American systems?—I cannot remember them.

16. In evidence given by an Auckland motorman he knew of no magnetic brakes being installed?—I cannot call to mind a single one.

17. Was it a very wide experience you had in America in tramway matters?—No, the lines were only short lines—one at Los Angeles and one at Nevada City.

18. Are there any grades in Los Angeles?—No, none at all.

19. What was your experience of the air brake? Were they all effective?—We had trouble with it, broken pipe and motor troubles, but it is not bad.

20. Do you remember any cases where failures have been caused by improper application by the motorman?—I remember no failures.

21. *The Chairman.*] Have you had experience of the flashing of the commutator with the magnetic brake?—Yes, often.

22. At a limited speed?—At high speed, and when the controller is brought into work too quickly; but the details of that can be given better by Mr. Ross.

23. At the present time is there any serious trouble with commutators and brush-holders?—No, it is very small, very small. Indeed, I have observed the working of the trams, and, though it is not my particular business, I know of the repairs that go on. It is not excessive; it is very small.

24. Is there not an increase in the cost of upkeep by the use of the magnetic brake?—It has been such a small amount that our attention has not been drawn to the necessity of any tests. In fact, our cars have given us very little trouble.

25. What do you consider a safe limit of speed?—I should not hesitate to apply the magnetic brake going at twenty-three miles an hour.

26. You are aware that the Westinghouse Company are introducing an anti-skidding device? You are not quite acquainted with that particular device?—No.

27. Are you acquainted with the hand-device which the Westinghouse people are introducing?—I have seen it described.

28. You consider that the use of this device on your cars would be no advantage?—There is great danger with a multiplicity of devices. When a man uses a device a great many times it becomes automatic, and he does the thing without thinking, and that is better than if he had a multiplicity of things to put his hand to.

29. Of course the first of these devices I was mentioning is automatic. I take it that you are absolutely satisfied with the brake application?—Yes.

30. They have given you absolute satisfaction?—I do not see the necessity of putting in an auxiliary device.

31. Have you weighed your cars here, Mr. Stark?—No; the weights are taken from the makers.

GEORGE ROSS sworn and examined.

1. *Mr. Alexander.*] What is your name?—George Ross.

2. You are what is called Shed Foreman, and employed by the Dunedin City Corporation?—Yes.

3. You have been employed for five years?—Five years in charge.

4. How many years before that?—Eighteen months—that is, six years and a half.

5. Prior to that, what occupation did you follow?—Marine engineer.

6. For how many years?—Sixteen years.
7. Were you at sea?—Yes, sixteen years.
8. What was your experience prior to that?—I was working on shore.
9. Do you hold any certificate?—First-class certificate, London, marine engineer.
10. I suppose you served your time out here?—Yes.
11. You were trained practically under Mr. Goodman for the position you are in at present?—Yes.
12. What is the procedure when any car is reported defective in any way, especially the controller, brakes, or motor?—We get it in as soon as possible.
13. And after you get it in?—We thoroughly examine and overhaul it, and then it is taken out for trial before it is put in traffic again.
14. Do the motormen make any reports regarding the cars?—I get reports sent on to me. I locate the fault, make out my report, and it is sent back to the Manager's office.
15. That is, the motormen's report calling attention to a fault is sent on to you, you examine, find out the fault, minute the report, and send it back?—Yes.
16. Suppose a motorman reported a fault at the sixth notch?—I should be able to locate the fault. I do not remember a case where I have been unable to locate the fault at any high register.
17. Have you known a car failing completely?—I cannot remember one failing completely.
18. Suppose you do not quite understand the fault, what procedure is taken then?—Well, I report to you, and you and I consult with the City Engineer.
19. Do we act on their advice, or do we not?—Certainly we do.
20. In every case?—Yes.
21. *Mr. O'Shea.*] Do you examine the brakes regularly?—Yes; we keep them in proper working-order.
22. Do you overhaul the controllers every night?—No; we run about three nights.
23. Do you clean the commutators every night?—Every morning.
24. Has there been any instance, or any number of instances, here, where motormen have reported a failure of the brake, and you have not been able to find any direct indication of the fault?—No, I always find the fault.
25. You can test, and by testing discover a fault in a brake?—Yes.
26. Is the brake, in your opinion, an effective brake?—Very.
27. *Mr. Rosser.*] I notice you are eighteen months in the service: in what capacity?—In the first place I was working in the shed, and later on was in charge of the night shift.
28. And you have never worked as a motorman?—No.
29. When a report comes in, I presume it goes through your hands?—I receive it from the Manager.
30. And did I understand you to say that you get the car in as soon as possible?—Yes.
31. What is the result of that? Do you give it an overhaul?—Yes. The car is brought in with a verbal report; the written report comes in at night.
32. Would it not be better to test that car under the same conditions as those under which the reported failure took place?—I do not consider it necessary. I get a description of the rate from the motorman.
33. But if you do not locate the fault you put the car under an examination and overhaul?—Yes.
34. Well, is it fair to that motorman to test that car afterwards?—I do not see that. My report goes in on that.
35. That is not equal conditions. Do you take that car and try it at the place where the failure is reported to have occurred?—No.
36. When a car is reported it is tested under different conditions?—Under service conditions.
37. Do you remember a car being reported for skidding in Princes Street through tar being used on the rails?—Yes.
38. Did you test the car afterwards?—No.
39. Did you report that the car was in a fit condition?—No.
40. Do you hold the opinion that the magnetic brake cannot fail?—As long as the electrical circuit is complete I do not think it would fail. It is the same with machinery of any description. There is always the liability of failure: there is no perfect machinery.
41. When a failure is reported is it not the usual thing to screen the equipment at the expense of the motorman?—Not to my knowledge.
42. There is equal possibility of either or both being at fault?—Certainly.
43. Do you remember some time ago that car 12 failed, and you were some weeks locating the fault?—That was before my time.
44. How long have you been Shed Foreman?—I have been Shed Foreman five years. The trouble was before my time, and the car is one of the best cars on the road.
45. Have you had many cases of alleged failures reported to you by the motormen?—There is not a great percentage of failures; very small, I consider.
46. Have you had many commutators burnt at the edges?—No.
47. Have you had them slightly burnt at the edges?—Occasionally, but not often.
48. How often?—I cannot say, it comes so seldom. Well, about one a week. That would be the outside. For a long time they run without any trouble.
49. Do the cars come into the shed every night, and are they inspected every night?—The motors are inspected every night, and the brake gear is inspected.
50. How often is the brake gear adjusted?—It will run for about a week without adjusting.

INSPECTOR MATHESON sworn and examined.

1. *Mr. Alexander.*] What is your name?—John Matheson.
2. You are an Inspector employed in the Tramways Department?—Yes.
3. Prior to that you were a motorman?—Yes.
4. How long did you act as motorman?—Two years.
5. How long as an Inspector?—Four years.
6. Of course during that time the magnetic brake has always been used for service stops and coasting?—Yes.
7. Do you remember your having a copy of the rule-book issued by Mr. Goodman as to instructions for use of magnetic brake?—I have one.
8. From your recollection, do you know whether Mr. Goodman issued instructions that the magnetic brake must be used for service stops and for descending hills?—See rule 74.
9. What has been your experience regarding the magnetic brake?—I have found no difficulty in operating this brake. I have always found it efficient, reliable, and simple to operate.
10. Of course you have heard the men pass remarks about the brake. Do you remember what they were?—Yes. Some considerable time ago I have heard them say, "She is a bit slow on the first notch."

Commission adjourned till 2.30 p.m.

Mr. Alexander offered to call out any car from traffic to take tests.

The Chairman.—Clean commutators. Put on the speed-indicators. Twenty-five per cent. overload. The car will be weighed; Commission will be present at weighing. At Caversham Rise there are bad grades. We will go over to the other afterwards. We want a flat for retardation. Chainman and Measurer.

INSPECTOR STEELE sworn and examined.

1. What is your name?—William Thomas Steele.
2. You are employed as Traffic Inspector in the Dunedin City Corporation tramways?—Yes.
3. How long service have you?—Since the electric cars began, and eight months before on the horse-cars—over seven years.
4. Were you motorman any part of that time?—Yes, I have passed through all the branches, from conductor upwards.
5. How long were you motorman?—Under three months.
6. And the remainder of the time Traffic Inspector?—Starter, Ticket Inspector, and Traffic Inspector.
7. As Traffic Inspector are you at the Post-office all the time?—Yes, at the Post-office all the time.
8. In your service, what has been your actual experience as regards the operation of the magnetic brake?—I have always found the brake safe, and have used it for coasting and for all service stops.
9. Did the brake ever fail while you were in charge of a car as motorman?—I have never had a complete failure of the magnetic brake while driving a car.
10. When the tram service was under the charge of Mr. Goodman, did he issue instructions *re* the operation of the magnetic brake?—Yes, instructions were issued during Mr. Goodman's management. I have a copy.
11. Instructions regarding the use of the magnetic brake in descending grades?—Yes. Cars must descend grades on magnetic brake. Rule 74 is the one regarding the magnetic brake.
12. Were these instructions always carried out?—To my knowledge they were.
13. In your duty as Traffic Inspector, all complaints by motormen are made to you?—Yes.
14. Supposing a report is made of anything wrong with the brake, what is the procedure?—It depends on the position of the car on the road. If it is a considerable distance from the shed I get the earliest car I can and go to the car, but in any case I have a report from the motorman. The car is brought in, and she is not put out again until she is overhauled by the Shed Foreman.
15. Have you ever had any complaint of any kind from the men regarding the magnetic brake?—Complaint?
16. As to its effectiveness?—No, I have not.
17. Is the emergency brake your service brake?—No.
18. Have you had a report that the magnetic brake failed right out?—Not to my knowledge. I have had men report that cars failed on certain notches.

The Chairman.—Might I ask, Mr. Alexander, what is meant by a brake failing right out?

Mr. Alexander.—As long as the car acts on seven notches it is not a complete failure. It is only a complete failure when the brake fails to come into action on any notch.

The Chairman.—Witnesses now will understand that when speaking of a complete failure he means the failure of the brake to stop the car on any notch.

19. *Mr. O'Shea.*] Are there any occasions where the magnetic brake has failed, not through any weakness in the motor, and it is found after that the brake is effective?—No, I cannot say that the fault has not been found.
20. What do you think of the magnetic brake? Are you satisfied with it in Dunedin?—Quite satisfied.
21. Under ordinary conditions of traffic, eight to fifteen miles an hour, do you get rapid stops in emergency? Supposing men, women, and horses get in front of a car, do you get rapid stops?—Yes, very sudden stops with the emergency brake.
22. What is the best you get?—To consider a question like that you must consider the conditions.

23. With good conditions, supposing you were going from eight to ten miles an hour on a good grade, what do you suppose you could get?—I do not think it would be much less than a car-length, 29 ft.

24. *Mr. Rosser.*] When reports are made to you, Mr. Steele, do you keep any record of them?—Yes. All reports are taken at night, and a duplicate is sent to the Night Foreman. Those reports are in small books, and, I think, are all kept.

25. Is it your business to make a report?—No; I write out the report. When the book is full it is sent on to the office.

26. So that the report-books are in your possession, and then become part of the archives of the Corporation?—Yes.

27. I understood you to say that you had worked three months as a motorman. Have you had any previous experience anywhere else—any experience in tramway matters at all?—Yes, as far as horse-cars are concerned, in Dunedin; nowhere else.

28. What is the usual course when a man is promoted to the position of motorman: does he undergo any examination?—In my own case I had to undergo an examination in regard to the equipment of the car, and answer, of course, examination questions, and then I was placed on the road.

29. Was there any theoretical examination expected of motormen?—Yes, when these cars were first installed there was.

30. You passed that theoretical examination?—Yes, I passed that.

31. Do you get any verbal reports from the men as to any partial failures?—The motorman is likely to ring up the shed on either of the Department's telephones, and I get word that way. The motorman, of course, when he comes into the depot fills in a report-form.

32. Your present position is to have supervision over the motormen from your position at the Post-office. Is that in regard to the traffic only, or in regard to the operation of the motormen?—In regard to the operation of motormen and conductors—in regard to the carrying-out of the rules of the service.

33. *Mr. Breen.*] I should like to explain my position here to-day, Mr. Chairman. The union that I represent has not considered in any shape or form the merits of the magnetic brake, and my object in being here this morning is to safeguard motormen in case any failure had been attributed to negligence. I understand there has been no suggestion of that so far. I should just like to ask Mr. Steele a question. He stated that he has never had a complete failure. I would like to ask if he has had any partial failures?—Yes; I had a partial failure in a car I took out for trial. She failed on the first three notches.

34. Of course, you did not attribute that to any negligence or inexperience on your own part?—Decidedly not.

35. What is the custom where a report has been sent in by a motorman: has the motorman's explanation been accepted as satisfactory? You do not know from your own knowledge where any motorman has been held responsible for a brake-failure?—No; not that I can call to mind.

36. You said you knew of one case of partial failure: have you heard of any others?—No. I have had, as I said, reports of cars failing on certain notches.

37. You have had a number of reports that cars have failed: have you had any experience of the flashing of the commutator at high speed?—On one car that I had I know the magnets danced a little.

38. They danced?—Yes, and down again.

INSPECTOR WOOLLEY sworn and examined.

1. *Mr. Alexander.*] What is your name?—William Woolley.

2. You are Chief Inspector on the Dunedin City Corporation Tramways?—Yes.

3. How long have you been employed?—Since the inception of them—six years and a half.

4. Had you any tram experience prior to that?—Three years as a motorman.

5. You were instructed under Mr. Goodman. Do you remember his instructions in regard to the use of the magnetic brake?—Must be used in descending hills and at all times for service stops.

6. Have you anything to do with testing cars?—Yes, I take out every car.

7. No car is allowed to go into traffic before it is inspected?—No.

8. The magnetic brake has been in use in Dunedin from the start?—Yes.

9. Have you worked out the number of times daily the magnetic brake was used for stops?—Yes; on a car working sixteen hours a day 672 stops were made on one car. That is, the estimated total number of stops per day in Dunedin is 15,546.

10. Regarding the choosing of motormen for the service, what is the usual procedure in Dunedin?—The man it put on to train on the road.

11. Where is he taken from?—Usually from the conductors. He goes on the road with four other motormen.

12. Who are these other motormen: do you select them?—We take our best men.

13. Do these men make any report?—Yes; they sign a sheet giving their opinion as to the man's performance of the duties as a motorman.

14. After a man training for a motorman has passed the examination, what is the procedure?—He comes out on the road with me. He is taken out on a special car, and he has to show to me that he knows how to stop that car and handle that car under any conditions.

15. Then what happens?—I take him out in traffic, and if he shapes well I send in a report.

16. And after that?—He comes up for examination. And if he passes that, he takes up his place as a driver on the road.

17. Have you ever heard of a complete failure as regards the magnetic brake?—No.

18. Of course there have been partial failures?—Any number of them.

19. There used to be a common report, "Failed on the first notch." What was considered the cause?—Well, a motorman might mistake his speed, and might not dwell quite long enough on the first notch.

20. What is the procedure whenever a car is reported anything wrong with the brakes?—It is taken to the shed as quickly as possible.

21. Is it the rule to blame the motorman?—The motormen have never been blamed at the expense of the equipment.

22. Are you generally satisfied with the magnetic brake?—I should think I am.

23. What are the best stops you get at ten to fifteen miles an hour? Suppose you had an emergency?—In emergency, at fifteen miles an hour, I should say in a length and a half. The best stops at ten miles an hour are 20 ft. and 24 ft.

24. Now, in your experience, is the magnetic an amply sufficient brake on your worst grade?—Yes, absolutely.

25. Is it satisfactory as a coasting brake?—It has been so here.

26. Have you ever had occasion to use the brake at twenty miles an hour in a grade of 1 in 16? How did it pull up then?—It flashed over, and the car stopped.

27. Do you call that a brake-failure?—If the car stops, how can you call it a brake-failure?

28. I noted you said, Mr. Woolley, that previous to six years and a half you had three years' experience as a motorman on the Roslyn electric trams?—I might say I was the first motorman who was trained in this country.

29. Then, I do not ask the question from any desire to hurt your feelings in any way, but do you consider yourself a competent motorman?—I do.

30. You were present this morning, and heard about that test with Car No. 20?—Yes.

31. I think it was stated that it was not the fault of the equipment, but that it was the fault of a bad stop by the motorman?—Yes, an improper application of the brake. It was the cause of dwelling too long between the notches.

32. Do you find many motormen that do not make that application cleanly like you do?—No; our motormen are all well trained.

33. When a partial failure takes place, it is not the fault of the motorman; it is the fault of the equipment?—Well, he may misjudge his speed, but we do not blame a motorman for that. He is not penalised in any way.

34. Suppose a man makes a misjudgment, is that booked up against him in any way?—If a competent man makes a misjudgment? If he made a serious accident it might be.

35. Do you know the case of Motorman Hill, who was reduced to the position of conductor?—I know the case well.

36. Do you not think it would be better if the sand-pipe led on to the two rails?—Undoubtedly it would.

37. You were asked by Mr. O'Shea what stops you make at ten to fifteen miles. Is there any regulation as to the speed in the city?—Fifteen miles is the limit.

38. Do cars run fairly fast when outside?—Well, it is hard to say. They might, but it is not expected of them. It is not necessary for them to do so.

39. How much time have you at the end of the journey to turn the switch-pole?—One minute.

40. Do you find you are able to run to time-table?—Yes.

41. What am I to infer from the statement, "Any number of partial failures"?—What I say—any number of partial failures—dozens of them in six years.

42. Mr. Woolley, you made a statement that men were specially chosen to teach beginners. Are there only four men specially qualified to teach beginners, or did you take four?—There are more than four, but four are selected.

43. Do you know if any of those men who have been chosen to teach beginners have ever had brake-failures?—They may have had.

44. Would you be surprised if they had?—Certainly not.

45. You would not?—No.

46. If there is any failure of the brake it is due to the equipment, and not to the motormen?—It might be so.

47. You have heard the reference to Mr. Goodman's instructions. Would you mind telling me the date of the instructions?—1905.

48. Do you remember when Mr. Goodman was in Dunedin?—1903.

49. When did he leave?—He left in 1907.

50. There is one point which I would like to ask this witness. Mr. Breen put the question, but omitted altogether the fact of the human equation. Is it generally the motormen who fail, or the machinery, when it is not an inevitable accident?—I cannot think of any such case.

51. Do you remember the Shearer case, for carrying a man too far under his car?—As a matter of fact, the motorman did not know he was there until the man's pants started to wear off.

52. Then you do know the case. Do you remember any other accidents?—Yes, we had an accident on the Caversham grade, where a man let his car run down from the top of Caversham grade to the bottom, and did not apply his brake until he got to the bottom. That was a case of the motorman failing.

53. You have had no cases in Dunedin of cars sent out and the equipment known to be bad?—Never.

54. You have had cases where the motorman failed?—Yes, quite true.

55. In those cases referred to by Mr. O'Shea the accidents were caused by the brake failing. In the Caversham accident it was the failure of the man to apply the brake at the right time. That was negligence?—Yes.

56. You do not suggest that it was a brake-failure?—No. The car must have been going about thirty or forty miles an hour, and he did not apply the brake until he was almost on the car at the bottom.

57. Is that man still in the service?—He was emptied out the next day.

58. Do you know of any accident occurring within the last four years through a brake failing?—No.

59. You say you know no cases of the complete failure of the magnetic brake?—Yes.

60. Are there many cases of partial failure?—Yes.

61. Do you attribute this to the motorman's misjudgment of speed?—In nine cases out of ten.

62. You were testing an experimental car the other day?—I was.

63. Did you receive any special instructions as to the way in which you should make that stop?—Yes.

64. What were you told?—I was told to endeavour to test the equipment.

65. With regard to these partial failures, you say the car stopped. Evidently it flashed over, and what happened them?—On that particular stop I should say it would be a little over two car-lengths we came down a grade of 1 in 16, and in spite of the flashing-over the car stopped in a little over 60 ft.

66. If a so-called partial failure occurred during an emergency stop, it might mean some accident?—Yes, it might.

MOTORMAN MACDONALD sworn and examined.

1. *Mr. Alexander.*] What is your name?—Donald Macdonald.

2. You are now motorman in the service of the Dunedin City Corporation Tramways?—Yes.

3. Prior to that you were motorman in the Glasgow trams?—Yes, I was both conducting and driving.

4. How long were you employed?—Three years.

5. How long as motorman?—Eight months conducting; two years and two months driving.

6. Of course there is a rule-book of the Glasgow Corporation trams?—There are certain rules for the use of the magnetic brake.

7. This was your rule in regard to rate of service and the use of the brake going down hills?—Yes.

8. Did you use the hand-brake for service stops there?—Yes, always.

9. Did you find it effective?—Yes.

10. You had very greasy rails there?—Yes.

11. Worse than in Dunedin?—Yes.

12. What is the worst grade?—Well, I think the grade going up High Street is the worst grade there.

13. Is it steeper than the Caversham grade?—Yes.

14. Longer?—Yes.

15. Do you know any other powerful brake?—They tell me the air brake is very good. I have never used it.

16. How long ago is it since you worked in Glasgow?—Between four and five years ago.

17. We had certain evidence from six or seven Glasgow men in Auckland, one of whom had worked as recently as two years ago, that instructions had been issued that the brake was not to be used for service stops or for coasting. Was that in your time?—No. It was to be used for emergency stops and coasting grades.

18. Do you remember a case where a woman was thrown over, and claimed £400 damages?—No.

19. Did you have instructions to try the brake at the top of a hill?—Yes. We had instructions to use the magnetic brake as soon as we left the shed, and then at the top of the hills. We were supposed to try it there.

20. Do you know why that was issued? Do you suppose the magnetic brake does not always work the same?—Yes. It does not work the same on all cars—it varies a little.

21. In the Glasgow service were you liable to get any car and all the cars, or did you get a different car?—We changed, like we do in Dunedin.

22. Would you kindly give me the date of those rules?—15th June, 1903.

23. *The Chairman.*] Do you know of any brake-failures in Glasgow?—It never failed with me.

24. Do you know of any failures?—We have had previous evidence of a considerable number of failures?—There have been several accidents there, but I never made any inquiries whether the brake had failed, because it is such a big city, and in a big city you know what is going on in your own depot.

25. Was it common talk amongst the motormen that the magnetic brake was unreliable?—I used to hear them say that, but I do not know that it was proved.

26. In your own personal experience it never failed at all?—It did not always work the same, but it never failed. It never failed to such an extent as to prevent me making a stop at a reasonable distance.

INSPECTOR ROBERTSON sworn and examined.

1. *Mr. Alexander.*] What is your name?—Alfred Robertson.

2. You are now Traffic Inspector in the Dunedin trams?—Yes.

3. How long have you been employed in this service?—The electric service or right through? About twenty-four years.

4. Did you ever act as motorman?—Occasionally.

5. Your duties are similar to Inspector Steele's?—Yes.

6. All complaints made by the men are made to you?—Yes.
7. Have you ever had a report of a complete failure?—No.
8. In a case of partial failure, what procedure do you take? Suppose a man says there is something wrong with the magnetic brake, what do you do?—Run the car into the shed immediately.
9. Do you think the Westinghouse magnetic brake has been satisfactory, so far as your experience in Dunedin goes?—Yes.
10. Have you seen any good stops in emergency with the magnetic brake, say, under ordinary conditions, ten to fifteen miles an hour in George Street?—In a car's length—perhaps two car-lengths.
11. *Mr. Rosser.*] With these splendid stops that you have seen in an emergency, have you seen a splendid huddle-up?—Yes, they are all sitting there.
12. There are no arm rests on the Dunedin cars. It is not severe on the passengers?—Not in any case I have seen.
13. Do you agree with the statements made by Inspector Steele and Chief Inspector Woolley in reference to the failures of the brake and the responsibility of the motormen in connection with it? Have you known of any partial failures of the brake, and in those cases do you attribute the cause to the motormen or to the brake itself? Would you consider that a partial failure of the brake was caused through negligence on the part of the motormen?—Sometimes.
14. Do you know of any case?—No.
15. If you were driving a car, and the brake failed, would you consider that was caused through your negligence?—No. I never had a failure.
16. Do you know whether motormen are held responsible when they report a brake-failure?—No.
17. Their statements are accepted as satisfactory?—Yes.

INSPECTOR HILLIKER sworn and examined.

1. *Mr. Alexander.*] What is your name?—William Arthur Hilliker.
2. You are now Ticket Inspector?—Yes.
3. Prior to that you acted as motorman?—Yes.
4. How long have you been in the service?—Since the inauguration of the service.
5. How long as motorman?—Over two years.
6. During that time, of course, you used the Westinghouse magnetic brake for coasting grades and service stops?—Yes.
7. From actual experience do you ever have partial failures of the magnetic brake?—Yes.
8. Have you ever had a complete failure?—No.
9. I suppose, like most motormen, you have had occasion to use it. How has it acted?—On every occasion it gave satisfaction.
10. From experience here do you think it is suitable for Dunedin?—I think so.
11. What distance have you known a car to pull up in in an emergency in the city?—It depends on the rate of the car.
12. Well, ten to fifteen miles an hour?—Many times, at the rate of ten miles an hour, in a car-length.
13. When a motorman reports a failure to an Inspector, the Inspector takes it as a matter of course that the car is out of order, is that not so?—That is so.
14. You told Mr. O'Shea that you had not had experience elsewhere, so that your opinion is confined to the use of the brake in Dunedin, under conditions prevailing in Dunedin?—Yes.
15. You said you had partial failures: one or more than one?—More than one.
16. And in these partial failures you have not known the brake to fail over three or four notches?—I think I have, once or twice.
17. It was effective on the last notches?—Yes.

INSPECTOR GOLDEN sworn and examined.

1. *Mr. Alexander.*] What is your name?—J. J. Golden.
2. You are at present Ticket Inspector in the employ of the Dunedin City Corporation?—Yes.
3. Prior to being Ticket Inspector you were motorman?—Yes.
4. How long have you been a motorman in the service?—Two years altogether.
5. How long have you been in the service altogether?—Well, including the horse-cars, eighteen years.
6. Have you been on the electric cars since they started?—No; five years.
7. In your experience, did you ever have a partial failure of the magnetic brake—that is, a failure on the first, second, and third notches?—Yes.
8. Have you ever had a failure right out?—No.
9. Has the magnetic brake, from your own active experience, been found a suitable brake for the Dunedin service?—Yes; I have found it very reliable.
10. What are the best stops you make in emergency, at eight to ten or ten to fifteen miles an hour on a level grade?—A little over a car-length I have made a stop.
11. How long have you been Inspector?—Well, altogether I have been about three years inspecting.
12. Have you ever heard any complaints about the insufficiency of the sand-gear on the Dunedin cars?—Not to my knowledge.
13. Have you ever seen a conductor throwing sand on the rail with his hand?—No.

14. I am told one of your men carries a tin for that purpose. Have you come across him?—No. Do you mean the conductor, or the track-man?

15. The conductor. He has time to come from the back of the car. Have you ever noticed that?—No.

16. And you consider that the sand-gear is effective?—I think it would be much better if operated on two rails.

17. What was the cause of the failure you refer to?—Well, I may have applied the notch too quickly.

18. And you consider that you were responsible for it?—I did not consider myself responsible. I may have made the notches too quickly.

19. When a failure is reported to you by a motorman, do you take it for granted that the mechanism is out of order?—I simply refer the matter to the Traffic Inspector on duty, or inform the depot, and the car is run in.

20. During your experience, have you found that the failure has been caused by negligence on the part of the men?—No.

Mr. ALEXANDER sworn and examined.

1. *The Chairman.*] What is your name?—Charles F. Alexander.

2. Are you Manager of the Dunedin City Corporation Tramways?—Yes.

3. How long have you been Manager?—I have been here since January, 1906.

4. What are your brakes here?—They are the hand-brake and the magnetic brake.

5. You use the magnetic brake for coasting and for a service brake. How do you find it act?—From my experience and from the reports that come before me, I think it is a first-class brake for Dunedin.

6. What was your previous experience in tramway matters?—I was in Brisbane before I came here.

7. Had you any experience of working the magnetic brake?—No.

8. Have you ever known the magnetic brake to act here when the controller was damaged?—Yes. On one occasion we had a collision here. The front of the car was almost completely smashed in; the controller was smashed. That car was immediately run in. Next morning we rang up Mr. Furkert, of the Public Works Department, and we tested that brake in every possible way we could.

9. Have you had any specially good stops with the magnetic brake?—I have seen some of our motormen make wonderful stops.

10. What distance can you stop at?—I have seen them pull up in about a car-length.

11. Is it from any defect in the brake that occasionally people get spilt with it?—If I hear that people have got thrown about in the car I think that motorman has made a first-class stop. I think it was last night, on the Post-office grade, a car was travelling at five miles an hour, and a lady went to board the car. The motorman saw her, and pulled it up in a foot.

12. Would you care to have your magnetic brake replaced by any other brake?—No; I do not want a change in Dunedin.

13. It satisfies you?—Yes.

14. Do you have any accidents?—We have fewer in Dunedin than on any tramway system I know.

15. Have you at any time advanced the opinion that the magnetic brake could not fail?—No.

16. Do you hold the opinion, then, in defence of your equipment, that in the case of any failure like that the fault is the motorman's and not the brake's?—Certainly not; each individual case must be judged.

17. *Mr. Rosser.*] With reference to that tarry rail that I spoke of this morning to several witnesses, that motorman was reduced to the position of conductor. What was the reason that he was reduced?—He was reduced because it was an error of judgment.

18. But the car skidded?—I do not remember the exact particulars now. After an accident we always make inquiries, and after that I come to a certain conclusion.

The Chairman.—Was this supposed to be a brake-failure?

Mr. Rosser.—Well, it was a case of skidding, and there was no sand on the rail on which the tar happened to splash. Therefore I take it that the installation of a proper sanding-gear would avert brake-failures.

Mr. Alexander.—This is the conclusion that I came to after full investigation of the circumstances leading up to the collision: I am of opinion that the collision was caused by an error of judgment, and, further, of the opinion that had the rail not been greasy the accident would not have happened; but the motorman stated that, in his opinion, if the car in front had been one car-length further away the collision would not have occurred. The following morning we tested the car in the presence of Mr. Furkert, and the brakes were found to be in perfect working-order. In my opinion the motorman was not guilty of gross negligence.

19. *Mr. Rosser.*] You are not able to state whether the wheel skidded on that occasion?—Yes Very likely if the brakes were improperly applied the wheels would skid, and it needs very good judgment to pull up a car.

20. Do you hold a motorman responsible for a skidding car?—It depends on the circumstances.

21. What would you have expected him to do?—He should never have come so far.

22. You do not remember any case of any brake-failure?—Absolute, straight-out brake-failure? None that I remember to have been reported to me.

23. Do you remember the case of a car skidding at the corner of Howe and Castle Streets, driven by Motorman Pearce?—No.

24. Do you keep a record of these failures?—Yes. I have them here for the last three months.

25. It was further back than that. Did you have a report sent in to you last night of the excellent stop that took place at the Post-office?—You must admit it was an excellent stop. The car ran 1 ft. after the motorman applied the brake.

Mr. Rosser.—Yes; I have nothing to complain of the motorman.

The Chairman.—How about you, Mr. Rosser?

Mr. Rosser.—Well, I fell inwards, and I took the lady to church that was injured.

26. *Mr. Rosser.*] Do you consider that your motormen in the Dunedin service compare favourably in regard to efficiency with motormen in other services?—Yes, I think so.

27. We have had no evidence in Christchurch that any inefficient stops were made there with the air brake. That being so, do you not consider it a good argument for the air brake? We have heard to-day about the liability of making these inefficient or incompetent stops. Do you not consider that this is an argument against the brake in which this liability arises?—If you take fifteen thousand stops a day, and one failure a week, I think that it very good.

28. *The Chairman.*] You are quite satisfied with the magnetic brake?—Yes.

29. Do you think it would be an improvement, on fairly steep grades, if the anti-skidding device were adopted?—Yes.

Mr. Rosser.—I should like to give formal evidence as to that stop last night, and the safety of the passengers.

Mr. ROSSER sworn.

The Chairman.—My name is Arthur Rosser. I am Secretary of the Auckland Tramway Employees' Union. Yesterday afternoon I left St. Kilda at about a quarter past five. On reaching the top of the Princes Street hill, coming down to the Post-office, I was seated with my back to the motorman on the front seat—that is, the first seat available for passengers. A lady prepared to alight, thinking the car had stopped. We were then going very slowly—at about four miles an hour. I got out on the step preparing to alight, and this lady got down on the step. The motorman, looking over his left shoulder, saw her, and applied the emergency. I got swung round face inwards, so that I was not in a position to see what distance the car travelled, but the effect of the stop was very serious. The lady herself got thrown on to the arm of the seat, and one very elderly lady standing in the doorway got thrown with great force on to the seat that I had been sitting on. She struck her knee against the edge of the seat. The motorman and conductor took the names of the two ladies and also of witnesses. My own was taken. The elderly lady was almost unable to stand, and I asked if I could assist her. She said she was going to First Church, and I assisted her to the church-door. She told me she was seventy-eight, and she was very badly injured. I give this evidence to show the severity of the magnetic brake upon the passengers.

Mr. Alexander.—I suppose the efficiency of an emergency brake is the distance in which that brake will bring up a car after it has been applied. That is, if you apply the emergency brake and it brings up a car within a few feet, it fulfils its purpose.

Mr. Rosser.—There is one point of efficiency, the effect on the passengers, which must be taken into consideration.

Mr. Alexander.—Supposing a car is going ten miles an hour, and is brought up by an air brake, is there any difference.

Mr. Rosser.—Yes. I was on a car at Sumner yesterday week. I gave this evidence before the Commission on Monday. It had no effect on the passengers whatever, and yet the car was brought up within 2 ft. of the lady who was riding a pony; so in my opinion the magnetic brake has a much severer effect on the passengers than the air brake. I may state that these are only coincidences, and have not been arranged on my part.

Mr. J. O'Shea, counsel for the Wellington City Corporation, said,—The first matter which I desire to touch on is the report of the last Commission which sat, dealing with this question, in Auckland. I allude to it not as in any way referring to Auckland, but as indicating the high opinion that was held of the magnetic brake by Mr. Holmes after his repeated experience in tests in Wellington. It appears to me to be certain that he—a gentleman of the highest authority in engineering—has from his experience in Wellington formed a very high opinion of the magnetic brake. The question of air brakes or any other brake has not been touched by that Commission, but, as I am addressing myself now to what I consider the splendid and safe position in which Wellington now stands, I desire to refer to the finding of that Commission as establishing the fact that engineers in New Zealand, after repeated tests extending over many years, are perfectly satisfied with the brakes in question. I would then desire to pass on to consider the attitude of the Auckland motormen, and especially the motormen that gave their experience of what took place in Glasgow. That the magnetic brake is used in Glasgow for coasting, I think, can be admitted. The settling of all this agitation in Auckland on the part of the men cannot have come about with any small amount of discussion amongst the men both in the street and at their meetings; and I have no doubt that to a very large extent these men's opinions have been swayed by the statements which they have from time to time heard about the air brake; and the vehemence of their feelings in Auckland, and the expressions which they have given as to many things, and the general peace which is now established there when they see the possibility of the air brake—the evidence given by the motormen is not evidence of fact, but of their own feelings. As against that you have the evidence that the officials in Glasgow still use the magnetic brake and still have faith in it. In the report which Mr. Alexander produced yesterday it is quite true the officials there admit the necessity of a most efficient brake, and they think they have it in the magnetic brake. Their officials are the highest in Great Britain. Every act of theirs is thoroughly canvassed, and they have to carry out the system in a most efficient manner. Further, they are not in any way limited as regards finance. It is a well-known fact that the Glasgow City trams are a very paying proposi-

tion, and if there is any way in which these gentlemen can improve their practical appliances, they have the assistance of the greatest engineers in England—both Government, private, and municipal engineers. There is no need to spare any expense. They have all sorts of ability at their disposal, and they have decided to adhere to the magnetic brake. Throughout the whole of England also, the London County Council and others have used the magnetic brake for years and are still using it, and from Mr. Fell's experience there are undreamed-of developments in the magnetic brake and in its efficiency.

We in Wellington know of no brake that in the past has been so efficient, and we know of no brake now that at the present time presents so many possibilities of improvement.

I should then like to say a few words about Mr. Goodman's evidence as given in Auckland. Mr. Goodman, no doubt, is a magnetic-brake man. Mr. Goodman went to Auckland, and he stated that he did not think it was safe to use it over fifteen miles an hour, and he said several other things about the magnetic brake. But you must remember Mr. Goodman was not subjected to any cross-examination by any one having a working knowledge of the magnetic brake. Mr. Goodman has installed the system here in Dunedin, and any one of us can see the cars going about at twenty miles an hour, and see them pulled up in the easiest manner. The magnetic brake will work easily up to twenty miles and twenty-two miles, and I think it has been proved without any doubt that the magnetic brake has stopped a car on grades at twenty-two miles, and on the flat at over twenty-five.

Now, sir, you were on the Brooklyn car when the junior motorman came down a grade of 1 in 14 at a speed of nineteen miles on his magnetic. His tendency throughout the whole of his day's operations was to use his hand-brake every service stop. Coming in from Seatoun he came in on the hand-brake all the way. That man coasted down on the hand-brake at nineteen miles an hour, and was able to pull it up. And I am perfectly satisfied that the stop on the Brooklyn grade at nineteen miles an hour was quite as good as any stop in Auckland on the flat at that rate. As far as Mr. Goodman's evidence goes in dealing with the magnetic brake, Mr. Goodman was convinced in Auckland that the air brake and the hand-brake were the best brakes in Auckland. We do not consider such a combination of brakes would be good for Wellington, and we should be very sorry to have such a system installed there, apart from the question of expense and any other consideration.

I need not repeat that we have been remarkably free from accidents in Wellington. Last year we took our own insurance throughout, and with the amount of money saved last year and this year we start with a fund of £7,000 to meet accidents. That fund is being made up of amounts that were previously paid away in insurance premiums. Now, that fact, I consider, alone is one that must weigh with the Commissioners in all their deliberations in this matter.

There are certain features about the air brake which I just wish to touch on, and which I would like the Commission to consider.

In my opinion the combination of the air brake and the track brake will shine not so much from its efficiency as an emergency brake, but from the fact that the putting-on of the brake will meet any emergency. To me it is extremely doubtful. I merely quote the proposition to the Commission for their consideration as mechanical experts as to whether it will be possible to put on the air brake and the magnetic in succession, the air and the track brake in succession, or the track brake first and the air brake afterwards. In the case of an emergency—and we have never had a failure in an emergency—the magnetic brake goes on, and it goes on in one application.

I have mentioned before the new developments in the magnetic brake, and I have no doubt that if our conditions of traffic in Wellington become any more difficult we shall gradually introduce the more powerful brake; but it must be remembered in discussing Wellington's position that Wellington is really the most difficult tramway system in the Dominion to work, and in Wellington the management is satisfied with its brakes, the motormen are satisfied, and the public are satisfied with the brakes.

In connection with this statement that I make, you have, as far as management goes, the evidence of Mr. Richardson, Mr. James, and Mr. Cable. Mr. James gave general evidence as to the efficiency in service, and you will observe that by the improvements made in the rolling-stock by Mr. Lear and his assistants in Wellington, a very high efficiency is attained.

The efficiency of the brake system has been called in question many times in Wellington, and I need only refer you to this fact: that we in the tramways have not lost a case in the Supreme Court. Where the question of negligence has gone to the Supreme Court we have never lost it.

I would also draw your attention again to the reports of the Public Works officials, and the Telegraph officials, Mr. Buckley and Mr. Holmes. Mr. Buckley is an electrician of standing as high as any man in New Zealand. They are perfectly satisfied that there is no failure of the equipment of the brake.

Then, sir, I think you mentioned yesterday and at other times the advisability or the non-advisability of the attachment of the non-skidding device. I would like to put before the Commission one view of that, and that is, that it is possible that with such an arrangement applied to such a powerful brake we may have the motormen taking great risks. We all know that, with motormen, the more confidence they get in brakes the more risk they will take. And we think serious danger may arise in heavy grades if the non-skidding arrangement is to be attached to the magnetic brakes. Further, it is adding another item of complicated machinery to an already complicated brake, and the cost of the service must go up. In Wellington the wages paid to the tramwaymen are so high, and the extension and improvements made in the service are so great, and having the present perfection that we claim, we deem it inadvisable to further interfere with the service and its upkeep.

The Commission has now travelled through the whole of New Zealand, and seen the tramway operations in the four centres, and I doubt if any Commission has ever gone through New Zealand to investigate any subject which has in its progress found such a high state of excellence throughout each department of every service. Most Commissions that have gone through New Zealand

have been met with abuses, weaknesses, defects of every description; but, as far as I can judge from the evidence and from my own personal observation, the Commission must have found that tramway conditions in New Zealand were in a far better state than ever they were dreamed to be. Each centre, instead of wishing to avoid publicity, has been clamant that the Commission should investigate every detail.

There is one matter now that I wish to call your attention to, and that is the marvellous position taken up by Mr. Fitzgibbon at the close of the Wellington evidence. His propositions, as I take them, were set out in the findings on page 56. In connection with the brakes he says there is a strain thrown on the motormen through the use of the hand-brake. Now, the only evidence that I have discovered in favour of that was the continuous attempt to establish it by Mr. Rosser. Throughout the Wellington and Christchurch inquiry Mr. Rosser was very keen on the strain caused by the use of the hand-brake. Well, sir, I think that you will read through that evidence of the old Commission, and I think any one reading between the lines there can see that these strains talked about were inherent defects in men, and not any defects in the brake. He also stated that the brakes will act wrongly, and afterwards cannot be detected. The only ground for such a statement has been dispelled by the evidence in Dunedin. In Wellington the evidence right through was that no such thing has existed. In Dunedin evidence was that it may have existed in the mind of the motorman when he failed to judge the speed of the car and failed to find the brake act more quickly on the first three notches. That may be the explanation. It is said that the brakes may fail on coming out of the shed. Well, it is admitted that there is a difficulty with the mechanism of the brake when it first starts from the shed after being laid up for a day or two. That position cannot arise in Dunedin, as the power is on continuously from the moment they start the car.

Then, too, it was said that the brakes will fail at the first notch: there was no evidence of that in Wellington. Then he talks about the abuse of motors due to the motormen trying to keep up to fast time: there was no evidence of that in Wellington. The cars have plenty of time at each terminus, and passing Brooklyn corner at any time you will generally see when the car comes from Brooklyn it stands for some time. The only wonder in my mind is how the management do it—but they do do it.

Then, sir, I would like to make a few remarks about Mr. Myers's reference to the unholy agreement in Wellington. I only wish to say this: that throughout the whole of the Wellington inquiry we were at arms' length. We were able at all times and have always been able to combat any evidence men may give as to the inefficiency of the brake, and it was the realisation of that fact that prevented the union from addressing any evidence to the Commission in Wellington. The union had nothing whatever to gain or hope for in giving evidence. They had practically reached the limit of wages that can be reached in Wellington without imposing further charges on the ratepayers and public, and in every way they are well treated by the management. They have had the utmost kindness shown throughout, and there was nothing for them to hope or gain by any attitude they would take up at this Commission, and I say, speaking personally, we had no agreements, no arrangements, no discussions with these people.

Mr. Mackenzie.—Mr. Myers did not say you had. He explained what he said.

Mr. O'Shea.—But he did not quite clinch it.

Mr. Mackenzie.—It was quite clear to every one here.

Mr. O'Shea.—Oh, well! it is my misfortune. I further submit that from your observations of our records in Wellington you will see that we get even better stops as emergency stops than has been shown so far in Dunedin—at any rate, from the evidence of the men. Yesterday I purposely examined them as to that point, and it may be proved from records of the Corporation here that they have done as well as us; but there have been occasions when we have had stops in 10 ft. in front of the Town Hall when the car was going at the rate of eight or ten miles an hour. We have also had stops in Lambton Quay which we say no other brake in the world could equal on our cars. We also say, sir, that this alleged brake-failure at Kilbirnie was not a failure at all. The confidence alone that was shown by that man in handling his car is a perfect revelation to any one as regards the efficiency of the magnetic brake.

I think I have sufficiently dealt with the facts relating to the magnetic brake. I consider it is the most efficient brake we can get for Wellington. We consider it is the most powerful brake on electric cars, and we think its probable developments in the near future are going to put it beyond the reach of any competition for all services such as ours. And in spite of the heat of the motors that takes place, there has not been a failure.

To leave that subject, I would now address myself to the tail of the Commission—that is, the legislation question. That may be viewed in two lights, either in a legal light or in a practical light. That is certainly in there for one purpose, and that is to give validity to the Commission. You will know, sir, that lately it has been the practice to attack Royal Commissions, and that two Royal Commissions have been set aside by the Supreme Court. A Bill was proposed last year—the Tramways Amendment Bill—and the Committee sat and took most voluminous evidence. Now, sir, that Bill, in the opinion of all tramway people in New Zealand who thoroughly considered the Bill, was not only an invasion of the rights and liberties of municipal bodies and companies running trams in New Zealand, but it was introducing Government interference of a most unparalleled and dangerous character. You gentlemen have been through the whole of New Zealand from the tramway point, and you have seen the differences in the systems, the various methods of each set of engineers—all very able men—the diverse methods in principles and details they have adopted and applied in order to provide an efficient system for each district. If Government inspection and Government interference is going to be set up by legislation that will efficiently deal with these systems, the Government will absolutely have to find a man or men who will have the same detailed and perfect knowledge of each branch of tramway engineering as is shown by at least three men in each centre that we have so far visited;

and each of these men is in his own way an expert of a different class, of a different nature, and of different powers from every other expert whom you have met. If the Government is going to have one man to do the lot, well, he is going to be a genius. And if they are going to get enough men to specialise, to have a set of officials doing nothing but training these men, well, then they have got money to burn, and I have never known of a Government yet that has had money to burn. The high efficiency of the present systems that we have seen is not a thing lightly to tamper with. The engineers who control tramways in these centres have evolved systems which are a credit to the community. The system as it exists at present is quite good enough for this country. In fact, the tramway systems are well ahead of the requirements of the public, and to try to improve them is, in my opinion, to "gild the lily."

But there is another very serious danger that will arise in these matters—that is, the division of responsibility. If a railway is to be built in New Zealand the Public Works Department builds it and takes responsibility. If a railway is to be run in New Zealand and maintained, the Railway Department takes the responsibility. In the running and maintaining our present responsibility is distinctly fixed. But if you have Government interference and control such as proposed by the Bill of last year, then you have this: that the Government will be responsible for everything because they order it. The officials who are in control of the thing will not be responsible, because they do not approve of it, and then the responsibility of the Government will be shelved on to those who are administering it. Now, sir, we have in New Zealand men acting as tramway engineers and officials who so far have taken their responsibility and borne it manfully. And I seriously suggest to the Commission that they should not undermine these men's positions by framing legislation that will put over their heads men who will not be so efficient. There is no doubt that the men who would be put in charge will not be men of experience of, say, Colonel Yorke, of the Board of Trade, and inefficiency will result, as you will never get men of high standing to take up responsibility in which they are not going to have the actual authority as well as the appearance of it, and it is a well-known fact that if you take a man's responsibility away you ruin him. I ask you, therefore, on that score alone, to be very chary of suggesting any new legislation whatever.

Then, sir, one position was freely put forward by the Minister of Public Works at the Tramways Committee on the Tramways Bill last December, and that was, that he had the power to revoke a Tramway Order in Council; and he maintained his position throughout the whole of the sitting of that Committee. He has subsequently discovered he is wrong, but he has not yet admitted it. Now, sir, I sincerely hope that this Commission will not in any way attempt to give a Minister of the Crown any power to interfere with an Order in Council. As I said on the occasion of that Committee's deliberations, it may be possible that improvements may occur in tramway brakes and equipments. It is only right, if they become obsolete, that they should be replaced, but that should not be done on the *ipse dixit* of a Minister. If there is to be an expenditure of over £10,000, that alteration should not take place until it is confirmed by the Supreme Court, or the party should have a right of appeal to the Court sitting with assessors as to any Order in Council being interfered with.

You know how inelastic financial limitations are. If, for instance, we were asked, in one matter alone, to provide cars to give every man a seat in the cars at 5 o'clock, we should be met with an expenditure of £80,000 to £100,000. Now, in Christchurch, where they have trailers, that is not nearly so important an item, but in Wellington it would be ruinous.

Then, sir, there are other things to be considered. The last Bill that was proposed suggested centralisation to an alarming degree. All the powers that control the tramways were to be taken away from the local bodies and given to the Government. Now, sir, the local bodies have carried out their responsibilities very well so far; and I think the Auckland company will admit that in Auckland, if the Auckland City Council did not keep them up to the mark, they have given every appearance of it to the outside world. In this connection I would point out to you that any legislation introduced would need to be adaptable to each of the various centres. Wellington and Dunedin are to a certain extent in the same box, but there are many things that suit one of these places that does not suit the other. If we are going to invest half a million pounds under an Order in Council that may be swept aside at any moment, then the best thing the Government can do is to take the tramways over at once. The position is one, sir, of the most serious responsibility. I am familiar with tramway legislation in New Zealand and the Old Country. Certainly in the Old Country power goes a little further than it does in this country, but it is exercised by one of the ablest sets of officials in the world, the English Board of Trade. Further, the motto of those officials is "Never to interfere if they can possibly avoid it." But they in England have nothing approaching the catholicity of the powers given to Ministers by the last Tramway Bill.

I would suggest that it is impossible for this Commission, in view of what it has seen, to make suggestions as to legislation of any far-reaching nature; and I say this, sir, advisedly: that if you are going to have regulations for stopping-places, speeds, and minor details like that imposed by statute authority from time to time by Ministers and Cabinet sitting in Wellington, you are not going to have the same efficiency that you have at the present time. And then, sir, you must consider this: that we have legislation made for us from time to time by the Supreme Court in the shape of judgments for damages. If there is any slackness, any inefficiency, any negligence, the Supreme Court is there, and juries are there ready and eager to visit any defect of equipment, any negligence, or any failure to save life, with the severest penalties. And there is no Municipal Corporation in the world which would tolerate any negligence on the part of the officials when it is visited by damages in the Supreme Court. And we have this, further: that we have the remarks of the Judges, we have public opinion watching us, and I consider that any interference with such a system is to be fraught not with any benefit, but with the gravest possible danger to the community.

Mr. A. Rosser, Secretary of the Auckland Tramways Employees' Union, said,—I should be quite content to leave the case on behalf of the air brake in the hands of the Commission. My friend Mr. O'Shea has addressed the Commission for upwards of an hour upon the advantages of the magnetic brake and certain matters connected with future legislation. If it had been an uninformed jury that my friend had been addressing I could have understood it, but with the two experts who, added to their previous knowledge, have now a comprehensive knowledge of the four systems of the Dominion, I should be content to leave the case of the air brake to the cold pitiless logic of facts, and let it rest with the Commission. But Mr. O'Shea has rightly, I suppose, from his standpoint, attempted to make good so far as Wellington is concerned with regard to the magnetic brake. But there are one or two points that, affecting the employees, should not go unchallenged. First, "The evidence of the Auckland motormen with regard to the brake is strongly tinctured with sentiment." Now, I deny that. We had evidence with regard to the air brake from nine men who had driven in Glasgow and used the brakes, and there was no sentiment there. The bulk of them were Scotchmen, and you do not expect much sentiment from a hard-headed Scotchman. It was the wrong place to get it, and it was not obtained. They spoke of their actual experiences. Their evidence was not tinctured by sentiment even, because we were careful to bring such men as had actual experience with the two experimental cars installed with the air brake on the Auckland system, and their evidence was actual experience; and when I remind the Commission that the tests made were made on a car that was proved to be overweight, one must consider that the Auckland car came out of the matter very well indeed. And this matter of overweight, I think, affects the results of the last Commission, because in the first Commission—the first, in which Mr. Holmes was Chairman—the weights of the cars were taken for granted; but in this Commission there has been nothing taken for granted. The actual weight of the car has been taken, and it has been found to be $16\frac{1}{4}$ tons, with sixty-six passengers weighing $4\frac{1}{2}$ tons: total weight, $20\frac{3}{4}$ tons. I am very gratified indeed that the Commissioners took steps to have the exact weight of the cars taken in all the different centres. There has been no rule of thumb in this case. And that leads me to ask this question: Whether the tests referred to in the first Commission were made with properly weighed cars?

Mr. O'Shea.—Our cars were weighed when they were landed. There was a very great disparity between the Harbour Board weight and the weight given by the manufacturers.

Mr. Rosser.—Then Mr. O'Shea mentions Mr. Goodman's evidence. I think that has been fully covered by Mr. Myers in his summing-up in Wellington. It was comprehensive and conclusive, and it seems strange to me that Mr. O'Shea should question Mr. Goodman's evidence, and imply that he is an adversary of the magnetic brake. Mr. Goodman declares that he has been called "the magnetic-brake man." Further than that, if he (Mr. Goodman) were called upon to reinstall the Dunedin or Adelaide tramways he would still install the magnetic brake. That clearly shows that Mr. Goodman is not opposed to the magnetic brake, which therefore makes his evidence in favour of the air brake for Auckland all the more valuable. The magnetic brake, he says, under certain conditions is the most perfect in the world, but these conditions do not obtain in Auckland. This Commission has to decide what is the best brake for the Auckland system, and not for the others. Mr. O'Shea says the air brake is very difficult to apply and act in cases of emergency. We have not had any difficulty in Auckland in the nine or ten months the cars have been running. This is evidently a creation of Mr. O'Shea's own.

Then he says the Commission should hesitate before it hands over to the Minister control of the tramways of the Dominion. The Minister has already that power. Before the special Committee mentioned by Mr. O'Shea, Mr. Blow, in answer to a question, said that power the Minister of Public Works possesses now.

Mr. O'Shea.—He had to deny it.

Mr. Rosser.—But there is no middle course. If there is anything wrong in the equipment that the company refuses to remedy, the only penalty is to stop the cars running—a very severe penalty indeed; and any legislation is in the direction of giving a medium course, to provide for minor penalties. He has the power now to stop them if in the opinion of his Chief Engineer such a course is necessary.

With reference to Mr. Fitzgibbon, and the statement put in, I do not think there is any answer necessary, because I would remind Mr. O'Shea that that statement was shown to him and all of us.

Mr. O'Shea.—It was not shown to me.

Mr. Rosser.—I distinctly remember it being shown round, but Mr. O'Shea may have been too preoccupied to notice it.

The reason I did not ask the question in Dunedin as to whether motormen were injured by the use of the hand-brake is that it was not such an important question in Dunedin as in the other centres, because Dunedin is the only place where there is unrestricted use of the magnetic brake for all purposes. Wellington has a regulation that provides for its use, but it is nullified by instructions to use it as little as possible. But I think it is a credit to Dunedin that they give it to the motormen for unlimited use. In Adelaide there is a restricted use, yet they are practically on the same lines. There are very few gradients in either of these places. But we fear that if the magnetic brake is brought into Auckland, by reason of the overheating of the motors, there will be a restriction of the use of the brakes, as laid down by evidence from Glasgow and from Adelaide by Mr. Goodman. And we ask for a brake that the men can use any part of the time or all the time, and we consider that that may be met by the installation of the air brake.

We have heard a good deal with regard to complete or partial failures, but I think that matter can be safely left in the hands of the Commissioners. There is only this to say: It matters not to the motorman who has a collision whether it is proved partial or complete. He has to judge whether it fails on the first, second, third, fourth, or even the fifth notch, and by

the time he is able to say whether he is to use the seventh notch the collision is over, and perhaps so far as he is concerned all matters of time are over too.

With regard to the air brake, there is not the shock to the passengers or motormen that there is with the magnetic brake. I do not wish to attack the equipment in other centres, and we are quite prepared to acquiesce in the retention by Wellington of its beloved magnetic brake. Dunedin, too, is on the same plane. We have no wish to attack it as applied to Dunedin, but our sole object in opposing it is to secure that, at any rate for Auckland, we shall have a brake that has been tested on the Auckland grades and found to be efficient.

I have been twitted that it is a strange thing that it is the first time the men and the company are in complete accord on any one subject. Every decade that we leave behind brings us nearer to the millennium, and it may be taken as one of the signs of the millennium coming. The prophecy of Isaiah is being fulfilled before our eyes, "The lion shall lie down with the lamb"; and there is no reason to find any fault, because such a blessed state has come about.

I think I have covered all the ground that I intended to cover after hearing Mr. O'Shea's address in reply. We ask for a brake that is simple in its application, that is quickly applied to the cars, that is quickly installed on the cars—and I would like to point out that that is the main factor in Auckland: the air brake could be installed by February next; the magnetic brake could not be installed under three years, and in the meantime our men are working the hand-brake. I pointed out in the opening that we have had no less than five cases operated on in hospital, and two cured without an operation, and our men are anxious that some amelioration in their condition shall be brought about, and so are asking for the air brake because of its quickness in being installed. It is the simplest, and lends itself to the safety and comfort of the travelling public. If it were a question of cost, that should not weigh with the Commission; but it is the general safety, the safety of human lives, that should weigh with the Commission, and not the question of cost. And when we find both those elements combined in the case of the air brake, then I submit most respectfully that the Commission should decide in favour of the air-brake system for the Auckland cars.

Mr. Mackenzie, counsel for the Auckland Tramway Company, said,—I recognise that the Commission has already been addressed on behalf of the Auckland Tramway Company, and the general case has already been put before it. I do not propose to refer even to the evidence since at Christchurch, and I should not refer at all to the Dunedin evidence were it not for some references to Mr. Goodman's evidence and some slight attempt to discredit it in certain particulars. Now, the chief point on which Mr. Goodman's evidence was criticized was in these instructions regarding the fifteen-mile limit. Well, what does it amount to? It amounted to this: Some years ago—1905, I think—instructions were issued which were embodied in a book of rules. These instructions are not exactly in conformity with the practice adopted by Mr. Goodman and explained in his evidence to the Commission. Well, the explanation seems to me very simple. The modification is very slight, and has no doubt been the result of greater practical experience by the expert who gave evidence before you. The remainder of the Dunedin evidence was confined entirely to the experience of men with the magnetic brake as used in Dunedin and under conditions that prevail in Dunedin. I did not ask all the witnesses the same question, but with any I did ask it was quite clear that their experience entirely referred to Dunedin, and in all cases their reference to the magnetic brake, even as used here, was to a certain extent qualified by the reference to the necessity for proper application. I think there were two witnesses who had had some experience elsewhere, both of them several years ago; and as far as the Glasgow rules were concerned, there was nothing whatever to show that any modification has been proposed or suggested —nothing was said except that some years ago—I think, 1903—the rules were as stated by the witness who had had experience there—I think Mr. Macdonald. All the others referred entirely to the conditions prevailing in Dunedin, which, as we all know, are different from those with which the Auckland Tramway Company has to contend; and I submit, sir, there was nothing in the evidence here that throws the slightest doubt on the accuracy of Mr. Goodman's evidence. I could quote a great deal of it, but, as it has all been before the Commission, I refrain from doing so.

Mr. Breen, secretary of the Dunedin Tramways Industrial Union of Workers, said,—I will say what I stated yesterday: The object of the union being represented was to protect the motormen from any suggestion or charge that the failure of the brakes to act was attributable to any negligence or incompetence on the part of the motormen. I feel convinced that all the evidence that has been given at this inquiry has demonstrated the fact that the failure of the brakes cannot be charged to any negligence on the part of the motormen. I do not know whether it is within the scope of the Commission to do so, but I should like some special reference made to that fact. There is another matter I should like to refer to, and that is with regard to the sand-pipes. The evidence of one witness in particular, Mr. Henderson, was that in his opinion the pipes should be attached to both sides of the car, so as to sand both rails, instead of one only, as at present. I should like the Commission, for the protection of the motormen, if they could, to recommend that such should be carried out on the Dunedin cars.

Mr. C. F. Alexander.—I do not think it necessary to address the Commission on the Dunedin evidence, but on behalf of the City Corporation I wish respectfully to thank you for acceding to the request to hold a sitting in Dunedin.

The Chairman intimated that that concluded the sitting of the Commission for the purpose of taking evidence.

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