ated, the great future of the commercial car was assured; but, so far, no satisfactory petrol engine had been brought forward that could drive direct, but with a steam-engine all that was necessary was a chain drive or a direct driving axle to the car.

The petrol motors were too easily put out of order. He had a paper here which set out what might go wrong in a petrol engine. There were 108 things that might go wrong; if any one of these things happened, the engine stopped.

There was no doubt about the convenience of motors for light work; but with a heavy car for commercial use, to be always ready to stop and start again with a heavy load, perhaps on an up-grade, he thought the petroleum lorry had not yet proved itself the best. The author had referred to the steam cars that miserably failed in Sydney, but that, he thought, was in consequence of the flash boilers adopted. The author was quite right in stating that they were unsuitable, but the modern tendency was towards a plain simple boiler, which could be easily kept in working order; such a boiler would never give any trouble. In working the engine there would be practically nothing for the driver to do but to turn a wheel. If the steam engineers worked on these lines, he thought they would give the petrol cars a good go for it. If the author had any information dealing with steam cars, perhaps he could, later on, give us a paper on this subject.

Steel tyres was another point in favour of steam cars, which could be used; but not so on a petrol waggon, as no petrol engine would stand the strain of the jolting of steel tyres, while a steam engine could.

Mr. A. D. Nelson (visitor) said he considered it was a very wise thought on the part of this Association to ask the Chamber of Manufacturers' representatives here to hear what was said on the subject. If motor lorries

are going to be brought into use in this country, the people that were going to use them were the manufacturers; and in the Chamber of Manufacturers there were all the leading people in the land, both in the city and country. From his own observations of the few lorries about the city at present, he was of the opinion that it was only a matter of time when we shall have many hundreds of them in the streets of Sydney and suburbs.

He had just figured the whole thing out for one firm, with the result that at the end of the year they would buy two motor lorries, and it was only a matter of a year or so when they will have disposed of all their horses. The lorries could take a larger load in one-half the time than the horses could, and for every journey of the horse the lorry could perform two or three.

Mr. J. Shirra said the author had referred to tyres and wheels tried in 1906. He would like to ask whether these motor vehicles had pneumatic or solid rubber tyres.

There was a point raised about white metal in the big end bearings. This was the same old trouble as used to be experienced with steam-engines. He did not see why white metal should not be used as well as bronze. There were a great many varieties. If they were cheap, they were mostly composed of lead; but he thought a suitable white metal could be obtained without difficulty.

Then came the great question of oils, not only for lubricating, but for fuel. There was an enormous waste of oil. They had the same difficulty with motor boats: the amount of smoke was something disgraceful, and he thought it was just on account of the extravagant use of cheap oils.

There were some interesting remarks on oils used for fuels. Fuel oil, or residual oil, was practically unobtainable in Australia; but, were there a demand for it, we could get any amount. It was a heavy oil—too

heavy for burning in lamps, and too light for lubricating. He was more interested in motor boats than cars. One great disadvantage was the quantity of oil that got loose in the boat: it was like having your boat strewn with loose gunpowder—the slightest spark might cause a conflagration. The Navigation Department was trying to lay down rules, etc., for regulating motor boats. If we could use kerosene it would not be altogether safe, but it would be safer than using volatile oils. He had had a few motor-boat drivers up for examination, and very few of them knew anything about the oils; they could not tell the difference between kerosene and butter-milk. It was rather hard to have to give a man a certificate as a motor driver when he did not know what "flash point" meant. He drove his boat all right, and he (the speaker) supposed that was all that was wanted.

Drivers must be educated into knowing the properties and dangers of the materials they use, but really very little was known generally about the products of petroleum.

Mr. J. Macartney said that it was not his intention to discuss the paper, but he would like to make a few remarks. About the latter part of 1906 he arrived in London, and on the morning of the first day he was aroused from his slumbers by a steam lorry. Between 6 a.m. and 9 a.m., if one passed his window there were quite a dozen—not only the lorries themselves, but several with trailers. On reaching London proper he was surprised at the number of motors, both steam and petrol, to be met with flying about the streets. For business lorries and delivery carts, steam was largely in evidence. The number of motor omnibuses surprised him. He found that motor vehicles were being used all over the country, but he thought that the author would admit that, for business purposes, distributing

goods, etc.—and more especially heavy goods—the steam lorry was almost universally adopted.

Factories that, in his early days, were devoted to making all kinds of machinery (land and marine)—and heavy machinery at that—not one, but many, had turned their attention to motors, both for business and private purposes. One firm in particular, whose representative was now present, who at one time devoted their whole attention to marine auxiliaries, were turning out one steam lorry per week, and hoped in a very short time to be turning out one per day. Those who had had anything to do with petrol engines and know the difficulties, the uncertainties, the unreliabilities, and the ninety-and-one troubles, would go a long way round to find a steam-driven machine. He admitted that the internal combustion engine was coming, but it would have to be considerably improved to knock steam out.

Mr. Shirra said something about oils. The motors with which he was particularly concerned were marine motors, and the oil used was benzine. Paraffin or kerosene was used to a certain extent, but the time lost in warming up depreciates it, although it may be safer in the handling and show a saving over benzine or naphtha. A petrol engine, fitted with a good vaporizer, will get along on anything, from the lightest gasoline to the heaviest benzine. He had known one to be brought along on gin, and another to be run for over 100 miles on ordinary turpentine. He admitted that the internal combustion engine or the oil engine had a big future before it; but the author would also admit that a great deal could yet be said in favour of the steam motor.

Mr. W. J. Hanna (visitor) said he was much interested in the paper; therefore he came to hear the discussion and see what he could learn in regard to the motor lorry, which he thought was the coming vehicle,

and he was pleased to hear that in London they had at last woke up to the fact that there was something in motor traction. He was very much surprised, in glancing over the first page or two of Mr. Boult's paper, to find that they had steam in London a very great number of years ago: he was not aware they were so early in the field as that, and could not understand why it was so quickly discarded. He was in London about seven years ago, and had some lively friendly discussions with his friends there who looked with supreme contempt on the electric trams, which he tried to impress upon them were such a splendid factor in the handling of large crowds and the general traffic. The majority of them seemed to be of the opinion that they would not have the streets of London disfigured with such vehicles, but he thought the two-horse 'buses were a very much greater disfiguration than our trams, and, furthermore, they occupied a great deal more valuable space and did not carry anything approaching the quantity of traffic that could be handled by the trams. At the Bank of England you could count them by the score waiting their turn to move off. He was very pleased to hear that better things were commencing in London, and he hoped they would continue. Here we had one of the best tramway systems that was to be found in any part of the world, and it only remained for a little experience in the handling and developing of the motor lorry and such vehicles for the handling of goods, when these vehicles would be just as popular and effective as our electric trams. He wished those who were pioneering this industry every success, and he was quite sure, with a few discussions and papers or lectures such as the one under discussion, the way would be greatly cleared for the advent of the motor lorry.

Mr. P. J. Taylor said there were a few points in this estimable paper which he would like to comment

on. He could not quite agree with the author in his condemnation of white-metal lined connecting rod bearings. Our experience was that gun-metal shells well tinned inside, and a thin lining of Richards plastic, metal, gave excellent results when carefully scraped and bedded to the pins. They had heavy 40-h.p. cars doing 300 miles at a stretch without the slightest trouble, and these bearings only needed stripping after 30,000 miles' use.

They also found that if the overhauling was properly done there was not the slightest trouble in starting up these heavy engines again.

The method of lubricating big ends by pumping oil through a hollow crankshaft under about 10lbs. pressure, and allowing it to escape through the big end bearings, gave good results, if the filter through which the oil was drawn was kept perfectly clean, so that the oil was not loaded with foreign matter. Another advantage of this method was that the oil was delivered to the bearings in an exact relation to engine speed, as the pressure was maintained by a pump driven from some revolving shaft.

The leather coned clutch, which the author thought was disappearing, still had a great many adherents because of its simplicity and reliability. The plate and metal clutches which had been in vogue for a couple of years seemed to be falling into disuse, principally because of the careful attention which they needed to keep them in good condition. A heavier or lighter oil than the correct grade either prevented the plates from freeing themselves or causing seizure. The clutch invented and manufactured by Dr. Hele-Shaw was the leader of this class.

The paper referred to the advantages which would be gained by having a heavy spring in the transmission train to take up the shock of starting. This was already

fitted to the "Albion" commercial vehicle, and was a splendid feature.

Under the heading of transmission, the author spoke of the efficiency to be gained by the use of a well-designed gear box, having hardened steel gears and efficient ball bearings. By the courtesy of Dalgety and Co. two examples of these, from 35 and 42-h.p. cars are shown on the table in front; also some other parts which demonstrate the high-grade machinery and material put into modern heavy road vehicles.

In connection with final drive the author was rather severe on worm gears, which he said wore very quickly. This was not their experience, as they could show worn gears on heavy Daimler cars which had done 15,000 miles and the teeth were hardly rubbed bright, much less worn.

On the subject of steel road wheels, these did not stand under Australian conditions as well as the author appeared to think, as the wheels on two steam waggons, a "Leyland" and a "Jesse Ellis," had to be rebuilt soon after their arrival in the State, as the spokes and rivets came loose.

Mr. W. Reeks said he had not quite lost his love for kerosene engines. He turned grey trying to learn how to run them. His experience with kerosene as fuel had been perfectly satisfactory, and if it was not giving the author too much trouble he, for one, would be very glad to have any information he could give us on the subject.

The President said that there were one or two points in the paper on which he would like to say a few words. He might mention that, in the year 1904, he was connected with the importation of a steam lorry for use in a brewery in Sydney, and regretted to say that, as occasionally occurs with pioneers, he had a considerable amount of trouble, and in the end not a small amount of loss. It was difficult to say exactly why this waggon

was the failure which it turned out. In the first place, it was supposed to be for delivery of beer to the distant suburbs, and the makers were fully aware that this was the intention. The waggon, however, was so high from the ground as to make the loading and unloading of casks of beer quite a serious problem, necessitating the employment of more labour than was usually necessary for this operation. However, he believed that this trouble could have been overcome had the waggon been in other respects satisfactory. Their first trouble was that the bearings heated after very short runs; this proved afterwards to be the result of the casing not having been properly pickled, moulders' sand being left in it. Eventually this trouble was got over and they started on the roads. Their next serious trouble was with the slide valve spindles: these were drawing out of the yoke, breaking things generally. After going very carefully into the sizes, etc., it was decided that the design of these slide valves was not at all satisfactory, and that the spindles were not of sufficient strength to actuate the slide valves, when the full pressure was used. They had new valves made locally by the Clyde Engineering Company, parts being strengthened and other parts being re-designed, and then they had more satisfaction; but even then their troubles were far from finished, as the wheels went to pieces very badly. The bosses were of cast steel, and the flanges on to which the mild steel pressed arms were rivetted were not nearly strong enough—so much too weak were they that in three wheels the flange on the inside of the wheel parted from the boss all the way round, the same having occurred at the outside flange of the fourth wheel. So serious did this fault become that they had to rebuild wheels here before getting the waggon to work, and it must be remembered that this waggon was only used on suburban roads, which could not be called bad. They

thought that the failure of the waggon (which, he might say, was capable of carrying six tons) did a good deal towards retarding the progress of this class of vehicle in Australia, and the builders should have been more careful, when sending a waggon to such a distance from Home, to see that it was absolutely perfect. It may be interesting to know that when they came to erect this waggon it was found that the boiler had been shipped out two-thirds full of water, which did not make the freight any cheaper.

He was surprised to hear that the author considered the future was for a horizontal engine in place of high-speed vertical; this was a new phase of the question, so far as he knew, and it would be extremely interesting to see what the ultimate development of the engine for this class of work would be. He was rather of the opinion that the horizontal engine was not so suitable for this class of work, and that the vertical lent itself considerably more to the conditions, as much less space was required—and that was one of the reasons for its adoption in place of the horizontal; but the author said the horizontal engine deserved further attention from the point of space economy, consequently he presumed that he had been in error.

On the question of cooling, he would be glad if the author would give some fuller explanation of the Thermo-Syphon system.

With reference to tyres and wheels, perhaps the author would give some information about the skidding of these 'buses. When last in London, he saw a number of motor 'buses skid quite badly, sometimes striking the curb very hard; and it was by no means a pleasant sensation to be in them when this took place.

The author, in looking at the future, did not seem to give much chance to the electric 'bus, until we could

get an unlimited supply of current from the air, or a very light storage battery; and probably he was fully justified in taking this view. At the same time, matters were moving in the electrical direction, and it was interesting to note that quite recently an improvement had been made and a 'bus, in which electrical accumulators were employed, had been run for sixty miles, on one charge of the accumulators—an increase of 25 per cent. on what could have been done with the same accumulators without the said innovation; consequently, should a lighter and reliable battery be brought on the market, he saw no reason why in the course of a few years the electric 'bus should not be a competitor with the petrol, it being granted, he thought, that the easiness of control and absence of smell appeal very strongly in favour of the electric 'bus.

The following extract from the "Electrical Review" of September 10th, 1909, may be of interest:—

"According to our contemporary, the 'Automobile Owner and Steam and Electric Car Review,' one unlooked-for effect of the new police regulations requiring the future 'bus not to exceed 3½ tons in weight has been to draw attention to the electric vehicle. At first sight, it would certainly appear that the electric 'bus, owing to the considerable weight of its accumulators, would be almost a last resort under the circumstances; but, again, according to our contemporary, the accumulators are not taken into account in estimating the weight of this type of omnibus. This curiously one-sided arrangement certainly presses hardly on the petrol-driven vehicle, and almost bears out the suggestion that the police are trying to shoulder out such vehicles on account of the many complaints received as to noise and smell. Nevertheless, believers in the electric 'bus, and electrically-driven vehicles generally, have every reason to rejoice in the prospective developments which should take place.