

## Correspondence.

Mr. Joly. Mr. HENRI L. JOLY remarked that he could not agree with the statement that abroad makers of electric vehicles were directly helped by government subsidies; he did not think any such subsidies had ever been granted. Orders based upon competitive tests, or on awards at exhibitions, could not be called subsidies. With respect to the  $\text{Zn}/\text{ZnSO}_4/\text{PbO}_2$  cell, it should be stated that, however tempting the high electromotive force of this combination might appear, all practical attempts had proved failures; and all future attempts were doomed to the same fate unless some means were found to prevent the re-dissolution of the deposited zinc in the acid electrolyte on open circuit. It was unnecessary to dwell at length upon the impossibility of relying upon a sound zinc deposit, the molecules of which could, like the material in the  $\text{Pb}/\text{H}_2\text{SO}_4/\text{PbO}_2$  cell, retain their respective positions and work at a regular pace, the local action troubles being much more considerable in the zinc cell. Another great obstacle resided in the high rate of charge which was needed to obtain a solid deposit of zinc—not muddy or spongy—a rate altogether fatal to light pasted positives, which, when submitted to such treatment, dropped to pieces in a very short time. As to charging batteries, the safest course was now generally recognised to be the graded rate, with the intensity of the charging-current diminishing towards the end of charge so as to avoid useless and even dangerous gassing. With regard to the Tables on pp. 10 and 11, the conditions of the tests were widely different; no doubt the figures quoted on p. 10 were obtained on discharging cells at a constant current; while in the Automobile Club tests the rate of discharge had varied according to a certain fixed programme stated in the report, reaching at times, and for short periods, 100 amperes. The changes of rate had been obtained continuously and automatically by means of a very ingenious time-switch, so as to secure conditions somewhat similar to those which obtained in actual practice. It was therefore impossible to compare the two Tables. It was unfortunate that the Author had not given the rates of discharge, and also the weights of cells referred to on p. 10. It was known that, as the rate of discharge increased, both the yield in ampere-hours and

the average voltage dropped, according to a law stated by Peukert,<sup>1</sup> Mr. Joly. the resultant watt-hour capacity varying accordingly. Peukert's coefficient varied with the type of cell,<sup>2</sup> and the following example would show how much better a cell could be made to appear, in comparison with another of equal weight, if the rates of discharge were different. A certain cell used by Mr. Joly gave, at the 15-hour rate, 16·7 ampere-hours per kilogram 7·6 ampere-hours per pound of cell complete, while at the 3-hour rate the capacity was only 11·5 ampere-hours per kilogram (5·2 ampere-hours per pound). This particular kind of cell, due to Contal, had shown itself to be remarkably efficient, and the life of the positive plates, under conditions of daily work in an electric victoria, was about 1 year. After 9 months' use, the drop in capacity, as shown by his tests, was less than 10 per cent. Recent improvements in accumulators had been especially directed towards cheapness and extended life of the mechanically weak plates. As to capacity, Reynier stated that about 1886 Faure made a cell the weight of which was at the rate of 25·5 kilograms per horse-power-hour, a figure which came within 0·66 lb. of the best results of the present day. The Riker four-pole motors of 1898 were very similar to those used in England by Reckenzaun over 12 years ago, having a steel yoke and four poles, two wound and two consequent. One of the lightest motors extant, if not the lightest, was the Contal-Gasnier, the 5-HP. size of which weighed barely 165 lbs. The method of connecting the batteries in parallel in order to alter the speed of the vehicle, was in his opinion objectionable though simple, because the differences in resistance of the various circuits thus formed cause unequal rates of discharge in the divided battery, and accordingly did not give the cells a chance of working properly. The benefit of recuperation was not so conspicuous in the case of road traction as in that of street cars or tramways; an obliging downward slope, 3 miles long, yielding a supply of energy by the action of gravity, was rarely met with; even with such a lucky occurrence, the chances were that the battery would have to yield enough current to manage equivalent or perhaps steeper hills on the return journey. The real advantage lay in the raising of the potential difference by even a very short re-charge. In his report upon the electric-vehicle trials of 1900, Dr. Kallmann, of Berlin, gave the power it was advisable to provide as 1 kilowatt per ton. He thought this figure was too

<sup>1</sup> Minutes of Proceedings Inst. C.E., vol. cxxx. p. 383.

<sup>2</sup> See *L'Éclairage Électrique* (Paris), vol. xv. p. 143.

Mr. Joly. small. He was sorry the optimistic figures put forward by the Author on p. 30 (50 watt-hours per ton-mile at a cost of 0·1*d.*) seem impossible at present. Although, in the experiments carried out by Fliess in Manhattan, so low a figure as 20·7 watt-hours per ton-mile seemed to have been obtained, the average consumption of that particular wagon was 78·3 watt-hours per ton-mile, which was the lowest of the whole series of tests. On the Continent 70 watt-hours per ton-kilometre (112 watt-hours per ton-mile) was considered a good figure in actual work. Mr. Muhlberg had made in 1898 some tests in Berlin on dry and level asphalt roads with a tractive coefficient stated to be 15 kilograms (33 lbs.) per ton. The results were :

Single-reduction spur-gear	61	watt-hours per ton-kilometre	{	(98	watt-hours per	
				ton-mile.)		
Double-reduction	66	"	"	"	(105	" " )
Chain drive	63	"	"	"	(110	" " )

The average was 65 watt-hours per ton-kilometre. He believed the vehicle used had had ball-bearings. The best figure in Dr. Kallmann's report already alluded to was also 61 watt-hours per ton-kilometre, or nearly 100 watt-hours per ton-mile. With regard to charging, it was necessary to point out that when central stations were equipped with continuous-current machines at more than 120 volts, the charging was rendered expensive by the use of motor-generators or resistances, and the cost of current became easily double the price per unit paid to the supply company. The late Electric Cab Company had found this out when transforming cheap alternating current at the beginning of its unfortunate career. Now, with the Nodon valve, and, he hoped, with that promising invention the Cooper-Hewitt converter, alternating-current supply should cease to be the nightmare of the user of accumulators. He feared that in the matter of cost the Author had let his enthusiasm carry him too far. The data available in regard to the cost of other mechanically-propelled vehicles was scanty, and some of the statements were quite unreliable. He was greatly surprised to see the cost of a London cab put down at only 1*s.* 4*d.* per day. The "Compagnie Générale" in Paris, with a unique and thorough organization, controlling thousands of vehicles, had given, in 1898, the following figure : 19·26 francs (16*s.* 4*d.*) per cab per day. The 1898 "Concours de Fiacles" in Paris had given for the electric cab, with current at 1½*d.* per kilowatt-hour, 20·22 francs (17*s.* 2*d.*). Ducasse (Cie. des Voitures electromobiles), with a remarkably equipped business,

came a bad third with 23 francs per cab per day (19s. 7d.). The Mr. Joly. Paris electric cabs were practically working at this last figure, and he knew that when the London cabs were working with sixteen vehicles the cost per week per cab (directors' fees not included) was £9 12s. 11d., or about 32s. per cab per day, the takings not exceeding 23s. per cab per day. The cost of maintenance of accumulators was given by Ducasse at 7 centimes per kilometre-car, that of tires at 6 centimes per kilometre-car. At the last meeting of the "Association Française pour l'Avancement des Sciences" (Montauban, 1902) various interesting Papers had been read bearing on the subject. Mr. Juman stated that the average cost of maintenance of cells came to about 0·043 franc per tonne-kilometre (0·67d. per ton-mile). Although a devoted exponent of electric traction, Mr. Joly could not be blind to the sorrowful example of all who had attempted to run public services of electric cabs on the basis of figures assumed or estimated to be as encouraging as those given in Table V. In Chicago, with 109 vehicles and an outlay of \$643,588, the cost of working over 4½ months had been \$265,885, the takings \$137,106, or a loss of \$8·75 (£1 15s.) per vehicle per day. The tale of Boston, the streets of which were by no means as smooth or level as the avenues of Chicago, was just as appalling. In 6 months 245 wagons had earned \$95,310, the running-expenses had been \$211,965, the capital outlay \$769,036, the loss per vehicle per day \$2·64 (10s. 8d.). With regard to the income electric vehicles brought to central stations, the Secteur de Clichy, which supplied only a part of Paris, had reported to its shareholders the receipt of £3,000 to £4,000 a year from this source alone, during the past 4 years. Was it not time for central-station engineers to pay attention to these figures? He believed that electric carriages maintained in large numbers on the "garage" system, as in New York and Paris, and by some London undertakings, would ultimately prove successful.

Mr. J. N. SHOOLBRED remarked that for a considerable extension Mr. Shoolbred. in the use of electric automobiles two things were necessary—first, a lighter and improved arrangement of storage-battery, and secondly, a much more extended system of charging-stations, and of facilities for using those stations. The first matter might fairly be left to the actual manufacturers of storage-batteries, seeing the inducement held out to them by such improvements; while the second was a matter to which he had paid much attention for some years past, not only for automobile traffic—which was a comparatively recent question—but for providing electrical energy for the

Mr. Shoolbred. many industrial purposes to which that form of power was being applied. If, for example, in the streets, where there was a hydrant, an electrical stand-post were also placed, a small electrically-driven pump would prove a much lighter and more easily handled fire-apparatus than the cumbersome steam fire-engine. The former would be got to work much more quickly and readily than the latter, especially if all large public buildings were supplied with such an electric fire-engine. This example was merely one of the many advantages which would follow in a large town from an increase in the number of points at which a supply of electrical energy was available. Owing to the general acceptance of the 500-volt low-pressure limit of the Board of Trade for both lighting and traction supplies, more especially where continuous current was used, there ought to be but little difficulty, thanks to this uniformity, in augmenting largely the number of charging-stations. At present there were in England two hundred and twenty continuous-current low-pressure, and eighty alternating-current generating-stations, for electric lighting alone. In stations where alternating current was in use, the conversion thereof into continuous current by means of rotary converters, or by the Hewitt static converter, which had recently been added to the list of converters, there would seem to be means by which the small charges of continuous current required by electric automobiles could also be obtained. Nor need the comparatively low pressure of, say, 80 volts, required for the automobile, present any difficulty. For it had been a not uncommon thing of recent years for private storage-batteries to be presented for re-charging at a 500-volt continuous-current station. The rapid extension of electric tramways, and light railways along the main roads, would facilitate enormously the multiplication of charging points for the use of, among other things, electric automobiles. As he had recently pointed out in the Correspondence on the Paper by Messrs. Mordey and Jenkin,<sup>1</sup> the coming tendency was to use electricity as the common motive power for all methods of transport. That Paper merely accentuated the advantages which followed from uniformity, whether in electrical pressure, or in the road-gauge of railways and tramways, or in other matters. The results of such uniformity must tend to cheapen the cost of transport generally. A striking indication of the tendency to bring the several modes of transport more into

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<sup>1</sup> Minutes of Proceedings Inst. C.E., vol. cxlix., p. 188.

uniformity had been furnished recently. The Liverpool Corporation, themselves the owners of an extensive system of electric trams having at present a daily total tramcar-mileage of about 37,000 miles, acting in conjunction with the South Lancashire tramways, whose system connected not merely with the Liverpool Corporation lines, but also with others inland, where cotton mills and large industrial works abounded, had applied to the Mersey Docks and Harbour Board for permission to take goods wagons into the dock estate and alongside of the vessels themselves, with the object of conveying the goods and other freight from the ship direct to the mills or other works some distance up the country, and thus avoiding any further change of transport, and at the same time dispensing with the vexatious railway terminal charges. Subsequently, in order to show the practicability of this interchange of traffic, a run with passengers had been made from Liverpool to Bolton. A service of goods transport of this character—one which could readily be carried out in other places—presented a serious matter for the consideration of the railway companies; while at the same time it accentuated the wisdom of the far-sighted views, which had already been expressed by some general managers of railways in England, that co-operation with, and not opposition to, electric tramways would be the proper policy for the railways themselves to adopt.

The AUTHOR, in reply, remarked that Mr. Joly appeared to blow hot and cold at the same time, and his criticism was not quite intelligible on that account. While he questioned the Author's figures of 50 watt-hours per ton-mile on a good hard level road, he quoted Fliess, with a figure in one instance of only 20·7 watt-hours per ton-mile. The Author considered that his experience on many trials and long runs justified him in giving the figure of 50 watt-hours per ton-mile. The efficiency of the electric motor, the comparative output and weight of the battery, the arrangement of circuits and commutation to avoid loss in resistances, the mechanical construction of the car body, its weight in proportion to its load capacity, the even distribution of the total weight of load and battery over the wheels, and the use of roller-bearings everywhere, were all factors governing the resulting all-round efficiency and tractive resistance. With regard to Mr. Joly's criticism of the Tables given on pp. 10 and 11, he would point out that the results given on p. 10 were the highest possible from the manufacturers' own figures, and, of course, must not be taken as the practical average output. He had obtained 12 watt-hours per complete cell from the Rosenthal battery, on a run of 53 miles

The Author. with the Car No. 3 in Table III. The results given in the Table on p. 10 were those obtained by the Automobile Club of France in 1899 under extreme and exacting conditions, and they were not given for comparison. The working costs of various methods of propulsion, given in Table V., were in detail to allow criticism; they had been prepared with great care, as far as the limited practice would allow; and he was of opinion that they were reliable. The figure given for the total cost of a London cab per day, namely 15s. 4d., was a fair average.

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20 January, 1903.

JOHN CLARKE HAWKSHAW, M.A., President,  
in the Chair.

The Discussion upon the Paper on "Electric Automobiles," by Mr. H. F. Joel, occupied the evening.

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