

## Discussion.

The President. The PRESIDENT moved a vote of thanks to the Author for his very succinct account of the great improvement which the London County Council had effected in the communication between the north and south of London by the construction of Kingsway and Aldwych.

The Author. The AUTHOR exhibited a series of lantern-slides illustrating the progress of the work.

Mr. Maurice Fitzmaurice. Mr. MAURICE FITZMAURICE remarked that the Paper showed very clearly what a great London improvement meant, not only with regard to the money involved, but also in respect of the time taken to complete the work from the date when it was first thought of. Without going quite back to the year 1836, mentioned by the Author, it was a fact that the work was in contemplation for many years before 1890. The present time was rather opportune to consider the question of improvements, as the matter had been very much before the public recently, particularly in connection with the Town Planning Act and with the approaching time when the Road Board would give its first contributions towards improvements in London and other parts of England. He hoped that from that source London would obtain a considerable sum. He was afraid the Town Planning Act would not help London so much as other cities and towns where there was more land undeveloped; in London there was only a very small area of such land. There were great difficulties in connection with any large improvement in London, and many people who had made suggestions for improvements had been much surprised at the time taken to go thoroughly into them to see whether such suggestions were of value or not. It was really only by very careful investigation that the value of any suggested improvement in London could be ascertained. That difficulty was well shown by the Report of the Royal Commission on London Traffic—a report of extreme value, on which the Commission spent a vast amount of time. Dealing with new streets and roads in London, the Commissioners divided the subject into two parts. They considered first new streets going from one part of London to another, and in that connection they simply put forward recommendations made by the Advisory Board of Engineers and said that they did not wish to offer an opinion whether the proposed streets were good or bad: all they desired to do was to say that they favoured any streets which would tend to develop tramways in

London or which would get rid of the difficulties at places where there was cross traffic. The second class of streets comprised those leading from London into the country, chiefly for keeping open approaches to or exits from London; and the view of the Board was that the construction of such streets was a question that should be dealt with by the Traffic Board which they proposed should be appointed. It would be seen, therefore, that the Royal Commission on London Traffic, although devoting a great deal of time to the subject, had been unable to come to any very general conclusion on street-improvements, and to a large extent they had passed the problem on to the Traffic Board, which they hoped to see appointed, but which up to the present had not materialized. With regard to the time required for such improvements as were dealt with by the Author, where there was so much money at stake—in the case under discussion, millions of pounds—it was quite impossible to go before Parliament to ask for compulsory powers unless some general agreement had been come to before the Bill was deposited. That was a matter that took very considerable time, because the different ways of carrying out the schemes had to be worked out, as had been done in the case of the Holborn-to-Strand Improvement, and estimates of the cost of property had to be gone into very carefully. The shifting of the line of a street by 100 feet or even 50 feet might make an enormous difference in the cost of the whole scheme. In addition, there were always the views of different people which had to be, and ought to be, dealt with. There were some who looked at a scheme simply and solely from the traffic point of view: that, of course, was the most important one, but there were others. Some looked at the scheme simply and solely from the financial point of view, and were much inclined, by economizing in small matters, to spoil what would be otherwise a very good scheme. On the other hand, there were people who were quite prepared to spend any sum of money for some very special object: it might be to obtain a vista terminating in some great historical building, or opening up some interesting building which had hitherto been completely enclosed by other houses. Then there were those who very properly looked upon a scheme as a help to get rid of large slum-areas: and some people were more interested in schemes regulating the architectural features of the street when completed. All those views were of great value, but of different degrees of value; they had all to be considered, because it was quite impossible unless, he would not say unanimity, but some sort of negative agreement was obtained, to ask Parliament for powers of compulsory purchase on a very large scale

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and involving such large sums of money. It was also necessary, under the Artizans' Dwellings Act, 1875, to provide for the accommodation, in suitable dwellings, of at least as many persons of the working class as might be displaced in the area with respect to which the scheme was proposed. Then, as was pointed out by the Author, even after parliamentary powers had been obtained, the acquirement of such an enormous amount of property occupied a long time. With regard to London improvements, he quite admitted that many were required. New ways were needed for getting the traffic from one end of London to the other—north and south, and east and west. That very day he had noticed in a Report of the London County Council that, in connection with the question of river-crossings, it was mentioned that in Paris there was one crossing of the river for every 600 yards of its length, whereas in London there was only one for every 2,200 yards. Apparently everyone was agreed that further improvements were necessary—new river-crossings, and especially new streets—because the congestion of traffic was increasing very much at the present time. Even the Victoria Embankment, where a few years ago it was possible to get along fairly quickly, was now becoming really congested, and the same might be said of Waterloo Bridge, Westminster Bridge, and Vauxhall Bridge. It was unnecessary to speak of the congestion in the streets in the City, the Strand, and other places. On the other hand, he was not one of those who wished to depreciate what had been done in London. Anyone returning now to the Metropolis after an absence of 10 years would see that an enormous amount of work had been done to facilitate traffic in London during that period. Within the last 10 years upwards of 20 miles of tube railways had been opened, the Holborn-to-Strand improvement had been made, 250 miles of electric tramways had been constructed, there were new tunnels under the river and a new bridge over the river, and widenings had been carried out in Piccadilly, Fleet Street, the Strand, Westminster, and various other places. Therefore, although further improvements were required, it should not be forgotten that a great deal had been done and was being done at the present time. The great cry of everybody was that improvements ought to be carried out "on a comprehensive scheme." It was a simple expression to use, but a comprehensive scheme was very difficult to get. He thought there was only one way in which a comprehensive scheme of improvement in London was possible, and that was, by having at the same time a comprehensive money scheme, providing for a certain fixed sum—say one million sterling per annum—for the purpose of carrying out the plans.

It was difficult to consider comprehensive schemes for improvements unless there was some chance of getting the money for carrying them out. The provision of the money was a very difficult matter. Eventually, he thought, it was bound to come not from the London County Council, the local authorities, and the Road Board only, but also from Imperial funds. It would not be the first time that the Government had assisted in widening London streets, and he thought it was only by co-operation of the Government, the Road Board, the London County Council, the City of London, the City of Westminster and the various borough councils, that it would ever be possible to deal with London in any comprehensive way. With regard to the Kingsway subway, he did not wish to discuss what had been discussed so often, the comparative advantages of tube railways and shallow subways; but the particular subway under discussion was a very good example of a mixture of a subway and a tube railway, all in a very short length, and showed the difficulties that arose in one of the simplest places in which a shallow subway could be made. In the central part of Kingsway, all the buildings having been taken down, it had been a simple matter to make a subway quite close to the surface, and yet even along that portion the cost worked out at the rate of nearly £250,000 per mile with one station. The other portion between Great Queen Street and Theobald's Road, including the tube portion under Holborn, had cost about £285,000 per mile. The cost of the portion under Wellington Street had reached £410,000 per mile. Those figures were for a subway of comparatively narrow dimensions, 20 feet wide, where there was less work than would be required in probably most subways which would have to be made below the streets of London. He thought it was a pity the subway had not been made for double-decked cars. He himself had been always in favour of so making it. The present height of the subway was 14 feet, and it required to be only 17 feet in order to be suitable for double-decked cars, so that any tramcar in London could pass through from south to north. But that 3 feet was a very serious matter. The whole difficulty arose at Holborn. To go down another 3 feet meant putting the station, now in Kingsway, a longer distance down Kingsway from Holborn, which would have been a disadvantage. At the Theobald's Road end there were several disadvantages: in the first place, it would have been impossible to have the entrance to the subway in its present position; it would have had to be turned round into Theobald's Road, and a considerable amount of property would have had to be acquired there; and with a deeper subway the open approach in the street would have been considerably longer. On a gradient of

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1 in 10 an extra 30 feet of approach would be required, and long open approaches were objectionable, especially where there were cross streets coming on to the open approach. Another point was that it was quite possible the Board of Trade might raise some objection to double-decked cars on a gradient of 1 in 10. No inquiry had been made as to that point in this case; but objection had been taken to double-decked cars on such a gradient. So that, although he was very much in favour of the double-decked cars, when the matter was fully gone into and it was seen what extra expense was involved, the Committee of the London County Council dealing with the matter came to the conclusion that, taking everything into consideration, it was better to keep to the single-deck cars. Personally, he would have spent the extra money, even though he had had to flatten the gradients a little and bring the station down Kingsway. A bit of bad luck had been experienced in going under Wellington Street. The first design was quite different from that shown in the diagrams, as it was thought that fairly good ground would be met with, it being assumed that the piers of the approach to Waterloo Bridge were founded on fairly solid material. But when it was found that they were on mud, the design had to be altered completely, and the concrete and rolled joists had to be put in. He hoped no student would try to work the design out on the latest theories for reinforced concrete, because, if he did, he would find there was no agreement. The concrete and rolled joists had been put in because the work had had to be done in a hurry, and it had been thought well to use the heaviest material that could be obtained from the rolling-mills immediately. As mentioned in the Paper, all the steelwork had been designed so that there should be practically no deflection, because the girders carried the brick arches which supported Wellington Street, and the least movement would have caused a serious collapse. One point might be altered if the subway had to be made again. He believed it was rather narrow, and would have been improved by being made 22 or 23 feet wide instead of 20 feet. He thought that this was probably the only place in Central London where it would be justifiable from the financial point of view to make a shallow subway of the kind. He hoped that the figures of cost given fully in the Paper—figures which he was always anxious to see in Papers—would be of value, but at the same time the conditions under which the work had been carried out should be remembered; the conditions in the centre part, where there was great facility in carrying out the work, differed considerably from those obtaining in the sections at the ends, which had been carried out with great difficulty.

Mr. H. V. LANCHESTER remarked that he was extremely interested in London improvements and street-works of all kinds, and had been connected with engineering sufficiently to see how remarkable was the work described in the Paper. He had realized for a long time that it was an ingenious solution of the problem of getting from north to south to take advantage of the difference in level between the upper roads and the Victoria Embankment. Mr. Fitzmaurice had referred to the need for new bridges in London, and for some time past it had appeared to him that there was another solution which, if practicable, would give a magnificent means of communication between the tramways north and south. He had been looking into the new scheme for the bridge at St. Paul's, and in that connection had considered the whole subject. Between Charing Cross and the Tower on the north side of London there was a high level, and on the south side a level practically near to Trinity high-water mark; and the difficulty in all bridges was that on one side there was a level or slightly rising approach, and on the other side a long descent to get down to the marshy ground on the south. That could be seen in London Bridge with its steep approach on the south, and to a less extent in Southwark and Blackfriars bridges; also in the case of Waterloo Bridge there was a long and difficult approach from the south. He exhibited a small model of a bridge which he thought would overcome to some extent the difficulty mentioned.<sup>1</sup> While the ends of the bridge appeared to be of equal height from the side view, the roadway was really about 15 feet lower at one end than at the other. On a gradient of 1 in 40 that would mean a saving of 400 feet in the length of the approach, or an equivalent reduction in the gradient. Another advantage was this: with a subway on the north side it was possible to carry the tramway through two subways under the footways, and to come out on the other side at the road-level. If such a bridge were built from the Gladstone statue to relieve Waterloo Bridge, and came out by the church in the Waterloo Road, the tramway-subway could be continued under the bridge until it reached a point over the Temple station; and the tramways would come out on the road-level at the south end of the bridge and run down into the Waterloo Road, and thus give a much shorter route between the north and south of London than at present. It was a big scheme, and he did not know whether it was a question within the range of practical politics, but it might be interesting to consider whether it was a practical way of dealing

Mr. Lan-  
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<sup>1</sup> British Patent No. 30,192 of 1909.

Mr. Lancaster. with the difficulty of linking up the subway tramways on the north with the level tramways on the south, and with the difficulty of getting over the long gradient required on the south side of the river. It was impossible to build a bridge crossing a river on a slope; no architect in his senses would put forward such a thing, and he believed most engineers were equally appreciative of the artistic qualities of their work. With regard to the proposed St. Paul's bridge, the same problem would probably arise there. Mr. Fitzmaurice had said that he did not believe in a comprehensive scheme, but the Municipality of Paris believed in a comprehensive scheme, and had prepared such a scheme. Whether the scheme was prepared with a view to its being carried out in 50 years or in 200 years, some sort of sketch of a comprehensive scheme ought to be prepared, which could be modified as circumstances required.

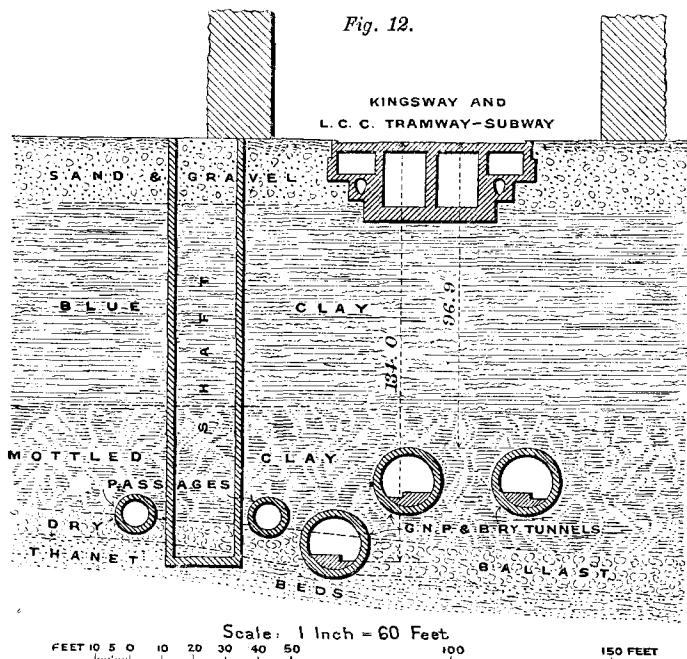
Mr. Benedict. Mr. ERNEST BENEDICT drew attention to an article<sup>1</sup> on the subject of the Paper which contained a reproduction of an Ordnance map showing the kind of buildings and slums that had been removed for the purpose of carrying out the Holborn-to-Strand improvement, the area acquired, and the position of the new works.

Mr. Ross. Mr. ALEXANDER ROSS thought that a description of so important a work was not quite complete without some account of the railway that had been constructed beneath the subway. That railway, originally known as the Great Northern and Strand line, was undertaken by an independent company promoted under the auspices of the Great Northern Railway Company. It was intended to commence at Wood Green and to run underneath the lands of the Great Northern Railway to the south side of King's Cross station; thence it was to turn westward, and eventually come underneath Southampton Row. At King's Cross it had to be kept down to 76 feet below the surface, in order to get under the Metropolitan Railway and also to avoid interference with some rights that company had for an additional line of their own. The line was to run under Southampton Row until it came to Holborn, where again it had to dip in order to clear the Central London Railway, so that at that point it was 134 feet below the surface. From Theobald's Road to a point at the south end of what was now Kingsway, it was constructed immediately under the subway described in the Paper. Eventually the Underground Electric Railways took the railway into the group they controlled: the portion between Wood Green and Finsbury Park station was abandoned, and the line was constructed from Finsbury Park, where

<sup>1</sup> *The Tramway and Railway World*, vol. xix (1906), p. 14.

there were ample facilities for intercommunication with the Great Northern Railway, to the station in the Strand, the works being commenced in 1902. In the meantime the Underground group had obtained powers to make a railway between Piccadilly Circus and Holborn, which was really the missing link, and in that way a through line was obtained from Finsbury Park to Hammersmith, which was opened in December, 1906. The Act was obtained in the same year as the Act of the London County Council for the acquisition of the lands on which Kingsway had been constructed, and the two works under that thoroughfare were in fact commenced and carried on practically simultaneously. No interference of one work with the other occurred, the tramway-work being carried on above the railway for about 650 yards. At the south end the subway turned westward, while the railway turned eastward and passed beneath the Strand, terminating in a station at the corner of the Strand and Surrey Street. At the time the Act was obtained, both the Engineer of the London County Council and himself were questioned closely as to the effect of one work on the other, and they gave exactly the same opinion, namely, that there would be no interference; and in the result there was none. It was unnecessary to describe the construction of tube tunnels by means of a shield propelled by hydraulic power, and the process of lining them with cast iron. At the corner of Kingsway and Holborn, shafts 24 feet in diameter were sunk, and perhaps what would interest engineers most was a section of the strata passed through (*Fig. 12*, p. 60). The first 3 feet was the usual debris and mould, and then for 18 feet there was water-bearing gravel and sand, after which came the blue clay, which was perfectly dry. At 85 feet the blue clay gave way to the mottled red clay, which also was perfectly dry, and at about 130 feet the dry ballast was reached—a pebbly ballast interspersed with beautiful clear silver-sand—and a few feet lower the Thanet bed was encountered. When the work was laid out, he anticipated great trouble at that spot, believing that the work would be inundated with water, and that it would be necessary to resort to pumping and other measures; but, much to his surprise, both ballast and Thanet bed were perfectly dry. That was interesting as showing, no doubt, that while at one time these strata were water-bearing, the surface of the water had been lowered by the continuous pumping from wells of the underground water of London. It might be interesting to mention, in connection with Mr. Fitzmaurice's reference to a "comprehensive scheme," that when he (Mr. Ross) laid out the line the objective he had in view was Waterloo Station

Mr. Ross. That point had not yet been reached, but the levels of the tunnels at the station in the Strand were suitable for continuing the tunnels underneath the Thames to Waterloo, and the tube station there required little alteration to receive them. All that was needed now was about £200,000 to cover the cost of connecting the great termini King's Cross and Waterloo, and he was not without hope that some day people would ask for that to be done. With regard to the traffic of London, no proper consideration could be given to it without taking tubes into account. The tube railway



of which he had been speaking carried about 40 million passengers per annum, and the five tubes in London carried about 160 million passengers annually. Adding to that the traffic of the Metropolitan and District railways, which together carried about 140 million passengers, it would be seen that the combined underground railways carried about 340 million passengers per annum. The difference that had made to London was hardly conceivable. It was not altogether apparent, for the streets of London seemed to be as full as ever; and, of course, at certain points, where the tubes poured out the people, the traffic was

naturally more congested than before. The important part played Mr. Ross. by tubes in the traffic of London could not be denied, and personally he thought that consideration of the requirements must lead to the conclusion that extension of the tubes in various directions was necessary. They were certainly costly, but he maintained that if they were built by great corporations who commanded the money market, and with the sympathy of the public authorities, they could be very much simplified: for one thing, the lifts could work directly from central platforms, so that no passages would be required at all. He was certain, from the way in which they were now used, that tubes could yield a good return for the money expended on them.

Sir ALEXANDER BINNIE, Past-President, observed that it had been Sir Alexander Binnie. highly gratifying to him to listen to a Paper so ably describing works carried out with such skill and success; especially as, with the exception of a small portion of the works, he had laboured at the initial stages of the scheme for 10 years. The laying-out of great thoroughfares in a large city was a comparatively simple matter: a parallel ruler and a lead pencil would give a line in any direction that fancy prompted. The architect could plan beautiful vistas and draw imposing elevations of the buildings that might be erected on that line. But between that initial stage and the stage described in the Paper a long and wearisome time had to be passed. First of all, someone must initiate and suggest; and as soon as definite suggestions arrived upon the scene, the objectors crowded around by hundreds, and everything that could be suggested was proved to be wrong. Unfortunately that state of things was aggravated in London by the conditions under which the Metropolis was governed. Many people were under the impression that the London County Council was an all-powerful body, but the Paper itself showed that certain local authorities claimed to have a voice in many matters—lamps and paving, for instance. The first concrete scheme put forward for affording direct communication between the Strand and Holborn was one which embodied a certain definite suggestion, and at the present time, when another great improvement was under discussion, he would like the members to reflect a little on the fate of that suggestion. The suggestion was one for a straight street from Holborn to the Strand, with a grand architectural termination at the beautiful church of St. Mary-le-Strand. The scheme met with a considerable amount of support, in fact it went so far that plans and sections were deposited in Parliament. Then arose the usual opposition. It was said by certain gentlemen that the street ought not to be straight, as the traffic coming from Holborn would have a westerly direction towards Waterloo Bridge,

Sir Alexander  
Binnie.

and they suggested a curve to the right at the bottom of Wellington Street. Another group of gentlemen, equally conscientious, said that the main flow of traffic would be in the direction of the Law Courts, and they propounded a scheme with an easterly curve in the direction of Fleet Street. The battle between the two parties was long and furious, and after a debate of some years the County Council and its officers did at last arrive at one conclusion, namely, that they were all agreed that the Strand should be widened—leaving on one side for the moment the question of communication with Holborn. An Act was obtained for that widening, and he then commenced the work which had been so ably carried out by his successor, Mr. Fitzmaurice, and by Mr. Humphreys. A very important concession was then made to both parties. A street (Kingsway) was decided upon running north and south for a certain distance and terminating with communications eastward and westward. No sooner was that settled than a number of conscientious gentlemen—whom he might call the æsthetic group—wanted the street to be this, that, and the other, and the County Council said: “We must meet these gentlemen in a reasonable way, because we cannot shut our eyes to the fact that architecture has an important bearing on any great thoroughfare.” Therefore they called for plans and suggestions from architects at large. The less said about that exhibition, he thought, the better for all concerned. He would only say that the impression produced upon his mind by looking at the designs was one of deep depression. Certainly none of them rose above Nash’s design at the time of the Regency, when he laid out, on a somewhat classic model, Regent Street and the Quadrant. Those conflicting ideas, brought before a great public body when it was endeavouring to do its best to carry out a work which everyone admitted was necessary, were productive of great friction and led to an enormous waste of the time of the London County Council and its officers.

Mr. Lynden  
Macassey.

MR. LYNDEN MACASSEY remarked that, as Secretary of the Royal Commission on London Traffic, he had listened to the Paper with great interest, and, while he could not attempt to criticize it from the technical standpoint, he could say that it was exceedingly valuable in its suggestiveness as to the all-important question of street-improvement in London. That question pressed itself upon one’s observation every day. All were agreed that it was a question which intimately concerned the progress and welfare of the Metropolis. In spite of the magnificent efforts of the London County Council, for which he thought they were entitled to all credit, no one could deny that London in respect of street-improve-

ment was much behind the great Continental capitals, such as Paris and Berlin. He did not believe the deficiency was in any way due to want of engineering ability at present, or of creative or constructive genius on the part of the engineering profession in the past. It was therefore all-important to ascertain the fundamental cause of that admitted deficiency. There were no better means of examining its cause than by applying those principles of logical investigation which the President of The Institution had so ably indicated in his recent Address. Asked to describe a street, one might say that it was described in judicial decisions in England and on the Continent as "A roadway continuously built upon on either side." Asked to give exemplifications, one could give Cannon Street or the Champs Élysées. But, if asked to state the logical qualities or functions of a street, the investigator would find that English and Continental municipalists parted company. There was a fundamental difference between the English and the Continental view when the function of a street came to be considered, and a great many of the difficulties in proceeding with street-improvements in London were due to that difference. On the Continent a street was a thoroughfare; in other words, its primary function was to serve for locomotion, and, subject to that, it might be used so far as possible for the purpose of trading. In London, on the other hand, taking, say, Cannon Street, Fleet Street, and other great metropolitan thoroughfares, it would seem that the English notion of a street was a yard which might be used for the purposes of the trade of the persons living in the street, and which, so far as they did not require to use it for their vans and carts, might be used for purposes of locomotion. The effect of that fundamental difference in conception was that as soon as any great street-improvement was projected, all persons who had warehouses, shops, and premises abutting upon the street, were in a position to put in a monumental claim for compensation for disturbance of trade. So deeply rooted in English law was the idea of the vested right of the frontager in a street, that to carry out any important system of street-improvement in London or any other large city in England to-day was very difficult. Without trenching upon politics, it did seem to him that if street-improvement was to proceed in London on the same scale as on the Continent, it was necessary to revise the English conception of the function of a street. The fundamental difference in conception led to a further and consequential difference between the Continental view of a street and the English view. If a street was not meant to be a mere market-place, but was to be a thoroughfare,

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there arose the all-important question, by whom and at whose expense great main street-improvements should be carried out. In days gone by, streets or roads in England were constructed largely at the expense of the persons through whose property they passed, and were maintained at the expense of the parish. Accordingly, there had grown up an obstructive, parochial view as to the shoulders on which the burden of the cost of street-improvements should be placed. He did not speak of improvements like the Holborn-to-Strand improvement, which had been carried out as a remedy to overcome the result of the historical development of street-construction, but of such a street as would be laid out by the owner of property who wanted to develop that property. Such a street might be formed and laid out on and over vacant land, or, if there happened to be an old cow-track passing through the property, the owner might build houses abutting on the cow-track and construct a street bit by bit. In either case the street had to be made of the width prescribed by the regulations of the local authority. If an owner of property were called upon to lay out a street of sufficient width to provide for the requirements of a great through artery of traffic, he would say: "Local requirements only necessitate a width of 30 or 40 feet, and it is inequitable that I, as an owner of property, should be called upon to lay out a street 60, 70, or 100 feet in width, as recommended by the Commission." And there was justice and reason in the owner's contention. When a street was made, the owner of the property was called upon by the local authority to pay the cost of forming and channelling the street, and of paving its surface. Why should he do so if that street was to be used not merely for local purposes, but also as a great through-fare? It was obvious that small areas should not be called upon to construct streets of sufficient width to make great through arteries. On the Continent the absence of local or private enterprise, and the exigencies of military transport from the earliest times, had made street- and road-construction a business of the State. Thus there had been evolved the Continental idea that, if a street was to be used as a main thoroughfare, somebody other than the local authority should pay for it. In France he thought the theory was correct, although he did not say the practice was perfect. There were three classes of roads: the national roads, which were constructed and maintained by the nation as through arteries; the departmental roads, constructed and maintained at the expense of the departments; and the communal roads, constructed and maintained by the communes or parishes. The idea was that the expenses of the construction and maintenance of roads should be apportioned and borne according to

the importance of the roads as through or local arteries of traffic. Mr. Lynden  
It seemed to him that until the people of England revised their <sup>Macassey.</sup>  
conception of a street—that was to say, until they spread over a  
wider area the cost of constructing and maintaining a street which  
was admittedly to serve more than mere local ends—great street-  
improvements could not be carried out in this country. And  
that brought him to a third difference between the Continental and  
the English conception of streets and roads. If streets were to  
be carried out as thoroughfares constructed at the expense of some  
area other than the local district, then the design and the direction  
of such thoroughfares must be controlled by other than the mere  
parochial authority. The Royal Commission on London Traffic had  
recommended the institution of a Traffic Board, and to a certain  
extent that had been adopted by the Government in their creation  
of the London Traffic Branch of the Board of Trade and the  
Road Board; but he was certain that until the line of direction  
and the character and dimensions of streets which were intended to  
serve as thoroughfares were controlled by some central authority  
removed from parochial influences, there would never be in London  
or elsewhere in England the same degree of perfection in street-  
improvement that Continental cities had reached. In the course of  
the investigations of the Royal Commission it had sometimes been  
found that owing to jealousy between two local authorities on the  
outskirts of London, one local authority laid out its streets east  
and west, while the adjoining authority laid out its streets north  
and south, so that the streets leading into London through those  
particular districts, instead of being in prolongation one of the  
other, were constructed in quite a different fashion. Everyone was  
agreed that in the interest of the community a large number of  
new streets and arterial thoroughfares in London, and of streets  
into and out of London, must be constructed in the near future,  
but until public opinion ceased to regard roads in a narrow  
parochial spirit it was impossible to carry out those improve-  
ments. A complete revision of the legislative conception of a  
street and a road was necessary in the immediate future. It was  
time Great Britain adopted the idea of the Continent as to a  
street and its functions, and when it was realized that a street or  
road was not a market-place for the purpose of individual business,  
but a thoroughfare to be constructed at the expense of the districts  
served, with or without national assistance and under central  
control, the country would be in a position to emulate the example  
of Paris and Berlin, and to construct thoroughfares worthy of the  
great Metropolis.

Mr. Kirkpatrick. Mr. C. R. S. KIRKPATRICK thought it was not quite fair to London to compare it with Berlin and Paris, where there were no such difficulties to contend with as existed in London. Neither of those cities had anything like the Embankment or Whitehall.

Mr. Waring. Mr. F. J. WARING remarked that, looking at the section given in Fig. 4, Plate 1, it appeared to him that above the level of the pipe-subways there was a good deal of unnecessary work. He could not see why the vaults under the footpaths should not have been extended to the edge of the footpaths, instead of stopping short at 11 feet. In that case one wall instead of two would have sufficed between the vault and the subway. Further, if the pipe-subways had been made with a girder or trough-floor roof, like that of the tramway-subway, the thickness of the wall between the tramway-subway and the pipe-subways might have been reduced considerably and the whole cross section would have resolved itself into five spans, the tramway span, the two pipe-subway spans, and the vaults, carried on four concrete piers and two rows of stanchions, with girder roofs. Accepting the principle of the tramways, he concurred with Mr. Fitzmaurice that it was much to be regretted that the headway was not sufficient to allow the double-decked cars to run. He had understood Mr. Fitzmaurice to say that for the double-decked cars an increase of 3 feet in headway would have been all that was necessary, but he had also understood him to say that that 3 feet of additional headway could not have been attained without extending the subway towards Theobald's Road. He could not quite follow that point. No doubt it would have been perfectly correct had the ascending and descending gradients of 1 in 10 been adjacent, but between them there was a length of 200 feet on a gradient of 1 in 200, and it appeared to him that an increase of 3 feet in the headway, maintaining the north approach of the tramway in the same position as at present, would have only encroached on the length of that gradient of 1 in 200 by about 30 feet. The open portion of the approach to the subway would have been extended also by 30 feet. With regard to future improvements, it had always appeared to him that St. Martin's Lane and its continuation northward urgently required consideration. It was the shortest thoroughfare from Westminster, Pimlico, and the southern part of Chelsea to the three great stations, Euston, St. Pancras, and King's Cross. Anyone in a hurry to get from Westminster to any of those railway-stations would find the route very often blocked, especially in Great St. Andrew Street, passing through Seven Dials, the early widening of which would be a great boon. The lower part of St. Martin's Lane might

be widened by degrees as the leases fell in. North of Long Acre and Cranbourne Street, opposite Aldridge's, the road was, perhaps, wide enough. It seemed to him also that the system of tube railways was not yet quite complete. Looking at the map of London, it would be seen that between the "Bakerloo" tube and the Inner Circle there was a very large space without any tube at all; and he could not help thinking that a tube railway from Paddington to Victoria, with possibly a station at the Marble Arch, would be a very desirable line to complete the system. No doubt there would be a good deal of opposition to such a scheme, people probably objecting to its going below a portion of Hyde Park, but such an objection could be, he thought, only sentimental. With regard to the financial aspect of the great work under discussion, he observed that the total cost of the scheme was £6,078,324—a very large sum. It was surprising that the actual cost of the construction of the work should be only about 6 per cent. of the total cost of the scheme, upwards of 5 millions sterling having been spent in the acquisition of the land. The site of Kingsway was formerly covered by a mass of mean and insignificant streets, and he thought that property possessing a frontage on the magnificent roadway now built should be worth a great deal more than property having a frontage on the streets displaced. But, according to the estimate given in the Paper, the reverse appeared to be the case. The estimated value of the surplus land still unsold was only £3,553,154, making, with land that had already been sold, and for which £351,811 had been received, £3,904,965. Therefore, out of the 2 millions, the interest on which the ratepayers probably had to pay,  $1\frac{1}{2}$  million was due for land alone. Anyone passing along a London street must have noticed the great inconvenience caused to traffic by the queues of people waiting outside theatres and other places of amusement, and he suggested that in future the ground-floor frontages of all theatres and music-halls, and other buildings of that class, should be set back 15 or 20 feet from the frontage of the adjacent houses, so as to afford a waiting-place for the people without obstructing the general traffic along the footpath. The space could be covered with a light verandah or by an extension of the upper part of the theatre to the frontage-line.

Mr. F. HUDLESTON thought Mr. Waring must have forgotten that for the purposes of the improvement it had been necessary to destroy an immense amount of property, which might have been mean, but which nevertheless had a value. When purchasing property for improvement work in London, it was necessary not only to purchase the land but also to compensate every man whose house was being pulled down, or whose business was being

Mr. Hudleston. interfered with. In most cases the compensation for freeholders' interest was practically not much more than one-half, and very often less than half, of the total payment. In the particular case under consideration, if the London County Council had managed to get back about 4 millions of cash—a good deal was still estimated, he believed—for an expenditure of  $5\frac{1}{2}$  millions on land and property, he thought they had done a very good stroke of business; for in that case  $1\frac{1}{2}$  million would represent the houses and the compensation for disturbance of trade. It was not quite fair to use the figure in the way Mr. Waring had used it; the inference would be that the County Council were paying too much for the land, when as a matter of fact they could buy land as cheaply as anybody. With regard to the subway, it seemed to him a pity that it had not been made for double-decked cars. Mr. Fitzmaurice had explained a little about the difficulty, but Mr. Hudleston was still of the same mind as Mr. Waring; he could not see why the north end could not have been altered. He understood years ago that the chief objection to putting double-decked tramcars through the subway was the belief in the minds of the County Council that a single-decked car was a better thing for carrying passengers. Personally, he thought that was a great mistake. At the present time it was only possible to run a special kind of car, which experience had shown was of no use for the rest of London; and accordingly the cars passing through the subway were confined to particular routes.

Mr. Walter  
Hunter.

Mr. WALTER HUNTER, while concurring to a considerable extent with what Mr. Macassey had said, thought he had hardly done justice to London. Forty years ago, when Mr. Hunter first went to Paris, it was a delight to go into those well-lighted and well-kept streets and boulevards; but, on a visit to Paris 2 months ago, he could not help being struck by the inferior way in which Paris was now kept, compared with its maintenance 30 or 40 years ago, and noticing the litter on the pavements and the general slovenliness. Forty years ago Paris was, in its scavenging, ornamentation, and lighting, better than London; but London had made immense strides during those 40 years, thanks very largely to the Metropolitan Board of Works, which constructed the Thames Embankment and the Main Drainage works, to the London County Council, and to the local authorities; and he thought that the advance that had been made ought to encourage the hope and belief that in time London would be made equal, at any rate, to any Continental city. London was often disparaged more than it deserved, because really it was improving very much. In time, he believed, it would be found to be one of the finest cities in the world, and even now he thought it was one of the most comfortable cities in Europe in which to live.

Professor R. H. SMITH asked why a station had not been put at the crossing of the Strand and Wellington Street, which appeared to be an important position where a great deal of traffic might be obtained by the tramway. With regard to the remarks that had been made as to London and Paris, he would remind the members that Paris was not all boulevards. Old Paris was made up of a mass of narrow and tortuous streets, and it was distressing to see the dirty fashion in which those streets of old Paris were kept. There was far more litter in the streets of Paris than in London streets under modern management.

Mr. W. C. COPPERTHWAITTE remarked that as he had carried out for Mr. Fitzmaurice a part of the subway under Wellington Street connecting with the Victoria Embankment, he might refer to one or two small interesting details of engineering construction. The Chief Engineer had already mentioned how the difficulty connected with the bad foundation was overcome, and he only desired to add some rather curious figures about the load which Thames mud would carry. Wellington Street to the north of Waterloo Bridge was carried on a viaduct of seventeen or eighteen arches of 16 feet span, the arches being carried on brick piers 2 feet thick, splayed out at the bottom with footings of about 6 feet, the footings resting on plain ribs of timber, which in turn rested on dirty, unpleasant Thames mud. They had been there for 90 years, the load on them being, roughly speaking, something over  $1\frac{1}{2}$  ton per square foot: and yet, as everybody knew, that viaduct had been perfectly steady. When work for the subway was started there it was proposed to put down monoliths of concrete to support the stanchions which the Chief Engineer decided should carry the arches; but, as the result of borings, it was found that those monoliths of concrete would have to be about 9 feet square, and some of them about 40 feet deep, so that there would be a good deal more under the track than above it. That idea was abandoned, and a concrete platform or raft, suggested by Mr. Fitzmaurice, was carried out very successfully. The load on that now, omitting any deduction that should be made for the fact that a certain quantity of soil had been taken away, was about 0.4 ton or 8 cwt. per square foot. It would be seen from the main section of the subway that the level of the blue clay under the whole length of the viaduct was below the level of the subway, and that the mass of concrete was standing on Thames mud. Of course there was no possibility of its moving, the Embankment being outside it; but the fact remained that the whole of the viaduct was now carried on nothing but mud. Another point on which he wished to

Mr. Copper-  
thwaite.

Mr. Copper-  
thwaite.

say something was the way in which the work had been carried out. For reasons which had commended themselves to the Engineer, the work had been done by administration—that was to say, by the Works Department of the Council—not on a schedule of prices but on the actual cost, and it had been actually finished for about £10,000 less than the Engineer's estimate. It was fortunate that it was carried out in that way, because it had been necessary to make considerable alterations in the methods. In the course of the last 5 or 6 years entirely new factors had been introduced in connection with work under the streets of London. To-day there was the motor omnibus weighing when fully loaded about 8 tons; and only those who had been under a roadway when motor-omnibuses were running above could realize the vibration caused by such a vehicle. Therefore it reflected great credit on the Author that he managed to underpin those sixteen arches under Wellington Street without any perceptible crack in the superstructure; there were not more than one or two hair-cracks in the whole 300 feet length after all the underpinning was done. In carrying out the work under the Strand it had been necessary to use cast-iron tubing. About 9 years ago he had the honour of reading a Paper before The Institution in which he mentioned the first use of lead washers round the bolts of cast-iron tunnels, the lead being put underneath the ordinary iron washer, so that as the bolt was screwed up the lead was forced into the bolt-hole, making a watertight joint. The method was somewhat criticized at the time, and he believed it was so still. As it happened, it had been his duty, under the Chief Engineer, to take care of the three tunnels under the Thames, the Blackwall tunnel, the Greenwich tunnel, and the Rotherhithe tunnel. The Greenwich tunnel was made with lead washers, and from it only 160 gallons of water were pumped every 24 hours—practically nothing. From the Blackwall tunnel, after making the necessary deduction for the inflow of water from the open approaches and from the shafts, the quantity of water pumped was about 1,400 gallons every 24 hours. The Blackwall tunnel was built without lead washers. In the Rotherhithe tunnel, which was 3 feet larger in diameter than the Blackwall, the quantity of water pumped every 24 hours was 465 gallons, about one-third of the quantity at the Blackwall tunnel. At the Rotherhithe tunnel lead washers were used. The comparison was rather interesting, because both tunnels had been built under practically the same specification, with the exception of the washers. They had also been built, curiously enough, under the same supervision, because the chief engineer of the Rotherhithe tunnel had been the resident

engineer of the Blackwall tunnel. It therefore seemed to him that the use of lead washers was of some value in rendering a tunnel watertight.

Mr. Copperthwait.

Mr. ERNEST BENEDICT remarked that he had known Paris fairly well, having been there for 19 months during the last Exhibition, and he could not endorse what Mr. Macassey had said, because even 10 years ago Paris did not compare with London in cleanliness. The main thoroughfares were beautifully kept, but the side streets showed a different state of things. He thought the same might be said of Berlin. If the traffic-arrangements were so excellent in those two capitals, it seemed curious that it should be found necessary to expend immense sums on underground railways in Paris, and that the people of Berlin should be calling loudly for tubes. One great advantage of the Continental method of building houses was that they had a *porte cochère* and a courtyard, a thing which did away with the necessity of carriages waiting at the door and blocking the road, and also enabled much better use to be made of a square plot—for instance, in the matter of light, which could be obtained inside as well as outside. He could not help thinking that if some of the large warehouses in Cannon Street were remodelled, and provided with courtyards, it would not only remove a great deal of obstruction in the street, but would actually help business. In London carts stopped outside a building, the unloading was done with great inconvenience across the pavement, and there was some difficulty in distributing the goods after they had passed through the narrow opening of the door. If the ground floor were recessed a little—as had been done in the case of a building in Fetter Lane—much better use could be made of the space. With regard to the method of laying out pavements at corners, when the new Government building was erected at the corner of Great George Street the pavement had a very sharp curve, which everyone objected to as being absurd, and it had been relaid with a curve of which the corner of the building was the centre. Outside the Gaiety Theatre the pavement was carried like a promontory right out into the road—quite unnecessarily, as there were no great crowds at that particular spot. If it were laid to the same radius as the theatre itself it would give so much more roadway, and form an easy turning into the Strand. He thought one way of getting out of the difficulty of widening streets—a heroic remedy—was to raise the footpaths to the level of the first floor. That could be done by means of cantilevers, as the Rue de Rome was to be carried along St. Lazare station in Paris, and would enable the space underneath to be occupied by carriages and carts, while the light on the first

Mr. Ernest Benedict.

Mr. Ernest Benedict. floor to the shop-fronts would be much better than it was at present. The passengers could cross streets by light bridges, and generally speaking the amenities of the town would be much improved. If the pavement were of glass the light would not be much obstructed, and carriage people might get out of their carriages on the ground floor and be carried up to the shops by lifts under cover. He did not say that plan was feasible except in new streets, but if such a thing were done, with electricity becoming more and more common, it would be possible to have escalators at necessary places, for taking people up to the footpaths.

Mr. Dolby. Mr. E. R. DOLBY pointed out that Mr. Benedict's idea had been carried out long ago in the city of Chester, where there were shops on the first floor with the footways in front of them. There were not, however, bridges over the streets, connecting these footways.

Mr. Fitzmaurice. Mr. FITZMAURICE wished to answer Mr. Hudleston's question with regard to the gradient of 1 in 200 on the north side of Holborn. The real difficulty had been that there was a street called Fisher Street opening on to Southampton Row, and it had been made a *sine qua non* that the open approach should not block Fisher Street; therefore the south end of the open approach had had to be kept north of where Fisher Street joined Southampton Row. It would have been impossible under these circumstances to adopt the suggestion Mr. Hudleston had made.

The Author. The AUTHOR, in reply, expressed his sense of the honour conferred upon him by the reading of his Paper before The Institution. He thought he had been fortunate in having been associated with a piece of work which merited recording, and it was due to the character of the work, rather than to the intrinsic value of the Paper, that so interesting a discussion had ensued. A question had been asked as to why the particular section of brick pipe-subway had been adopted and the troughing not extended over the pipe-subways instead of using brick arches. One of the diagrams in the Paper showed that, wherever the circumstances demanded it, that particular form of construction had been adopted. The roof of the pipe-subway on each side was in that case composed of the same troughing as the tramway-subway, carried by walls at the side, but the outside line of the pipe-subways remained approximately in the same vertical plane. With regard to the reason why the vaults had not been extended farther back and the back vault-wall done away with, curiously enough only that day he had seen a proposal from some applicants who wished to get a little farther under the street, and suggested that such a system should be adopted; in fact, they had even gone so far as to suggest a tunnel underneath for the purpose of enabling

gentlemen to pass from one part of a Turkish bath to another. He would point out that the little space between the vaults and the pipe-subways was very valuable if the street was to have the amenity of the trees. If that space were done away with, trees could not be planted in Kingsway. With regard to the roof, it was hardly necessary to say that a semicircular brick arch was a much more lasting form of construction than a steel covering, however well maintained. Inquiry had been made as to why there was not a station at a very important part of the Strand, but he was afraid that if he were to answer that question exactly he would disclose too many secrets. He could say, however, that a station had been designed to come out approximately at the place where the convenience was shown; but about 3 years ago the matter was abandoned. Several speakers had asked for further explanation as to the dip under Holborn. It had been suggested that it would have been only necessary to continue the two inclined planes farther down and the thing would have been done. The guiding factor, however, was the roof of the subway, which just cleared the sewer. To have interfered with the sewer would have entailed making the cost of the tramway-subway a great deal more formidable than it was at present, and there had really been no other way, except by raising the roof, which could not be done. The question of going into Southampton Row or into Theobald's Road had been examined, and it had been decided by the powers that be that the thing had to be where it was. He had hoped that some of the speakers would say something about the general applicability of the system of subway construction to other places in London. No doubt it had been noticed that, of the total cost of the works, the cost of construction accounted for £385,000, of which one-half, roughly speaking, was due to the construction of the tramway-subway. In stating that figure certain assumptions had had to be made. In order to get at it an estimate had been made of what the street would have cost as a street furnished with pipe-subways, vaults, and sewers, but without the tramway-subway; so that some argument might arise as to whether the allocation of those costs was really a proper one. At all events, the fact remained that in order to make a tramway-subway which had cost £190,000 it had been necessary to construct a street at the same time; therefore, if the question of constructing a tramway-subway had to be considered by itself, its probable cost would be on a considerably higher scale. He did not wish to prophesy, but he thought that the application of that form of construction to some of the heavy crossing-places in London might be looked for and would be of great advantage. With

The Author.

The Author. the advent of the motor-vehicle a gradient of 1 in 10 or perhaps 1 in 15 was not a thing to be regarded so seriously as it would be perhaps with horse traffic only, and if in the future some means could be found whereby the faster traffic could be arranged for on the same principle as a fly-over junction on railways—the traffic going in one direction being taken right through instead of crossing a very congested thoroughfare—such expenditure would be well-advised.

The President. The PRESIDENT wished to say a few words with regard to the comparison that had been made between London and Berlin. It should not be forgotten that in 1870 Berlin was a comparatively small town, and that its immense growth had taken place during the last 40 years. Accordingly it had been very easy to provide that all the new quarters should have wide and well-arranged streets. An example of the best streets was the Bismarck Strasse, which was a prolongation of Unter den Linden and of the avenue through the Tiergarten. There there were two tram-lines with grass lawns between the rails, so that the tram-cars made no dust whatever, and there was a roadway for vehicles on either side, a footway in the middle of the street, and two foot-pavements. The street was 120 feet wide and planted with trees, and was a very pleasant street indeed. Streets could be so planned when a town was newly laid out, but it was a totally different thing in London, where the town extended 15 miles in any direction, and where alterations involved pulling down houses and erecting new buildings. The old part of Berlin, he thought, was very much as it had been 40 years ago. It was the practice in a good many German towns for the town council to draw up a plan of how future streets ought to be laid out, and that plan was published, so that anybody who wished to criticize it could do so. Whether the town council would listen to the criticism was another matter: at all events, the towns were not allowed to grow anyhow, but only according to a definite plan; and of course such a thing could not be thought of in London, because London had not been planned but had grown.

### Correspondence.

Mr. Bradley. Mr. J. W. BRADLEY remarked that the historical references in Mr. Humphreys's Paper might perhaps permit mention of the fact that long before 1836 the question of a metropolitan town-planning scheme received consideration. He had an old print, published at