

Discussion.

The Author introduced the Paper with the aid of a series of lantern slides.

Sir William Halcrow observed that to Londoners the Author's brief summary of the evolution of London Transport made fascinating reading. The statistics of vehicles employed, the improvement in the average speed of travel, and the numbers of passengers carried made an imposing record. The problems affecting the future of the London Passenger Transport Board's activities were many, and in particular those affecting tube railways were probably the most difficult owing to the high cost of construction. He did not, however, intend to discuss tube railways, but to consider the reference which the Author had made to London planners.

Planning had become a popular word during the war, and there was a danger that the general public might build high hopes for the future which would not materialize. Members of the architectural profession had been active in preparing schemes for replanning London, believing that they were specially qualified for the task. He trusted, however, that something better would emerge than what had been seen in the layout and design of the buildings in the vicinity of the Millbank Estate carried out in recent years. The Council's view, as expressed in the Practical Planning Exhibition, was that planning shall be the work of professional and business men working in close co-operation.

Some recent proposals by architects had attracted his attention. One was that the terminal stations such as those in the north of London belonging to the London and North Eastern Railway and the London Midland and Scottish Railway should be grouped into one huge terminus. The effect of that would be to concentrate at one point the traffic now distributed over three or four stations, and in his opinion it would be a retrograde step.

Assuming that a colossal terminus were built and that an adventurous passenger were successful in reaching the booking office by cab, Sir William could visualize the necessity for another cab to traverse the distance between the booking office and the departure platform. In his view rather than concentrate traffic at one point, consideration should be given to further decentralization. Waterloo station, for example, was almost too large for the convenience of passengers.

Architects appeared to have taken a strong dislike to the buildings of the London railway-stations. Doubtless when they were built they were the last word in architecture, but fashions changed. A way out of the difficulty would be to reconstruct the stations with modern façades, but he suggested that the time had come when serious consideration might be given to the provision of electric haulage on all the main lines from a point on the outskirts of London. For example, Watford might be selected for

the Euston terminus of the London Midland and Scottish Railway. If all trains were hauled electrically into London the station buildings could take the form of a block of offices, the height of the ground and first floors being sufficient for the station. In addition to removing the outward signs of the railway, the railway cuttings which passed through the northern part of London could, when electric traction was introduced, be covered over and the space used for buildings or gardens.

A suggestion had been made in the "County of London Plan" that the railways on the south side of the river should be put underground and that the terminal stations on the north bank of the river should be abandoned. He considered that it would be a great hardship to the workers of London if they were denied the use of those termini. It should be possible to rebuild, say, Charing Cross station for electric traffic with a block of offices above. If used for suburban traffic only, with, say, four tracks across the river, giving eight platforms, without materially widening the present bridge, a 20-foot road with one-way traffic could be introduced on either side of the railway section of the bridge. The whole bridge could be reconstructed with materials and to a design to satisfy present-day taste.

He did not think that the suggestion to put the main line railways underground needed to be taken seriously. The cost would be prohibitive and the only advantage to be gained would be the removal of viaducts in South London. Those viaducts might offend the eye, but, in rebuilding South London, would it not be possible to plan buildings to flank and back on to the railway viaducts so that they could not be seen except at road crossings where bridges of pleasing appearance could be built?

He had never quite understood why elevated railways were considered an eyesore, and elevated roads an excellent example of advanced planning.

Planning for the future of London Transport was a big task—there was no question about that—but it appeared difficult to make any concrete proposals until it was known whether London as a whole would continue to grow or whether the suggestion for the dispersal of a large section of the population would materialize.

Mr. A. S. Quartermaine said that the Author had referred to the difficulty of providing any new London facilities, and had stated that the annual cost of interest on capital for tube lines amounted to about half the total expenditure for operating and maintaining them, whilst the tube railways in the inner areas, with their heavy traffic, were able to return only about 1 per cent. interest per annum on their cost: he had also expressed the view that an economically planned financial solution appeared unlikely. Although there was room for further improvement in the matter of facilitating travel on the tubes, in general the cost was the over-ruling factor.

Those references might be misleading, but the London Passenger Transport Board had by their combined efforts done excellent work, at

very heavy expense, in improving transport facilities in London so that at many of the tube stations the public were able to reach the platforms within perhaps 1 minute from leaving the pavement and in peace time they could hope to enter a train within 1 or 2 minutes of leaving the street.

The improvement of the station facilities in speeding up trains had saved passengers half a minute here and there and during the course of the day each passenger probably saved several minutes, so that more time could be spent over lunch or looking at the shops—or possibly doing something useful. In any case the passenger looked upon all travel as so much waste of time, and paid no more for transport at that high speed.

Mr. Quartermaine presumed that it would not be possible to put many more omnibuses on the roads. Before the war there was almost a continuous line of buses from the Marble Arch to the Bank of England. The improvement in the provision of transport was likely to consist in saving, for the hundreds of thousands, or possibly millions, of people who daily used the tubes an additional minute or two in the time of their journeys.

The very success of the Board's operations during the past 20 or 30 years had been a means of aggravating the transport problem, and if still better facilities were provided the public would only abuse them, because they would leave it to the last minute of the rush hour to make their journey. The problem was whether there was wisdom and justification in spending further vast sums of money to save the multitude of people who travelled daily on the tubes or on the buses—particularly the former—a few minutes each day.

What he had in mind was reactionary, but he thought it worthy of mention. The following statements had been made in the London County Council Town Planning Scheme: "It is assumed in the Plan that we submit that a large number of people and a considerable amount of industry are to be removed from their present central location and situated elsewhere. It is also hoped that these removals will result in a balanced community in which work and home will not be unduly separated." That proposal was an attempt to check the ever-increasing demand on London transport by taking some of the people and the industries in which they worked out of London, though not necessarily far away. That would doubtless result in opposition and difficulties, but the planners were faced with the fact that the growth of London had been largely due to improvement in transport, and engineers could certainly improve those facilities still further.

The question, however, was whether it was wise, or whether the engineer would be misdirecting his skill if he produced further facilities to enable the public in even greater numbers to rush from outer into inner London every day. It was an engineer's duty to advise his client wisely, and Mr. Quartermaine was not sure that the engineer would be doing right if he fostered concentration of the public in the London area by further efforts on his part.

His view might be considered reactionary, but it was not necessarily

wrong to take the line of thought that perhaps the maximum concentration in that respect had already been very nearly reached and that the position ought not to be aggravated but possibly rather ameliorated; and engineers might find it well to advise their clients accordingly.

Mr. George Ellson said that the Author had indicated certain limitations in the problem of dealing with the future of London transport. Those limitations would persist until more was known of the broad lines of policy which would be followed in the replanning of London. The major question of London transport in its widest sense, by road and rail, would have to be kept in the forefront, and the Paper provided some very useful data concerning the engineering aspects of the problem.

A number of plans had been published or exhibited for the re-planning of London, and various methods of dealing with the existing railways had been proposed. The favourite solution was to abolish the surface lines for some distance from the centre of London and put them underground.

The Author had indicated some of the major engineering difficulties, such as waterlogged strata, sewers, public services, etc., which attended any extension of the existing tube railways. It had also to be borne in mind that the construction gauge of the Southern Railway should accord with the needs of the Continental services when traffic to the Continent was resumed.

Further, in South London the main approach lines to the termini now numbered about 36 in order to meet the traffic demands, and those from the northern side were considerably more. The question of underground stations for the huge volume of traffic would also arise. Trains of, say, 800 ft. in length would be needed, with a constant tendency for the length to increase. Many trains running into and out of London to-day were already 1,000 feet long. Such trains would require platforms rather more than twice the length, he thought, of any in the present tube stations. The time involved in raising and lowering by escalators the number of passengers arriving and departing would materially add to the length of the journey time. The depth of the tunnels, from rail-level to surface, would probably have to be from 70 feet to 100 feet.

In order to avoid congestion the passages leading to the platforms would have to be much wider, the capacity of the escalators would have to be increased on the same scale, and in addition, facilities for parcels traffic and luggage would have to be provided to an extent which did not obtain on the present underground and tube systems. Multi-platforms with facilities for parallel and interchange movement, would be essential, and extensive underground signal-boxes exceeding in size any now in use on the tubes would be required.

The Author had stated that the tube lines in the inner areas, with their heavy traffic, were only able to return about 1 per cent. of their cost. The larger tunnels necessitated by the proposals indicated would cut that return very heavily. Public inconvenience and interference with traffic

would be enormous, extending over many years and adding greatly to the cost of the work.

Finally, the maintenance of such works would involve the employment of far greater numbers of men than were required for surface lines of similar capacity, as it would only be possible to carry out that maintenance work during a limited period in the small hours of the morning when trains were not running.

It was difficult to see a satisfactory solution to the engineering problems involved, and still more difficult to see that the object aimed at, namely, the removal of the viaducts, justified the proposals. It should surely be possible to avoid that gigantic expenditure and public inconvenience by leaving the railways substantially where they were, as it should not be beyond the skill of engineers and architects to make such alterations as would remove any unpleasant feature which had arisen. Those unpleasant features were of later creation, because viaducts in themselves were not objectionable eyesores, and in districts where there had been slum clearance and replacement by flats a substantial improvement had taken place.

Further, the development on the southern side of London since the electrification of the Southern Railway indicated that a public demand existed for surface stations in the positions they now occupied, inasmuch as people lived in places from which they could most conveniently and comfortably reach their place of business.

A remark had been made by Sir William Halcrow concerning Charing Cross station. Years ago a number of schemes were proposed for dealing with that station in some way which would be suitable for present-day demands and architectural considerations, including rebuilding the present station, enlarging it somewhat, and carrying the railway across the river on an arched bridge side by side with a new road 60 feet wide. That scheme was perfectly feasible, and was recommended to the Scott Committee by the representatives of The Institution, but unfortunately it did not get any farther.

Sir John Thornycroft said that the statistics and lantern slides had carried his mind back for fifty or sixty years. One could hardly believe that one lived in the same world. He recalled the old Underground Railway, always with such steam and smoke that not more than half the platform could be seen. He remembered also that the roads were macadamized from Knightsbridge to Piccadilly, and, unless scavengers were constantly at work, were very unpleasant to travel upon owing to the leavings of the "motive power" of that day.

He considered that the public owed a debt of gratitude to the engineers of the London Passenger Transport Board for the wonderful improvement and increased travelling facilities they had provided, but perhaps the travelling public had been rather spoiled, getting more than they required in some ways, with the result that the tubes and railways did not pay and were really run at the expense of the buses. As London Transport ex-

tended into fresh areas of Greater London it was again necessary to pool the traffic of the existing main line railways in order to pay its way.

The increased travelling facilities provided resulted in great increases in the number of passengers to be provided for and congestion of traffic. Town Planners might say that if it had not been for those developments London would have remained a reasonable size and have been a better place to live in.

He had been interested to hear that engineers were held responsible or to blame for financial results. He thought that those were regarded as the responsibility of traffic departments, and that engineers generally had to provide such facilities as policy had determined.

Mr. J. C. L. Train desired to congratulate the London Passenger Transport Board. Their experience might have been a little lavish, but they had had the sense to anticipate traffic and not just to rebuild the stations after the traffic had come to them. Sir William Halcrow had referred to the enormous improvement which could be effected in station design if it were decided to electrify for a good many miles out—say 30 miles—and run all trains by electric power. He would go farther than Sir William Halcrow, and say that, in his private opinion, if that were not done, in 20 years' time the public would not patronise the railways because of the dirt and soot associated with steam working.

He had been interested in the Table showing traffic speeds. The trolleybus seemed to beat all other forms of transport except in regard to the rate of retardation. He was not clear why it should be so inferior in that respect. He wondered whether the association of rubber tires and electricity did not cause the Author to think that perhaps more development would occur along the lines of three or four vehicle electric trains running, as in France, on rubber tires and having an extraordinary range of acceleration and deceleration.

The London and North Eastern Railway had been a "Cinderella" in the electrical field. In peacetime about 230,000 passengers used Liverpool Street station every day, and about 1,200 steam trains were dealt with daily. Happily, in conjunction with the London Passenger Transport Board, they were following out the new London development plan before the war by putting some of their traffic into tube trains below the ground instead of bringing it into Liverpool Street station and electrifying some of their own lines.

He congratulated the Board on their train indicator system; in that and other developments they had gone farther ahead than any other system.

Mr. G. L. Groves observed that much of what the Author had stated about the Underground railways hinged on the question of construction costs. Perhaps not unnaturally, those costs appeared rather in the guise of the villain than of the hero of his story, but it might be fair to point out that the cost of constructing an average tube railway was little more

than half—about 60 per cent.—of the total outlay necessary to bring that tube railway into being, the remainder of the expenditure being made up of numerous items—land, rolling stock, cables, signalling, sub-stations, and so forth. But construction costs were a heavy burden, and they seemed to increase with each new project.

The Author had pointed out that it was the Board's duty to tempt people to travel. Mr. Groves thought that everyone would agree that the Board had set up a new and high standard of amenity in their modern stations, but it was a costly business. In years gone by he used to question the Board's policy of spending money in providing the refinements of convenience for a public already pampered in the matter of underground travel. But now—it was a confession of middle age—he quite appreciated the necessity for them if people were to be tempted to travel. It was true to say that psychology played no small part in determining the Board's policy.

The Author had also referred to the increasing congestion in London's subsoil. As yet that did not prejudice the planning of a new route so much as it added enormously to the cost of creating sub-surface features such as booking-halls, subways and escalators. In any fully built-up area where it was possible at all—and there were already some focal points where it was virtually impossible—the construction or remodelling of those features was very costly.

But the weightiest factor in determining the cost of a tube railway was the presence or absence of a stratum of London clay at suitable depth and of suitable thickness. If the clay was not there compressed air working would almost certainly be necessary, and the construction costs would increase by 40 or 50 per cent. It might be said that the existing network had skimmed the cream of the subsoil, with the result that it was just those districts which were separated from London by bad ground that had yet to be adequately served by a tube connexion with the central area.

With those and other influences all tending to throw more and more out of balance the already disproportionately low return on capital to which the Author had drawn attention, the Board doubtless felt that they had reached an impasse in the matter of underground construction. Their position struck him as analogous to that of the dear old lady whom he once saw at Charing Cross Station pluckily trying to reach the level of the District Railway from the Bakerloo by way of a descending escalator!

He trusted that no district which needed an underground service to and from the central area would be prevented from having that service provided by mere prejudice against the word "subsidy." Post-war London would see great changes, but if additional transport facilities were required it was fairly clear that all could not be provided on the surface without risking a return to the chaotic conditions which obtained in the 'thirties.

The Author had emphasized the great responsibility resting on engineers

in planning the construction of a better world. No engineer would shirk any responsibility in connexion with so vital a matter, but engineers might be excused if they had some misgivings as to whether that responsibility would be laid upon them at the right time and to the proper extent to enable them to do justice to it. It was disquieting that the London County Council—the governing body of London—should have seen fit to issue a report on the Replanning of London without an engineer as one of the signatories, especially as engineering on the grand scale was implicit in their plans.

Nothing of that, however, applied to the London Passenger Transport Board, in whom London was fortunate to have a body which was fully alive to the proper functions of engineers, architects and other specialists. With their far-seeing leadership the Transport Board had great influence, and he hoped that that influence might play an important part in helping to create that better order of society to which all looked forward in the years to come.

The Author, in reply, observed that he was very grateful for the reception accorded to his Paper. He wondered whether Sir William Halcrow would have considered 15 years ago that Waterloo station was too large : if he possessed the Author's knowledge of the Southern Railway he might think it too small. The railways were actively considering the question of electric haulage.

Mr. Quartermaine and other speakers had referred to the cost of construction. The Author suggested that Mr. Quartermaine's forecast might not be quite right. One solution to overcrowding was surely the staggering of hours. It was extraordinary what a difference the staggering of hours had made to the comfort of people travelling by Underground. If staggering of hours was a great inconvenience to the public it would have to be reconsidered, but he thought that it was not.

Mr. Ellson had said that in considering the post-war planning of London station platforms more than 1,000 feet long would have to be visualized. Platforms three or three and a half times longer than the longest tube railway platforms of to-day would be needed to accommodate some of the very long trains to which Mr. Ellson had referred.

Sir John Thornycroft had given an interesting and instructive discourse on higher policy concerning finance and fares. It had always been a necessity, even in the Author's early days, for engineers to economise as far as possible, and that was why he had introduced that question in the Paper.

Mr. Groves had brought up the controversial point concerning tempting people to travel. It might be argued that the tubes and Underground were crowded, so why tempt people to travel more ? But if the tubes could not, under present conditions, earn more than 1 per cent., why not tempt people to travel in out-of-peak periods when capacity was available so that the tubes could earn more ? That was admittedly

an arguable point, but one which would influence the policy of the future.

He agreed entirely with Mr. Groves that the London Plan should not have been released without the advice, help, and support of the civil engineer. The replanning of London could not possibly be executed without civil engineering cooperation.

Paper No. 5399.

**“ Remedial Works in Connexion with the Waldershelf Slip—
Broomhead Reservoir.”**

(Ewden Valley Waterworks of the Corporation of Sheffield)

By LAURENCE BENDELOW, Assoc. M. Inst. C.E.

(Ordered by the Council to be published with written discussion.)†

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INTRODUCTION.

THE object of this Paper is to give a description of remedial works successfully carried out in connexion with a landslip, now known as the Waldershelf slip, situated close to the northern end of the embankment and adjacent to the overflow works of the Broomhead reservoir.

The portion of unstable ground forming part of what was originally known as the Waldershelf Knob, was some 12 acres in extent. Its move-

† Correspondence on this Paper can be accepted until the 15th July 1944, and will be published in a Supplement to the Institution Journal for October 1944. Contributions should be limited to about 600 words.—SEC. INST. C.E.