FROM THE FILES

The following are from files donated to the Society by Desmond Croome, to whom we are most grateful.

1. DOORS FOR RAILWAY ROLLING STOCK

The following is taken from a paper dated May 1951 by the Research and Development Committee of London Transport, but edited (and corrected) lightly.

During peak hours trains spend comparatively long times at stations picking up and setting down passengers. These long station stop times impose a limit on the number of trains which can be run and also on their overall speed. The investigation to be described was made to examine the effects of the number, size and distribution of train doors and thereby to provide information to assist in designing a car which would allow the speediest possible passenger movement. Although the original intention was to study doors alone, it soon became clear that seating layout, by affecting access to the doors, also has an influence, and for this reason seating layouts were also considered.

The history of the development of 'Tube' cars shows a continuous increase in the amount of door space provided. The earliest of the types at present in service is the 1923-1929 series of the Piccadilly and Central lines. Trailer cars of this series have two 4ft 6in wide doorways and the driving motor cars one 5ft 7in wide doorway as the sole means of entrance and exit. As a further variation, certain of the 5ft 7in wide doorways are divided by a central pillar. In the 1931-34 series, on the Piccadilly Line, an extra 2ft 3in door is provided at each end of the trailer cars and at one end of the motor cars. To allow this improvement, the seating capacity of the trailer cars had to be reduced to 40 seats, compared with the 48 seats of the earlier cars.

The provision of single doors at the ends of the cars is continued in the 1938 Tube Stock used on the Northern and Bakerloo lines – the outstanding improvement is that the traction equipment is all installed below floor level, so that the maximum space is available for passengers. 1938 Tube Stock driving motor cars are similar to the trailer cars except that a cab replaces one end vestibule and door.

The development of stock for the District and Metropolitan Lines has been similar to that of Tube Stock of recent years but there has been a greater variety of designs as the dimensional limitations are not so severe. Because Tube Stock presents the more difficult problem, it has received most consideration in this enquiry but the principles evolved apply also to the Surface lines.

THE SURVEY

Because the cars in service are of a variety of designs, an observational approach to the problem has been possible and the flow of passengers through all the sizes and dispositions of doors described above has been-studied. Teams of two observers each recorded the numbers of passengers boarding and alighting and the times taken at each door they observed. The observations were made at several stations, and were confined to the peak hours. To obtain results which are statistically reliable the survey had to be made on a considerable scale. Altogether 6,000 observations were made, and 140,000 passengers counted.

It is the experience of every peak hour traveller that boarding and alighting are rendered more difficult, and slower, when trains are heavily loaded. To take account of this, the observers made a subjective estimate of the state of congestion within the car in the region of each door observed.

The estimates were based on an arbitrary scale of three loading densities, the least congested state corresponding to a few passengers standing and the worst corresponding to the "crush loaded" condition. To minimise differences in the judgments of the various observers the survey programme was shared between them in such a way that the differences would have no effect on the results.

The results are available as a series of tables of the. times taken for different numbers of passengers moving through each type of doorway at each of the three loading densities. Conversion of the results into the form of simple ratios of "seconds per passenger" has been deliberately avoided since these ratios vary according to the number of passengers, and doubling the number of passengers does not necessarily result in double the time being taken. For this reason, and because of the variety of operating conditions encountered, it is not possible to quote a single "figure of merit" for each type of doorway – they have, therefore, been compared only in those cases where the numbers of passengers using them were equal.

In the results it is possible to distinguish between 'passenger' effects on the rates of boarding and alighting, and 'design' effects associated with different types of rolling stock.

PASSENGER EFFECTS

Boarding and alighting can be seriously impeded when passengers stand near the doors, either in the vestibule or on the platform waiting to board, and as a measure of these effects the following examples may be quoted. If a dozen or more passengers are waiting to board, the time taken by the passengers alighting is 5 seconds more than it would be if the platform were empty. Similarly, when cars are loaded to the "crush" level, the time taken for a given number of passengers to board is 40 to 50 per cent greater than when only a few people are standing. In the case of alighting the effect of congestion is even greater and the increase in time ranges from 55 per cent for 20 passengers, to 85 per cent for 5 passengers.

Both the effects described above could ideally be reduced by the co-operation of the passengers themselves and the oft-heard exhortations to "let them off first" and "pass down inside" are intended to encourage this. In the design of the cars some further encouragement to passengers can also be given, firstly by distributing the door space so that the crowd of intending passengers at anyone door is not unduly great, and secondly by providing longitudinal rather than transverse seats, for it has been observed that passengers are not willing to stand between transverse seats, even under the extreme pressure created by congestion in the vestibules.

DESIGN EFFECTS

Two design features which affect passengers' actions have been mentioned already. Consideration is now given to the width of doorways and to the various possible arrangements of doors along the side of a car.

As would be expected, the 5ft 7in doors permit the fastest rates of movement and their advantage is most pronounced at the higher levels of congestion. Where a central pillar is fitted, this does not have the expected effect of encouraging a two-way flow – rather do the figures point to the opposite conclusion that the pillar is a hindrance, especially at the heaviest loading level. The rate of movement does not increase in proportion to the doorway width – the rate through a 2ft 3in door is more than half that through a 4ft 6in door. Because of this, increase in door width beyond the present standards of 2ft 3in and 4ft 6in is not recommended, except in the special circumstances which are discussed below.

RECOMMENDED DESIGNS

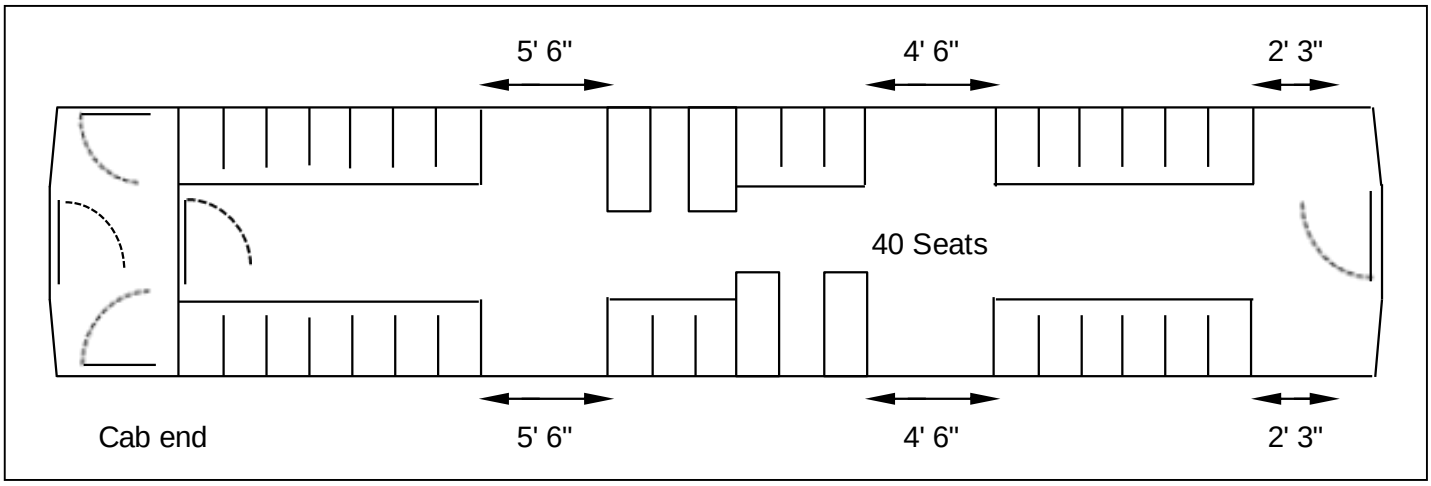
For Tube Stock the arrangement of two end single doors and two double doors is dictated by mechanical considerations, and as this arrangement leads to a reasonably uniform distribution of the door space it is generally satisfactory. However, at the centre of a seven- or eight-car train, which must be divisible into two shorter trains, this uniform distribution is upset by the juxtaposition of two driving cabs and therefore the double doors adjacent to cabs are used by more passengers than are the other doors of the train. Similar remarks apply also to the front and rear cars, particularly the latter which, at present, has a cab at one end and the guard at the other. To overcome these difficulties, it is proposed, in the 1952 Tube Stock, to place the guard near the centre of the train, in a non-driving car, and to dispense with a cab at the inward end of the three-car portion of a seven-car train. For eight-car trains it will not be possible to dispense with one cab and it is recommended, therefore, that the doors adjacent to cabs should be of 5ft 6in width, to compensate for the greater number of passengers using them.

A similar design could be adopted for Surface Stock but, as there is here no restriction on the position of the doors, an arrangement is recommended which more nearly approaches the ideal for speed of loading and unloading. In this design every car, whether trailer or motor, would have three 4ft 6in doors so placed as to be regularly disposed along the train. Seats would be of the longitudinal type except, perhaps, at the ends of the cars. Such cars should accommodate large numbers of standing passengers without the doorways becoming congested as frequently as in the present types.

The purpose of the surveys described has been to expedite the movement of passengers during the peak hours in the Central Area and the design of trains suitable for rural and outer suburban traffic has not, therefore, been touched upon. It has been necessary to emphasise the functional purpose of a train, namely its suitability for carrying large numbers of passengers, a considerable proportion of whom cannot be provided with a seat in any case, and for allowing them to board and alight as swiftly as possible.

PROPOSED LAYOUT FOR NEW 'TUBE' MOTOR CARS
WITH ENLARGED DOORWAY OPENING NEAREST TO DRIVER'S CAB

AND REVISED LAYOUT IN CENTRE SECTION OF SALOON



2. HISTORY OF THE 1949 TUBE STOCK PROGRAMME

The following is taken from a London Transport paper dated 18 November 1952 and addressed to A.W. Manser, but again edited lightly.

The Tube Rolling Stock programme was initiated shortly-after the war for the purpose of balancing the 1938-type rolling stock, because there was at that time a number of trains running in non-standard formation, and also a number of spare cars. This had come about because some of the stock had been purchased in special 9-car-set formation for the Northern Line (instead of the standard 4-car and 3-car sets to make 7-car trains), and subsequent abandonment of 9-car train operation had made it necessary to break up the 9-car sets and make up non-standard 7-car trains.

It was found that correction of the stock position could be achieved by purchasing 89 new cars, all motor cars with driving cabs, and by converting certain 9-car-train cars and the 18 streamlined experimental motor cars which were the forerunners of the 1938 Tube Stock. These cars had been in store since early in the Second World War. The stock thus made available would enable the full requirements of the Northern and Bakerloo lines to be met with 1938-type stock, with enough trains left over to re-equip the Northern City Line. All trains would be made up of standard 4-car and 3-car units. The proposals were approved by the L.P.T.B., the B.T.C. gave approval on 27 February 1948, and permission to submit the S.E.R. was requested of the Executive on 21 August 1948.

Further review of the proposals followed, and it was decided that there could be considerable simplification of the conversion work to be done on existing stock and economies in the new stock building programme, if the running of block trains would be satisfactory. This was agreed, and a memo to the Executive, dated 10 January 1949, set out the new proposals. The order for new cars with the Birmingham Railway Carriage & Wagon Co. was changed so that only 67 of the 89 cars would be driving motor cars, and the remaining 22 would be trailers.

At that time it was thought that there was little immediate prospect of uncoupling in service being re-introduced, so there would be no disadvantage if driving cabs in the middle of trains were dispensed with. The extra passenger doors and standing space would be an advantage. Furthermore, the new cars would be cheaper as NDMs instead of DMs and only one type of body would be required for the whole order, instead of two. Recommendations that the order be changed to 67 NDM cars and 22 trailers were submitted to the Executive in a memo dated 17 May 1949, and this course of action was agreed. It was at this time pointed out that if uncoupling were re-introduced, it would be necessary later to buy all driving motor cars for the Camberwell extension, in order to balance the rolling stock.

Uncoupling programmes, and deferment of restocking the Northern City Line, reduced the requirements of the Northern and Bakerloo lines for 1938 type stock, and it was decided that, when the new cars were delivered, there would be enough available to provide 15 1938 Stock trains on the Piccadilly Line until completion of the Camberwell Extension.

These trains would be used in substitution for Pre-1938 trains in peak service. In order to provide the correct number of spare cars it would be desirable to increase the new stock order to 91 cars, 70 of them NDM cars and 21 trailers. This was agreed by the Executive (memo dated 8 June 1950).

With the indefinite postponement of the Camberwell Extension, it was realised that the number of block trains involved in the programme, which would be a considerable embarrassment from the uncoupling point of view, could not be reduced in the near future by further stock purchases. Designs were, therefore, prepared for a small cabinet, containing essential driving controls, which could be fitted in the end panels of an NDM car, and so make it possible for the new block trains to be uncoupled in service. The 4-car portion of the train would be standard, and the 3-car portion, having at its inner end an uncoupling non-driving motor car, could be uncoupled from it and driven away to a siding by a driver using the shunting control cabinet. Instructions for the incorporation of control cabinets in the 70 UNDM cars being purchased, and in 22 conversion cars, were issued in November 1950. Operating Department requirements have made it necessary for the simple equipment originally envisaged to be elaborated, but there is still a considerable saving in cost over a fully-equipped driving motor car, and there is no obstruction of passenger space or doorways by the driving equipment. The prototype car, an Acton conversion, was available for inspection in June 1951.

A further effect of the Camberwell postponement was seen when, on 2 January 1951, the Operating Manager submitted a memorandum proposing that the 15 1938-type trains to be transferred to the Piccadilly Line should be transferred permanently, and that the number of "1952 Tube Stock" trains to be purchased for re-equipping the line should be reduced by a corresponding number. It was then necessary to plan the disposal of the displaced Piccadilly Line Pre-1938 cars, and it was decided to use some of them to strengthen more 7-car Central Line trains to 8-car length, and the remainder to replace cars of 1923 vintage, mostly running on the Central Line. The fourteen best motor car of this type would be retained to allow scrapping of the 1906 cars used by the Chief Engineer for hauling ballast trains, and the remainder of the cars would be scrapped. A memo to the Executive dated 31 July 1951 gave full details of the proposals. Redeployment of 1938 Stock cars between the Northern and Bakerloo lines went ahead, a train was provided for training of Piccadilly Line crews in operating the modern stock, new cars arrived and were prepared for service, and training of Northern and Bakerloo Line crews in operating the UNDM cars proceeded. Because of the time needed for training, it was not possible to put the UNDMs in uncoupling service immediately, and in any case there were technical difficulties on the new cars which required solution. So, in order that the stock transfers and conversions should not be delayed, it was arranged that the cars should go into service at intermediate positions in block trains. This was fairly simple on the Northern Line, but on the Bakerloo there were no existing arrangements for block working, and fitting the trains in without running unnecessary car mileage was not easy. However, the first block trains containing UNDM cars went into service in March 1952 on both lines, and others followed until it was possible to put uncoupling trains in service.

Meanwhile, consultations regarding the new type of car and its operation were going on with Sectional Council No.3, and it was a serious setback to the programme when, in June, 1952, the staff representatives announced that they would not work the proposed uncoupling arrangement at Watford Junction (Bakerloo). They contended that the motorman's equipment on the UNDM car was unsuitable for making the 1½ mile trip over running lines to Croxley Green Depot with an uncoupled 3-car unit, and it was decided not to press the proposals. Alternative arrangements had, therefore, to be made, and there seemed no satisfactory alternative to a drastic alteration of the programme. So that only 3-car units with driving cabs both ends should be provided for uncoupling at Watford, the number of UNDM cars to be run on the Bakerloo in substitution for DM cars had to be reduced. The fifteen trains for the Piccadilly Line, which were to have been formed of standard 1938 Stock 4-car and 3-car units, will now have an UNDM car on the 3-car portion, so that 15 more standard trains can be provided on the Bakerloo. This arrangement is not as satisfactory to the Piccadilly Line as the original one (because the 3-car portion is now at the west end, whereas it is at the east end on Pre-1938 trains), and furthermore, it will not be possible to run the 1938 trains on uncoupling turns until the crews have been trained on the unfamiliar shunting control equipment.

Uncoupling trains of the new type eventually went into service on the Northern and Bakerloo lines on 29 September 1952, and the first Piccadilly Line block trains with UNDMs entered service on the same day. The number of these trains is gradually being increased as the new and converted cars become available and the new formations can be made up. Transfers of Pre-1938 Stock cars from the Piccadilly Line to the Central Line have been going on since September 1952, the modifications required having been carried out at Acton previously, and the fourteen 1923 Stock motor cars to be converted for ballast-train working have now been selected.

3. REPLACEMENT OF PICCADILLY LINE ROLLING STOCK

A memorandum to the Executive from A.W. Manser, the Chief Mechanical Engineer (Railways) and Chief Financial Officer, dated 16 September 1952.

After the 91 new Tube cars now in course of delivery have entered service and certain other changes have been effected, the remaining stock – known as the "Pre-1938 Stock" – and still running on the Piccadilly, Central and Northern City lines will comprise the following (opposite):

This report reviews the effects of deferring the replacement of the Piccadilly Line stock which will, in turn, defer the replacement of the stock on the Central and Northern City lines. For convenience, the references to Central Line stock in this report include the Northern City Line stock.

Year entered service	Age (years) in 1952	Piccadilly Line	Central Line	Northern City Line
1925	27	–	123	18
1926	26	–	123	4
1926	26	–	104	16
1928	24	–	111	30
1929	23	184	216	–
1930	22	52	1	–
1931	21	43	25	–
1932/33	20	275	–	–
1935/36	17	26	–	–
		580	**703**	**68**
	Total:	←	**1351**	→

IF THE REPLACEMENT OF THE PICCADILLY LINE STOCK BE PROCEEDED WITH AT THIS TIME with delivery, say, during the years 1954 to 1956, 40 cars of the Pre-1938 Stock on the Piccadilly Line will be scrapped, 38 will be transferred to the Northern City Line in replacement of the oldest cars on that line and 502 will be transferred to the Central Line to lengthen the remaining 7-car trains to 8-cars and to replace the oldest cars on that line. The Central Line stock, when these transfers have been completed in, say, 1957 would consist of 812 cars, which would be sufficient to meet the present Northern City service and also to provide 79x8-car trains plus spares on the Central Line. The composition of the stock; and the changes would then be as above.

Year entered service	Existing stock	To be scrapped	To be transferred from Picc Line	Revised Stock position
1925	141	141	–	–
1926	247	247	–	–
1928	111	111	–	–
1929	246	–	144	390
1930	1	–	52	53
1931	25	–	43	68
1932/33	–	–	275	275
1935	–	–	26	26
	771	**499**	**540**	**812**

If the Piccadilly stock were replaced during the years 1954/56, no exceptional repairs to either the Piccadilly or the Central Line stock would be necessary at this time. Moreover, assuming the replacement of the Central Line stock to follow on immediately after the Piccadilly stock has been replaced, the present Piccadilly stock which would have been transferred to the Central Line would also run until scrapped without exceptional repair, except that the cost of overhauling the 241 cars of UCC construction is likely to increase appreciably.

The 502 cars being transferred from the Piccadilly Line to the Central Line would need to be modified as to contact shoes because of the non-standard current rail on the Central Line, as to individual door control (unless individual door control were dropped on the Central Line as a whole) and as to the position of certain air reservoirs on 274 motor cars. The cost of these modifications would be of the order of:

Contact shoes	£15,000
Door control	£95,000
Reservoirs	£16,000
Total:	**£126,000**

IF THE REPLACEMENT OF THE PICCADILLY STOCK WERE DEFERRED FOR A PERIOD OF FIVE YEARS to – say – 1959/61 and were followed by the replacement of the Central Line cars in, say, 1962/65, the consequences would be as follows:

(a) There could be no further strengthening of the Central Line service earlier than 1959/61 and no additional carrying capacity would be provided on the Piccadilly Line until 1959/61.
(b) Some deterioration in the standard of reliability would probably result, even although additional expenditure on maintenance were incurred.
(c) The Piccadilly Line stock, including its service after transfer to the Central Line, would need to run until 1962/65, a period of ten to thirteen years from today. This could be done without exceptional rehabilitation, although overhaul costs would tend to become heavier, particularly in the case of the 241 cars of UCC construction already mentioned.
(d) The existing 771 cars on the Central Line and Northern City Line would continue in service until 1959/61, a period of seven to nine years from today. This could be done without rehabilitation, although additional maintenance would be necessary at a cost, approximately estimated at £46,000 per annum;
(e) The saving of an overhaul cost, always realised when replacement takes place, would, however, be deferred for five years in the case of both the Piccadilly and Central Line stock.

IF THE REPLACELIFMT OF THE PICCADILLY STOCK WERE DEFERRED FOR A PERIOD OF TEN YEARS, the consequences would be as follows:

(a) There would be no further strengthening of the Central Line stock earlier than 1964/66 and no additional carrying capacity would be provided on the Piccadilly Line until 1964/66.
(b) No improvement in standard of reliability could be promised on either Line before 1964/66. Despite more critical maintenance standards, with an ageing vehicle the extension of life as now proposed incurs a risk of reduction in reliability and that risk becomes disproportionately greater with the ten-year as compared with the five-year proposal.
(c) The existing Central Line and Northern City Line cars would continue in service until 1964/66, a period of twelve to fourteen years from today. This would involve exceptional rehabilitation expenditure to be undertaken in the years 1953 to 1956, at a cost estimated approximately at £1,520,000, including one overhaul.
(d) The Piccadilly Line stock, including its service on the Central Line, would need to run until 1967/70 – a period of fifteen to eighteen years from today, and this would involve exceptional rehabilitation expenditure, including one overhaul, to be undertaken – say – in the years 1957/60, at a cost estimated approximately at £1,130,000.
(e) The saving of an overhaul cost on replacement of both Piccadilly and Central Line stock would also be deferred for ten years.

IF REPLACEMENT WERE DEFERRED FOR EITHER FIVE OR TEN YEARS, there would be a deferment, for five or ten years as the case may be, of the expected savings on current consumption, assuming the new stock to be constructed in light alloy, and also of the savings to be effected on maintenance and overhaul of the new stock as compared with the Pre-1938 Stock.

On the other side of the account, deferred replacement would lead to a saving of interest on the cost of the new stock for the period of deferment. It would also effect a saving equivalent to depreciation on the full cost of the new stock. Depreciation on the book value of the present stock would continue during the extended life and these depreciation provisions would result in larger depreciation accumulations (and smaller obsolescence charges) when replacement was ultimately effected. As regards depreciation on the higher cost of replacement, this would obviously be deferred until replacement took place.

If it be decided to defer the replacement of stock at this time, the Chief Mechanical Engineer (Railways) will seek authority for expenditure of the order of £150,000 for the purchase of a prototype train of new stock so that new developments can be thoroughly tried out. This will ensure that when new stock is ordered a proven design will be available to enable a standard stock of reliable performance to be purchased for a programmed replacement of the major part of the Pre-1938 Tube Stock. This was done prior to the purchase of the 1938 Stock and led to the decision to purchase the PCM equipment, the performance of which is so exceptionally good on the 1938 stock cars. This policy should also lead to a reduction in manufacturing costs (and therefore in price) when the time comes to go into full-scale production of the new stock.

The various effects of deferment arise at differing dates. Moreover, some of them are suffered once and for all, whilst others continue over a period. In order, therefore, to express the relative financial effects of deferment for five or ten years, all factors of cost or of saving have been expressed in terms

of present capital values as at 1954, taking interest at 4 per cent, and 5 per cent, respectively. The following tables summarise the results of these calculations:

	Savings £	Increased cost £
Effect of Deferment for 5 years – based on 4 per cent interest		
Interest and depreciation on cost of replacement stock –		
Piccadilly Line	2,350,000	–
Central & Northern City lines	2,530,000	–
Overhaul costs –		
Piccadilly Line	–	205,000
Central & Northern City lines	–	575,000
Repair costs –		
Piccadilly Line	–	220,000
Central & Northern City lines	–	490,000
Current consumption –		
Piccadilly Line	–	35,000
Central & Northern City lines	–	120,000
Cost of modifications to Piccadilly Line stock	25,000	–
Cost of Prototype train	–	150,000
Totals:	**4,905,000**	**1,795,000**

The net saving would thus be £3,110,000 but the net saving assuming 5 per cent interest would be roundly £3,500,000.

	Savings £	Increased cost £
Effect of Deferment for 10 years		
Interest and renewal charges on cost of replacement stock –		
Piccadilly Line	4,250,000	–
Central & Northern City lines	4,600,000	–
Overhaul costs –		
Piccadilly Line	–	20,000
Central & Northern City lines	–	395,000
Repair costs –		
Piccadilly Line	–	235,000
Central & Northern City lines	–	480,000
Current consumption –		
Piccadilly Line	–	65,000
Central & Northern City lines	–	245,000
Cost of modifications to Piccadilly Line stock	40,000	–
Rehabilitation of existing stock –		
Piccadilly Line	–	640,000
Central & Northern City lines	–	1,000,000
Cost of Prototype train	–	150,000
Totals:	**8,890,000**	**3,230,000**

The net saving would thus be £5,660,000 but the net saving assuming 5 per cent interest would be roundly £6,300,000. The savings shown in the tables (above) have been calculated on the assumption that sufficient Central Line cars of the new type would be purchased to give an overall equivalent passenger carrying capacity, with a reduction in the number of cars required from 812 to 687. If, in fact, more than 687 cars of the new type were to be purchased for the Central Line when replacement is effected, so as to increase the capacity of the line, the calculated savings as shown above would be very substantially increased.

4. THE CHESHAM BRANCH RAILCAR TRIAL

In previous issues of *Underground News*, we have mentioned the trial of a Great Western diesel railcar on the Chesham branch prior to the Second World War. A report on the trial has come to light and is dated 6 April 1936 and signed by George Hally, the Underground's Operating Manager (Railways). It reads –

REPORT ON TRIALS OF DIESEL ENGINED RAILCAR GWR No.16 ON MET. & G.C. JOINT LINES ON 20 MARCH 1936

The scheme for the electrification of the Metropolitan & Great Central line as far as Amersham does not include the electrification of the Chesham branch, so it will be desirable to meet the protests of the Chesham people by improving the shuttle service, both in frequency of operation and quality of rolling stock.

When the electrification to Amersham is completed, the whole of the Metropolitan Line steam service north of that point will be taken off, and it will be necessary to provide a compensating shuttle service between Amersham and Aylesbury. At the same time, traffic will be stimulated by a closer interval service than obtains today, along with the use of a more suitable type of rolling stock.

In order to determine whether a diesel engine railcar would be satisfactory for the service mentioned above, some experiments were carried out on the Met. & G.C. Joint line, with a diesel car built by the Associated Equipment Company to the order of the Great Western Railway Company, for use in their Bristol area.

The car left the Southall Works of the Associated Equipment Company on Friday morning 20 March 1936 and travelled along the G.W. & G.C. Joint line via Princes Risborough to Aylesbury. It then proceeded by the Met. & G.C. Joint line to Chalfont, where it ran five double trips on the Chalfont – Chesham branch. It returned via Aylesbury and Princes Risborough to Southall, where it arrived at about 19.00 that evening.

Throughout the day the weather was showery and the rails were wet. No fuel consumption tests were carried out and no effort was made to maintain high speeds because the driver did not know the road and the pilotman was afraid to run any risks. The car is geared for a maximum speed of 70 mph but this figure may be varied, as desired, in any new vehicle, by altering the gear ratio.

The trials were satisfactory. The car rode steadily at all speeds and was handled with ease by the driver. The engine power was sufficient for main line running, and the braking capacity enabled the driver to pull up much more quickly than would be possible with a steam train. There was no vibration or noise from the engine whist the car was standing still or running at speed. Altogether, it is considered that this car would be suitable for use on the services between Amersham – Aylesbury and Chalfont – Chesham.