DISTRICT ELECTRIC TRAINS
1 – THE BEGINNING
by Piers Connor

A REPRISE

Between 1968 and 1970, I wrote a series of articles for this journal, which was then known as “Underground”, called “District Electric Rolling Stock”. The series outlined the history of the electric trains used by the District Railway up to 1970. Since that time, more archive information has been found and there has been some resurgence of interest in the heritage of the Underground, so I thought it was time to reprise the series and to give it a face lift with new text, extended coverage up to the recent past, some drawings and photos, a few anecdotes and some technical and operational details. I should mention that many of the photos I am proposing to use have been published before but they are worth including where necessary to illustrate special features of the trains, to add some interesting aspects of train operations, to correct errors in captions or for completeness as a historical record.

STOCK IDENTIFICATION

We should begin with sorting out one, often misunderstood subject – that of District rolling stock identification. The perceived wisdom in Underground historical circles is that the District always identified its electric trains by a letter indicating the stock type, as in “B Stock”, ”Q Stock” and so on and that this system has lasted to this day as we see in the new “S Stock” for the Sub-Surface lines. Well, yes, a system of lettering was applied to the District’s fleets over the years and yes it has survived to this day but its use for the electric stock seems to be founded no earlier than the late 1920s, when the first evidence of it was with the introduction of the 101 motor cars ordered in 1927 and delivered from 1928 (Fig. 1). This order was known by the operators as the 1928 Stock but it was also labelled “K Stock”. The “K” description was, at the time, the exception rather than the rule. It only became common currency later but it was not the first time the District had used letters to describe batches of its rolling stock. There is evidence, both in the company’s board minutes and on its coach drawings, that the locomotive-hauled coaches used in steam traction days were identified by the letters A to G, which matched the orders placed over the years for various batches.

Fig. 1: Official photo of K Stock motor car as prepared for service in 1928. On the solebar, just forward of the cab door step, the letters “KM” appear. These apparently denote the stock identification code as K and the car as owned by the LMSR. However, this method of showing stock identity on the actual vehicles was inconsistent and appeared on some, but not all, new vehicles up to the 1937-built O Stock. Photo: LT Museum U5144.

Strangely, this system was dropped for electrification by the District's new American owners and it seems to have been forgotten until its revival for the K Stock in 1928.

The 1927 cars (I will use 1927 from now on, despite the use of 1928 in District Railway papers for many years), which London Transport later decided to call Q27 Stock, were originally identified as K Stock, apparently because someone in the Underground's engineering organisation had realised that the District, by then having three types of trains which were technically and operationally incompatible, needed some way of identifying its vehicles beyond the various casual references used up to then. They must have worked back through the fleet acquisition dates and allocated a letter for each build, starting with "A" for the 1903-built experimental cars and reaching "K" for the 1927 cars. As is often the case in such systems, "I" and "J" were left out. Perhaps it was devised by someone who remembered the old system used on the steam stock and who decided to revive it. In spite of this, for many more years the system was hardly ever used. It only began to appear more regularly during the influx of new trains just before the Second World War until it gradually became common currency. Eventually, the engineering based stock letters appeared in working timetables (WTTs), Traffic Circulars and other notices until they became recognised as the norm. In the table below, I summarise the various stocks and the corresponding letters eventually used.

Stock Date	**Original Name**	**Letter**	**Comments**
1903		A	Later combined with B Stock as "Standard Wooden Stock" or "Local Stock".
1905	Standard Stock	B	Later became known as "Standard Wooden Stock" and then as "Old Standard Stock", as it got older.
1910-4	Steel Stock	C, D & E	Later became "H Stock".
1920	1920 Stock	F	Nicknamed "Tanks" throughout most of their life.
1923	1923 Stock	G	Earliest stock to be incorporated into Q Stock conversion programme, eventually becoming Q23.
1925-8	Rebuilt Wooden Stock	H	Used for refurbished B Stock cars given an extension of life over a period of years in the 1920s.
1927	1928 Stock	K	Became Q27.
1931	1931 Stock	L	Became Q31.
1935	1935 Stock	M & N	Became Q35.

Fig 2: Table of former District Railway rolling stock naming systems. Note the term "Standard", which we would normally associate with tube stock rather than Sub-Surface stock. It was commonly used on the District. The letters "I" and "J" seem to have been deliberately left out, probably to avoid confusion. The letter "H" was used twice, first to distinguish those B Stock cars which had been through a refurbishment programme in the late 1920s and later to denote hand-worked door trains, so as to distinguish them from air-door trains.

The use of stock ID letters was complicated by the fact that both before and after their 1928 re-introduction, the Operating Department used different letters from those adopted by the engineers[1]. As a result, in the late 1930s, the District's WTTs showed the following codes for rolling stock:

- "D" = Metadyne Stock on the District. They couldn't use M (Metadyne) or N (New) as they were already in use – see below. I have no idea why they chose "D".
- "M" = 8-car train composed of two 4-car or "Main" portions (4+4 instead of the usual 4+2+2 arrangement). This meant that two west-facing motor cars were required instead of one, with a corresponding reduction in the number of east-facing motor cars in the train from three to two. It also meant an 8-car train could be split into two 4-car trains for service.
- "N" = 1920 Stock (F Stock to us). Probably as it was originally "New" as far as the District was concerned and it carried this letter into the 1930s, even though it was no longer new.
- "S" = Described officially as "Old Standard Stock" (B Stock to us).

In the timetables, these letters appeared against the number of cars making up the train concerned in the depot lists. If there was no letter it was assumed to be made up of any other stock built between 1910 and 1935. But, as if things weren't confusing enough, the letter M was also used to denote Metropolitan trains which appeared in the District WTTs, including the Circle trains provided by the Metropolitan. In this case the letter appeared against the train number in the appropriate timing column. And, just to throw more fuel on the fires of confusion, the Metropolitan WTTs of the same period used the letter M to denote Metadyne trains.

There will be more details about all the issues regarding stock types and train formations as the series progresses. I will also look at how trains were used and some of the issues this raised. Now though, it is time to take a look at the District in the years leading up to its electrification in 1903-05.

THE DISTRICT IN THE LATE 19th CENTURY

In the 1890s, the District ran steam train services over much of the same system as we see today, i.e. to Ealing, Richmond and Wimbledon in the west but only as far as Whitechapel in the east. In a hate-hate relationship with the Metropolitan Railway, a relationship which, some would say, isn't entirely dead even today, the two railways jointly operated the Circle Line. In terms of finance, the Metropolitan was relatively prosperous but the District was in a dreadful state and things weren't about to get better.

In 1890, the City & South London Railway opened to the public. This line ran from Stockwell to the City of London in tube tunnels and it used electric traction. It cost a lot of money to build and was never able to show much profit as a commercial enterprise but it did show that electric traction was a viable means of transport and that it worked in an underground environment. The poor return on the capital invested in it was to slow the development of other new underground schemes but two, the Waterloo & City Railway and the Central London Railway, did get enough

[1] What? Operators and engineers not getting together to use the same system? There's nothing new, is there?

backers and did get built. Their openings (1898 and 1900 respectively) encouraged other tube railway schemes across central London, three of which were to become the Bakerloo, Hampstead and Piccadilly lines.

The new and planned electric tube lines all cut into the central area ringed by the Circle Line. With the Circle being steam operated, passengers had long complained about the smoke-filled tunnels, the soot-covered trains and stations and the discomforts of the heat and fumes they endured when travelling underground. People avoided the tunnels as much as possible, especially in hot weather. In 1898, an enquiry by the Board of Trade into air quality in the Circle's tunnels rather obviously suggested that the best solution was electrification. Indeed, since the new tube lines offered the possibility of a vastly superior journey once they were opened, they were going to create a huge dent in the District's (and Metropolitan's) income. The District, especially, couldn't take much of that and survive.

PROBLEMS OF ELECTRIFICATION

In the late 1890s, electric traction was still a relatively new idea. There were a number of tramways and urban routes in the US which had introduced electric trains and, in Britain, the Liverpool Overhead Railway, as well as the two new tube lines in London, opened with electric traction. But building a new electric line was considered a far easier prospect than converting an existing busy urban route like the Circle, with its mix of passenger and goods traffic (the ratio was about 2% goods but it was still the intention to keep it), running up to 19 trains per hour at the busiest times and with six flat junctions included in the route.

When the Central London opened between Shepherd's Bush and Bank it was in direct competition with the District's route to Mansion House, which is a short walk from Bank. The District, being in a bad way financially, rarely ever paid a dividend on its ordinary shares. Off-peak traffic was very light. Apart from some commuter traffic from the western suburbs, the fortunes of the railway seem to have rested on the popularity or otherwise of the various exhibitions which were staged on District land at Earl's Court. Alexander Edmonds, in his history of the District[2], regularly describes how the income fluctuated during the final years of the 19th century in accordance with the levels of exhibition traffic. It was a precarious railway company indeed that relied on showmanship by others for its survival.

Under these conditions, there was little chance of raising capital for improvements. Most investors would ask, why throw good money after bad? "Electrification is expensive and we can't see the prospect of a good return on our investment". Even so, disregarding the financial position, the District's management was forced to get into negotiations with the Metropolitan Railway over how things might be improved. Electrification was obviously the only way forward and, with their joint operation of the Circle, they had to choose the same system. With the long-standing rivalry between the two companies, they must have struggled to get through the animosity to decide how to tackle the problem. Still, eventually they did and they agreed, in May 1898, to try out an experimental installation of electric traction between High Street Kensington and Earl's Court.

Siemens Equipment

[2] Edmonds A, "History of the Metropolitan District Railway to June 1908", published by London Transport, 1973.

The contract for the Earl's Court experiment was eventually given to Siemens. Being a joint Metropolitan and District venture, as you might imagine, it was not without controversy[3]. It had been the intention to use The Electric Supply Company of Wolverhampton, who had equipped the Liverpool Overhead Railway and who had been awarded the contract for the electrical equipment of the C&SLR extension to Moorgate. Strangely though, Thomas Parker of the Electric Supply Co., apparently decided, soon after the joint experiment contract was awarded, to drop the work, perhaps because the C&SLR work was more profitable or, very likely, he was short of resources and the necessary technical expertise.

Whatever the reason, the District responded quickly and gave the work to Siemens Brothers. The Metropolitan only found this out by accident and weren't best pleased, not so much because of Siemens, rather because they weren't kept in the loop. They were so annoyed that they then asked Parker to conduct some experiments of his own, which he did in the yard at Neasden.

The Siemens brothers were well-known in both Germany and Britain. One of them, William, made his home here and gained such status with his telegraph business that he was knighted by Queen Victoria. His company had equipped the Waterloo & City Railway successfully and seemed to be a good choice for the District experiment. Doubtless the directors of the District were taken to see the new tube line and would surely have been convinced that it was a workable solution. Doubtless too, they were pressed by Sir William to try out a proven system.

And so they did. The traction current for the joint experiment was supplied at 500 volts DC, from a specially built power station at Warwick Road, to pairs of current rails (one positive and one negative) located on the track. Both rails were positioned outside the running rails in the style later adopted by the Great Northern & City Railway but the arrangement was never used on the rest of the Underground network[4].

Train Formations

Throughout this series the following train formation notation will be used:

DM = Driving Motor car or coach.

EM = End Motor car – a title peculiar to the first two batches of electric stock owned by the District which differentiated it from a MM.

MM = Middle Motor car, which had a driving cab at both ends instead of the usual cab at one end only. It could and did operate as a single car.

T = Trailer car – one without motors.

THE SIEMENS TRAIN

The Earl's Court experiment used a special 6-coach train, ordered in May 1899 from Brown Marshall & Co. of Saltley, Birmingham (later absorbed into the group

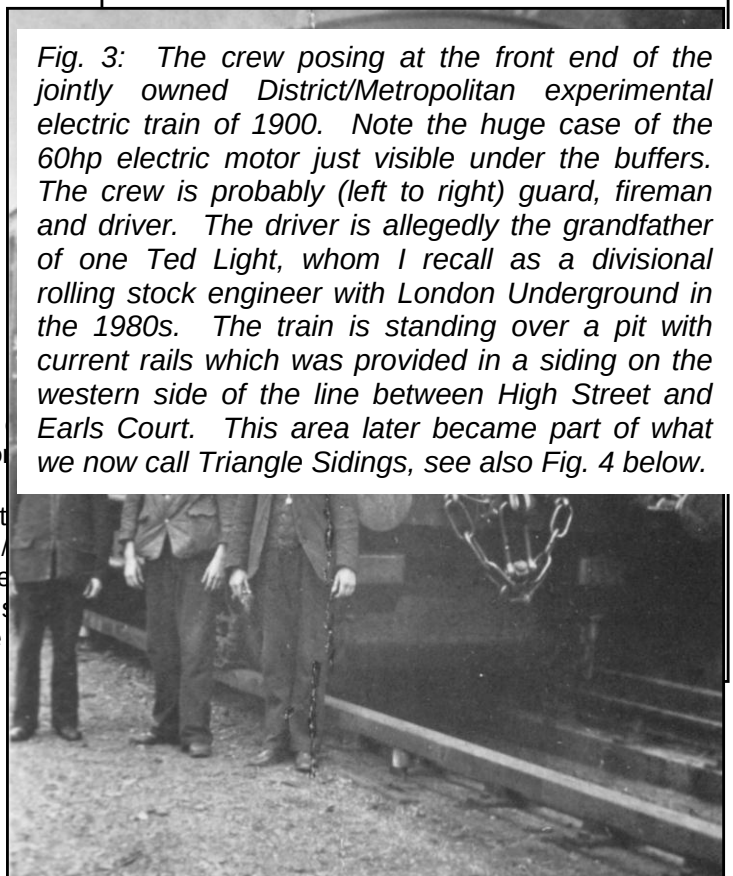

Fig. 3: The crew posing at the front end of the jointly owned District/Metropolitan experimental electric train of 1900. Note the huge case of the 60hp electric motor just visible under the buffers. The crew is probably (left to right) guard, fireman and driver. The driver is allegedly the grandfather of one Ted Light, whom I recall as a divisional rolling stock engineer with London Underground in the 1980s. The train is standing over a pit with current rails which was provided in a siding on the western side of the line between High Street and Earls Court. This area later became part of what we now call Triangle Sidings, see also Fig. 4 below.

[3] The detailed story of the early moves towards railways appears in "A History of London Transpor pp 54-60.

[4] This arrangement would have presented a difficult Circle. Let's say the positive rail was on the north/ High Street. If you carried this on round the Circle Tower Hill, the positive rail would now be on the s positive rail would now be on the other side of the wonder how long they took to realise this.

that eventually became Metro-Cammell) which was delivered late in 1899 to the District's depot at Lillie Bridge. Trial running started early in December 1899 and continued spasmodically up to 21 May 1900, when public operation began. The District charged a fare of one shilling – 5p in decimal money but actually the equivalent of £4 today. Naturally, the train ran practically empty, since the ordinary fare was about 20% of that and it only took the District a week to drop the special fare. Even so, the train never did "pay its working expenses", as reported at the time – hardly surprising, since it was a high-tech experiment over a very short piece of line. We might wonder why anyone thought it would give a meaningful assessment of running costs in the first place.

The train was formed DM-T-T-T-T-DM (see box above about the initials), all vehicles being based on traditional British compartment style coaches with "slam doors". The motor coaches were actually electric locomotives in their own right, the leading coach hauling the whole train without assistance from the other motor coach at the rear, which was towed like a trailer. There was no though control and no power connections to the rear motors from the front but there was a pair of "bus lines"[5] connecting the collector shoes at each end of the train. This reduced the risk of the train getting "gapped", i.e. stalled at the breaks in the current rails necessary at points and crossings due to loss of contact between the shoes and the current rails[6]. The whole train weighed 185 tons, 20 tons more than "a loaded Inner Circle Line steam train" and 30 tons more than a 6-car train of "standard wooden stock" as later built for the main electrification of the line in 1905. There is no mention of the power developed by the motors of this train but each motor coach had four of them and one could imagine that they were similar to the 60hp gearless type used by Siemens on the Waterloo & City trains that they equipped. Indeed, it would be safe to assume that, apart from the motor control, the whole electrical system was very similar to the W&C arrangements[7].

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5 This can be defined as a "common user" electric conductor where fixed connections are added to supply various circuits or systems. From "omnibus", Latin for "all".

6 Contemporary accounts report that the gaps were up to 40ft long – longer than the span of collector shoes on one coach.

7 I describe the W&C equipment in Article 3 of my series "The Underground Electric Train", *Underground News* No.525, September 2005. There is much more detail in John Gillham's book "The Waterloo & City Railway", Oakwood Press, 2001. "The Electrician" magazine of the period reported that the equipment was very similar to the W&C arrangements.

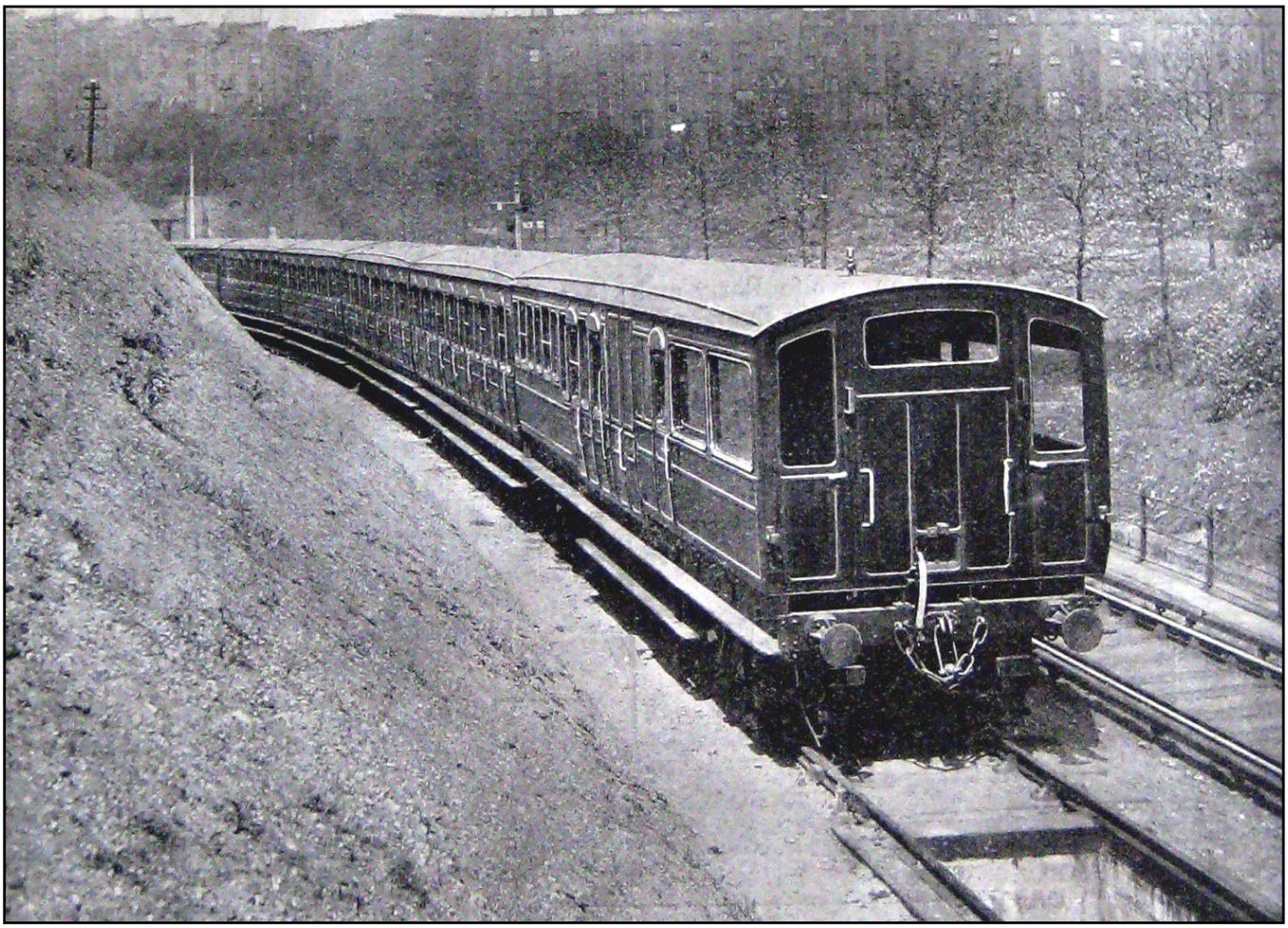

Fig. 4: The 1900 experimental train stabled in a siding next to the eastbound track between Earl's Court and High Street Kensington. This is the Earl's Court end of the train. The westbound track is lower and out of sight as it drops down towards the flyunder. This whole area is now underground. The train is stabled where a row of pillars now stands supporting the development above. The camera is standing on the site of the present No.37 road in Triangle Sidings.

The motor coaches (see Fig. 5 below for a drawing) had a control compartment at the leading end with a power controller operated by a large hand-wheel. The driver sat beside it. Power passed through this controller at full line voltage so the switches were very large compared with what we see today in modern low voltage driver's controllers. The motors were mounted directly on the axles so there was no reduction gearing. This meant that the motor revolutions were the same as the wheel's. Once electric traction had developed a bit and successful geared drives were introduced, the ratio was about 3.5 to 1 motor speed to wheel speed.

The motors were very large so the driving wheels had to be 4ft (1219mm) in diameter compared with the usual 3ft diameter for coach wheels. In fact, the motors were so large that the motor coach floors had to be raised about 6in (152mm) higher than normal over the bogies at each end of the vehicle. For passengers using these coaches, access doors were restricted to the central part of the body and, inside, the floors sloped upwards to the seats provided over the bogies. The seats were longitudinal in these areas.

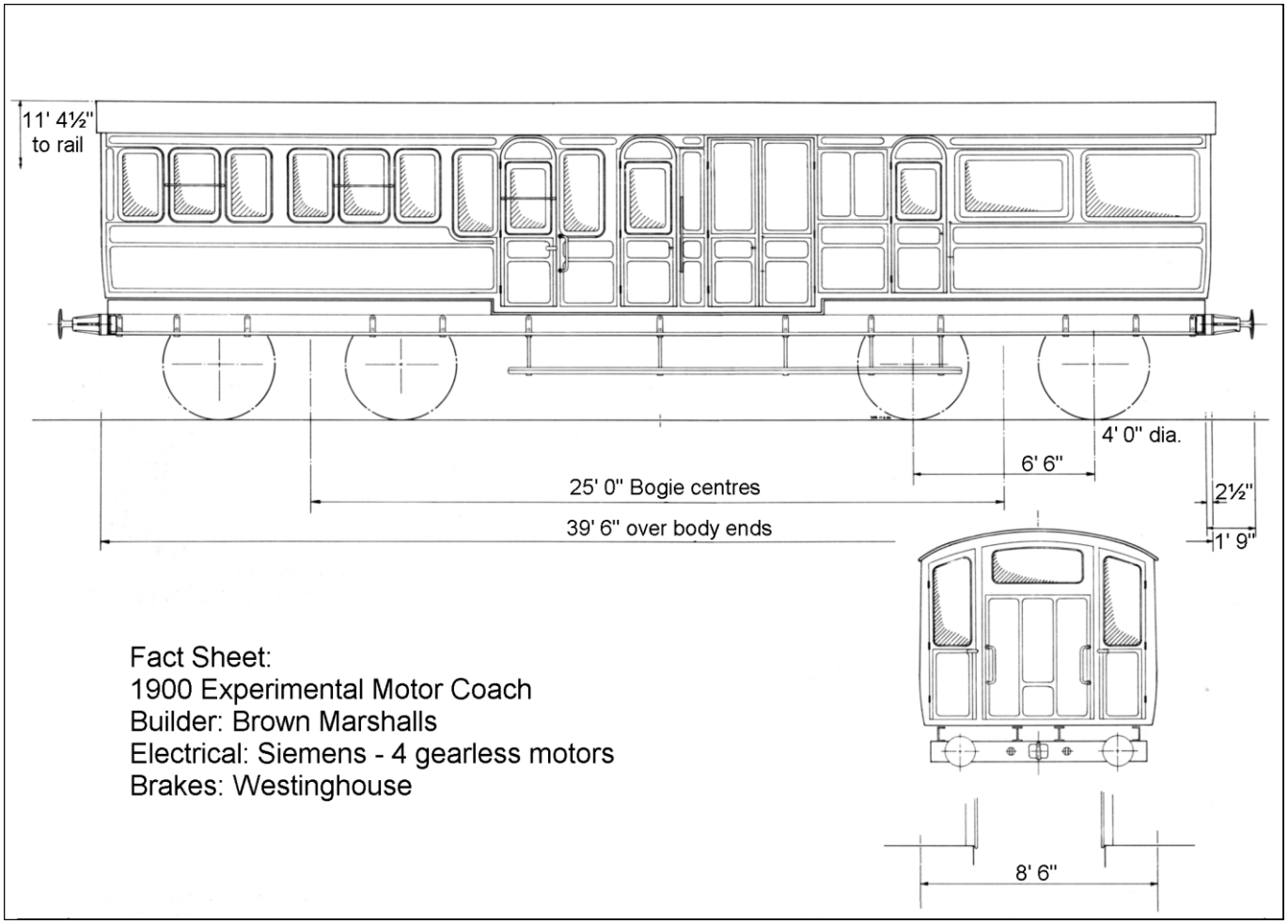

Fig. 5: Superb scale drawing by Jim Snowdon of the 1900 experimental electric motor coach used between Earl's Court and High Street Kensington[8]. The drawing shows the two doors in the front end, apparently arranged to allow space between them for the massive, centrally positioned traction power controller.

It has been suggested[9] that one of the reasons for the adoption of the outside current rail arrangement was because of the size of the gearless motors. Being mounted directly on the axles meant that the clearance to the track below the motor was very tight and would not be sufficient to accommodate a current rail. This does not seem to have presented a problem on the Central London, nor the Waterloo & City, even though the clearances on both those lines were very tight. It may be that, with their experience on the W&C, the Siemens engineers thought the outside current rails offered more scope for larger motors.

The trains were provided with the Westinghouse air brake and an electrically driven compressor was fitted in each motor car to supply it, the sanding equipment and the whistle. The Westinghouse was already the brake used by the District and it was to become the standard brake of the Underground railways in London and, in spite of the fact that the Metropolitan used the vacuum brake on its steam trains, it too

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8 One of a large range of drawings in his book "Metropolitan Railway Rolling Stock", Wild Swan Publications, 2001.

9 J. Graeme Bruce, Steam to Silver, 2nd edition, Capital Transport Publishing, 1983.

adopted the air brake on most of its electric trains[10]. Sand to aid adhesion was provided on steam locomotives as standard equipment and many early electric trains had it too but the Underground soon abandoned it since it had the effect of occasionally isolating the trains from the track circuits and thus rendering the automatic signalling system useless. It also got into the point machines and into the grease used for lubricating them especially, which annoyed the P-way engineer no end. This however, was in the future and the District was learning all about electric traction in the usual way of these things – try what you know and, if that doesn't work, try something else.

The non-powered passenger coaches, or "trailers" as we would call them today, were typical of British compartment stock and were similar to the Metropolitan Railway's "Ashbury" coaches of 1898. The whole train had seats for 312 passengers including accommodation for 1st, 2nd and 3rd class. One of the motor coaches was 2nd class and one 3rd class. The four trailers were arranged so that there was one of each class and one composite. Only a few years later, second class was dropped nationally so that only first and third were available. Both the District and Metropolitan provided first and third classes up to the early part of the Second World War.

Circles – More or Less

The title "Inner Circle" might seem strange to us today since we are used to only one Circle Line but originally, there were three "Circle" services in London. These were known as "Inner", "Middle" and "Outer" Circles. The Inner Circle is the one we have today – the yellow line on the map. Its operation was shared by the District and Metropolitan, who each used their own trains to go round it. Most of the time there were more Metropolitan trains than Districts, usually 8 to 6 because the Met. owned more of the track.

The Middle Circle was never a proper circle. It was operated by the Great Western Railway between Aldgate and Mansion House via Westbourne Park, Latimer Road, using the link (severed by a bomb in 1940) to Addison Road (now Olympia) and then Earl's Court to Mansion House. The service was cut back to Earl's Court in 1900 and stopped completely in 1905, upon the electrification of the District's main line.

The Outer Circle wasn't a proper circle either. It ran from Broad Street (the now closed station which used to be next to Liverpool Street main line station) via Willesden Junction, Addison Road and Earl's Court to Mansion House. It too was cut back to Earl's Court in 1910.

Then, just to confuse people further, there were the terms "Inner Rail" and "Outer Rail" used (even today) by staff to describe the anticlockwise and clockwise trips round the Circle. We, the Met. men who worked most of the Circle service, went round our own circular world calling the inner rail "westbound" or "down" and the outer rail "eastbound" or "up", even when on the District side facing the other way round!. ***We*** never got confused!

NEXT STEPS

The experimental service went on through the summer of 1900, finally being wrapped up on 6 November when the train was withdrawn and stored in the District's depot at Lillie Bridge pending a decision on its future[11]. Various interested parties had been to have a look at it while it was in service, including Thomas Parker, who had abandoned The Electric Traction Co. completely and was now working for the Metropolitan Railway as a consultant. He, rather uncharitably, reported unfavourably on the equipment, even thought the Metropolitan had paid for half of it and had gone along with the whole scheme. The District responded wryly by suggesting that the trial electric section should be extended to Putney Bridge. Unfortunately, the power

[10] For details of Westinghouse brake operation, see Article 6 of "The Underground Electric Train", *Underground News* No.528, December 2005.

[11] The coaches of the experimental train were not given numbers. The three Metropolitan coaches were moved to Neasden on 27 March 1903 and were drawn into its own stock while the District's were sold to the Colne Valley Light Railway.

plant at Warwick Road was not considered up to the job and the joint committee were not minded to stump up the cash to pay for more equipment.

Even while the experiment was still going on, the joint committee asked for a report into "the whole question", as Alexander Edmonds put it, of electrification. They were soon told they should electrify "the whole system" and that they would need "two or more" new trains on the "multiple unit" system for the Inner Circle and some electric locomotives to haul the existing coaches on the branches. In referring to the "multiple unit" system of electric traction control, the report was referring to what was a new idea being developed in America at the time. It was untried in the UK but it was soon to arrive here and it became the bedrock of electric traction across the world.

The experimental train was still running when, on 3 August 1900, nine different firms were invited to tender for the electrification of the Circle. It is an interesting thought that the tenders were due to be returned by 1 December *in the same year,* while our modern procurement processes seem to demand that London Underground's SSL resignalling contract requires six months just to pre-qualify. No wonder our signalling is now so expensive.

Two suppliers for the electrification project became what we would call today "preferred bidders" – British Thomson-Houston (B T-H), the UK arm of the US General Electric Company, and Ganz & Co. of Hungary. B T-H proposed the DC 3rd rail system to become familiar across the world in many urban railway systems, with earlier versions already in place on the Central London and City & South London railways, while Ganz offered a 3000-volt, 3 phase AC system requiring three conductors – twin overhead wires for two phases and the running rails for the third phase. The electrification committee came down in favour of Ganz, without a doubt because it was the cheapest offer but almost certainly against the advice of any sane electrical engineer of the time. Regardless of it being untried and untested, just the electrical clearances required for the twin overhead lines in the tunnels of the Circle should have disqualified it.

In the event, the whole question of the choice of electrical system was turned on its head by the inability of the District Railway to raise capital in London and by their turning to the US for it, where a certain Charles Tyson Yerkes was persuaded to finance both the District's electrification and the building of several tube lines[12]. Yerkes brought a technical advisor to the UK, one James Russell Chapman, who had considerable experience of setting up electric railways in the US, notably in Chicago. Chapman quickly realised the weaknesses of the Ganz system and set his mind in favour of something akin to the B T-H proposal, already tried and tested in the US and, as we have seen, adopted by the other underground railways in London. This was in direct opposition to the joint electrification committee's choice of Ganz and it set in motion months of argument between the District and Metropolitan, which ended up going to arbitration. The arbitrator's decision, which was in favour of the District's DC system, was made in December 1901. An interesting hint in Edmonds'

[12] The whole story of the electrification of the Circle and its associated financial and technical goings-on could not be detailed here but they are documented in various books and papers and probably warrant a story in their own right.

history suggests that, as is often the way in such things, the Metropolitan only fought the District over the DC proposal because Ganz were paying their costs.