Handbook of Research on Emerging Innovations in Rail Transportation Engineering

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Chapter 1
Past Futures:
Innovation and the Railways of Nineteenth-Century London and Paris

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ABSTRACT

Innovation was central to developments in urban railway transport in nineteenth-century London and Paris. Innovation was often political, the result of an encounter between and across a range of actors, including railway entrepreneurs and their companies, railway engineers, civil engineers, architects, intellectuals, a range of authorities –local, municipal, metropolitan, regional and national –, and the rich mix of people affected by the opening of a new railway line. The chapter opens up the notion of innovation to issues that cover three different dimensions: the politics, the culture and the social concerns behind the building of railways. It shows how London and Paris coped, but also dealt with one of the most transformative forces of nineteenth-century Britain and France. An important part of that story relates to the different futures that were envisioned in the two cities, in response to specific concerns and determined by a particular set of conditions. This approach highlights the process of how innovations took place rather than the end result.

INTRODUCTION

Innovation was central to developments in urban railway transport in nineteenth-century London and Paris. Innovation was often political, the result of an encounter between and across a range of actors, including railway entrepreneurs and their companies, railway engineers, civil engineers, architects, intellectuals, a range of authorities –local, municipal, metropolitan, regional and national –, and the rich mix of people affected by the opening of a new railway line: shopkeepers whose business would be affected by the scale of the works; landlords who were forced to deal with the noise, the pollution, and the viaducts across their properties; tenants displaced without recourse to much else beyond their own means, the largest majority consisting of the poor.

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This rich and diverse mix of people and interests is very important. When we think about railway innovation, a common tendency is to think about which new technologies are now at our disposal: lighter and more spacious cars, new signaling instruments, automated doors, improved tracks, faster trains, and so on and so forth. Important as they are, however, these are only part of the kinds of innovation that are prompted by the very conceiving, planning, designing and building of railways. I believe this is a reality that is felt most acutely in cities. In nineteenth-century London and Paris, for example, innovations involved a range of topics:

- Using the underground spaces and cellars of market buildings
- Defining an area that railways would not cross
- Early trains for the working and poorer classes
- Collaboration between private companies and metropolitan authorities so that the building of a new railway line might be linked to street improvements
- New forms of governance, especially in terms of the degree to which London and Paris might use railways to direct their growth
- Concessionary fares for excursion trains on Sundays
- Conditions of employment in the context of municipal socialism, characteristic of developments in cities in Europe and North America at the turn of the 20th century

My aim in this contribution is twofold. I want to open up the very notion of innovation to issues that cover at least three different and inter-related dimensions: the politics, the culture and the social concerns behind the opening of new railway lines in nineteenth-century London and Paris. Secondly, I wish to show how the two cities coped, but also dealt with one of the most transformative forces of nineteenth-century Britain and France. An important part of that story relates to the different futures that were envisioned in the two cities, in response to specific concerns and determined by a particular set of conditions. This approach highlights the process of how innovations took place rather than the end result. My concern is, therefore, with the debates, ideas and challenges of getting to the object or point we call innovation, not the ready-packed model that we know circulates, widely and far.

LONDON AND PARIS IN THE NINETEENTH CENTURY: A BRIEF OVERVIEW

There are important similarities and differences in relation to the transformation that London and Paris experienced during the nineteenth century. Key among them are population growth, in both cities largely fueled by immigration; changes in their administration which present us with a sharp contrast between, on the one hand, the City of London and the metropolitan-wide authorities, the first of which was the Metropolitan Board of Works, created in 1855, succeeded in 1889 by the London County Council; and, on the other, the Paris municipal council, appointed by the Seine Prefect, in turn accountable to the national authorities which, throughout the nineteenth century, changed a number of times with three republics, two empires and an eighteenth-year long monarchy (Porter 2000; Jones 2004; White 2008; Marchand 1993). Administration was directly concerned with the limits and extent of the two cities' built-up areas, in other words, up to which point did London and Paris extend. The contrast is again illuminating: Paris was a walled city up to after the First World War; an area called *intra-muros* was contained for a period of nearly two decades in-between the late-eighteenth-century wall of the *Fermiers Généraux* or Farmers

General and the outer fortifications built in the 1840s. The wall, first that of the Fermier Generaux and, since 1860, the Thiers fortifications, performed an important function for Paris's finances, namely the *octroi* or the tax levied on any products entering the city (Picon 1994; López Galviz 2013b). Walls had become something of a relic in London since at least the Great Fire in 1666. At the same time, the City of London retained full control of its jurisdiction, as it still does today, within what is often called the 'old square-mile'. Growth in and around the West End, Westminster, Southwark and eastwards by the river docks was largely the result of private initiative and brought under one administration only gradually from the mid nineteenth century onwards, following the creation of the Metropolitan Board of Works.

Between 1801 and 1901(Table 1), the rate of London's population increase was both more consistent and generally higher than that of Paris. At the same time, the populations in the two cities grew exponentially, about five times during this period. This growth would have significant consequences on the provision of public utilities such as water, food, sanitation, housing and transport, but also in terms of public order, education and health.

As for the way people travelled during the second half of the nineteenth century there were, again, important similarities and differences between the two cities. Tables 2 and 3 provide an overview of the key tendencies.

In London, the number of travellers had increased by ten times between the first half of the nineteenth century and the mid-1890s. There were ninety-three journeys per head in 1894, an increase of more than five times compared with 1864. The share of the Metropolitan Railway and the Metropolitan District Railway companies, the operators of the first two 'Underground' lines, was limited to approximately four journeys in 1864, subsequently increased to thirty in 1894. In Paris, the number of travelers increased nearly an eightfold between 1855 and 1890. While thirty-six journeys were made per head in

Table 1. Population in London and Paris, 1801 – 1901

London (a)		**Paris (b)**	
Year	**Population**	**Year**	**Population**
1801	959,130	1801	547,756
1811	1,139,355	1807	580,609
1821	1,379,543	1817	713,966
1831	1,655,582	1831	785,862
1841	1,949,277	1841	936,261
1851	2,363,341	1851	1,053,261
1861	2,808,494	1861	1,696,141
1871	3,261,396	1872	1,851,792
1881	3,830,297	1881	2,269,023
1891	4,227,954	1891	2,477,957
1901	4,536,267	1901	2,714,068

Notes: (a) The population of Greater London in 1899 was approximately 6,528,000. I have considered the jurisdiction of the Metropolitan Board of Works (smaller in area) as applicable to the entire period based on the Census figures (Ball & Sunderland 2001, p. 42). (b) The population of the Département de la Seine (inclusive of the arrondissements of Saint Denis and Sceaux was approximately 3,670,000 in 1901 (Chevalier 1973, pp. 182 – 83). The figures from 1861 to 1901 include the suburbs annexed in 1860. The comparison between the London and Paris figures is based on their respective administrative areas which leaves out significant sections of Greater London and the Département de la Seine, respectively.

Table 2. London passenger traffic per operating company 1864 – 1894

	1864	1874	1884	1894
LGOC (a)	42,650,000	48,340,000	75,110,000	133,132,000
Metropolitan	11,720,000	44,120,000	75,930,000	88,514,000
District		20,770,000	38,520,000	42,097,000
Tramways		41,930,000	119,260,000	231,522,000
Road Car Co			3,060,000	44,610,000
CSL (b)				6,959,000
Total (T)	54,370,000	155,160,000	311,880,000	546,834,000
Population (P)	2,940,000	3,420,000	4,010,000	5,900,000 (c)
Ratio T to P	18 to 1	45 to 1	78 to 1	93 to 1

Notes: The unity of measurement is the number of journeys as recorded by the operating companies: (a) London General Omnibus Company; (b) City and South London Railway; (c) estimate for the Greater London area whose population in 1891 was 5,572,012 and in 1901 was 6,506,954. Source: J. Greathead 1896.

Table 3. Paris passenger traffic per operating company 1855 – 1890 (1)

	1855	1865	1875	1885	1890
CGO (a)	40,000,000	107,358,111	125,061,957	191,218,501	198,228,364
Ceinture (b)	2,407,039	4,902,554	13,883,681	31,007,212	34,032,588
Riverboats (c)		3,567,010	9,578,631	18,820,922	23,591,967
Mainlines (d)			9,383,128	13,619,324	18,010,272
Tramways			5,723,882	50,578,734	51,858,179
Total (T)	42,407,039	115,827,675	163,631,279	305,244,693	325,721,370
Population (P)	1,174,346	1,825,274	1,988,800	2,344,550	2,477,957
Ratio T to P	36 to 1	63 to 1	82 to 1	130 to 1	131 to 1

(1) Population figures are for the years immediately after, namely, 1856, 1866, 1876, 1886, and 1891. (a) Compagnie Générale des Omnibus; figures comprise urban and suburban omnibus routes; the railroad service to Saint Cloud (including the service from the Louvre to Versailles since 1881); and tramway services since 1875; (b) the 1855 figure corresponds to 1856 and is only from the Auteuil line; (c) the 1865 figure corresponds to 1867 when riverboat services started operation on the occasion of the *Exposition Universelle* of the same year; as an indication of the substantial increase in passenger traffic during the exhibitions the figure of 1889 was 52,885,104. Figures incorporate suburban and urban passengers. (d) Main line railways, the figure of 1875 does not include the services of Paris-Charenton (Vincennes line). Source: A. Martin 1894.

1855 (the vast majority of them by omnibus), there were one hundred and thirty-one in 1890 distributed across omnibuses, tramways, riverboats, main line railways, and a suburban railway ring (Ceinture). It is important to bear in mind that no underground or metropolitan railway was opened before 1900 in the French capital. Paris was able to learn from the London experience for a period of over thirty-five years.

Figures for passenger traffic in the two cities are only estimates and should be treated cautiously. There was nothing like a consolidated way of recording traffic, let alone one that was consistent. In the case of railway companies, receipts were a generally accurate indication, but every company would account for a journey differently: was it a return or a single journey? Or, were different times of the day

when different fares were charged accounted for? At the same time, what can be said with a degree of certainty is that more people travelled more frequently and, here the comparison is again illuminating: in London people travelled longer distances than they did in Paris, which is not surprising, given that London's built-up area was over three times that of Paris. If there was anything like a general tendency in terms of urban and suburban travel, we might say that there was a correspondence between a higher number of modes of transport and ever growing numbers of passengers. Which side drove the other is a far more contentious matter and one that I will not be discussing here.

The idea of taking trains beneath and above the streets of London and Paris emerged, therefore, in a context where population growth, shifts in but also changing regimes interacting with metropolitan administration, and ever newer –allegedly better – modes of transport combined to transform the two cities into new entities that would develop a close relationship with railways, for better and for worse. The encounter between railways and the two cities was fraught with challenges, but also opportunities. Innovations sprung up, specifically in response to the conditions that London and Paris posed: connectivity to the central food market, the post office, the river docks; the necessity to think about railway building and street improvements as part of one and the same vision in the interest of a more cohesive urban form; the different ways in which new technologies –electricity – might prompt the emergence of a system suited for the specific needs of the metropolis.

These are questions that planners, authorities, architects, engineers and others face in cities across the world today: in India, Latin America, the Middle East, China. The contexts are different, of course, but I think that some valuable insights and parallels across space and over time might be drawn; the question is how and using which criteria. The notion of 'past futures' is of service here.

Past futures concern the futures that have been envisioned in the past, using a range of media –textual, visual, oral, performative – and as a result of a combination of circumstances. An important part of that process relates to who took part in envisioning which future and in response to what kind of motivations. This, of course, raises the question of whether or not there are or there have been conflicting futures in the past; futures that were chosen over others; futures that were obliterated, ignored, sidelined; futures that, by contrast, were celebrated, however unrealised.

In the specific context of cities, we may talk about locating the imagining of their future at different times in their history, in other words, were problems such as traffic congestion and housing overcrowding, or, discriminating the traffic of goods and people in relation to a changing urban geography understood in similar ways in medieval European cities than in classical Rome, or in the megalopolises of the Global South in the twenty-first century and, if so, do the solutions that we are able to reconstruct reflect those similarities, or, on the contrary, are solutions specific to the contexts where they are produced and, therefore, contingent?

Thinking about past futures invites us to move away from the idea of 'models' that can be imported and exported –as, indeed, they do – and reflect on issues such as innovation as historically contingent, the result of a long process that is riddled with unforeseen conditions and unintended consequences and through which a range of actors, institutions, beliefs and perceptions collide, mix and diverge. It is the process that counts: innovating where, how, and with whose involvement.

Past futures is useful in another important respect. One of the notions that is central to German historian Reinhard Koselleck's exploration of the relationship between the past and the future is what he called a horizon of expectation (*Erwartungs-horizont*), that is, the imagined domain that structures action in the present in the interest of a vision of the future over which a monopoly, religious, political, cultural or otherwise, keeps a tight hold (Koselleck 2004). An important part of the 'moments of innova-

tion' that I discuss here forecast the future, structuring a horizon of expectations that gives purpose to action not by the consistency of how real the forecast is but by the commonality of moving in a certain direction. That direction often involves a future that is measurable, manageable so that concerns about the present become subordinate to the vision of a future that might never materialize. Both what did not happen, the routes not taken, and the actual outcomes of innovation are therefore constitutive of what past futures entail. They supplement each other and qualify how we understand the kinds of futures that have been envisioned in the past.

In what follows, I concentrate on three moments of innovation and what each tells us about the transformation that London and Paris experienced during the nineteenth century: the centrality of the food market and the extent to which railways provided an alternative to, but also a nuisance against the 'circulatory' needs of the two metropolises; the completion of the inner circle in London, an important part of which involved joining railway building and street improvements; and the refining of electric traction as the technology that was suited for the specific needs of the metropolis, namely, lighter, speedier and more frequent trains for passengers and their luggage rather than steam locomotives skirting out of town in a growing network that with time and some direction might become a system.

1. Connecting to the Heart of Metropolis

The London and Greenwich was the first railway line built in London reaching, first, Spa Road, Bermondsey –from Deptford – open on 8 February 1836, followed by an extension to London Bridge on 14 December 1836. The Gare St Lazare was the first railway terminal built in Paris, open in 1837 by the Chemin de Fer Paris-St-Germain. By the mid nineteenth century, there would be seven railway lines with a terminus in London, five on the north bank of the Thames, at Paddington, Euston, King's Cross, Bishopsgate and Fenchurch Street (in the City), and two on the south bank at London Bridge and Waterloo. Seven termini would serve Paris around the same time, four on the right bank of the Seine: Gare St Lazare, Gare du Nord, Gare de l'Est, Gare de Lyon; and three on the left bank: Gare d'Orléans, Sceaux, and Montparnasse also known as Gare de l'Ouest rive gauche (Kellett 1979, Freeman and Aldcroft 1985, Caron 1997, Bowie and Texier 2003).

Railways attracted higher numbers of traffic, both of goods and passengers. Existing streets became visibly insufficient accommodating a growing number of vehicles, horses, animals en route to the market, hackney cabs, pedestrians, carters and porters. The extent to which railways could take some of that traffic off the streets raised at least two different questions: whether or not to allow railways further into the city centre, and how to connect the lines that had been built as well as those that were planned. Railway connectivity took a number of forms: through a link line connecting the railway termini, via junctions in the periphery, or, through a central station. Whatever the option, the idea was to allow traffic to connect to, cross or bypass the central districts of the two cities. Markets at Smithfield in London and Les Halles in Paris posed some of the most important challenges and they did so against the background of their very transformation from cattle to meat markets, with abattoirs being relocated outside the centre, to the periphery in areas like Copenhagen Fields and La Villette. The traffic related to the Post Office and the river docks was also important.

The debates around the redesigning of Les Halles in Paris followed by the findings of a royal commission on railways termini in London will show precisely how innovation was a part of railway developments in both cities and, perhaps more importantly, the degree to which the new transport technology prompted readings of the city that were both original and an important precedent for future growth.

Paris

By the mid 1830s, the *Quartier des Marchés* in Paris consisted of four different buildings: the Marché aux Poissons, the Halle à la Viande, the Marché aux Oeufs, and the Halle aux Draps, catering for fish, meat, eggs and drapery, respectively (Fleury and Pronteau 1987). In 1842, a commission decided to preserve the location on the right bank of the Seine, after considering plans for its transfer to a site next to the Halles aux Vins on the left bank. The planning and design of a new market was the beginning of the larger transformation that Paris would experience as a result of the imperial 'politics of airing', a key aim of which was to sanitise the centre (Boudon 1977).

One of the plans produced on the occasion of the 1842 commission was by Hippolyte Meynadier, one of the many intellectuals involved in thinking about the Paris of the future and who placed the market building in a larger and more ambitious 'general plan of grand circulation' consisting of the opening of wide thoroughfares and parks; the redistribution of public buildings of both national and municipal significance; and the sale of those properties owned by the city, with little or no artistic and historic value (Meynadier 1843; Perreymond 1844). Interestingly, the basis for his proposal was Meynadier's own close examination of everyday life in the city: 'It is by journeying Paris in every sense; travelling its sites at different times of the day; observing the oscillations of the plebeian masses on the public road; penetrating the corners and nooks of all the old streets […] that one can estimate the need for large thoroughfares in Paris and that one can indicate assuredly the points that [people] use most' whether it is 'for their departures, destinations [or] crossings.' (Meynadier 1843, Bourillon 2001, pp. 150-51). Improving circulation required wide thoroughfares that would help regulate the dithering movement of the plebeian masses. Similarly, railways provided a suitable alternative for the kind and scale of circulation required in a new and larger central market.

A new public enquiry took place in 1845, specifically concerned with the new building of the central market or Les Halles Centrales (Lemoine 1980, Lavedan 1969). The project conceived by Victor Baltard and Félix Callet would receive a direct commission from the municipal administration in August the same year (Baltard and Callet 1863, pp. 13-14). In response to the decision, the architect Hector Horeau published an *Examen critique du projet d'agrandissement et de construction des Halles Centrales d'Approvisionnement pour la Ville de Paris* in October the same year, and in which he outlined the disadvantages of the commissioned project contrasting these with the benefits of his own scheme. The publication was followed soon after by a new pamphlet *Nouvelles Observations*, which focused on how other European markets functioned. This was a critique of the report of the official visit to markets in England, Belgium, Holland and Prussia, also published in 1846. (Horeau 1845, Horeau 1846, Lemoine 1980, p. 84). Baltard was part of the official mission. Of particular interest to him were the markets at Liverpool and Birkenhead due to the full enclosure of the market area and the use of cellars for the preservation of foodstuffs (Baltard and Callet 1863, pp. 12-13; Lemoine 1980, pp. 79, 82).

The importance of the Halles lay in the provisioning of the capital to which effective connectivity with regional centres and lines of distribution across France was central. Baltard's project was primarily concerned with the functional apparatus that would concentrate all the market activities in one building complex and was focused on the engineering, architectural and decorative features of its structure. Horeau's ideas were different, as his plan devised connections to the main streets of the immediate surroundings and the river so as to consolidate an effective movement within and without the market, a vision that resonated with Meynadier's general plan of grand circulation (Papayanis 2004). Horeau's scheme consisted of six different pavilions and was served by railways connecting the central market

to the eastern and western districts of Paris (Horeau 1845, p. 7). Connection to the main line railways was underground using the cellars for the storage and circulation of classified produce, which occupied the entire area beneath the proposed pavilions. Horeau's concern was how the waste and produce would circulate through the building complex without interfering with the acute traffic congestion of the area in and around Les Halles.

After a renewed attempt in 1849, Horeau's plans were deferred and Baltard's scheme prepared for their execution. Construction works for the new market building started in 1851. Two large wings, east and west, accommodating six pavilions were complete in 1858 (Lemoine 1980, pp. 94-103, 164). Access and connectivity to the market remained dependent on existing roads.

In 1869, *Le Figaro* would accuse Baltard of plagiarising Horeau's design. Despite their support to Horeau's plans, the *Revue Générale d'Architecture et Travaux Publics* –a key publication for contemporary trends and developments in Paris during the second half of the nineteenth century – gave Baltard the opportunity to publish a letter dismissing the claims and reasserting the originality of his building (Revue Générale d'Architecture et Travaux Publics 1869, col. 206 ; Saboya 1991, p. 258). Differences between the two architects aside, what was characteristic of Horeau's vision was the way in which he subordinated the idea of improving an existing building to accommodating a special function, namely, the reception, storage, and distribution of foodstuffs into, across and out of the city. The circulatory needs of the capital became central to his project as a result of this, more specifically, the centrality of effective connections to the market for which railways provided an increasingly sound alternative. Horeau's ideas provided an innovative reading of the city's needs alluding to the importance of thinking about the market in relation to the new kinds of connectivity that the combination of railways and underground spaces beneath buildings might accommodate. His was a vision of urban circulation rather than an isolated architectural statement.

London

Connections to the market at Smithfield were also central to the initial plans of what would become the Metropolitan Railway in London. In the 1840s, dozens, if not hundreds, of plans put forward by railway companies proposed to connect London to the rest of Britain in what became known as the 'railway mania'. A good number of proposals included connections to Smithfield market. The 'mania' had its peak in 1847, by which time the fortunes of businessmen and laymen alike had bulged, shrunk and disappeared in vast numbers (Lambert 1984, Lewin 1936, Barker and Hyde 1982).

At the same time, traffic congestion in London was turning distance into a function of time more so than of space: 'You may find it takes you as long to go from Kensington to the London-bridge terminus of the Brighton Railway, as from London-bridge to Brighton. Nay, of two friends taking leave at London-bridge, one for Brighton by rail, and one for Kensington by omnibus, the traveler to Brighton might reach his destination first.' London, the commentary on *The Times* went on to assert, 'will speedily find the means of balancing these disparities; and when that has been done by an internal system of railways, the long-lined railways will obtain the means of using the internal system as an extension of their own.' (The Times, 13 October 1845, p. 6).

Plans for London railways before Parliament soared in 1846. A royal commission was appointed in response to the situation. Its remit: assessing the role that railways should play in metropolitan communications. Nineteen different schemes were examined, fifteen north of the Thames, four in the south.

With the exception of two lines, both south of the river, the commission advised against all the schemes. The commission's report was to provide an assessment of the benefits and problems of crossing the city centre. Their suggestion was to connect the railway termini by means of 'branches skirting the Town, and terminating at points without the line described in our Instructions [rather] than by penetrating within it.' (Houses of Commons and Lords, 1846, p. 6; Bradley 2006, p. 33) The 'line' introduced a new geography of the city in an attempt to limit the further extension of railways into London's central and inner districts and covered both riverbanks.

Four other aspects were central to the commission's report: the choice of a central terminus, the handling of goods traffic outside the central districts, the perceived and real impact of railway plans on property, and the relationship between new railway lines and street improvements.

As the names of several proposals indicated, Farringdon Street was the site that companies favoured for the sitting of their termini in the City, given its proximity to Smithfield Market. But having a central station raised the question of who was to benefit: 'If the convenience of passengers does not call for the prolongation of railways into the heart of the Metropolis', the commissioners reported, 'still less does it require the establishment of any one Central Terminus, at which the railways from different parts of the country should unite.' The evidence proved sufficiently just how complicated the arrangements were when several different competing companies shared the use of a central terminal rendering the suggestion both impractical and unwelcome (Houses of Commons and Lords, 1846, p. 6).

In terms of goods traffic the commission recommended 'a line which should pass outside the Metropolis on the North, at such a distance as to avoid interference with populous districts and the thronged thoroughfares, and so connect the goods' stations of the various railways from West to East with each other, terminating at some convenient point on the Thames or within the Docks.' A junction crossing the river west of Vauxhall Bridge would connect the northern and southern lines avoiding concentrating traffic at a central station. A different yet related benefit of this 'circuitous communication' was the need 'to establish an unbroken connection between the railways of the North, South, and West' across Britain, also in the interest of strengthening national defense (Houses of Commons and Lords, 1846, p. 6, 21).

As for property the commissioners affirmed that they were 'not disposed to attach any weight to the assumption which [they] found to be a common one, that districts thickly inhabited by a population of the lowest class, and where vice and destitution prevail, are sensibly improved by the passage of a railway through them.' Often the evidence showed the opposite, for the railway 'does not open the streets to any new traffic, nor does it lead to the improvement of dwellings on either side of the line; and where the improvements which such districts most require, viz., the formation of new streets, with better built houses, better ventilation, and better drainage, are in contemplation, or are likely to be effected, it tends in most cases to obstruct, rather than to facilitate them.' Examples of these were the viaducts of the London and Blackwall and the Eastern Counties railways on the eastern end of the City (Houses of Commons and Lords, 1846, pp. 7, 9; Kellett 1979, pp. 36-37).

The disruption to public works prompted most proponents 'to combine, more or less with their own works, and at their own expense, the improvement of existing, or the formation of new Thoroughfares for the benefit of the public.' But as the commissioners explained, the situation, though specific to every scheme, had developed into equalling railway building to works that were planned and carried out in the public interest, with important differences in terms of who absorbed the costs and under which conditions (Houses of Commons and Lords, 1846, pp. 7-8). Any collaboration between railway companies and public authorities, their report advised, 'should be planned and prescribed to the companies [that agreed

to these conditions], and finally carried out under the authority of some Department of Your Majesty's Government, in conjunction with the Corporation of the City of London, or with the local Authorities of the District in which the works are to take place.'

The debates around and the evidence provided in favour or against a central railway terminus, the bypassing of goods traffic around the city, the effects of railways on property, and the challenges of connecting railway plans to street improvements contributed to recognising the innovative role that railways might play in the transformation that London was experiencing. The significance of these debates, in Parliament, but also in a whole array of specialist circles, lay in their providing the arena where the question of metropolitan communication was addressed. Moreover, through the work of commissions such as that of 1846, ideas about the public rendered the benefits of railways in a light that subordinated the disjointed and conflicting efforts behind railway operation to the goals that were shared by citizens: 'under no circumstances should the Thoroughfares of the Metropolis, and the property and comfort of its inhabitants, be surrendered to separate schemes, brought forward at different times, and without reference to each other.' (Houses of Commons and Lords 1846, p. 21; Kellett 1979, p. 43).

These were the debates, however. The reality looked very different. Railways continued to cover London's geography with their viaducts and trenches, their river bridges and steam locomotives. The innovative dimension of the debates rests on their challenging of existing practices and the further refining of the capitalist spirit, forcibly heralded in the culture of laissez faire. A significant part of what the 1846 royal commission advocated was how to direct capital so that it met the interests of the many and not the few.

2. London's Inner Circle

The contrast between railway developments in London and Paris would take a distinct turn in the second half of the nineteenth century. For one thing, the first section of the Metropolitan Railway in London would open to services in January 1863, whereas the first line of the Métropolitain in Paris opened in 1900. Innovation in London concerned learning about specifically metropolitan needs and the degree to which railways were a means to address them. Similar questions were raised in Paris, but in this section, I wish to concentrate on one specific challenge that led to a distinct form of innovation closely related to the transformation of Paris's central market, but also recognized by the royal commission in London, namely, whether and how to combine railway building and street improvements (López Galviz 2013b).

The first section of the Metropolitan Railway represented a clear benefit for a population consisting primarily of businessmen who travelled between Paddington and Bank, the busiest omnibus route ever since the 1830s. As the chairman of the Metropolitan, William Malins, said soon after the opening: the time saved by trains running beneath the congested London streets was well received and supported by 'gentlemen engaged in commercial and business avocations' (quoted in Bradley 2006, p. 53). It was for this particular segment of the population that the journey between home and work might represent a daily pattern.

Trains of several main line railway companies used the new line. Separate agreements between the Metropolitan and the companies included tolls charged to trains running on Metropolitan tracks, tolls the Metropolitan paid to other companies for using sections of their tracks, or, indeed, reciprocal agreements (Huet 1878, p. 45). One example was the convention of 2 September 1867 that gave the Midland Railway rights to run their trains, machines, and use their own staff on the new 'widened' lines between King's Cross and Moorgate. The Midland had also a separate platform for their passengers and storage

premises at Moorgate Station. In return, the Metropolitan received a percentage of the Midland revenues for the operation of this section of the line. (Huet 1878, pp. 45-47; Jackson 1986).

Although, overall, these arrangements helped Metropolitan services, the regular and intensive use of their tracks by other main line railways (the Great Western, the Midland, the Great Northern and the London Chatham and Dover) constituted a challenge for a vision of railway development that was based on outer and inner circles, each specializing in either local or through traffic, an idea that emerged out of the debates connected to a new parliamentary committee on metropolitan communications in 1863. Things would change little after the opening in December 1868 of the first part of the southern section of the inner circle, between South Kensington and Westminster, built and operated by a separate company, the Metropolitan District Railway. The opening was reported as part of the works on the 'Metropolitan Inner Circle' or the 'Metropolitan underground system', terms that seemed 'a little perplexing to the uninitiated' (*Illustrated London News*, 2 January 1869, quoted in Halliday 2001, p. 28; *The Builder*, 2 January 1869, p. 2).

Agreements like those between the Metropolitan and the main line railways were planned at Victoria Station which, according to a report in *The Builder* was 'exceptional in its arrangement', in that 'a mezzanine floor [was] introduced for the booking-office, which is on a level, about half-height between the platforms of the Brighton and Chatham companies and the street, for the more easy access of passengers from these lines.' (*The Builder*, 2 January 1869, p. 3). Similarly, in one of the shareholders' annual meetings, the District's chairman, James Staats Forbes, would mention that the company had made an agreement with the London and North Western Railway whereby the latter would run its trains from its own lines, north of Euston, on to the District's' via the West London to Earl's Court, using 'the District's tracks to run into Mansion House, thus giving it access to the City.' The London and North Western paid for the agreement along with the 'tolls for the two trains an hour using the facility' (Halliday 2001, p. 31).

The District extension from Westminster to Mansion House opened in 1871, where the company's terminal would remain for over thirteen years. Competition, financial difficulties, but also coordination between the Metropolitan and the Metropolitan District, and the metropolitan and City authorities were among the factors contributing to the time that completing the inner circle would take. In 1874, a new company, the Inner Circle Completion Railway, was formed precisely to that effect. But eventual opposition from the Metropolitan Board of Works, the City Commissioners of Sewers and the Lord Mayor and Aldermen halted the initiative.

In 1878, the Metropolitan and District approached John Hawkshaw, a prominent civil and railway engineer responsible for several projects across Britain and overseas, including the Severn railway tunnel, which he would take charge of a year later in 1879 (Chrimes 2013). Hawkshaw 'recommended that the circle should be completed by extending the railway southward from Aldgate to Tower Hill, and thence westward along Great Tower Street, Eastcheap and Cannon Street to join the District Company's railway at Mansion House'. Hawkshaw's idea was, essentially, joining the completion of the inner circle to street improvements, namely, 'the widening of Eastcheap and Great Tower Street, and the construction of a new street between Mark Lane and Trinity Square', projects that were under the jurisdiction of the Metropolitan Board of Works and the City (Barry 1885, p. 35). Hawkshaw and John Wolfe Barry were appointed the same year to produce the plans for and execute the works. Their plan included an eastern extension to join the East London railway, which would give both the District and the Metropolitan, as well as the main line railways on both riverbanks, access to the more easterly and south-easterly districts. The extension ran under Whitechapel Road and included a terminus for the exclusive use of the District adjoining the East London's Whitechapel Station (Barry 1885, pp. 35-36).

The street improvements, inner circle and the Whitechapel extension were complete in October 1884. The Metropolitan Board of Works and the City Commissioners of Sewers together contributed £800,000 to cover the costs of the street improvements (total of £929,412). The Metropolitan and District, also responsible for the purchase of property and the execution of all works, met the rest (Barry 1885, pp. 36-38). As Barry asserted: 'The completion of the ring of railway has been rather the joining together of two parallel lines than the completion of a circle.' Moreover, the arrangement of trains per hour consisted of six different types of services, reflecting the degree to which the so-called circle was divided into lines, rings, loops and circuits:

1. Eight Inner Circle trains going 'completely round the circle'
2. Six District trains running 'from Ealing, Richmond and Fulham, by way of Earl's Court, South Kensington, and Mansion House to Whitechapel or (via the Thames Tunnel) to New Cross'
3. Two Middle Circle trains from Aldgate by King's Cross, Bishop's Road, Paddington, via the Hammersmith Branch to Latimer Road onto the West London railway to Earl's Court, South Kensington and Mansion House
4. Two Outer Circle trains from the London and North Western terminal at Broad Street, Bishopsgate, via the North London railway through Dalston, Camden Town, Willesden and onto the West London to Mansion House
5. Two Metropolitan trains from Aldgate to New Cross via the Whitechapel extension
6. Eleven Metropolitan trains between Moorgate and Edgware Road during the busiest hours, excluding 'the traffic of foreign companies' that used the widened lines. (Barry 1885, p. 50; López Galviz 2013b)

This amounted to up to thirty-one steam-operated trains per hour in each direction during the busiest times running through different sections that extended far beyond the inner circle. Not surprisingly, there were severe problems: 'Despite the four days of experimental working which preceded the opening […] services were thrown into chaos by the new schedules […] Dislocation was so severe that traffic sometimes came to a complete standstill for hours on end, and there is at least one well-authenticated case of exasperated passengers having to get out of their train in the tunnel and walk to the nearest station' (Barker and Robbins 1963, pp. 232-33).

The difference between through, long-distance, and local traffic in London was the result of the agreements between private railway companies. The interest of the Metropolitan and the Metropolitan District, in particular, was suburban not local traffic as the extensions of their lines illustrated. Their extensions were coupled to suburban growth, notably north and west of London, where the main lines that used the inner circle originated (Jahn 1982). At the same time and despite the problems concerning the operation of outer, middle and inner circles, there was a sound awareness of the complexity and scale of railway communication in London and the extent to which its development might be used in the interest of metropolitan growth. This qualifies further the assertion that London seemed to be 'rearranging its built fabric around a completely new means of transport, but in a way which did not immediately suggest that the metropolis was being consciously and centrally planned' (Sutcliffe 1983, p. 10). The centrality was somewhat manifest in the role that the Metropolitan Board of Works and the City played. True, the building of any system depended on the actual financial model behind railway operation. But rather than being the long-overdue outcome of the battle between the chairmen of the two railway companies, as we have learned from previous historiography (Halliday 2001, Wolmar 2004, Jackson

1986, Barker and Robbins 1963), the completion of the inner circle might also be seen as the history of a joint innovative effort: between the metropolitan and the City authorities, on the one hand, and the Metropolitan and the District, on the other. Steps were taken, indeed, to direct the centrifugal forces of railways in favor of a more orchestrated development of London, one that was representative of different publics: private companies encouraging and competing for suburban traffic; authorities with interests that were both complementary and mutually exclusive; and passengers for whom time was money and the difference between home and work a question of daily travel. Not one dominated; nor could either account for the benefit of all.

3. Shield Tunneling and Electricity

Using electricity in railway operation became a real option towards the end of the nineteenth century. In November 1890, *The Engineer*, a specialist periodical, would produce a concise summary of the state of electric traction in connection with means of urban transport: 'A number of small tramways, both on the Continent and in the United Kingdom, have been worked electrically, and in the United States many of the street tramways are worked in this way; but it has not hitherto been applied on any large scale to the working of a railway of the usual gauge for passengers.' (*The Engineer*, 7 November 1890, quoted in Barker and Robbins 1963, pp. 309-10). 1890 was the year when the City and South London, the first of the electric 'Tube' lines in London opened to passenger services shortly before Christmas on 18 December. As a pioneer, the operation of the City and South London set the pace of developments that were yet to come, but it also showed the challenges and limitations of using a new technology. The combination of tunnel, rail, car and electricity proved to be one of the most significant innovations in urban railways ever since. What is more, electric traction prompted the conception of a system that was based on circuits, a significant precedent that would supersede the allure of steam locomotives, particularly in cities.

London

In the early 1880s, the Siemens brothers obtained the concession to build an electric railway connecting Trafalgar Square to the area in the immediate surroundings of Waterloo Station, crossing the river with a bridge: 'the scheme did not get beyond the building of 20 yards of tunnel under Northumberland Avenue and the Embankment', and was subsequently abandoned (Barker and Robbins 1963, p. 304). A second attempt was the London Central Electric Railway (1884), also by the Siemens, which proposed to link this time Charing Cross (a few yards from Trafalgar Square) and Cheapside, in the City. The officer of the Metropolitan Board of Works, William R. Selway, objected to the scheme, calling it 'speculative and experimental' (quoted in Barker and Robbins 1963, p. 305). Like their first scheme it was also abandoned.

The same year, in 1884, the City of London and Southwark Subway received an Act of Parliament to build a line between King William Street in the City and the Elephant and Castle, south of the Thames. The line was to be built by a 'tube' system of tunneling with trains operated by cable traction (Sekon 1899). Tunneling was devised with an entirely different construction technique than the 'cut-and-cover' of the Metropolitan and District lines. The idea was to take the line deeper into the city's soil using a system that incorporated both traction and tunneling as had been conceived in the mid-1860s by Peter William Barlow.

In the patent of his invention 'Improvements in Constructing and Working Railways, and in Constructing Railway Tunnels', Barlow explained the benefits of a new system for working underground and

other railways. This consisted in 'employing local in contradistinction to constant power to propel trains of carriages on railways', whether underground lines, tunnel crossings, or standard over ground 'where trains are required to start and stop at short intervals.' (Barlow 1864, p. 2). The trains would be attached to and hauled by a rope connected to 'cylinders worked by hydraulic power'. Tunnelling would follow the cylinder principle (in effect, a tube), devising gradients on either end of every station as to alleviate the pressure on the brakes of arriving trains and facilitating their departure by gravity and inclination (Barlow 1864, pp. 1-3).

In terms of its operation this was a system 'consisting of iron tunnels 8 feet in diameter, in which single steel omnibuses, [would] seat twelve passengers each.' There were no stations, at least not in the ordinary sense, passengers paying their fare directly in the omnibuses. The arrangement became more elaborate as the topography required it with 'three series of subways at different levels, the carriages as well as the passengers being lifted in passing from one to the other' at intersections with steep gradients. (Barlow 1867, Barlow 1871, Greathead 1896). The Tower Subway, opened in August 1870, would be a test version of Barlow's system. The subway was fitted with lifts on both riverbanks and a tramcar hauled by a cable which in turn was propelled by stationary engines. Barlow's initial plan was for the subway to be 'manumotive', relying on the strength of 'two and a half men, if the journey was made in one minute' in a carriage with twelve passengers covering a distance of 1320 ft (402 m), or, alternatively and as was originally proposed, 'one manpower constantly applied' which increased the journey time to approximately two and a half minutes (López Galviz 2013a, pp. 71-73). The subway later became a footpath, following the bankruptcy of the Tower Subway Company in November 1870, closing to the public in 1894 when Tower Bridge opened offering the same connection above (Thornbury 1878, pp. 122-28; Dennis 2008; Lascelles 1987; Lee 1973).

James H. Greathead, one of Barlow's collaborators during the construction of the subway, was appointed chief engineer of the City of London and Southwark Subway (CLSS) while John Fowler, engineer of the Metropolitan and District, accepted a role as consulting engineer (City of London & Southwark Subway Company 1884-1889, pp. 8, 29). By 1890, the largest part of the tunnelling work was ready and the electric locomotives tested (Greathead 1896). The Lord Mayor and other gentlemen were taken on a trial journey from the City to Elephant and Castle on 5 March; the results seemed satisfactory. Lighting remained a problem and so the company's 'solicitor was instructed to communicate to Mss. Mather and Platt [contractors for the electric equipment] that as they were unable to efficiently light the stations with electricity under the terms of the contract it had been decided to substitute [electric lamps with] the use of gas.' Prior to the official opening, an agreement was reached for a five-minute frequency and a service restricted to weekdays (no Sundays nor Christmas day), starting at 8 am. (City of London & Southwark Subway Company 1889-1892, pp. 29, 44, 68, 103).

The names of the six stations were King William Street, Borough, Elephant and Castle, Kennington, The Oval, and Stockwell, where the car sheds and generating plant had been built. Regular passenger services started on 18 December 1890, though the company, now called the City and South London, experienced the problems and difficulties associated with the use of a new technology (Lascelles 1987; Barker and Robbins 1963, p. 310). The combination of the insufficient power generated from a plant situated at the southern end of the line and the weight of the locomotives produced questionable results. The locomotives used were 'ponderous, noisy, and slow' (Simmons 1995, p. 94). Stations were eventually lit by gas, while 'on the trains themselves [the electricity supplied] gave only a feeble glimmer whenever a number of locomotives all accelerated at the same time.' (Barker and Robbins 1963, p. 312-13). The

state of lighting on the trains was still unsatisfactory by 1895 (Greathead 1896, pp. 17-18). Furthermore, the decision to follow the pattern of streets forced an awkward arrangement on the City end station (King William Street) whereby the two tunnels that for the largest part of the route ran more or less parallel were built one above the other (Greathead 1896, p. 6). The station was reorganised in 1895, with two pairs of tracks and an 'island platform', replacing a single line and platforms on either side as it had been built in the first place (Barker and Robbins 1963, p. 314). But it was not until the opening of the northern extension first to Moorgate and Bank stations, in 1900 and then to Angel, Islington in 1901, that the company could solve the problems at King William Street, by closing the station on 24 February 1900, and adjusting the line's route.

As stated by the general manager of the City and South London, Thomas Chellew Jenkin, the first 'north-to-south railway' incorporated a number of different features that distinguished it from the Metropolitan and the District (Sekon 1899, p. 8). Stations were fitted with lifts to cover the considerably larger distance between platforms and streets and, perhaps more visibly, the power and smoke of steam engines had been replaced by the pale light and traction of electric locomotives. By contrast, there was also something that the City and South London, the Metropolitan and the District shared, as the Prince of Wales, later Edward VII, stressed during his speech preceding the official opening ceremony on 4 November 1890:

'This railway today', the Prince affirmed, 'this first electric railway which has been started in England will, I hope, do much to alleviate the congestion of the traffic which now exists, so that business men who have a great distance to go will find easy means of getting away from this great city and enjoying the fresh air of the country and I hope that it will also be a great boon to working men who are obliged to work in an unpleasant atmosphere, and who by its means will be able to get away for a little fresh air.' (*Daily News*, 5 November 1890; quoted in Wolmar 2004, p. 136)

This was the trinity of congestion, travel, and health. Overcrowded streets and residences that might give way to comfortable travel in a growing London by opening up the healthy country to businessmen and workmen alike: this was the promise of the new railway, a promise that had been heard before, a number of times in rather similar terms. The royal comment encapsulated an understanding of urban life that was characteristic throughout the nineteenth century. What had changed by 1890 when the City and South London opened to services was the context in which these remarks were made, namely, London had a metropolitan-wide authority: the London County Council, created in 1889 and succeeding the Metropolitan Board of Works.

Without a doubt, the advent of electricity added a new dimension to urban transport, but the question was also whether transport might be a way to solve other problems, some pressing like the acute housing crisis that Parliamentary commissions examined from the mid-1880s onwards. Four decades had passed since some of the early plans to house artisans in North London were first voiced. The struggle to house the working classes and the poor turned into a political battle fought between moderates and progressives in the London County Council and in other circles, but also including figures such as Charles Booth, Sydney and Beatrice Webb, Octavia Hill and others (López Galviz 2012). These were issues beyond the choice of electricity or steam locomotion for the running of railway lines, old and new.

At the same time, now lines could be dug deeper, creating a system of tunnel, rail and carriage. This differed substantially from the cut and cover technique and shallow tunnels that had been employed before. Difficulties were all too evident: the feeble glimmer, the ponderous noise, the wanting pull. In hindsight, the City and South London differed, but only so much, from the Metropolitan and the District: trains were

still pulled by a locomotive, electric, yes, but locomotive nonetheless. Trains ran to the same frequency: five minutes, no less, no more. The newness of the electric railway consisted in setting a precedent for future developments; the very precedent that continues to shape the London Underground today.

Paris

Which rolling stock to use and what kind of electric system should be in place became paramount to refining the Métropolitain as it would be built in Paris. Fulgence Bienvenüe, engineer of the Technical Service of the Métropolitain, explained each in detail in a report on urban railways operated by electric traction (Bienvenüe 1896). In it, Bienvenüe distinguished between two types of vehicle: coupling or trailing carriages (*voitures d'attelage*) and carriages fitted with their own motors (*voitures automobiles*). Broadly speaking, this recalls the difference between the electric locomotives of the City and South London, and the Sprague multiple unit system introduced in the later tube lines (Duffy 2003, pp. 23-33). In Bienvenüe's estimates, each carriage of the Métropolitain would seat forty-four passengers, while the length of platforms (seventy-five metres) would accommodate six carriages.

In terms of operation, the proposed network –in its mid-1890s version consisting of a circular line and two transversals – was divided into six different electric circuits: west, east, north, Porte Maillot (circular north), Porte Maillot (circular south), and north-south diameter (Bienvenüe 1896, p. 7). The circular line followed for the most part the external boulevards, while the two transversals ran, one, east to west (partly along the Rue Réaumur) and, the other, north to south crossing the river Seine. Four types of circulation resulted from this arrangement, namely, at one, two, three, or four circuits, based upon traffic sections of different intensities (*sections de trafic à intensités differentes*). In other words, the type of service that the Métropolitain would provide depended on the frequency of trains, their speed, the timing of boarding stops and, of course, the power needed to supply the system: eight trains per hour in each direction in the sections that were operated with one circuit; sixteen trains with two circuits; twenty four trains with three circuits; and thirty two trains with four circuits (Bienvenüe 1896, p. 8).

In its entirety, the network supported 'forty-five trains circulating simultaneously in each direction [at any one time] or ninety in total'. Vehicles were fitted with dynamos; the lighting of stations and the powering of other facilities were by electricity. Two depots housed the power plants, the rolling stock and yards: the depot at Vaurigard supplied the circuits west, Porte Maillot (south circular), and the north-south line. Charonne's, in turn, supplied the circuits east, north, and Porte Maillot (north circular). An intermediate substation was planned at Montmartre to break the distance between the two (Bienvenüe 1896, pp. 9-10). Bienvenüe's report was instrumental to clarifying the extent to which electricity was necessary to create a metropolitan railway system. By the end of the nineteenth century, there were little doubts that electricity was 'the only possible [type of traction] for the operation of a metropolitan network' (Huet 1896, annexe p. 2).

The agreement between the city and the concessionaire stipulated that the latter was to raise capital enough to operate the network, providing the rolling stock, including tracks, as well as the access points to stations. In its turn, the city was responsible for the infrastructure, including platforms. Further to the execution of the works, 'the concessionaire was required to begin the works of superstructure two months after the platforms of each section were delivered by the city' and have every such section ready for operation within ten months (Robert 1967, p. 26). Infrastructure consisted of the works relating to tunneling, the diversion of existing networks (water, sewerage, gas) whenever needed, and the handling

of disruption and changes to existing streets, buildings and public spaces where appropriate. Superstructure concerned the works needed for the final operation of the system including power supply, plants, substations and the layout of the electric system. The distinction between the two, infrastructure and superstructure, would prove to be a contentious point illustrated later by the disagreement between the eventual concessionaire and the municipal council about the construction of a new plant for the generation of electricity, a point that is, nonetheless, beyond the scope of our discussion (Beltran 1988, p. 118-20).

The initial contract was granted to the *Compagnie Générale de Traction*, which associated itself with the *Établissements Schneider du Creusot*, the well-known steel manufacturers and with firm interests in electricity under the leadership of Eugène, Henri's son. Henri Schneider was among the most prominent members of the family, having been régent of the Banque de France, vice-president of the Comité des Forges, administrator of two railway companies, the Paris-Orléans and the Midi, mayor of Creusot, and general councilor and deputy of Autun, Burgundy, eastern France (de la Broise and Torres, 1996). The association of the two companies –the *Compagnie Générale de Traction* and the *Établissements Schneider du Creusot* – represented an important shift in that the new industries concerned with the production and distribution of electricity would take a position normally occupied by main line railway companies (Larroque 2002, p. 78). Shifts in financing would be accentuated further with the agreement between the eventual concessionaire, the *Compagnie du Chemin de Fer Métropolitain de Paris* (CFMP), and the *Société d'Électricité de Paris* on the construction of the generating plant at St. Denis, in operation from 1906. Moreover, foreign capital, notably from the Belgian conglomerate of Général Baron Édouard Empain, would become increasingly central to the operation of the Métropolitain as the twentieth century progressed (Conseil Municipal de Paris 1898, *Procès verbal* and *Délibérations*, pp. 835, and 463-64, respectively; Beltran 1988, pp. 115-17).

Line 1 opened on 19 July 1900, three months after the opening of the Exposition Universelle on 14 April. The extension of the Compagnie de l'Ouest from their Gare St. Lazare to Champ de Mars would serve the exhibition grounds first, including the junction between the Champ de Mars and the Invalides, also operated by electric traction and in service the same day (14 April) (Robert 1967, p. 34). The new spaces underground of the Métro would be a much needed shelter from the heat of the Parisian summer by late July (*L'Illustration*, 14 July 1900, pp. 22-23; *The Builder*, 28 July 1900, p. 72). Eight stations were in service at Porte de Vincennes, Place de la Nation, Gare de Lyon, Place de la Bastille, Hôtel de Ville, Palais Royal, Champs-Élysées, and Porte Maillot (Robert 1967, p. 35). The sections between Étoile and Trocadéro and between Étoile and Porte Dauphine of line 2 opened in October and December the same year. At peak hours, trains ran every ten minutes; from 20 September the frequency was increased to six minutes between 5:30 am and 9:30 pm and back to ten between 9:30 pm and 12:30 am. From 30 January 1901, and largely as a response to passenger demand, trains would run to a three-minute frequency (Robert 1967, pp. 35-36, 38). Lines 3, 4, 5 and 6 would be complete by 1910, all operated by electricity.

Bienvenüe, and indeed Parisians, had reasons to celebrate. Their Métropolitain had left the drawing rooms and the meeting halls of national, regional and municipal assemblies where it had remained for nearly forty years. The map of Paris was now a map with a cohesive network that covered the city from east to west and north to south, although there were no connections between the Métropolitain and the main line railways, to a large extent the very instigators of the new railway in the first place. By contrast to how metropolitan railways evolved in London, Paris's own Métropolitan was based upon a vision that was limited to the city walls: it was contained, perhaps insular, more so than it was expansive. At the same time, it was the crystallization of a vision that had been refined for years. The city was able

to benefit from the range of innovations that electricity provided, not least a system that worked like one rather than a network consisting of separate lines, connecting at certain points, reaching into an ever growing periphery. That was the service of steam. In the city, in Paris itself, metropolitan railway transport was electric.

PAST FUTURES

To an important degree the building of railways in nineteenth-century London and Paris was the result of innovations in a range of fields. They were technological, most exemplary in the combined system of shield tunneling, tube, rail and carriage, but also in connection to the emergence of an exclusively urban system separate from main line railways as it was conceived and built in Paris. Innovation also concerned governance in the greater or lesser degree of influence that authorities were able to exert over the planning and building of railways that were metropolitan, that is, railways for local or urban traffic rather than extending outwards to the suburbs and beyond. Envisioning the city as a circulatory system at the centre of which were key structures such as the food market was also innovative in the sense that scale –more produce for more people – prompted new kinds of structures, the market buildings themselves, but also using railways to connect to them, whether underground or outwards to their new locations in the periphery. Each was a field of innovation in its own right. Each was determined by the political cultures and the social concerns around the joining of a new railway line to street improvements, or, the challenging of existing practices so that the capitalist spirit was refined and directed in the interest of a range of publics.

At a time when cities across the world face questions that are similar to those London and Paris faced in the nineteenth century, it is important to remind ourselves of the historical context in which innovations emerged: should it be a line connecting main line railway termini, port facilities or the food market? Or should it be a network of two or more lines with transfer stations, each dedicated to passengers or goods? Or might it be a system that directs the growth of a city using a technology suited to specifically metropolitan needs? The answers will of course be local and contingent. At the same time, what is important to realize is that whatever the strategy, a line, a network or a system, a horizon of opportunities is formed. The character of that horizon is political: at its most basic it involves praxis, the very practice of debate, argumentation and disagreement; on the other hand, it draws on allegiances that move and change as do regimes, institutions and individuals.

The role that railways can play in imagining the future of cities must include learning about the processes that led to the very envisioning of those futures and the innovations they shaped: less the system of tunnel, rail and car than the debate and process of getting to that solution in the first place. Such an approach recuperates voices and visions that have not been seen let alone heard loudly enough.

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