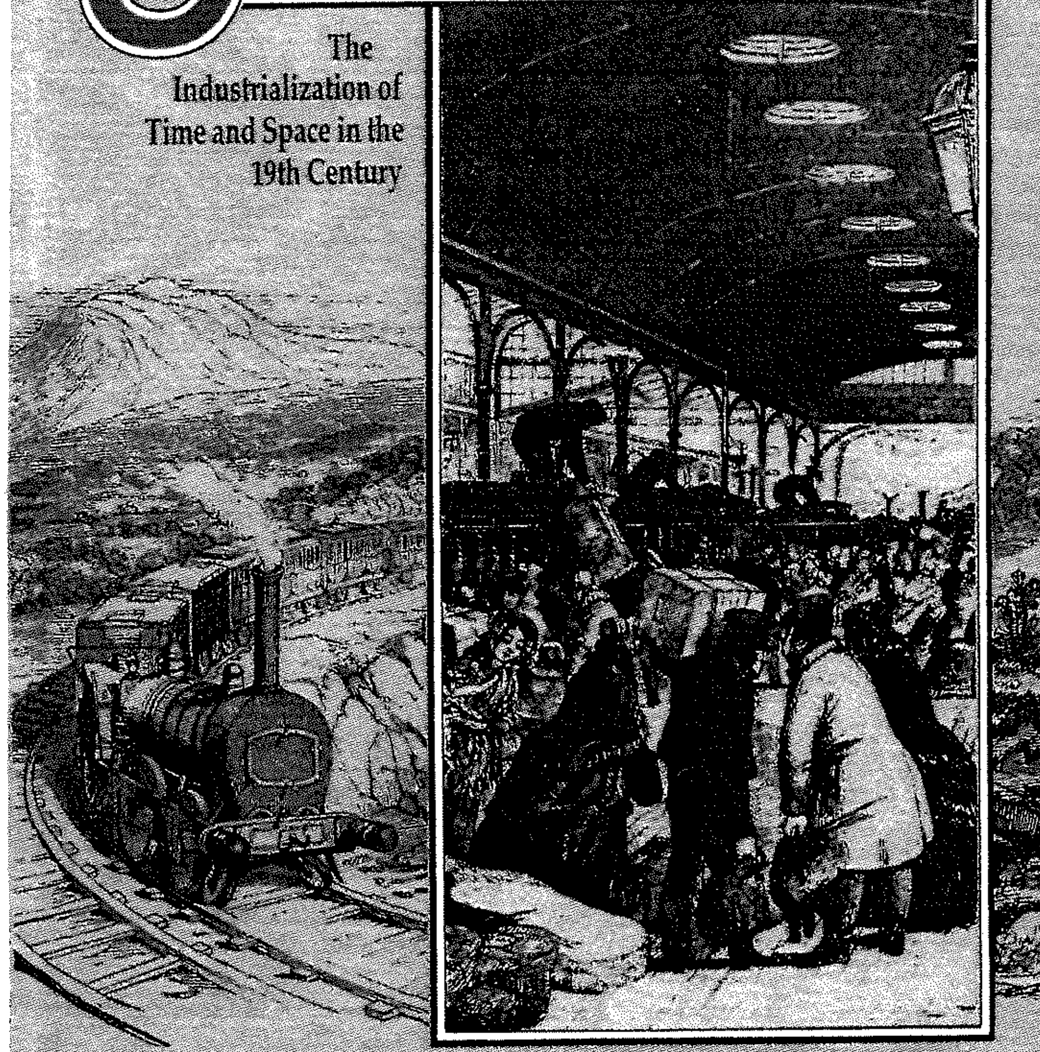
The Railway Journey

The Industrialization of Time and Space in the 19th Century



• WOLFGANG SCHIVELBUSCH •

a new way. The book contributes provocatively to a much-needed critical history of the origins of modern industrial culture.

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[1] The Mechanization of Motive Power

L'industrie est devenue la vie des peuples.
[Industry has become the life of the nations.]
— Marc Séguin, 1839

In the economic life of the pre-industrial era, wood was the prime material, universally used in construction and as combustible matter. The shipbuilding industry of the European maritime powers, the iron works and the machines built in the manufacturing and early industrial period were all based on the use of wood. Werner Sombart, the economic historian, regarded the exhaustion of this resource (i.e., the deforestation of Western Europe in the eighteenth century) as an essential factor, or perhaps even *the* main incentive for the development of industrial capitalism. In the pre-industrial era, 'wood affected all areas of cultural existence, being the prerequisite for the prosperity of all branches of economic life: so general was its use in the production of material goods that the characteristics of culture before the eighteenth century were decidedly wooden, and thus that culture retained an "organic" quality in its material and sensual aspect'.[1]

Next to wood, water and wind power were the main energy sources of pre-industrial economic life. The Industrial

1. Werner Sombart, *Der Moderne Kapitalismus*, vol. 2, p. 1138 (1st ed., Munich, 1902).

Revolution, generally seen as having begun in the last third of the eighteenth century, was a complex process of denaturalization. The abolition of 'live' workmanship by the division of labor, a process first described by Adam Smith, corresponded in terms of materials and energies to the 'emancipation from the boundaries of nature' (Sombart) which occurs when 'live' natural materials and energies are replaced by mineral or synthetic ones. Thus wood lost its universal function. Iron became the new industrial building material, coal the new combustible.[2] In the steam engine, the prime mover of industry, these two combined to produce energy in theoretically unlimited amounts. The technological development of the steam engine in the eighteenth century exemplified the gradual process of industry's emancipation from nature. The initial economic utilization of steam power occurred in the early part of the century when Newcomen's atmospheric steam engine was deployed in the Newcastle mining region to pump water out of mine shafts. The Newcastle region can be regarded as Europe's first industrial landscape in that coal began to determine the physical aspect of the environment. Thus Daniel Defoe, who had a clear understanding of the economics of his day, traveled through the region and expressed his astonishment at the 'prodigious Heaps, I might say Mountains, of Coals, which are dug up at every Pit, and how many of those Pits there are; we are filled . . . with Wonder to consider where the People should live that can consume them'.[3] The Newcomen engine was a crude contraption, only capable of a back-and-forth motion, consuming incredible amounts of fuel, and comparatively weak in performance. However, as it was used in the coal-producing region, its excessive fuel (i.e., coal) consumption was no problem. As early as 1767, fifty-seven Newcomen engines were working in the area.[4]

The waterwheel remained the main energy source for Eng-

2. Lewis Mumford (following the Scottish sociologist Patrick Geddes) has coined the terms 'eotechnology' and 'paleotechnology' to describe this epoch-making change in materials and energy: 'The eotechnic phase is a water-and-wood complex; the paleotechnic phase is a coal-and-iron-complex.' (L. Mumford, *Technics and Civilization*, New York, 1963, p. 11.)
3. Daniel Defoe, *A Tour Thro' the Whole Island of Great Britain* (1st ed., 1724–7; repr. 2 vols., London, 1968), vol. 2, p. 659.
4. Conrad Matschoss, *Geschichte der Dampfmaschine* (Berlin, 1901), p. 55.

land's manufacturing industry in the eighteenth century. Yet, following the evolutionary pattern characteristic of the Industrial Revolution, the water-wheel was to be aided by a curious intermediate adaptation that pointed the way to mechanization: water-powered factories attempted to end their dependence on seasonally variable water levels by installing the Newcomen engine to pump back the used water (i.e., the water that had already passed through the wheel and would have been lost otherwise).[5] This recycling process was a kind of mechanization of the mill race: it regularized the previously natural and erratic stream of water and transformed it into an aqueous driving belt. Thus water-power became a merely incidental element in a uniform and regular mechanized process whose true mover was the steam engine.

That bypass became obsolete with the development of a steam engine capable of rotary motion. Watt's low-pressure engine, perfected in the 1780s was such a technological advance. Thus steam power left its original 'natural' habitat, the coalfields, and became an essential part of the manufacturing industry. Watt's engine used only a fraction of the fuel required by Newcomen's. Its performance was also far better and it produced the rotary motion required by industry. (The immediate incentive for Watt's development of the low-pressure engine was the saturation of the coal mine market with Newcomen pump engines. Its manufacturer, the firm of Watt & Boulton, urged Watt to develop an engine for the new market of the manufacturing industries. The success of this speculation demonstrates that industry had in the meantime indeed developed a need for mechanical power.)[6]

At the turn of the eighteenth and nineteenth centuries, the evolution of the steam engine reached its culmination in Oliver Evans' high-pressure engine. Once again, the improvement was tremendous: the engine's performance was no longer based solely on condensation, but on the immediate effect of steam pressure. This made it possible to further reduce the size of the engines, which had been quite unwieldy, while increasing performance and reducing fuel consumption. On the other hand, it

5. Thomas Ashton, *Iron and Steel in the Industrial Revolution* (1st ed., 1924; repr. ed., Manchester, 1951), pp. 99–100.
6. Matschoss., op. cit., p. 77.

became necessary, in order to meet the requirements of increased temperature and pressure, to improve the quality of machine technology and its materials.

The intensification achieved by the high-pressure engine — maximal work performance with minimal machinery — permitted the *mobile* use of the steam engine, that is, its use as locomotive. This first occurred at the beginning of the nineteenth century in the coalfields around Newcastle, where the Newcomen engine had found its first application a century before. In the wake of the now full-blown Industrial Revolution and its increased demand for coal, the region, already transformed by coal production in Defoe's time, underwent further changes. The land between the mines and the river Tyne became covered by a dense network of railways up to ten miles long — descendants of the rails used in mountain mine shafts since the late Middle Ages. These railways were appendages of the mines and were used only to move coal. The wagons were first pulled by horses, but after the end of the Napoleonic Wars these were progressively replaced by steam-powered locomotives. The changeover to mechanized motive power was possible because in the mining region, fuel (coal) was cheaper than food — which latter had to be shipped from other regions. From 1815 on, coal became cheaper to use than food throughout England and in that year, Parliament, dominated by agricultural interests, passed a Corn Law which, by imposing steep taxes on imported grain, forced grain prices to rise.[7] Obviously, the artificially high level of grain prices helped to replace horsepower by mechanical power in much the same way as the shortage of wood in eighteenth-century Europe had accelerated the development of coal production. Confirmation for this is provided by a contemporary, Thomas Grahame, who, in 1834 when steam locomotion was an accomplished fact, described the

7. Concise information on the history of the English Corn Laws can be found in: Eric Hobsbawm, *Industry and Empire: From 1750 to the Present Day*, Pelican Economic History of England, vol. 3 (Harmondsworth/New York, 1968); Asa Briggs, *The Age of Improvement, 1783–1867* (New York, 1959), pp. 202, 312; R. K. Webb, *Modern England* (New York and Toronto, 1970), pp. 153, 185–6. The corn legislation after 1815 can be seen as a temporarily effective skirmish conducted by the land-owning class against the rising industrial bourgeoisie. No later than 1828 the pressure of free-enterprise interests caused the law of 1815 to be modified, and by the mid-1840s it had been abolished entirely, after the industrial bourgeoisie and the working class (i.e., the Chartists) had joined, in 1838, to form the Anti-Corn Law League.

choice the English industrial capitalists had to make: 'The landed capitalists of Britain . . . have by the taxes on corn and provisions more than doubled the price of animal labour, whether of man or horses. To avoid the effects of these taxes the monied capitalists of Britain have been for years devoting their capital to the promotion of those inventions by which taxed animal power may be dispensed with; and their endeavours have been crowned with eminent success'.[8]

From the beginning of the nineteenth century, there were plans to develop the railroads into a general and national mode of transportation. The 1820s saw the origins of a fully-fledged 'railroad movement', whose main promoters were agreed that the railroad, which in the meantime carried not only coal but other goods and passengers, must be powered by steam. The high cost of grain was a recurrent and standard argument. According to Adam Smith, the upkeep of a horse was equal to the feeding of eight laborers. Thus, it was argued, when the one million horses kept for purposes of transportation in England were made redundant by mechanization, they would release additional foodstuffs for eight million laborers.

Thomas Gray, the most important railroad promoter of the time, whose *Observations on a General Iron Rail-Way* appeared in five editions between 1820 and 1825, considerably expanded each time, argued for his proposed steam-driven railroad as follows: 'The exorbitant demands now made on the public, for conveyance of goods and persons by waggons and coaches, are caused principally, if not altogether, by the enormous expense of a stock of horses, the continual renewal of the stock, and the intolerable expense of their keep'.[9]

It is possible to see how advanced mechanization was in Britain at this time, in both theory and practice, when one consults a roughly contemporary French statement on the question of animal versus mechanical power. Pierre-Simon Girard, an engineer and member of the Académie des Sciences, who in 1819 had been given the task of planning and realizing a

8. Thomas Grahame, *A Treatise on Internal Intercourse and Communication in Civilised States* (London, 1834) p. vi.
9. Thomas Gray, *Observations* . . ., 3rd ed. (London, 1822), p. x.

street-lighting system for the city of Paris, ostensibly summarized the state of the English debate on horse-power versus steam power in an article published in 1827; in fact, his account, tinged with eighteenth-century physiocratic theory, projects French conditions onto England:

> The use of steam engines as locomotives on the railways is still a great open question in today's England. While one is willing to agree with the partisans of this solution that locomotives would be more economical than the use of horses, it is necessary to point out that the fuel on whose consumption these engines depend for the production of their motive power has to be extracted daily from natural deposits whose vast expanses nevertheless are not inexhaustible . . . The use of horses is not subject to similar hazards; the motive power horses are able to produce is fed by products of the soil that nature renews every year and will continue to reproduce in ever greater abundance as agriculture grows more advanced.[10]

The apprehension that coal resources would be exhausted one day, combined with the notion that organic horsepower is able to reproduce itself *ad infinitum*, reflected not only the physiocratic tradition that guided Girard's thinking, but also the economic realities of France during this period: specifically, the state of French coal production. During the first third of the nineteenth century, coal, in France, was *un produit révolutionnaire.*[11] While in England, coal production was sixteen million tons in 1816, thirty million tons in 1836, forty-four million tons in 1846, and fifty-seven million tons in 1851, French production figures were much lower: one million tons in 1820, two million tons in 1837, and five million tons in 1846.[12]

In addition, French production was not centered in one region, but was scattered throughout the country. Unlike the English, whose coal industry was centralized in a way that altered both landscape and consciousness, the French were unable to perceive coal as *the* endlessly available fuel. It was precisely because of the physical reality of the concentration of English

10. P. S. Girard, Foreword to the French edition of Friedrich von Gerstner's *Mémoire sur les grandes routes, les chemins de fer, et les canaux de navigation* (Paris, 1827), pp. cxxv–cxxvi.
11. C. Fohlen, in *Charbon et sciences humaines: Colloque international de l'Université de Lille en mai 1963* (Lille, 1963), p. 148.
12. Op. cit., pp. 141–2.

coal production, and their awareness of it, that the English were able to mechanize motive power with such ease.

The mechanization of overland traffic subjected it to the same degree of regularization that had already been firmly established in bourgeois self-discipline and in industrial production. Unlike traffic on the waterways,[13] land traffic had until then been the weakest link in the chain of capitalist emancipation from the limits of organic nature, because animal power — on which land traffic was based — cannot be intensified above a certain fairly low level. Yet one should not underestimate the efforts made in the decades before the advent of the railroads to increase the efficiency of land traffic within the framework of these narrow natural limits. These efforts did, in fact, introduce a trend that eventually made mechanization appear as the final logical step. According to Bagwell — who, interpreting the material available to him, saw the English 'transport revolution' as beginning as early as 1770 — traveling time between the most important cities was reduced by four-fifths between 1750 and 1830, and cut in half between 1770 and 1830.[14] The trip from London to Edinburgh, which in the 1750s still required ten days in the summer, took only forty-five and a half hours in 1836.[15] With the increase in traveling speed came increases in the number of traveled routes, in traffic intensity and in the number of transportation enterprises. In the ten most important English cities, there were eight times as many regular departures in 1830 as there had been in 1790; Bagwell thinks that the number of passengers was multiplied by a factor of fifteen, as some of them were carried 'outside' (i.e., on top of the coach) on regular runs.[16] Due to these improvements, the stagecoach surpassed the riding horse as the fastest mode of land transportation.[17] Karl Philipp Moritz gives us a vivid impression of that highly developed mode of passenger traffic in his *Reisen eines Deutschen in England* (*Travels of a German in England*). At this time, in the 1780s, the German

13. Traditionally, traffic on waterways has always been greater than overland traffic. From the early fifteenth century to the end of the nineteenth century, sailing-ship technology was sufficient for the transportation needs of capitalism in all its phases of expansion. Fifty years after the mechanization of land traffic by means of the railroad, sailing-ship technology (i.e., the clipper) still dominated ocean traffic.
14. Philip S. Bagwell, *The Transport Revolution from 1770* (London, 1974), p. 41.
15. Ibid., pp. 42, 43.
16. Ibid., p. 43.
17. Ibid., p. 49.

traveler mostly proceeded on foot. Moritz, who attempted to wander about England in this manner, found himself regarded as a curiosity. He noted with surprise that in England even the lower orders traveled by stagecoach.

Finally, the high degree of development that the coach system achieved can be seen in its economic concentration: of the 342 scheduled daily departures from London listed in John Bates' *Directory of Stage Coach Services* for 1836, 275 were run by three enterprises, the largest of which, owned by William James Chaplin, also had considerable interests in the catering business and employed a total of more than two thousand people and eighteen hundred horses. (Bagwell, p. 50).

One of the main arguments for replacing the horse teams with steam locomotives was presented by Nicholas Wood, author of the most authoritative technical work of his time on railroads: 'The greatest exertions have been used to accelerate the speed of the mails (which have hitherto been the quickest species of conveyance), without being able to exceed ten miles an hour; and that only with the exercise of such *destruction of animal power*, as no one can contemplate with feelings except of the most painful nature; while, upon the Liverpool Rail-way, an average rate of fifteen miles is kept up with the greatest ease'.[18] (Italics added.)

How long overdue the mechanically produced means of locomotion must have seemed to the progressive contemporary consciousness — and how hopelessly anachronistic the animal power still in use — can be seen in a text from 1825 that juxtaposes both forms of locomotion:

> The animal advances not with a continued progressive motion, but with a sort of irregular hobbling, which raises and sinks its body at every alternate motion of the limbs. This is distinctly felt on horseback, and it is the same when an animal draws a load. Even in walking and running one does not move regularly forward. The body is raised and depressed at every step of our progress; it is this incessant lifting of the mass which constitutes that drag on our motions which checks their speed, and confines it within such moderate limits. . . . With machinery this inconvenience is not felt; the locomotive engine rolls regularly and progressively along the smooth tracks of the way, wholly unimpeded by the speed of its own motions; and this, independent of its economy, is one of the great advantages it possesses over animal power.[19]

18. Nicholas Wood, *A Practical Treatise on Rail-Roads, and Interior Communication in General*, 2nd ed. (London, 1832), p. xii. Within the mail system, there were attempts to increase physical capacity from the sixteenth century on: letters were no longer carried long distances by means of only one courier, but from one station to the next, 'with either changes of horses, or of couriers, *relays*, in any case, consisting of runners or riders or drivers'. (Sombart, op. cit., vol. 2, p. 382.) This subdivision of the formerly unified effort caused the process to become intensified, but the system remained subject to the limits of physical capacity, even though this was now the sum of the physical capacities of all the individual relays. This intensification also intensified costs, and thus only the mails employed this mode of transportation.

The mechanical motion generated by steam power is characterized by regularity, uniformity, unlimited duration and acceleration. 'No animal strength', says Gray, 'will be able to give that uniform and regular acceleration to our commercial intercourse which may be accomplished by railway'.[20]

As the motion of transportation was freed from its organic fetters by steam power, its relationship to the space it covered changed quite radically. Pre-industrial traffic is mimetic of natural phenomena. Ships drifted with water and wind currents, overland motion followed the natural irregularities of the landscape and was determined by the physical powers of the draught animals. Charles Babbage observed, concerning the eotechnical utilization of wind and water power: 'We merely make use of bodies in a state of motion; we change the directions of their movement, in order to render them subservient to our purposes, but we neither add to nor diminish the quantity of motion in existence'.[21]

The earliest perceptions of how steam power dissolved that mimetic relationship can be found in descriptions of the first steam-powered ships. An eyewitness to John Fitch's steamboat experiment in 1790 found it particularly remarkable that the boat proceeded in a straight line, instead of tacking, as one would expect, in the traditional eotechnically 'natural' manner of marine vessels.[22] Putting it differently, another account said of

19. James Adamson, *Sketches of Our Information as to Rail-Roads* (Newcastle, 1826), pp. 51–2.
20. Thomas Gray, *Observations* . . . (London, 1822), p. 39.
21. Charles Babbage, *On the Economy of Machinery and Manufacture* (Philadelphia, 1832), p. 27. An application to the motion of sailing ships, the text goes on to say, would mean that 'the quantity of motion given by them [the sails] is precisely the same as that which is destroyed in the atmosphere'.
22. Report in *New York Magazine* (1790), quoted in Seymour Dunbar, *A History of Travel in America*, 4 vols. (Indianapolis, 1915), vol. 1, pp. 256–7.

steam power that 'it *forces* the ships to traverse the ocean against wind and waves'.[23] (Italics added.)

Thus steam power appeared to be independent of outward nature and capable of prevailing against it — as artificial energy in opposition to natural forces. While this was first perceived in steamship traffic, it became even clearer only a little later, when animal power was abandoned in favor of mechanical power. As long as the conquest of space was tied to animal power, it had to proceed within the limits of the animals' physical capabilities. One way of gaining an immediate perception of the distance traveled was to observe the exhaustion of the draught animals. When they were over-taxed, it was seen as 'destruction of animal power'. Steam power, inexhaustible and capable of infinite acceleration, reversed the relationship between recalcitrant nature (i.e., spatial distance) and locomotive engine. Nature (i.e., spatial distance), which had caused the animal 'locomotive engines' to strain themselves to exhaustion, now succumbed to the new mechanical locomotive engine of the railroad that, in a frequently used metaphor, 'shoots right through like a bullet'. 'Annihilation of time and space' was the *topos* which the early nineteenth century used to describe the new situation into which the railroad placed natural space after depriving it of its hitherto absolute powers. Motion was no longer dependent on the conditions of natural space, but on a mechanical power that created its own new spatiality.

> We have seen the power of steam suddenly dry up the great Atlantic ocean to less than half its breadth. . . . Our communication with India has received the same blessing. The Indian Ocean is not only infinitely smaller than it used to be, but the Indian mail, under the guidance of steam, has been granted almost a miraculous passage through the waters of the Red Sea. The Mediterranean, which is now only a week from us, has before our eyes shrunk into a lake; our British and Irish channels are scarcely broader than the old Firth of Forth; the Rhine, the Danube, the Thames, the Medway, the Ganges etc., have contracted their streams to infinitely less than half their lengths and breadths, and the great lakes of the world are rapidly drying into ponds![24]

23. W. Heimann, *Über Dampfmaschinen, Dampfwagen und Eisenbahnen* (Frankfurt, 1836), p. 2.
24. *Quarterly Review*, vol. 63 (1839), p. 23.

The shrinking of the natural world by means of mechanical transportation was perceived and evaluated in different ways, dependent on the evaluator's economic and ideological position: there was shrinkage as economic gain versus shrinkage as loss of experience. The representatives of industry and free enterprise saw transportation's release from nature's fetters as a gain: nature, in the form of distances that were hard to bridge, and exhaustible and unpredictable energy sources, had been an obstacle to the development of world trade. Mechanical energy rendered all transportation calculable. The promoters of the railroad regarded steam power's ability to do away with animal unreliability and unpredictability as its main asset. Here is Thomas Gray:

> The dangers to which the present coach system is obnoxious (such as the untractableness of horses, the imprudence of drivers, cruelty to animals, the ruggedness of roads, etc.), would not be encountered on the rail-way, whose solid basis and construction render it impossible for any vehicle to be upset or driven out of its course; and as the rail-way must also be perfectly level and smooth, no danger could be apprehended from the increased speed, for mechanic power is uniform and regular, whilst horse-power, as we all very well know, is quite the reverse.[25]

This rational and progressive evaluation was opposed by a contrary position, in which the loss of organic natural power was not seen as an elimination of interfering factors that have hitherto hindered the smooth conduct of business and transportation, but as the loss of a communicative relationship between man and nature. Thus for instance, Thomas De Quincey described the lost experience of coach travel:

> Seated in the old mail-coach, we needed no evidence out of ourselves to indicate the velocity. . . . The vital experience of the glad animal sensibilities made doubts impossible on the question of our speed; we heard our speed, we saw it, we felt it as a thrilling; and this speed was not the product of blind insensate agencies, that had no sympathy to give, but was incarnated in the fiery eyeballs of the noblest among brutes, in his dilated nostril, spasmodic muscles, and

25. Gray, op. cit., p. 55.

thunder-beating hoofs.[26]

We should not read that account of a past mode of travel merely as a reactionary-romantic tirade against the new technology. De Quincey described the disorientation experienced by the traveler when the traditional, 'natural' mode of travel, the one based on traditional technology, was superseded by a new travel technology. Contemporaries perceived the transition from coach to railroad technology as a decisively reduced expenditure of work or power: in the form of animal exhaustion, that expenditure had been immediately perceptible to the senses, and spatial distance had been experienced by means of sensory recognition of that physical exhaustion. As the sensory perception of exhaustion was lost, so was the perception of spatial distance. De Quincey's description of this process was echoed in numerous variations in contemporary literature and journalism, as in this anonymous polemic from the year 1839:

> When we are travelling by stage-coach at the rate of eight or ten miles an hour, we can understand the nature of the force which sets the vehicle in motion: we understand in a general way the nature of animal power: we see how soon it is exhausted; every successive hour do we watch the panting and reeking animals in their stalls, and, in the course of a day's journey, we can appreciate the enormous succession of efforts required to transport a loaded vehicle from London to a distant town.
>
> But, when proceeding on a journey by the rail-road, we are seldom allowed to get a sight of the wondrous power which draws us so rapidly along. The scene is altogether changed, there are no animals yoked to the car, to excite our pity by their apparently short, but really severe labour; we hear the steam gushing from the safety valve, while the machine is for a short time stationary; then we hear a number of rapid beatings: we feel that we are moving; the motion soon increases rapidly, and the journey which by the stage-coach is so tedious, is here, long before we are aware of it, at an end. The traveller then wonders not only at the rapidity of his journey, but often wishes to inspect and comprehend the means by which it was effected.[27]

26. Thomas de Quincey, *The Collected Writings*, ed. David Masson (London, 1897), vol. 13, pp. 283–4. (First published in 1849 in *Blackwood's Magazine*.)
27. *The Roads and Rail-Roads, Vehicles, and Modes of Travelling, of Ancient and Modern Countries* . . . (London, 1839), p. 279.

As the new technology terminated the original relationship between the pre-industrial traveler and his vehicle and its journey, the old technology was seen, nostalgically, as having more 'soul'. In addition to this sentimental line of thought there appeared another criticism of steam power that also had a high regard for the old technology but, while using the same arguments to be found in de Quincey and others, invested them with a modern content. This was accomplished by transferring the economically obsolete old technologies to a new realm, that of leisure and sports. What de Quincey deplored as a loss of sensory perception, others now attempted to reinstitutionalize. Thus, for instance, W. B. Adams' *Pleasure Carriages*, published in 1837, was the precursor of a literature of leisure and sports whose ever-increasing growth the century was to witness.[28] In this book, the use of horse-power was no longer treated nostalgically, but from a point of view that regarded the use of steam as merely unsportsmanlike:

> Steam is a mere labourer — a drudge who performs his work without speech or sign, with dogged perseverance but without emotion. . . . He may be personified when speaking *of* him; but no one pats his neck or speaks *to* him in a voice of encouragement. It is not so with a horse or horses. They are beautiful and intelligent animals, powerful yet docile; creatures that respond to kindness, and shrink from cruelty and injustice. The driver and owner can love them or feel proud of them; they step with grace, and can vary their form and movements in a thousand ways. They are creatures of individual impulses. . . . The man who rides a horse, feels a pleasure when the creature responds willingly to his purposes; and when he responds unwillingly, he feels a pride in the exercise of his power to compel him to obedience. Even when a horse is vicious, there is a pleasurable excitement in riding him. The rider's nerves are strung, his senses are quickened; eye, hand, and ear are alike on the alert; the

28. 'In the manual on the art of driving published by the president of the Four-in-Hand Driving and Coaching Club, which was revived in 1870 by the Duke of Beaufort, there is a chapter titled "The coaching revival" that deals exclusively with the club members' new practice of driving coaches on busy routes (e.g., to Brighton, Dover, Tunbridge Wells) and racing the railway trains to those destinations; this activity made the long-abandoned inns of the coaching era come alive again with the neighing of horses and the cracking of whips.' (P. D. Fischer, *Betrachtungen eines in Deutschland reisenden Deutschen* [Berlin, 1895], pp. 43–4. Fischer also mentions the following coaching titles published in the 1880s: Stanley Harris, *Old Coaching Days*; W. Outram Tristram, *Coaching Days and Coaching Ways*.)

blood rushes through the veins, and every faculty is aroused.[29]

The final fate of carriage-riding, the traditional mode of travel, was to become the amateur sport of the privileged classes. In everyday existence, the new technology took over. Only during a transitional period did the travelers who transferred from the stagecoach to the railway carriage experience a sense of loss due to the mechanization of travel; it did not take long for the industrialization of the means of transport to alter the consciousness of the passengers: they developed a new set of perceptions. The uniform speed of the motion generated by the steam engine no longer seemed unnatural when compared to the motion generated by animal power; rather, the reverse became the case. Mechanical uniformity became the 'natural' state of affairs, compared to which the 'nature' of draught animals appeared as dangerous and chaotic. An anonymous text from the year 1825 gives us an idea of the adaptation to this industrialization of travel. It discusses the 'sensitive or nervous man' who will find the new mechanical mode of transport more agreeable than the horse-drawn vehicle:

> It is reasonable to conclude, that the nervous man will ere long, take his place in a carriage, drawn or impelled by a Locomotive Engine, with more unconcern and with far better assurance of safety, than he now disposes of himself in one drawn by four horses of unequal powers and speed, endued with passions, that acknowledge no control but superior force, and each separately momentarily liable to all the calamities that flesh is heir to. Surely an inanimate power, that can be started, stopped, and guided at pleasure by the finger or foot of man, must promise greater personal security to the traveller than a power derivable from animal life, whose infirmities and passions require the constant exercise of other passions, united with muscular exertion to remedy and control them.[30]

The 'sensitive and nervous man', in whom those horses in front of the coach, tended to cause unhealthy excitement, was enabled to relax in the railway carriage, and to sit in it without moving a muscle, without 'exertion' or any 'other passions'.

29. W. B. Adams, *English Pleasure Carriages* (London, 1837), pp. 198–9.
30. *The Fingerpost; or, Direct Road from John O'Groat's to the Land's End*, 3rd ed. (London, 1825), pp. 24–5.

Despite the apparent smoothness of transition to industrialized travel, certain residues of anxiety remained. We get an inkling of this from the report written by Thomas Creevy, the Liberal politician, about a trip on Stephenson's locomotive in 1829: 'It is really flying, and it is impossible to divest yourself of the notion of instant death to all upon the least accident happening'.[31]

31. John Gore, ed., *The Creevy Papers* (New York, 1963), p. 256.

[2]
The Machine Ensemble

Le chemin de fer et les chariots qu'il porte forme une sorte de machine complexe dont les parties ne sauraient être envisagées isolément.

[The railroad, and the carriages on it, make up a complex machine whose parts cannot be considered separately.]

— Anonymous, 1821

Like any other means of transportation, the railroad provided a medium for moving things from one place to another. Yet the precise way in which it accomplished this distinguished it from the other means of transportation.

Transportation on roads and canals, as developed in eighteenth-century England by private enterprise, made both a technical and an economic distinction between the *route* and the *means*. The capital investment companies that provided canals and turnpikes to be used upon payment of tolls did nothing further: they had nothing to do with the vehicles that were used on their routes. Anyone using one of these artificially created land routes or waterways did so with his own vehicle or hired an entrepreneur to transport the goods; that entrepreneur, in turn, operated quite independently from the canal or turnpike company. Route and means of transportation existed independently from one another, because individual movement of vehicles — their mutual flexibility in granting right-of-way, etc. — was technically possible.

The railways put an end to that liberal state of affairs. Route and vehicle became technically conjoined on the railroad: there was no leeway between the rails and the vehicle running on

them, nor was it possible for one train to pull to one side when confronted by another. This was realized early on: all initial definitions of the railroad unanimously described it as a machine consisting of the rails *and* of the vehicles running on them. 'It is necessary . . . to insist that the railroad and its carriages be considered as one machine, or, as an indivisible entity,'[1] a French author stated in 1821. In 1839 Guillaume Tell Poussin went into somewhat greater detail:

> A railway is far from being the simple construct that a canal or a turnpike is: these have to fulfil quite limited objectives. A railway, on the contrary, is a construct that has to adjust to the eventual exigencies of a new engine, in which each day of experience may cause important new modifications. Consequently, in order for there to be harmony between the two quite distinct parts that a railway consists of, i.e., its rails and its engine, there has to be reciprocal interaction, so that the ameliorations of the one determines the improvements of the other. Thus it is evident that one cannot separate the increasing knowledge of steam engines from the construction of the railways.[2]

In an early phase of the railroad's technological evolution, the concept of 'one machine' appeared with particular clarity: the locomotive was not seen, as yet, as a self-contained, autonomous motive apparatus, but simply as a steam engine mounted on an undercarriage. Thus, a report in the *Bulletin de la société pour l'encouragement de l'industrie nationale* (1815) on the railways in the English coal-mining district says: 'New application of steam engines. For some time now, a steam engine has been mounted on wheels in Leeds, making it move on rails, by

1. Quoted in Peter J. Wexler, *La Formation du vocabulaire des chemins de fer en France, 1778–1842* (Geneva and Lille, 1955), p. 31.
2. G. T. Poussin, *Examen comparatif de la question des chemins de fer en 1839 en France et à l'étranger* (Paris, 1839), pp. xi–xii. English literature does, of course, offer corresponding definitions, e.g., Lardner (see n. 20 below). The French definitions are attractive in their clarity, which is based partly on the French consciousness of language, and partly on the fact that these definitions are, essentially, descriptions of something that was still unknown to the French reading audience in any immediate sense. Thus it is amusing to read a French report from England, written in 1820, that apparently corrects erroneous notions arising from the words '*chemin de fer*': 'Il y en a qui croient que ces routes sont pavées avec des plaques de fer, mais ce n'est pas cela du tout, ce ne sont que des ornières en fer fondu'. ('There are those who believe that these are roads paved with sheets of iron, but that is not the case at all, it is merely a matter of cast-iron rails.') (Quoted in Wexler, op. cit., p. 44.)

means of a large cogwheel'.[3]

That steam engine mounted on an undercarriage did not connect with its rails by rolling on them but by means of interlocking cogs: it moved by propelling cogwheels along proportionately serrated rails. The latter appeared as horizontal cogwheels, providing counterparts to the engine's wheels. In their experimental phase, railways were constructed according to this technical principle; it is hard to imagine a more vivid demonstration of the railways *machine* character. In retrospect, in 1849, Dionysius Lardner described one of these creations, built by the mining engineer Blenkinsop: 'He obtained a patent, in 1811, for the application of a rack-rail. The railroad thus, instead of being composed of smooth bars of iron, presented a line of projecting teeth, like those of a cog-wheel, which stretched along the entire distance to be travelled. The wheels on which the engine rolled were furnished with corresponding teeth, which worked in the teeth of the railroad; and, in this way, produced a progressive motion in the carriage'.[4]

This curious, technically redundant form of construction also existed in a variant in which the driving wheel was a cog that connected with a cograil laid between the running rails. The engineers who designed mine railways adhered to this model for a surprisingly long time. Even the illustration that Thomas Gray provided in the fifth edition of his *Observations* in 1825 showed such a cogwheeled locomotive. The 'imaginary difficulty' (Lardner) in the minds of the early railway engineers was

3. In Wexler, p. 99. On pp. 107–8 Wexler notes how hesitantly the adjective *locomotif* becomes the noun *locomotive*. Generally, Wexler provides an excellent account of the railroad vocabulary's slow development from its initial 'descriptive period' to the later stage when it has become a new technical vocabulary (p. 128). The process can be demonstrated more easily in French than in English: in the latter, the development of a railway vocabulary took a much longer time. Yet it is possible to see the corresponding trend in English, as in the simplification of the initially descriptive term *iron rail-way* to *rail-way* and finally to *railway*.
4. D. Lardner, *The Steam Engine*, 3rd American ed. from 5th British ed. (Philadelphia, 1849), p. 161. Even Lardner, who sees the cogwheel episode as a historical mistake, based on the erroneous notion that smooth rails and wheels could not provide traction, is still able to comprehend without difficulty how it was possible to arrive at this erroneous conclusion on the basis of theories of physics derived from the tradition of Galileo and Newton. He explains the notion as follows: 'If the face of the wheel and the surface of the road were absolutely smooth and free from friction, so that the face of the wheel would slide without resistance upon the road, then the effect of the force thus applied would be merely to cause the wheel to turn around, the carriage being stationary, the surface of the wheel would slip or slide upon the road as the wheel is made to revolve.' (Op. cit., p. 160.)

the notion that smooth wheels could not provide traction on smooth rails. Until simple experience proved otherwise, smooth steel on smooth steel did not seem capable of sufficient adhesiveness. That such a notion seemed plausible even to engineers, and for a relatively long time, is instructive in a number of ways: it sheds light on the history of cultural and psychological perceptions of iron and steel, and points to a fundamental change in the history of the wheel. For the first time, the wheel was no longer set in motion by a power extraneous to itself — the draught animal — but was, to all appearances, propelling itself along.

The cogwheel episode now looks merely like a symbolically exaggerated demonstration of the concept of rail and carriage as *one* machine: it shows the esthetic exuberance of technology. The final standardized form of the railroad — smooth wheels on smooth rails — retains that concept of unity of parts, which became ever more important as the railroad was technologically perfected. Franz Reuleaux, who in his *Theoretische Kinematik* (1875) summed up the development of machinery in the nineteenth century, agreed with the early chroniclers of the railroad that the joining of rail and wheel was the decisive step *'that joined carriage and road into one machine'*.[5] (Italics in original; we will return to Reuleaux's theory of the machine later on in greater detail.)[6] He then described the development of the machine in the direction of increased performance, intensification, etc., in terms of an ever more precise interaction between its individual parts: 'During the last century we have gradually become used to understanding the wheel and its cogs as a unit, a whole, and thus to seeing those cog profiles in context. It is my conviction that, in only a few decades, all cogwheels will operate *without play*'.[7] (Italics added.) While Reuleaux was speaking about the cogwheel, he used it as a paradigm for *the* machine part in general. The disappearance of 'play' concerned all parts of the machine.

This tendency in machine development appeared early on in the railroad's continuous evolution toward ever greater speed,

5. Franz Reuleaux, *Theoretische Kinematik: Grundzüge einer Theorie des Maschinenwesens* (Brunswick, 1875), p. 231.
6. See the last few pages of Chapter 10 of the present work.
7. Reuleaux, op. cit., p. 234.

regularity, and uniformity. In *An Exposition of the Danger and Deficiencies of the Present Mode of Railway Construction*, published in 1846, we find a description that anticipates the prophecy made by Reuleaux thirty years later — or, to put it another way, the descriptions of the railroad in the text of 1846 parallel the theoretical formulations on the development of machines in general made by Reuleaux in 1875:

> The wheels, rails, and carriages are only parts of one great machine, on the proper adjustment of which, one to the other, entirely depends the perfect action of the whole. And as the velocity given to the moving parts increases, so does the necessity for perfect adjustment increase also, because the imperfect action, which, at moderate speed, would only cause a *jolt*, will, when moving at high velocity, gain sufficient force to cause an overthrow. Therefore, from this cause it becomes necessary, in order to secure safety when moving at great speed, to have the parts in contact adjusted to each other in such manner as at all times, and under varying circumstances, to preserve a true relationship one to the other, at the same time having a tendency to resist and counteract the impulses which would otherwise destroy their equilibrium, and endanger the safety of the moving body.[8]

The machine character of the railroad was dual: first, the steam engine (locomotive) generated uniform mechanical motion; secondly, that motion was transformed into movement through space by the combined machinery of wheel and rail.

We observed how the process of the mechanization of formerly organic motive powers by the steam engine was experienced as denaturalization and desensualization. Let us now see how the development of the railway completes the detachment from nature initiated by the discovery of steam power.

As it is the function of the rail to overcome natural resistances, or obstacles, it can be defined as a technical means to implement Newton's First Law of Dynamics, which states: 'Every body continues in its state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by forces impressed upon it'.[9]

8. C. H. Greenhow, *An Exposition of the Danger and Deficiencies of the Present Mode of Railway Construction* (London, 1846), pp. 5–6.
9. The technical principle of the railroad is a practical demonstration of Newton's law of

The natural obstacles that are to be overcome by means of the rail are of two different kinds: first, the friction between wheel surface and road surface; secondly, the irregularity of the terrain. Friction may be called the microphysical resistance; the varying elevation of the land, the macrophysical. How does the rail deal with the microphysical resistance? Lardner provided a definition for the ideal (i.e., frictionless) road, acknowledging that it is directly derived from Newton: '*A perfect road should be smooth, level, hard, and straight*. Were it possible to construct a road between two places, absolutely smooth, absolutely level, absolutely hard, and absolutely straight, then a carriage put in motion from one end of this road would move to the other end without any tractive force at all, except so far as the resistance of the atmosphere would require it'.[10] (Italics in original.)

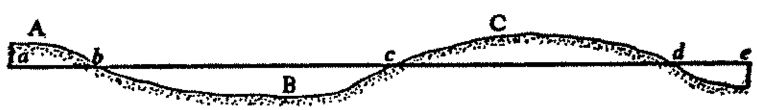
According to Lardner, the railway line was the optional approximation of that ideal road. Significantly, he based his argument on a brief delineation of traditional road-building technology. Only when the draught animals were replaced by mechanical motive power did it become possible to construct a road that possessed all four qualities — smoothness, hardness, levelness, and straightness: as long as road traffic relied on animal power, internal contradictions were inevitable. The smoothness and hardness of the road that the wheel required were directly opposed to the animals' technical demands, as their hooves could not get traction on a smooth and hard road; conversely, a road with a soft and uneven surface, ideal for hooves, did not meet the technical demands of the wheel. This contradiction was impossible to resolve as long as wheeled vehicles were pulled by draft animals. 'A road, then,' Lardner concluded, 'cannot be perfect, or even nearly perfect, for both purposes.' A 'compromise between the two principles is inevitable: a road that is as smooth and hard as possible, while being as soft and rough as is necessary for the horses' hooves'.[11]

motion; Newton's law, on the other hand, is based on the technical realities of its own time (i.e., shipbuilding, machine construction, and arms technology, especially ballistics), being, as it were, the theoretical sum of that technology. These connections are discussed brilliantly in B. Hessen's *The Social and Economic Roots of Newton's 'Principia'* (New York, 1971). (Originally an address to the International Congress of the History of Science and Technology in London in 1931.)

10. D. Lardner, *The Steam Engine, Steam Navigation, Roads and Railways*, 8th ed. (London, 1851), pp. 315–16.
11. Lardner, op. cit., pp. 339–40.

As the latter were replaced by the locomotive, the contradiction ceased to exist. Henceforth the four essentials of the mechanically perfect road could be realized without compromise. The railroad did this first and foremost by means of the rail, which was harder, smoother, more level, and straighter than any road before it. While this revolution in transportation technology took place in a location separate from the traditional road grid, it influenced the latter nevertheless. Serving the need for short-distance transportation not provided by the railroads, the old type of highway survived until the end of the nineteenth century; it became obsolete as the automobile began to mechanize road traffic, and as road-building technology made an effort to approximate the technical principles of the railroads. When road vehicles were no longer pulled by horses but propelled by the internal combustion engine, the roads they ran on tended to become as smooth, hard, level and straight as the rails. By the twentieth century, their surfaces were covered with asphalt and concrete, whereby they achieved the technical standards set by the railroads in the nineteenth century.

The rail's primary function, to minimize the resistance caused by friction, was complemented by its further function of leveling the irregularities of the terrain. To keep friction at a minimum, the rail must be smooth and hard, to achieve optimal performance with the least expenditure of energy, the rail must run a level and straight course. Before laying the track, considerable earth moving was necessary to lay a level and straight roadbed through uneven terrain. Nicholas Wood provided an illustration and description of this in the third edition of his standard technical work of 1838:



> Let A, B, C, Fig. 1, represent a section or the outline of the country over which the railways is to pass, and a, b, c, d, e, the level at which the railway is to be formed. All those parts of the section which are above the line a, b, c, d, e, to the extent of the width required for the railway, will, therefore, require to be cut through, excavated, or levelled down; and those portions which are below that line, will

> require to be embanked or levelled up. The portions A and C, will, therefore, have to be cut down, and the portion B, raised up or embanked. The portions of railway, a b, and c d, of the section, are, consequently, called *excavations*, or *cuttings*; and the portions b c, d e, *embankments*, or *embanking*.[12] (Italics in original.)

Cuttings and embankments were the staple procedures of railroad construction. Greater irregularities of the terrain, such as valleys and mountains, were overcome by means of tunnels and viaducts.

The railroad, built thus across the terrain by means of cuttings, embankments, tunnels, and viaducts, made its mark on the European landscape from the 1850s on; it also made its mark on travelers' perceptions. The alienation from immediate, living nature that was initiated by the mechanization of motive power was increased as the railroad was constructed straight across the terrain, as if drawn with a ruler. The railroad was to the traditional highway as the steam engine was to the draught animal: in both cases, mechanical regularity triumphed over natural irregularity. The abandonment of animal power in favor of steam was experienced as the loss of sensorially perceptible animal power/exhaustion, i.e., as the loss of the sense of space and motion that was based on it. As the natural irregularities of the terrain that were perceptible on the old roads were replaced by the sharp linearity of the railroad, the traveler felt that he lost contact with the landscape, and surely experienced this most directly when going through a tunnel.

Early descriptions of journeys on the railroad noted that the railroad and the landscape through which it ran were in two separate worlds. Thus a report on a trip from Manchester to Liverpool in 1833: '. . . we enter the Olive Mount excavation. Here a passage for the railway has been effected through the solid rock by a cutting seventy feet deep and about fifteen wide. . . . Several bridges are thrown over to connect the opposite precipices, and appear to the eye, as we move along the depth below, like communications belonging to beings of another sphere'.[13]

Similarly, a description of a journey from London to Birming-

12. Nicholas Wood, *A Practical Treatise on Rail-Roads*, 3rd ed. (London, 1838), p. 136.
13. *The Railway Companion* (London, 1833), p. 40.

ham in 1839: 'As far as the eye can range, one immense chasm through the earth appears before the observer, and at intervals are bridges carrying roads across the railway at a frightful height. . . . The echoes in this place are very distinct, and whilst traversing its extent you seem shut out from all communication with the world'.[14]

The empirical reality that made the landscape seen from the train window appear to be 'another world' was the railroad itself, with its excavations, tunnels, etc. Yet the railroad was merely an expression of the rail's technological requirements, and the rail itself was a constituent part of the machine ensemble that was the system. It was, in other words, that machine ensemble that interjected itself between the traveler and the landscape. The traveler perceived the landscape as it was filtered through the machine ensemble.

That was the nature of the new perception of landscape and motion. If the material bases for the old perception of landscape and motion were the physical power of the draught animals, the road that followed the contours of the terrain, and the 'leeway' given to the vehicle on the road,[15] and if the old perception occurred via all these natural and only loosely connected elements of transportation technology, then the character of the new machine ensemble was one of tremendous technical discipline. To follow Reuleaux's argument, the appearance of the machine ensemble signalled the end of free play between the individual elements of machines in general. Compared to the old technology, the new appeared more derived, more unnatural, even more restrictive: this has been documented in contemporary literature and journalism. Yet it was not only the critical mind of the era that found it hard to accommodate itself to the new transportation technology. The railroad was such an entirely novel apparatus that even those who advocated its use

14. Thomas Roscoe, *The London and Birmingham Railway, With the Home and Country Scenes on Each Side of the Line* (London, 1839), pp. 67–8. The Liverpool–Manchester Act actually required the isolation of the railroad from the surrounding countryside, highways, etc., as Cohn points out while summarizing the edicts, 'a railway shall at no point intersect with another road, but shall proceed separately from all other thoroughfares by means of viaducts etc.' (Gustav Cohn, *Die Entwicklung der Eisenbahngesetzgebung in England, Untersuchungen über die englische Eisenbahnpolitik*, vol. 1 [Leipzig, 1874], p. 34.)
15. It is true that the highway and the vehicle moving on it also constitute a machine ensemble, because of their interrelationship. Yet that unity is, in practical terms, a very loose one, as the vehicle is individually manoeuverable and mobile on the road.

as a means of public transportation misunderstood it at first. They regarded it as a means like any other: they were aware of the peculiarity of rails but unable to recognize the consequences. It was obvious that an iron wheel running on an iron rail had less friction to contend with than a wheel on a highway, yet at first no one considered the possibility of constructing railroads independent from existing traditional roads. Thus, for instance, Richard Lovell Edgeworth — who in 1802, twenty years before Gray, published the first proposal to construct railways for public transport — saw the rail entirely in the context of the road, and thus proposed that the existing roads, more specifically, the ones with the heaviest volume of traffic, be furnished with rails. Here, the railroad was not seen as an autonomous traffic system, but merely as a highway provided with rails which essentially retained its traditional traffic pattern. The only change perceived was that friction was reduced. The vehicles remained individual road vehicles, but for the duration of their travel on the rails they had to be lifted onto an undercarriage that is fitted to the rails:

> Now to accommodate coaches and chaises, etc., to these rail-ways, I would have them carried, wheels and all, in cradles or platforms, *which should have wheels adapted to the rail-ways.* By these means no alteration would be necessary in any of the carriages commonly used; but the horses of any coach or chaise might, as soon as they had got out of town, walk up an inclined plane into the cradle or platform, and draw their respective carriages after them: the horses should then walk out at the farthest end of the platform, upon the road belonging to the rail-ways. They would then draw the chaise not upon its own wheels, but upon the wheels of the platform or cradle in which the *chaise* should be detained.[16] (Italics in original.)

A little later, in the same text, Edgeworth stressed once more the autonomy retained by the private vehicles using the rails: 'The chief convenience of this project arises from the mode of receiving and transporting on rail-ways every carriage now in use *without any change in their structure* so that a traveller may quit and resume the common road at pleasure'.[17] (Italics in

16. William Nicholson, *Journal of Natural Philosophy, Chemistry, and the Arts* (London, 1802), p. 222.
17. Op. cit., p. 223.

original.)

While Edgeworth still saw his 'rail-way', quite naively, as a potential extension of the common road, he was, however, aware of the rail's tendency to restrict the free and individual maneuvering of vehicles. This gave rise to his suggestion that four separate railways be constructed on a road, two in either direction, and in each pair, one for coaches, one for vehicles carrying goods. That first premonition of a reorganization of traffic according to the technology of the rail was developed further twenty years later in Gray's proposal for a *national* system of railways. Gray still thought in terms of the categories of individual traffic, but his railways were to constitute a traffic system independent from the existing highways.[18] Gray quite clearly demonstrates the ever-more acute perception of the inherent contradiction between the rail and individual traffic, a contradiction that remained unresolved until the late 1830s. While the technical concept of the rail did not tolerate individual traffic, the economic thinking of the time could conceive of nothing *but* such individual traffic. As long as the contradiction remained unresolved, the only way in which both conditions could be satisfied was to multiply the number of parallel railways. Between Edgeworth's time and Gray's, their number had already grown: 'In order to establish a general iron rail-way, it will be necessary to lay down two or three rail-ways for the ascending, and an equal number for the descending vehicles. In the immediate neighbourhood of London the traffic might demand six rail-ways'.[19]

In the writings of Edgeworth and Gray, the conflict between the rail and individual traffic appeared merely in the form of proposals and projections for ways of organizing railways for public transportation; however, the actual practice of such transportation, as it became a reality in the 1820s, became more and more seriously impeded by that conflict.

In 1855, Lardner retrospectively described the economic views

18. The very first edition of Gray's *Observations* (1820) contains a map of England, Scotland and Wales, on which the national railroad network has been drawn in as a series of *straight* connecting lines between the major cities. In the subsequent editions we find an increasingly strong emphasis on the idea that this would have to be a transportation network of an entirely novel kind. Thus, for instance, in the fifth edition, Gray speaks of the 'absolute necessity of an entirely new system of national intercourse'. (p. 1.)
19. Gray, 5th ed. (London, 1825), p. 12.

of the early period, when the railroad was regarded simply as a means of transportation similar to canal and turnpike, to be used by individual vehicle owners upon the payment of tolls:

> It was expected that the public should be admitted to exercise the business of carriers upon them [the rails], subject to certain specified regulations and by-laws. It soon became apparent, however, that this new means of transport was attended with qualities which must exclude every indiscriminate exercise of the carrying business. A railway, *like a vast machine*, the wheels of which are all connected with each other, and whose movement requires a certain harmony, can not be worked by a number of independent agents. Such a system would speedily be attended with self-destruction. The organization of a railway requires unity of direction and harmony of movement, which can only be attained by the combination of the entire carrying business with the general administration of the road.[20](Italics in original.)

It took a while before the technological necessity of the railroad companies' monopoly on transportation (i.e., the management of both rails and carriages under one supervisory agency) prevailed against the liberal view that was based on principles applicable to canals and turnpikes. As late as 1838, there were private vehicles on the Liverpool–Manchester line.[21] W. T. Jackman enumerates the following reasons for the termination of such individualism in transportation, which was occurring despite the fact that 'laissez-faire doctrines were so predominant in every other aspect of the national life':

(1) Dangers caused by non-coordination of trains of vehicles traveling on the line.
(2) The absence of technically necessary facilities along the line (coal and water depots).

20. D. Lardner, *Railway Economy* (London, 1851), pp. 421–2.
21. W. T. Jackman, *The Development of Transportation in Modern England* (1st ed., 1916; repr. London, 1962), p. 573. Jackman deals with the entire complex on pp. 572–9. Cohn quotes the clause of the Liverpool–Manchester Act which guarantees free access to all vehicles: 'All persons shall have free liberty to use with carriages all roads, ways and passages for the purpose of conveying goods or passengers or cattle' (op. cit., p. 36). Cohn continues: 'For this to be possible, the carriages used by the freight entrepreneurs have to conform to those regulations that the railroad company deems practicable and advertises in every station. Furthermore, the owners of adjoining property receive the right to construct branch lines to the Liverpool–Manchester line' (op. cit., pp. 36–7).

(3) Negligible profits for the private transport entrepreneurs.
(4) The disregard evinced by those entrepreneurs and private users of the line towards the railroad's technical regulations.[22]

Jackman describes the end of individual rail traffic:

> Soon it became evident to the railway companies that, with due regard to the efficiency of their line and to the public convenience and safety, they could not allow rival parties to run engines and carriages on the same line; and it was eventually acknowledged that these lines of communication must be placed under undivided control and authority. Accordingly, a Parliamentary Committee of 1839 urged the necessity of prohibiting, as far as locomotive power was concerned, the rivalry of competing parties on the same line of railway; and the Committee of 1840 decided that railway companies using locomotive power possessed a particular monopoly for the conveyance of passengers, from the nature of their business.[23]

Thus, finally, after many vain efforts to accommodate the new transport technology to juridical concepts appropriate to the old, the inherent character of that new technology prevailed even in the juridical realm. The railroad as a machine ensemble received its legal and politico-economic sanction in the form of the transport monopoly.

The process by which the institutions accommodated themselves to the railroad as a machine ensemble did not end with the acceptance of the transport monopoly. The chaos caused by individual traffic on the rail lines, now terminated by the monopoly, repeated itself on a higher level. In England (although not in Belgium or France) the railroad system grew without central planning, on a purely private-enterprise basis. The railway network grew denser through the construction of more and more lines, but never became a unified entity: it remained merely the sum of numerous local and regional lines that operated independently from each other. Technologically, it was a national transportation grid, providing fast and comfortable

22. Op. cit., pp. 573–4.
23. Op. cit., p. 574; see also Cohn, p. 45.

access to all its parts; but as an organization, based on private enterprise, it was a multitude of individual lines, isolated, working without coordination, or even working against each other. While objectively the expansion of the system should facilitate travel, in fact it increased the difficulties involved in changing trains and in transferring goods from one line to another, by creating impediments such as uncoordinated schedules and stations located at long distances from one another.

The unification of the railway network proceeded just as slowly and reluctantly as did the development of the transport monopoly. Finally, in 1842 the English railway companies created a cooperative and coordinating authority to deal with traffic moving along more than one line — i.e., through traffic, as distinct from merely local and regional traffic.[24] This through traffic was becoming more and more important to the national economy.

Thus the railroad as a machine ensemble finally became institutionalized even in this respect, despite the resistance offered by the economic thought of the period, which was based on the principle of competition. The machine ensemble, consisting of wheel and rail, railroad and carriage, expanded into a unified railway system, which appeared as one great machine covering the land.[25]

In order to guarantee the proper functioning of this machine, juridical and politico-economic regulations had to be revised, but technological improvements proved equally necessary. The most important technological addition to the railways was the electrically operated telegraph system.

While this telegraph system had been technically perfected at the beginning of the nineteenth century, before the advent of the railroad it did not, at first, find any practical application; there was no part for it to play. That changed with the coming of

24. The institution was the Railway Clearing House, based on the Clearing House of English Banks. The best description of its genesis and function can be found in Philip S. Bagwell, *The Railway Clearing House in the British Economy, 1842–1922* (London, 1968).
25. The notion of the railroad as a great machine spread out over the land is implicit in the early definitions of the railroad as a machine ensemble. There is a vivid example of it in Governor Everett's speech at the opening of the Boston–Albany Line (quoted in J. S. Buckingham, *The Eastern and Western States of America* [London, 1842], vol. 1, p. 51): 'Let us contemplate the entire railroad, with its cars and engines, as one vast machine! What a portent of art! its fixed portion a hundred miles long; its moveable portion flying across the State like a weaver's shuttle'.

the railways, on which a signaling system played a vital part from the very beginning. The machine ensemble, whose parts had to be minutely adjusted to each other, must not fall prey to catastrophes. Contemporary illustrations demonstrate the tense watchfulness that characterized early journeys on the railroad. On each carriage of the train we see one, two, sometimes three persons, whose sole task it is to scan the line ahead for obstacles, approaching trains, etc. The first optical and acoustical signals that were devised to assist in this activity soon proved insufficient in dark, foggy or noisy conditions and, of course, when going through tunnels.

Tunnel passages provided the telegraph with its first practical application.[26] The system devised for its use (first in tunnels, later all along the line), the 'space interval system', consisted of a division of the entire line into separate 'blocks', each served by a telegraph transmitter. This transmitter signalled to the block ahead when the line was clear; the engine-driver then received an optical signal that told him to go ahead. The system relieved the engine-driver from any remaining obligation to exercise his personal powers of perception and judgement on the conditions that prevailed around him and his train: all he needed to do was to follow the signals given by a distant telegraph center. Because a train runs on a predetermined line an engine-driver could never aspire to the social role of a 'captain on dry land': the electric telegraph confirmed his true status, that of an industrial worker, an operator of a machine. The telegraph became an integral element of the machine ensemble; Max Maria von Weber, a philosophically-minded railroad expert and son of the well-known composer, observed that without the telegraph the railway would be like an organism without a nervous system: '. . . as the muscle of a human body without the nerve flashing through it would be a mere lifeless hunk of flesh, so would the flying muscles that Watt's and Stephenson's inventions have lent to humanity be only half as capable of winging their way, if they were not animated by the guiding thought imperiously flashing through the nerves of the telegraph wires'.[27]

26. Cooke and Wheatstone introduced it from Germany to England in the early 1830s. (Karl Zetsche, *Geschichte der elektrischen Telegraphie* [Berlin, 1877], p. 157.)
27. In Dolf Sternberger, *Panorama, oder Ansichten vom 19. Jahrhundert*, 3rd ed. (Hamburg, 1955); transl. as *Panorama of the Nineteenth Century* (Oxford and New York, 1978). The

However, the electric telegraph did not gain such tremendous significance solely for its effect on the actual running of the machine ensemble. Its visual imagery became a major emblem of railway travel: the outer world beyond the compartment window was mediated to the traveler by the telegraph poles and wires which flashed by — no longer did he see only the landscape through which he journeyed, but also, continuously, the poles and wires that belong to the railroad as intimately as the rails themselves do. The landscape appeared *behind* the telegraph poles and wires; it was seen *through* them. As we noted earlier, the rail traveler's perceptions were changed by the intervention of the machine ensemble between him and the landscape; there was a material demonstration of that intervention in those poles and wires, which were a part of the machine ensemble. They interposed themselves, both physically and metaphorically, between the traveler and the landscape.[28] To use Dolf Sternberger's term, the resulting perception was 'panoramic'. Verlaine, in the seventh poem of his cycle *La Bonne Chanson*, describes it with technical precision. The hurtling railroad train appears as the very motion of writing and the telegraph poles and wires are the calligraphic instruments with which the new perception inscribes the panoramic landscape upon the real one:

Le paysage dans le cadre des portières
Court furieusement, et des plaines entières
Avec de l'eau, des blés, des arbres et du ciel
Vont s'engouffrant parmi le tourbillon cruel

passage comes from the posthumously published volume *Vom rollenden Flügelrade* (1882). The phrase 'flying muscles' refers to the railroad's trademark, or symbol, the winged wheel. Sternberger quotes the passage while discussing the mutual influence exercised by technological and organic metaphors in the nineteenth century.

28. A prosaic footnote to the poetic perception of telegraph poles can be found in an anonymous work of 1848, *Railway Appliances in the Nineteenth Century; or, The Rail, Steam, and Electricity* (London, 1848), p. 32. It is a proposal to determine the speed of the train (which could not yet be determined directly due to lack of technical 'instinct') by means of close observation of the telegraph poles, i.e., by measuring the time that the train needs to pass from one pole to the next. 'These [the poles] are generally erected about sixty yards apart, or thirty in the mile, so that the speed of the train is easily found by counting the number of poles passed in a minute and multiplying by two, which, of course, gives the rate per hour'. Thus the telegraph poles act as a kind of gauge for determining an element of the journey, i.e., velocity, that can no longer be experienced in an immediate way. This is a factor that contributes to the traveler's alienation from the landscape.

Où tombent les poteaux minces du télégraphe
Dont les fils ont l'allure étrange d'un paraphe.

(The scene behind the carriage window-panes
Goes flitting past in furious flight; whole plains
With streams and harvest-fields and trees and blue
Are swallowed by the whirlpool, whereinto
The telegraph's slim pillars topple o'er,
Whose wires look strangely like a music-score.)[29]

29. Paul Verlaine, *Oeuvres poétiques complètes* (Paris, 1951), p. 106. The cycle 'La bonne chanson' was written in the winter of 1869/70; transl. Gertrude Hall, in *Baudelaire, Rimbaud, Verlaine: Selected Verse and Prose Poems*, (New York, 1947).

[3] Railroad Space and Railroad Time

> Economically, the railways' operation . . . causes distances to diminish . . . Lille suddenly finds itself transported to Louvres; Calais to Pontoise; le Havre to Poissy; Rouen to Sèvres or to Asnières; Reims to Pantin; Strasbourg to Meaux; Lyon to a place half-way between Melun and Corbeil; Marseilles to Nemours; Perpignan to Pithiviers; Bordeaux to Chartres or to Étampes; Nantes to Arpajon, etc.
>
> — Constantin Pecqueur, 1839

'Annihilation of space and time' was the early-nineteenth-century characterization of the effect of railroad travel. The concept was based on the speed that the new means of transport was able to achieve. A given spatial distance, traditionally covered in a fixed amount of travel time, could suddenly be dealt with in a fraction of that time; to put it another way, the same amount of time permitted one to cover the old spatial distance many times over. In terms of transport economics, this meant a shrinking of space: 'Distances practically diminish in the exact ratio of the speed of personal locomotion', Lardner says in his *Railway Economy*.[1]

The average traveling speed of the early railways in England was twenty to thirty miles an hour, or roughly three times the

1. D. Lardner, *Railway Economy* (London, 1850), p. 35.

speed previously achieved by the stagecoaches.[2] Thus, any given distance was covered in one-third of the customary time: temporally, that distance shrank to one-third of its former length. In early-nineteenth-century writings the temporal diminution is expressed mostly in terms of a shrinking of space. An article published in the *Quarterly Review* in 1839 speaks of 'the gradual annihilation, approaching almost to the final extinction, of that space and of those distances which have hitherto been supposed unalterably to separate the various nations of the globe', and continues:

> For instance, supposing that railroads, even at our present simmering rate of travelling, were to be suddenly established all over England, the whole population of the country would, speaking metaphorically, at once advance *en masse*, and place their chairs nearer to the fireside of their metropolis by two-thirds of the time which now separates them from it; they would also sit nearer to one another by two-thirds of the time which now respectively alienates them. If the rate were to be sufficiently accelerated, this process would be repeated; our harbours, our dock-yards, our towns, the whole of our rural population, would again not only draw nearer to each other by two-thirds, but all would proportionally approach the national hearth. As distances were thus annihilated, the surface of our country would, as it were, shrivel in size until it became not much bigger than one immense city.[3]

The image of a temporal shrinkage seen as a spatial one appeared in an even more extravagant guise in the work of Constantin Pecqueur, the economist and Saint-Simonian, whose *Economie sociale* received a prize from the Institut de France in 1838. Here, the temporally shrunk transport space is a new geography of France, a geography based on the new conditions of speed, a condensed geography, as it were. The cities of France approached each other while simultaneously advancing on Paris. These changes in location, enumerated in

2. According to H. G. Lewin, *The Railway Mania and its Aftermath, 1845–52* (London, 1936), the average speed, up to 1845, was 'between 20 and 30 miles per hour' (p. 95). The Great Western Express, the fastest English train, reached a speed of 46 mph. Lardner says the speed of the stagecoaches was a little less than 8 mph (*Railway Economy*, p. 36), whereas Lewin claims that the fastest coaches achieved 10 mph. The actual speed of English trains in the 1840s, i.e., their top speed, was, according to Lardner, frequently 60 to 70 mph (*Railway Economy*, p. 170).
3. *Quarterly Review*, vol. 63 (1839), p. 22.

the epigraph to this chapter, are summarized in Pecqueur's statement that it had become possible to see 'the new France as fitting into the space of the *old* Île-de-France, or its equivalent'.

The diminution of transport distances seemed to create a new, reduced, geography, yet it did not actually alter the size of the spaces between the points connected by the new mode of transport. 'Yet by a sort of miracle,' says the *Quarterly Review* article, after describing the shrinking process, 'every man's field would be found not only *where* it always was, but *as large* as ever it was'. Pecqueur expressed the same notion in literary hyperbole: the diminished transport geography of France contained the true geography of France within it in a condensed form: 'Each bit of terrain, each field on this surface would still remain intact; so would every house in a village, the village itself, or the town; every territory with its village in the center would remain a province; on the map of the imagination, all of these would finally be reproduced and reduced down to the infinitely small! As for Louvres, or Pontoise, or Chartres, or Arpajon, etc., it is obvious that they will just get lost in some street of Paris or its suburbs'.[4]

The notion that a French town could fit into a Paris street demonstrates that the alteration of spatial relationships by the speed of the railway train was not simply a process that diminished space, but that it was a dual one: space was both diminished *and* expanded. The dialectic of this process states that this diminution of space (i.e., the shrinking of transport time) caused an expansion of transport space by incorporating new areas into the transport network. The nation's contraction into a metropolis, as described in the *Quarterly Review*, conversely appeared as an expansion of the metropolis: by establishing transport lines to ever more outlying areas, the metropolis tended to incorporate the entire nation. Thus the epoch of the suburbs, of the amoebic proliferation of the formerly contained cities into the surrounding countryside, began with the railroads. This is Lardner in 1851:

> It is not now unusual for persons whose place of business is in the centre of the capital, to reside with their families at a distance of from

4. Constantin Pecqueur, *Économie sociale* (Paris, 1839), vol. 1, p. 26.

fifteen to twenty miles from that centre. Nevertheless, they are able to arrive at their respective shops, counting-houses, or offices, at an early hour of the morning, and to return without inconvenience to their residence at the usual time in the evening. Hence in all directions round the metropolis in which railways are extended, habitations are multiplied, and a considerable part of the former population of London has been diffused in these quarters.[5]

The notion that the railroad annihilated space and time was not related to that expansion of space that resulted from the incorporation of new spaces into the transport network. What was experienced as being annihilated was the traditional space–time continuum which characterized the old transport technology. Organically embedded in nature as it was, that technology, in its mimetic relationship to the space traversed, permitted the traveler to perceive that space as a living entity. What Bergson called the *durée* (duration, the time spent getting from one place to another on a road) is not an objective mathematical unit, but a subjective perception of space–time. The dependence of this perception on transport technology illustrates Durkheim's notion that a society's space–time perceptions are a function of its social rhythm and its territory.[6] 'What is decisive', says Erwin Straus, discussing the psychology of distances, 'is not the objectively measured distance, but the relation of such distance to potentiality.'[7] Transport technology is the material base of potentiality, and equally the material base of the traveler's space–time perception. If an essential element of a given sociocultural space–time continuum undergoes change, this will affect the entire structure; our perception of space–time will also lose its accustomed orientation. Sorokin, following Durkheim, distinguishes between sociocultural and physico-mathematical notions of space–time, and has described the hypothetical effects of a sudden replacement of customary sociocultural time measures with purely mathematical ones: 'If we try to replace sociocultural time by a purely quantitative time, time becomes devitalized. *It loses its reality, and we find ourselves in an exceedingly difficult position in our efforts to orient ourselves in the time process, to*

5. Op. cit., p. 36.
6. Émile Durkheim, *The Elementary Forms of the Religious Life* (Glencoe, Ill., 1947), pp. 10–11, 440.
7. Erwin Straus, *The Primary World of the Senses* (New York and London, 1963), p. 385.

find out "where we are" and where are the other social phenomena on "the bridge of time"'.[8] (Italics in original.)

Thus, the idea that the railroad annihilated space and time must be seen as the reaction of perceptive powers that, formed by a certain transport technology, find suddenly that technology has been replaced by an entirely new one. Compared to the eotechnical space–time relationship, the one created by the railroad appears abstract and disorientating, because the railroad — in realizing Newton's mechanics — negated all that characterized eotechnical traffic; the railroad did not appear embedded in the space of the landscape the way coach and highway are, but seemed to strike its way through it.

Heinrich Heine captured the disorientation experienced by the traditional space–time consciousness when confronted by the new technology; apropos the opening of railway lines from Paris to Rouen and Orléans in 1843, he wrote of the 'tremendous foreboding such as we always feel when there comes an enormous, an unheard-of event whose consequences are imponderable and incalculable', and called the railroad a 'providential event', comparable to the inventions of gunpowder and printing, 'which swings mankind in a new direction, and changes the color and shape of life'. Heine continues in this vein:

> What changes must now occur, in our way of looking at things, in our notions! Even the elementary concepts of time and space have begun to vacillate. Space is killed by the railways, and we are left with time alone. . . . Now you can travel to Orléans in four and a half hours, and it takes no longer to get to Rouen. Just imagine what will happen when the lines to Belgium and Germany are completed and connected up with their railways! I feel as if the mountains and forests of all countries were advancing on Paris. Even now, I can smell the German linden trees; the North Sea's breakers are rolling against my door.[9]

We have now clearly stated the two contradictory sides of the same process: on one hand, the railroad opened up new spaces that were not as easily accessible before; on the other, it did so by destroying space, namely the space between points. That in-between, or travel space, which it was possible to 'savor'

8. Pitrim A. Sorokin, *Sociocultural Causality, Space, and Time* (Durham, NC, 1943), p. 197.
9. Heine, *Lutezia*, pt 2, lvii, Elster ed., vol. 6, p. 360.

while using the slow, work-intensive eotechnical form of transport, disappeared on the railroads. The railroad knows only points of departure and destination. 'They [the railways] only serve the points of departure, the way-stations, and the terminals, which are mostly at great distances from each other', said a French author in 1840, 'they are of no use whatsoever for the intervening spaces, which they traverse with disdain and provide only with a useless spectacle'.[10]

As the space between the points — the traditional traveling space — was destroyed, those points moved into each other's immediate vicinity: one might say that they collided. They lost their old sense of local identity, formerly determined by the spaces between them. The isolation of localities, which was created by spatial distance, was the very essence of their identity, their self-assured and complacent individuality. Heine's vision of the North Sea breaking on his doorstep in Paris was tinged with 'tremendous foreboding' because both localities — Paris and the North Sea — were still presented in their mutually isolated state, 'worlds apart': thus their collision appeared unfathomable. Thirty years later, as an interlocking network of railroad lines connected all of Europe, that kind of consciousness was no longer realistic. Regardless of their geographical remoteness, the regions appeared as close and as easily accessible as the railways had made them. One generation after Heine, the more privileged inhabitants of Paris had the option of letting themselves be transported, in a matter of hours, to a region that was as distant from their city as Heine's North Sea. The Mediterranean does not extend its shores right up to Parisian thresholds, but it could be reached so much more quickly than before that the journey there was no longer experienced as such. The Parisians who migrated south in the winter saw nothing but blue skies and the sea. As Mallarmé wrote in the winter of 1874/5, in *La Dernière Mode*, the journal he edited, they are 'calm, self-absorbed people, paying no attention to the invisible landscapes of the journey. To leave Paris and to get to where the sky is clear, that is their desire'.[11] They were no longer travelers — rather, as Ruskin puts it, they were human parcels who dis-

10. Charles Dunoyer, *Esprit et méthodes comparés de l'Angleterre et de la France dans les entreprises de travaux publics et en particulier des chemins de fer* (Paris, 1840), p. 104.
11. Stéphane Mallarmé, *Oeuvres complètes*, Pléiade ed. (Paris, 1970), p. 843.

patched themselves to their destination by means of the railway, arriving as they left, untouched by the space traversed.

Even though the railroad was incapable of bringing the remote regions physically to Paris, the speedy and comfortable accessibility of those regions created a consciousness of distance that approximated to Heine's vision of space, but without the sense of foreboding. The region that could be reached by train from Paris realized itself for the Parisians by means of the train. It then appeared as the product or appendage of the railroad, as in a phrase of Mallarmé's: 'Normandy, which, like Brittany, is part of the Western Railway'.[12]

But if Normandy and Brittany, being its destinations, were part of the Western Railway, then the point of departure of that same railway, the station in Paris, became the entrance to those regions. This was a common enough notion in the nineteenth century: it is to be found in every one of Baedeker's travel guides that recommends a certain railroad station as the point of departure for each excursion.

The identification of the railroad station with the traveler's destination, and the relative insignificance of the journey itself, were expressed by Mallarmé in *La Dernière Mode*, under the heading *Gazette et Programme de la Quinzaine*; the following subheadings represented equally important institutions for entertainment: *Les Librairies*, *Les Théâtres*, *Les Gares* (the last sometimes replaced by *Les Voyages*). Thus a railroad journey appeared in no way different from a visit to the theater or the library — the purchase of a train ticket was equivalent to that of a theater ticket.

A generation after Mallarmé, Marcel Proust, in *A la Recherche du temps perdu*, discussed the difference between a journey by train and one in a motorcar:

> The journey was one that would now be made, probably, in a motor-car, which would be supposed to render it more interesting. We shall see too that, accomplished in such a way, it would even be in a sense more genuine, since one would be following more clearly, in a closer intimacy, the various contours by which the surface of the earth is wrinkled. But after all, the special attraction of the journey lies not in our being able to alight at places on the way and to stop

12. Op. cit., p. 774.

altogether as soon as we grow tired, but in its making the difference between departure and arrival not as imperceptible but as intense as possible, so that we are conscious of it in its totality, intact, as it existed in our mind when imagination bore us from the place in which we were living right to the very heart of a place we longed to see, in a single sweep which seemed miraculous to us not so much because it covered a certain distance as because it united two distinct individualities of the world, took us from one name to another name; and this difference is accentuated (more than in a form of locomotion in which, since one can stop and alight where one chooses, there can scarcely be said to be any point of arrival) by the mysterious operation that is performed in those peculiar places, railway stations, which do not constitute, so to speak, a part of the surrounding town but contain the essence of its personality just as upon their signboards they bear its painted name.[13]

The fate wrought upon the outlaying regions by the railroads affected goods even sooner: as long as production and consumption were strictly regional — which they were until the beginning of modern transportation — goods remained part of the local identity of their place of production. Their route of circulation was to be perceived at a glance. Only when modern transportation created a definite spatial distance between the place of production and the place of consumption did the goods become uprooted commodities. In *Grundrisse*, Marx makes an observation about the relation between spatial distance and the nature of commodities; it tells us a good deal about how modern transportation has affected our perception of goods: 'This locational movement — the bringing of the product to the market, which is a necessary condition of its circulation, except when the point of production is itself a market — could more precisely be regarded as the transformation of the product *into a commodity*'.[14] (Italics in original.)

With the spatial distance that the product covered on its way from its place of production to the market, it also lost its local identity, its spatial presence. Its concretely sensual properties, which were experienced at the place of production as a result of

13. *Remembrance of Things Past*, vol. II, *Within a Budding Grove*, I; transl. by C. K. Scott Moncrieff (New York, 1934, pp. 489–90).
14. Karl Marx, *Grundrisse, Foundations of the Critique of Political Economy* (London, 1973), p. 534.

the labor process (or, in the case of the fruits of the land, as a result of natural growth), appeared quite different in the distant market-place. There the product, now a commodity, could realize its economic value and simultaneously gain new qualities as an object of consumption. No longer was it seen in the context of the original locality of its place of production but in the new locality of the market-place: cherries offered for sale in the Paris market were seen as products of that market, just as Normandy seemed to be a product of the railroad that takes you there. Pecqueur touches on the notion of the unity of the realization of economic value and the biological process, using the example of the ripening of fruit: 'For instance, economically speaking, and for the sake of freshness and price, the cherries of Montmorency really ripen on the uncultivated summits of the Quartier Lafayette; the roses of Fontenay burst into bloom and fragrance in the flower beds of the Jardin du Luxembourg; the peaches of Montreuil in the Parc de Monceaux, and the grapes of Fontainebleau, too, ripen on some hill closer to Paris than the one where the Surênes is still greening'.[15]

The regions, joined to each other and to the metropolis by the railways, and the goods that are torn out of their local relation by modern transportation, shared the fate of losing their inherited place, their traditional spatial–temporal presence or, as Walter Benjamin sums it up in one word, their 'aura'.

The detaching of the remote region from its original isolation, its opening-up by the railroad, can well be defined as the 'loss of its aura', as Benjamin characterizes the aura and its loss in his essay 'The Work of Art in the Age of Mechanical Reproduction'. The notions of spatial–temporal presence and distance were integral parts of Benjamin's concept of the aura. He defined the 'aura of natural objects' as 'the unique phenomenon of a distance, however close it may be'.[16] The aura of a work of art is 'its unique existence at the place where it happens to be'.[17] This spatial–temporal singularity, this 'happening-but-once-ness', this *genuineness* of the object, is, according to Benjamin, destroyed by reproduction. 'The situations into which the product of mechanical reproduction can be brought may not touch the

15. Op. cit., pp. 34–5.
16. Walter Benjamin, *Illuminations*, (New York, 1973), p. 222.
17. Ibid., p. 220.

actual work of art, yet the quality of its presence is always depreciated.'[18] It is tempting to apply this statement to the outlying regions that were made accessible by the railroad: while being opened up to tourism, they remained, initially at least, untouched in their physical actuality, but their easy, comfortable, and inexpensive accessibility robbed them of their previous value as remote and out-of-the-way places. 'The staple of the district is, in fact, its beauty and its character of seclusion and retirement', Wordsworth wrote in 1844, defending the Lake District against the intrusion of the railways.[19] The devaluation of outlying regions by their exploitation for mass tourism, by means of the railroad in the nineteenth century and air traffic in the twentieth, is a familiar occurrence. As soon as the railroad reached the seaside towns of southern England that had been strongholds of the aristocracy far into the nineteenth century, the middle classes took them over. Then the aristocracy retired to remote localities such as Scotland, Ireland, and the Lake District.[20] Contemporary air-line tourism is engaged in further devaluation of formerly exclusive, very remote regions.

The destruction of aura by means of reproduction, of which Benjamin speaks, is an expression of the same trend that brought the masses 'closer' to the outlying regions in the nineteenth century: 'The desire of contemporary masses to bring things "closer" spatially and humanly . . . is just as ardent as their bent toward overcoming the uniqueness of every reality by accepting its reproduction'.[21] The remote regions were made available to the masses by means of tourism: this was merely a prelude, a preparation for making any unique thing available by means of reproduction. When spatial distance is no longer experienced, the differences between original and reproduction diminish. In the filmic perception — i.e., the perception of *montage*, the juxtaposition of the most disparate images into one unit — the new reality of annihilated in-between spaces finds its clearest expression: the film brings things closer to the viewer as well as closer together.

The regions lost their temporal identity in an entirely concrete

18. Ibid., p. 221.
19. William Wordsworth, *The Prose Works*, ed. A. B. Grosart, (London, 1876, vol. 2), p. 326.
20. J. A. R. Pimplott, *The Englishman's Holiday* (London, 1947), p. 118.
21. Benjamin, ibid., p. 223.

sense: the railroads deprived them of their local time. As long as they remained isolated from each other, they had their individual times: London time ran four minutes ahead of time in Reading, seven minutes and thirty seconds ahead of Cirencester time, fourteen minutes ahead of Bridgwater time.[22] This patchwork of varying local times was no problem as long as traffic between the places was so slow that the slight temporal differences really did not matter; but the temporal foreshortening of the distances that was effected by the trains forced the differing local times to confront each other. Under traditional circumstances, a supra-regional schedule would be impossible: times of departure and arrival are valid only for the place whose local time is being used. For the next station, with its own time, that previous time is no longer valid. Regular traffic needs standardized time; this is analogous to the way in which the machine ensemble constituted by rail and carriage undermined individual traffic and brought about the transportation monopoly.

In the 1840s, the individual English railway companies proceeded to standardize time, but did not coordinate their efforts; each company instituted a new time on its own line. The process was so novel that it was repeated daily, in the most cumbersome manner, as Bagwell describes, apropos of the Grand Junction Company's procedure: 'Each morning an Admiralty messenger carried a watch bearing the correct time to the guard on the down Irish Mail leaving Euston for Holyhead. On arrival at Holyhead the time was passed on to officials on the Kingston boat who carried it over to Dublin. On the return mail to Euston the watch was carried back to the Admiralty messenger at Euston once more'.[23]

When, after the establishment of the Railway Clearing House, the companies decided to cooperate and form a national railroad network, Greenwich Time was introduced as the standard time, valid on all the lines.[24] Yet railroad time was not accepted as

22. Philip S. Bagwell, *The Transportation Revolution from 1770* (London, 1974), p. 124.
23. Op. cit., p. 125.
24. Greenwich time is the time kept at the Royal Observatory in Greenwich, founded in 1675. 'The precise standardization of time measurement dates from the foundation of the Royal Observatory in 1675' according to G. J. Whittow, *The Nature of Time* (London, 1972). Like the later standard time, the original Greenwich time was created to meet the needs of expanding traffic, i.e., shipping, in the seventeenth century. Vessels carried Greenwich time with them on their chronometers, as it was necessary for orientation and navigation. However, it was not used as a generalized norm for the division of the

anything but schedule time until late in the century. As the rail network grew denser, incorporating more and more regions, the retention of local times became untenable: in 1880, railroad time became general standard time in England. In Germany, official recognition came in 1893; as early as 1884, an international conference on time standards, held in Washington, DC, divided the world into time zones.

In the United States, the process was more complicated, as there was no cooperation whatsoever between the private railroad companies. Each company had its own time, in most cases the local time of the company's headquarters. In stations used by several different lines there were clocks showing different times: three of these in Buffalo, six in Pittsburgh.[25] In 1889, the United States was divided into four time zones, essentially unchanged to this day; officially, at first, the times within the zones were regarded only as railroad time; in practice, these became regional standard times, although they were not given legal recognition until 1918.

day: Greenwich time was still restricted to the walls of the cabinet that contained the chronometer during the voyage.

25. John Stover, *American Railroads* (Chicago, 1961), p. 157.

Excursus
The Space of Glass Architecture

The railroad reorganized space. In architecture, a similar reorganization occurred with the introduction of glass and steel as new building materials. The railroad machine ensemble multiplied speed and capacity of traffic; steel and glass multiplied the capacity of roofed structures. Both the railroad and the glass buildings were direct expressions of the multiplied productivity brought about by the industrial revolution. The railroad brought new quantities of goods into circulation; the edifices of glass architecture — railroad stations, market halls, exhibition palaces, arcades — served as places of transit and storage. The spatial capacity of glass architecture stands in a similar relation to the capacity of traditional architecture as the railroad's capacity stands to that of preindustrial transportation. This is due to the greater strength and resistance to stress characteristic of steel, the necessary complement to glass, compared to the previously utilized building materials. According to Alfred Gotthold Meyer, steel, in terms of stress resistance, is forty times as strong as stone, ten times as strong as wood.[1] The combination of steel as the carrier and glass as the filler led to a reappraisal of all previously recognized architectural principles; Meyer expresses it as follows:

(1) *The reappraisal of strength and mass.* By means of mathematical

1. Alfred Gotthold Meyer, *Eisenbauten: Ihre Geschichte und Ästhetik* (Eßlingen, 1907), p. 11.

calculation, it is possible to determine the statistically possible minimum of material required for a given structure, using a material that has hitherto unheard-of powers of resistance. The opposing forces are rationally divided into vectors of push and pull and then dealt with by appropriately formed cross sections. The result is strength without mass.
(2) *The reappraisal of spatial boundaries.* The wall masses shrink to thin boundary surfaces. The contained space no longer functions in terms of walls and vaults: it stands on its own, and does so inside as well as outside, without intermediaries.
(3) *The reappraisal of light and shadow.* New purposes demand maximal interior light: thus we get the glass roof, and with it, a diffuse light without contrast, lacking plastic definition of form, but also lacking painterly indefiniteness.
(4) To greater extent than with other building materials, the effective form of glass and steel architecture is based primarily on the structure itself, with its ubiquitous logical pattern of girders: The essential thing is now *the line*, not the self-contained mass.[2] (Italics in original.)

To sum up: it was the very nature of glass architecture that put an end to traditional architecture and its inevitable contrasts of light and shadow. As Meyer says, glass architecture creates a 'light-space'. 'The striving for lightness', he writes, 'is one of the main motivating forces in the developmental history of interior space. In the walls erected by stone or wood architecture, it could express itself only by breaking through the surfaces, in order to provide light for the interior; there was a conflict between light and shadow, between light and dark. It is, primarily, that contrast that gives us our sense of interior space and that gives a building its character, inside as well as outside.'[3]

The Crystal Palace, erected for the Great Exhibition in London in 1851, was the first true large-scale realization of glass and steel architecture; it caused perceptual shocks similar to those experienced by the first railway travelers. 'The enormous areas of glass introduced into the vaulting', Giedion says, describing contemporary reaction, 'almost blinded contemporary spectators, who were unaccustomed to the amount of light that was admitted.'[4]

2. Op. cit., p. 184.
3. Op. cit., p. 64.
4. Siegfried Giedion, *Space, Time and Architecture* (Cambridge, Mass., 1962), p. 255.

In his report on the 1851 Great Exhibition, Lothar Bucher — an emigré after the German Revolution of 1848, and later a collaborator of Bismarck — gave a vivid picture of the dazzling effect of ferro-vitreous architecture on the customary patterns of light and shadow perception:

> We see a fine network of symmetrical lines that does not, however, provide any clues whereby one could estimate its distance from the eye or the actual size of the mesh. The side walls stand too far apart to be taken in at a glance, and instead of meeting a facing wall, the eye moves upward over an endless perspective, or one whose end appears diffuse and blue. We do not know whether that mesh hovers a hundred or a thousand feet above us, or whether the ceiling is flat or formed by a number of small parallel ceilings; this is due to the total absence of shadows, which normally aid the psyche in comprehending the impression received by the optical nerve. If we let our gaze slowly move downward again, it encounters the filigreed girders, painted blue, far apart from each other at first, then moving ever closer, then superimposed on each other, then interrupted by a shining band of light, and finally dissolving in a remote background in which everything corporeal, even the lines themselves, disappears and only the color remains. Looking at the side walls, we orient ourselves, by seeking out, from among the profusion of carpets, tapestries, animal skins, mirrors, and a thousand other draperies, a single uncovered pillar — so slender that it does not seem to be able to hold up any weight, but is there only to satisfy the eye's need to recognize a support; we can estimate its height by comparing it to some person passing by, and by observing a second and a third one above it.[5]

The impression of glass architecture can be summed up in one word: evanescence. The uniform quality of the light and the absence of light–shadow contrasts disorientated perceptual faculties used to those contrasts, just as the railroad's increased speed disorientated the traditional perception of space. The motion of the railway, proceeding uniformly and in a straight line, was experienced as abstract, *pure* motion, dissociated from the space in which it occured. Analogously, the space of ferro-vitreous architecture appeared as pure and abstract light-space,

5. Lothar Bucher, *Literaturhistorische Skizzen aus der Industrieausstellung aller Völker* (Frankfurt, 1851), pp. 10–11 (also quoted by Meyer and Giedion).

dissociated from all customary architectural form, a space without qualities and contrasts. Richard Lucae described the space of the Crystal Palace as an 'artificially created environment' that 'no longer is a space', and continues with an elegant simile:

> As in a crystal, there no longer is any true interior or exterior. We have been separated from nature, but we hardly feel it. The barrier erected between us and the landscape is almost ethereal. If we imagine that air can be poured like a liquid, then it has, here, achieved a solid form, after the removal of the mold into which it was poured. We find ourselves within a cut-out segment of atmosphere. . . . It is, in my opinion, extraordinarily difficult to arrive at a clear perception of the effect of form and scale in this incorporeal space.[6]

In dissociating light and atmosphere from the context of the natural overall atmosphere by means of 'an almost ethereal' barrier, ferro-vitreous architecture created a novel condition. Light and atmosphere were perceived as independent qualities, no longer subject to the rules of the natural world in which they had hitherto manifested themselves. This process was comparable to the experience of pure speed on the railroad, that is, speed perceived as an independent quality because it is divorced from the organic base of horse-power. (At the beginning of the twentieth century, the human voice was subjected to that same process of dissociation from its natural habitat, its natural condition, by the microphone and the radio.)[7]

Considering the newly gained independence of light from nature and the dissolution of corporeality that characterize Bucher's and Lucae's perceptions of the Crystal Palace, one might call their descriptions 'Impressionist'. Max Raphael's definition of the Impressionists' method of painting corresponds, in detail, to their perceptions of the inner space of the Crystal Palace: 'A dissolution of the object, in its closed form as well as in its inherent significance within the atmosphere; a cancellation of

6. Richard Lucae, 'Über die Macht des Raumes in der Architektur', *Zeitschrift für Bauwessen*, vol. 19 (1869), p. 303. A similar comment was made by the French architect Boileau in regard to the Galerie des Machines of the Paris World Expo of 1878: 'The spectator is not aware of the weight of the transparent surfaces. These surfaces are to him air and light, that is to say, an imponderable fluidity'. (Quoted in Giedion, op. cit., p. 265.)
7. I owe this realization to Hans-Thies Lehmann, who applies the thought successfully to this analysis of the early poetry of Bertolt Brecht.

the material concepts, e.g., the local color, the line of three-dimensional form, in favor of a relationship with light; an emphasis on appearance that simultaneously removes it into distance; the removal of space from the realm of visual representation'.[8] Siegfried Giedion[9] understands the effect of the Crystal Palace on its contemporaries as objectively Impressionist in intention, and makes a connection between Turner's painterly objectives and those of the architect of the Crystal Palace; that seems far-fetched, but it does seem justifiable to view Impressionism as a codification of a certain nineteenth-century perception of an evanescence whose most powerful material manifestations are the railroad and ferro-vitreous architecture.[10]

This digression on the novel spatiality of that architecture would not be complete without a reference to the developments that led to its demise. The Crystal Palace was the culmination and termination of ferro-vitreous architectural functionalism: it was followed, in the latter half of the century, by restorative developments. Ferro-vitreous methods of construction were relegated to tasks of roofing and dome-building. Builders reverted to the erection of massive and pompous stone fronts: these covered up the ferro-vitreous constructions, which could not be abandoned entirely owing to the lighting requirements of large interior spaces.

By the turn of the century, as it became possible to generate inexpensive artificial electric light by industrial means, ferro-vitreous architecture became redundant. The need for large structures for the display, storage, and merchandising of commodities remained, but the dependence on natural light disappeared. The ferrous mode of construction, which remained necessary for the stability of large rooms and buildings, detached itself from the vitreous aspect and took the form of steel

8. Max Raphael, *Von Monet zu Picasso* (Munich, 1913), p. 59.
9. Giedion says that Turner's painting *Simplon Pass*: '. . . uses a . . . humid atmosphere to dematerialize landscape and dissolve it into infinity. The Crystal Palace realizes the same intention through the agency of transparent glass surfaces and iron structural members. In the Turner picture the means employed are less abstract, but an equivalent insubstantial and hovering effect is produced'. (Op. cit., p. 253.)
10. The general economic base for this evanescence of perception is the fact that less and less labor (i.e. value) was invested in the individual product. Natural organic materials were increasingly replaced by synthetic surrogates; mass-produced objects were given built-in obsolescence; and 'surface finish' was emphasized.

skeletons for edifices that were once again constructed in the traditional massive materials.

Artificial electric light as a mass phenomenon originated and achieved its most extended potential in the United States of Edison's day. It was another giant step in the direction of independence from nature. Although ferro-vitreous architecture was an initial development in that same direction, it was still dependent upon and orientated toward nature, in that it attempted to maximize the use of natural light. The new, artificially lighted type of enclosed space required the very opposite — the minimization of glass windows. No longer was daylight an exploitable raw material but an uncertain factor that should be eliminated, as Matthew Luckiesh points out in his work *The Lighting Art*, published in 1917: 'Natural light does not possess the potentiality that artificial light does because it is generally less readily controlled and adapted to the problems'.[11] Windows were not only sources of irregular, unreliable and difficult-to-control natural light, they also presented problems of expenditure. Luckiesh: 'The cost of natural light for indoor illumination is considerable because of the floor and wall area that has to be sacrificed for window space; in addition there are various minor factors which increase the cost of natural light indoors'.[12]

The solution that determined the future development of commercial building spaces was artificial light, i.e., the production of the same amount of light that filled the inner space of vitreous architecture by technical means. 'In considering future applications of artificial daylight it is well to note that even when natural daylight is available *it cannot be brought into interiors without cost*. The construction of the daylight entrance is more expensive than ordinary roofing and blank walls.'[13]

In less than a century, the problem of lighting underwent two revolutionary transformations. In the first half of the nineteenth century, ferro-vitreous architecture dissolved the elements of traditional architecture in order to gain natural light. As a result of the development of artificial light, this was followed by a

11. M. Luckiesh, *The Lighting Art* (New York and London, 1917), p. 210. Luckiesh was still aware that the price paid for such controlability is monotony: 'In fact, the most striking feature of daylight is its variability and, although this is often annoying, the lack of monotony is one of the attractive features of daylight'.

12. Op. cit., p. 3.

13. Op. cit., p. 85.

movement in the opposite direction, by a closing-off of interior spaces against uncontrollable daylight, a tendency leading to the elimination of windows and glass buildings.[14]

This second turn did not have anything like the effect on contemporary consciousness and perception that the 'light-space' of glass architecture had. It is not difficult to see why this was so: glass architecture had dissolved the traditional forms because it fulfilled a dual function — it was architecture as well as lighting technology and a technical and architectural surrogate for the artificial light that was not yet available. It prepared the way for artificial lighting by making the natural light appear artificial — a process comparable to the development of the water wheel which initially received its regular water supply by means of a steam-powered water pump before it was replaced by the steam engine.

14. However, such radical changes took place only in the USA. A German engineering text (Hefele, *Das Fabrik-Oberlicht* [Berlin, 1931]) presented a critical view of American efforts to eliminate the use of daylight in buildings. This argument is an excellent example of how the different developmental stages of any given industry (e.g., its degree of productivity) influence the engineering consciousness. In the Germany of 1931 an engineer could still make a case for the use of daylight because the German electrical industry was not yet as productive and dominant as the American; because artificial light had not yet been made available *en masse* and cheaply; and because there were traditional and cultural reasons for using daylight.

[4]
Panoramic Travel

Dreamlike traveling on the railroad. The towns which I pass between Philadelphia and New York make no distinct impression. They are like pictures on a wall. The more, that you can read all the way in a car a French novel.
— Emerson, *Journals*, 7 February 1843

In Goethe's journal on his trip to Switzerland in 1797, there is the following entry:

> Left Frankfurt shortly after 7:00 A.M. On the Sachsenhausen mountain, many well-kept vineyards; foggy, cloudy, pleasant weather. The highway pavement has been improved with limestone. Woods in back of the watch-tower. A man climbing up the great tall beech trees with a rope and iron cleats on his shoes. What a village! A deadfall by the road, from the hills by Langen. *Sprendlingen*. Basalt in the pavement and on the highway up to Langen; the surface must break very often on this plateau, as near Frankfurt. Sandy, fertile, flat land; a lot of agriculture, but meagre . . .[1]

As Goethe told Eckermann, this journal was 'merely jotted down as given by the moment'. Thus it is no poetic text, but a description of a journey by coach in the late eighteenth century, a record of impressions received on that journey. Goethe's trip from Frankfurt to Heidelberg consisted of a continuous sequence of impressions that demonstrate how intense was the experience of traversed space. Not only the villages and towns on the way are noted, not only the formations of the terrain, but even details of the material consistency of the pavement of the highway are incorporated into his perceptions.

1. *Werke*, East Berlin ed., vol. 15, pp. 348 ff.; the complete journal of the Swiss journey in *Werke*, Sophia ed., vol. 2, sec. 3.

The railway put an end to this intensity of travel, which had reached its peak in the eighteenth century and had found its cultural expression in the genre of the 'novel of travels'. The speed and mathematical directness with which the railroad proceeds through the terrain destroy the close relationship between the traveler and the traveled space. The space of *landscape* becomes, to apply Erwin Straus' concept, *geographical* space. 'In a landscape', says Straus, 'we always get to one place from another place; each location is determined only by its relation to the neighboring place within the circle of visibility. But geographical space is closed, and is therefore in its entire structure transparent. Every place in such a space is determined by its position with respect to the whole and ultimately by its relation to the null point of the coordinate system by which this space obtains its order. Geographical space is systematized.'[2] Straus sees the railroad as the essential agent of the transformation of landscape into geographical space:

> The modern forms of traveling in which intervening spaces are, as it were, skipped over or even slept through, strikingly illustrate the systematically closed and constructed character of the geographical space in which we live as human beings. Before the advent of the railroad, geographical connections evolved, for the traveler, from the change in landscape. True, today the traveler also goes from place to place. But now we can get on a French train in the morning, and then, after twelve hours on the train (which is really being nowhere), we can get out in Rome. The old form of traveling provided for a more and better balanced relationship between landscape and geography.[3]

The nineteenth century found a fitting metaphor for this loss of continuity: repeatedly, the train was described as a projectile. First, the projectile metaphor was used to emphasize the train's

2. Erwin Straus, op. cit., p. 319.
3. Op. cit., p. 320.

speed, as in Lardner: a train moving at seventy-five miles an hour 'would have a velocity only four times less than a cannon ball'.[4] Then, as Greenhow points out, there is the cumulative power and impact that turns a speeding train into a missile: 'When a body is moving at very high velocity, it then, to all intents and purposes, becomes a projectile, and is subject to the laws attending projectiles'.[5] In 1889, after the complete cultural assimilation of the railroad, the projectile metaphor was still quite attractive. 'Seventy-five miles an hour', says a technical text published in that year, 'is one hundred and ten feet a second, and the energy of four hundred tons moving at that rate is nearly twice as great as that of a 2,000-pound shot fired from a 100-ton Armstrong gun.'[6]

The train was experienced as a projectile, and traveling on it, as being shot through the landscape — thus losing control of one's senses. 'In travelling on most of the railways . . .', says an anonymous author of the year 1844, 'the face of nature, the beautiful prospects of hill and dale, are lost or distorted to our view. The alternation of high and low ground, the healthful breeze, and all those exhilarating associations connected with "the Road", are lost or changed to doleful cuttings, dismal tunnels, and the noxious effluvia of the screaming engine.'[7] Thus the rails, cuttings, and tunnels appeared as the barrel through which the projectile of the train passes. The traveler who sat inside that projectile ceased to be a traveler and became, as noted in a popular metaphor of the century, a mere parcel.[8] 'It matters not whether you have eyes or are asleep or blind, intelligent or dull', said Ruskin, 'all that you can know, at best, of the country you pass is its geological structure and general

4. D. Lardner, *Railway Economy*, p. 179.
5. C. H. Greenhow, *An Exposition of the Danger and Deficiencies of the Present Mode of Railway Construction* (London, 1846), p. 6.
6. H. G. Prout, 'Safety in Railroad Travel', in *The American Railway*, ed. T. M. Cooley (New York, 1889), p. 187.
7. *Horse-Power Applied to Railways At Higher Rates of Speed than by Ordinary Draught* (London, 1844), p. 48.
8. 'It [the railway] transmutes a man from a traveller into a living parcel.' (Ruskin, *The Complete Works*, vol. 8, p. 159.) Manfred Riedel provides the two following quotes from lesser authors: for Ida Hahn-Hahn, the traveler 'demotes himself to a parcel of goods and relinquishes his senses, his independence' (Manfred Riedel, 'Vom Biedermeier zum Maschinenzeitalter', *Archiv für Kulturgeschichte*, vol. 43, (1961), fascicle 1, p. 119); and, according to Joseph Maria von Radowitz, 'for the duration of such transportation one ceases to be a person and becomes an object, a piece of freight'. (Op. cit., p. 120.)

clothing.'[9]

This loss of landscape affected all the senses. Realizing Newton's mechanics in the realm of transportation, the railroad created conditions that also 'mechanized' the traveler's perceptions. According to Newton, 'size, shape, quantity, and motion' are the only qualities that can be objectively perceived in the physical world. Indeed, those became the only qualities that the railroad traveler was able to observe in the landscape he traveled through. Smells and sounds, not to mention the synesthetic perceptions that were part of travel in Goethe's time simply disappeared.

The change effected in the traveler's relationship to the landscape became most evident in regard to his sense of sight: visual perception is diminished by velocity. George Stephenson testified to this in a statement given at a parliamentary hearing on safety problems on the railways in 1841: when asked for his estimation of the engine-driver's ability to see obstacles, he replied: 'If his attention is drawn to any object before he arrives at the place, he may have a pretty correct view of it; but if he only turns himself round as he is passing, he will see it very imperfectly'.[10]

Unlike the driver, the travelers had a very limited chance to look ahead: thus all they saw was an evanescent landscape. All early descriptions of railroad travel testify to the difficulty of recognizing any but the broadest outlines of the traversed landscape. Victor Hugo described the view from a train window in a letter dated 22 August 1837: 'The flowers by the side of the road are no longer flowers but flecks, or rather streaks, of red or white; there are no longer any points, everything becomes a streak; the grainfields are great shocks of yellow hair; fields of alfalfa, long green tresses; the towns, the steeples, and the trees perform a crazy mingling dance on the horizon; from time to time, a shadow, a shape, a spectre appears and disappears with

9. Ruskin, vol. 36, p. 62; this is essentially echoed by a French medical author: 'He [the traveler] hardly knows the names of the principal cities through which he passes, and only recognizes them, if at all, by the steeples of the best-known cathedrals which appear like trees by some faraway road'. (A. Aulagnier, *L'Union médicale de la Gironde* [Bordeaux, 1857], p. 525.)
10. Great Britain, *Parliamentary Papers*, 'Report from the Select Committee on Railways', vol. 5 of the section 'Transport and Communications' (repr. ed., Shannon, Ireland, 1968), p. 125.

lightning speed behind the window: it's a railway guard'.[11] And Jacob Burckhardt wrote in 1840: 'It is no longer possible to really distinguish the objects closest to one — trees, shacks, and such: as soon as one turns to take a look at them, they already are long gone'.[12] In a text from 1838 we find the statement that it is impossible to 'recognize a person standing by the road while driving past him' at the 'greatest speed',[13] which prompted the following advice: 'He who has good eyesight . . . does well to acquire the habit of observing from a certain distance everything that attracts his attention while traveling: given some power of observation, he will not miss anything at all, not even during the stage of utmost velocity'.[14]

The recommendation to look at things 'from a certain distance' does not seem entirely realistic, in view of the traveler's situation in the train compartment: enclosed in it, the traveler has no way of distancing himself from the objects — all he can do is to ignore them and the portions of the landscape that are closest to him, and to direct his gaze on the more distant objects that seem to pass by more slowly. If he does not modify his old way of observing things while traveling — if he still tries to perceive proximity and distance in equal measure — the result, as noted in 1862 by *The Lancet*, a medical journal, is fatigue:

> The rapidity and variety of the impressions necessarily fatigue both the eye and the brain. The constantly varying distance at which the objects are placed involves an incessant shifting of the adaptive apparatus by which they are focused upon the retina; and the mental apparatus by which the brain takes cognizance of them is scarcely pro- effort by which the brain takes cognizance of them is scarcely pro- ductive of cerebral wear because it is unconscious; for no fact in physiology is more clearly established than that excessive functional activity always implies destruction of material and organic change of substance.[15]

Increased velocity calls forth a greater number of visual impressions for the sense of sight to deal with. This multiplication

11. Quoted in Baroli, *Le Train dans la Littérature Française*, Paris, 1964, p. 58.
12. From Manfred Riedel, op. cit., p. 112.
13. G. Muhl, *Die westeuropäischen Eisenbahnen in ihrer Gegenwart und Zukunft* (Karlsruhe, 1838), p. 18.
14. Op. cit., p. 19.
15. *The Influence of Railway Travelling on Public Health*, (London, 1862), p. 44 (is a compendium of articles previously published in *The Lancet*).

of visual impressions is an aspect of the process peculiar to modern times that Georg Simmel has called the development of urban perception. He characterizes it as an '*intensification of nervous stimulation* which results from the swift and uninterrupted change of outer and inner stimuli'.[16] (Italics in original.) 'Lasting impressions', Simmel says, 'impressions which take a regular and habitual course and show regular and habitual contrasts — all these use up, so to speak, less consciousness than does the rapid crowding of changing images, the sharp discontinuity in the grasp of a single glance and the unexpectedness of onrushing impressions.'

The difference between the quality of stimuli in the metropolis and those of railroad travel need not concern us here: what is decisive is the quantitative increase of impressions that the perceptual apparatus has to receive and to process. Contemporary texts that compare the new travel experience with the traditional one demonstrate how that stimulus increase produced by increased velocity is experienced as stressful. The speed causes objects to escape from one's gaze, but one nevertheless keeps on trying to grasp them. This is implied in Eichendorff: 'These travels by steam keep on shaking the world — in which there really is nothing left but railway stations — like a kaleidoscope, incessantly, the landscapes speeding by in ever-changing grimaces even before one has been able to perceive any genuine traits of physiognomy; the flying salon presents one with ever new coteries, even before one has been able to really deal with the old ones'.[17]

John Ruskin, whose dislike of the railways created the most sensitive descriptions of the peculiar traits of pre-industrial travel, proposed an almost mathematical negative correlation between the number of objects that are perceived in a given period of time and the quality of that perception: 'I say, first, to be content with as little change as possible. If the attention is awake, and the feelings in proper train, a turn of a country road, with a cottage beside it, which we have not seen before, is as much as we need for refreshment; if we hurry past it, and take two cottages at a time, it is already too much; hence to any

16. *The Sociology of Georg Simmel*, ed. Kurt M. Wolff (Glencoe, Ill., 1950), p. 410.
17. Joseph von Eichendorff, *Werke* (Munich, 1970), vol. 2, p. 895.

person who has all his senses about him, a quiet walk along not more than ten or twelve miles of road a day, is the most amusing of all travelling; and all travelling becomes dull in exact proportion to its rapidity'.[18]

That final statement — traveling becomes dull in exact proportion to its rapidity — represents the evaluation of railroad travel made by all those nineteenth-century travelers who were still accustomed to pre-industrial travel and thus not able to develop modes of perception appropriate to the new form of transportation. Dullness and boredom resulted from attempts to carry the perceptual apparatus of traditional travel, with its intense appreciation of landscape, over to the railway. The inability to acquire a mode of perception adequate to technological travel crossed all political, ideological, and esthetic lines, and appeared among the most disparate personalities of the nineteenth century. Flaubert wrote to a friend in 1864: 'I get so bored on the train that I am about to howl with tedium after five minutes of it. One might think that it's a dog someone has forgotten in the compartment; not at all, it is M. Flaubert, groaning'.[19] Before a railway journey, Flaubert stayed up all night in order to be able to sleep through the journey and not experience it at all: he could do nothing with the vista offered to him by the compartment window.[20] The most diverse sources provide any number of similar complaints. To indicate the width of the spectrum, and its independence from attitudes based on *Weltanschauung*, let us examine one more piece of evidence: the report of a railroad journey in the United States by the politically liberal German-American Francis J. Lieber in 1834:

> From Albany to Schenectady, you travel by rail-road; and the least

18. Ruskin, vol. 5, p. 370. Elsewhere, Ruskin speaks of the travelers 'who once in their necessarily prolonged travel were subjected to an influence, from the silent sky and slumbering fields, more effectual than known or confessed', (Vol. 8, p. 246.)
19. *Correspondence* (Paris, 1929), vol. 5, pp. 153–4.
20. Op. cit., letter dated 30 October 1873, quoted in Baroli, *Le Train*, p. 201. People slept in their train compartments not only out of boredom; an equally strong motivation was the need to escape from the tiring influx of stimuli by means of sleep: 'There are people, hurried by their business, who . . . in the course of one day have to cast their eyes upon the panoramas of several hundreds of places. They arrive at their destination overwhelmed by a previously unknown fatigue. Just ask these victims of velocity to tell you about the locations they have traveled through, to describe the perspectives whose rapid images have imprinted themselves, one after another, on the mirror of their brain. They will not be able to answer you. The agitated mind has called sleep to its rescue, to put an end to its overexcitation'. (Gustave Claudin, *Paris* [Paris, 1867], pp. 71–2.)

> exciting of all traveling, it seems to me, is decidedly locomotion by steam on a rail-road. The traveler, whose train of ideas is always influenced by the manner in which he proceeds, thinks in a steam car of nothing else but the place of his destination, for the very reason that he is moving so quickly. Pent up in a narrow space, rolling along on an even plain which seldom offers any objects of curiosity, and which, when it does, you pass by with such rapidity, that your attention is never fixed; together with a number of people who have all the same object in view, and think like you of nothing else, but when they shall arrive at the journey's end — thus situated, *you find nothing to entertain or divert you*, except now and then a spark flying into the window of the car. . . . There is no common conversation, no rondolaugh, nothing but a dead calm, interrupted from time to time, only by some passenger pulling out his watch and uttering a sound of impatience. . . .[21] (Italics in original.)

While the consciousness molded by traditional travel found itself in a mounting crisis, another kind of perception started to develope, one which did not try to fight the effects of the new technology of travel but, on the contrary, assimilated them entirely. For such a pair of eyes staring out of the compartment window, all the things that the old consciousness experienced as losses became sources of enrichment. The velocity and linearity with which the train traversed the landscape did not destroy it — not at all; only under such conditions was it possible to fully appreciate that landscape. Thus, a description of a trip from Manchester to Liverpool in the year 1830:

> The passenger by this new line of route having to traverse the deepest recesses where the natural surface of the ground is the *highest*, and being mounted on the loftiest ridges and highest embankments, riding above the tops of the trees, and overlooking the surrounding country, where the natural surface of the ground is the *lowest* — this peculiarity and this variety being occasioned by that essential requisite in a well-constructed Railway — a level line — imposing the necessity of cutting through the high lands and embanking across the low; thus in effect, presenting to the traveller all the variety of mountain and ravine in pleasing succession, whilst in reality he is moving almost on a level plane and while the natural face of the country scarcely exhibits even those slight undulations which

21. Francis Lieber, *The Stranger in America* (London, 1834), vol. 2, pp. 1–2.

are necessary to relieve it from tameness and insipidity.[22]

That is not a picturesque landscape destroyed by the railroad; on the contrary, it is an intrinsically monotonous landscape brought into an esthetically pleasing perspective by the railroad. The railroad has created a new landscape. The velocity that atomized the objects of Ruskin's perception, and thus deprived them of their contemplative value, became a stimulus for the new perception. It is the velocity that made the objects of the visible world attractive. Let us compare the following passage with Ruskin's comments, and we shall see how differently velocity and evanescence can be experienced during the same period of time: 'The beauties of England', an American traveler wrote in 1853, 'being those of a dream, should be as fleeting':

> They never appear so charming as when dashing on after a locomotive at forty miles an hour. Nothing by the way requires study, or demands meditation, and though objects immediately at hand seem tearing wildly by, yet the distant fields and scattered trees, are not so bent on eluding observation, but dwell long enough in the eye to leave their undying impression. Every thing is so quiet, so fresh, so full of home, and destitute of prominent objects to detain the eye, or distract the attention from the charming whole, that I love to dream through these placid beauties whilst sailing in the air, quick, as if astride a tornado.[23]

To Benjamin Gastineau, whose newspaper essays on travel were collected in 1861 in book form as *La Vie en chemin de fer*, the motion of the train through the landscape appeared as the motion of the landscape itself. The railroad choreographed the landscape. The motion of the train shrank space, and thus displayed in immediate succession objects and pieces of scenery that in their original spatiality belonged to separate realms. The traveler who gazed through the compartment window at such successive scenes, acquired a novel ability that Gastineau calls 'la philosophie synthétique du coup d'oeil' ('the synthetic philosophy of the glance'). It was the ability to perceive the discrete, as

22. Henry Booth, *An Account of the Liverpool and Manchester Railway* (Liverpool, 1830), pp. 47–8.
23. Matthew E. Ward, *English Items; or, Microcosmic Views of England and Englishmen* (New York, 1853), pp. 71–2.

it rolls past the window, indiscriminately. The scenery that the railroad presents in rapid motion appeared in Gastineau's text as a panorama, without being explicitly referred to as such:

> Devouring distance at the rate of fifteen leagues an hour, the steam engine, that powerful stage manager, throws the switches, changes the decor, and shifts the point of view every moment; in quick succession it presents the astonished traveler with happy scenes, sad scenes, burlesque interludes, brilliant fireworks, all visions that disappear as soon as they are seen; it sets in motion nature clad in all its light and dark costumes, showing us skeletons and lovers, clouds and rays of light, happy vistas and sombre views, nuptials, baptisms, and cemeteries.[24]

In another, roughly contemporary, French text we find all three essential characteristics of the panorama described. Jules Clarétie, a Parisian journalist and publicist, characterized the view from the train window as an evanescent landscape whose rapid motion made it possible to grasp the whole, to get an overview; defining the process, he made specific use of the concept of panorama: 'In a few hours, it [the railway] shows you all of France, and before your eyes it unrolls its infinite panorama, a vast succession of charming tableaux, of novel surprises. Of a landscape it shows you only the great outlines, being an artist versed in the ways of the masters. Don't ask it for details, but for the living whole. Then, after having charmed you thus with its painterly skills, it suddenly stops and quite simply lets you get off where you wanted to go'.[25]

What, exactly, did this new perception that we are referring to as 'panoramic' consist of? Dolf Sternberger uses this concept of the panorama and the panoramic to describe European modes of perception in the nineteenth century — the tendency to see the discrete indiscriminately. 'The views from the windows of Europe', Sternberger says, 'have entirely lost their dimension of depth and have become mere particles of one and the same panoramic world that stretches all around and is, at each and every point, merely a painted surface.'[26] In Sternberger's view,

24. Benjamin Gastineau, *La Vie en chemin de fer* (Paris, 1861), p. 31.
25. Jules Clarétie, *Voyages d'un parisien* (Paris, 1865), p. 4.
26. Dolf Sternberger, *Panorama, oder Ansichten vom 19. Jahrhundert*, 3rd ed. (Hamburg, 1955), p. 57.

modern transportation, the railroad first and foremost, is the main cause for such panoramization of the world: 'The railroad transformed the world of lands and seas into a panorama that could be experienced. Not only did it join previously distant localities by eliminating all resistance, difference, and adventure from the journey: now that traveling had become so comfortable and common, it turned the travelers' eyes outward and offered them the opulent nourishment of ever changing images that were the only possible thing that could be experienced during the journey'.[27]

What the opening of major railroads provided in reality — the easy accessibility of distant places — was attempted in illusion, in the decades immediately preceding that opening, by the 'panoramic' and 'dioramic' shows and gadgets. These were designed to provide, by showing views of distant landscapes, cities, and exotic scenes, 'a substitute for those still expensive and onerous journeys'.[28] A newspaper of the year 1843 described the Parisian public 'reclining on well-upholstered seats and letting the five continents roll by at its pleasure without having to leave the city and without having to risk bad weather, thirst, hunger, cold, heat, or any danger whatsoever'.[29] That the diorama fad died out in Paris around 1840,[30] more or less at the same time that the first great railways were opened (lines from Paris to Orléans and Rouen appearing in 1843) would seem corroborative evidence for the presumed connection. The simultaneous rise of photography provides more support for the thesis. According to Buddemeier, the public became fascinated, at first:

> Not by the taking of a picture of any specific object, but by the way in which any random object could be made to appear on the photographic plate. This was something of such unheard-of novelty that the photographer was delighted by each and every shot he took, and it awakened unknown and overwhelming emotions in him, as Gaudin points out. . . . Indeed, the question arises: why did the exact

27. Op. cit., p. 50.
28. Hans Buddemeier, *Panorama, Diorama, Photographie: Entstehung und Wirkung neuer Medien im 19. Jahrhundert (Origin and Effect of New Media in the Nineteenth Century)* Munich, 1970, p. 41.
29. Ibid., p. 45.
30. Ibid., p. 48.

> repetition of reality excite people more than the reality itself? Gaudin hints at an answer: he describes how intensely the first photographs were scrutinized, and what people were mostly looking for. For instance: looking at a picture of the building across the street from one's own window, one first started counting the roof shingles and the bricks out of which the chimney was constructed. It was a delight to be able to observe how the mason had applied the mortar between the individual stones. Similar instances occur in other texts dealing with photographs. Tiny, until then unnoticed details are stressed continuously: paving stones, scattered leaves, the shape of a branch, the traces of rain on the wall.[31]

Thus the intensive experience of the sensuous world, terminated by the industrial revolution, underwent a resurrection in the new institution of photography. Since immediacy, close-ups and foreground had been lost in reality, they appeared particularly attractive in the new medium.

Sternberger observes that the vistas seen from Europe's windows had lost their dimension of depth; this happened first with the vistas seen from the train compartment window. There the depth perception of pre-industrial consciousness was, literally, lost: velocity blurs all foreground objects, which means that there no longer is a foreground — exactly the range in which most of the experience of pre-industrial travel was located. The foreground enabled the traveler to relate to the landscape through which he was moving. He saw himself as part of the foreground, and that perception *joined* him to the landscape, included him in it, regardless of all further distant views that the landscape presented. Now velocity dissolved the foreground, and the traveler lost that aspect. He was removed from that 'total space' which combined proximity and distance: he became separated from the landscape he saw by what Richard Lucae, speaking of ferro-vitreous architecture, has called an 'almost immaterial barrier'. The glass separated the interior space of the Crystal Palace from the natural space outside without actually changing the atmospheric quality of the latter in any visible manner, just as the train's speed separated the traveler from the space that he had previously been a part of. As the traveler stepped out of that space, it became a stage setting, or a series of

31. Ibid., p. 78.

such pictures or scenes created by the continuously changing perspective. Panoramic perception, in contrast to traditional perception, no longer belonged to the same space as the perceived objects: the traveler saw the objects, landscapes, etc. *through* the apparatus which moved him through the world. That machine and the motion it created became integrated into his visual perception: thus he could only see things in motion. That mobility of vision — for a traditionally orientated sensorium, such as Ruskin's, an agent for the dissolution of reality — became a prerequisite for the 'normality' of panoramic vision. This vision no longer experienced evanescence: evanescent reality had become the new reality.

While the railroad caused the foreground to disappear, it also replaced looking at the landscape with a new practice that had not existed previously. Reading while traveling became almost obligatory. The dissolution of reality and its resurrection as panorama thus became agents for the total emancipation from the traversed landscape: the traveler's gaze could then move into an imaginary surrogate landscape, that of his book. By the mid-nineteenth century, reading while traveling had become an established custom. The following observation is found in the minutes of an 1860 congress of French physicians: 'Practically everybody passes the time reading while traveling on the train. This is so common that one rarely sees members of a certain social class embark on a journey without first purchasing the means by which they can enjoy this pastime'.[32]

The idea of reading while traveling on trains is as old as the railroad itself. An article in the *Quarterly Review* of 1830 noted that the journey is 'so easy,' that a passenger might read a newspaper with perfect comfort'.[33] A German text of 1833 made a connection between the dissolution of the outer world by means of velocity, and the opportunity to compensate for this by developing an activity within the train compartment that will engage one's attention. Lips spoke of 'a speed at which the objects outside rush past the eye without color or contour, and thus cannot be recognized anymore', and continued: 'And yet, the motion of such a steam-car is so imperceptible, smooth, and

32. *Congrès médical de France, troisième session tenue à Bordeaux* (Paris, 1866), p. 828.
33. *Quarterly Review*, vol. 42 (1830), p. 384.

comfortable, that it is not only possible to *read* but even to *write* in it with the greatest ease; thus, a great number of people, such as scholars, officials, merchants, etc., need no longer rest or interrupt their regular routine while traveling, but can pursue it while sitting in the steam-car'.[34] (Italics in original.)

In the late 1840s, English booksellers established stalls in railway stations, as well as a peculiar kind of lending library, to meet the general demand for things to read while traveling. John W. Dodds describes this development:

> The development of railways encouraged the sale of books of all kinds. Until 1848 no systematic attempt had been made to supply passengers with either books or papers at the railway stations. In that year W. H. Smith got the exclusive right to sell books and papers on the Birmingham Railway. His first bookstall was at Euston Station. Shortly he had the franchise for the entire London and Northwestern System. By 1849, the station library at Paddington terminus contained one thousand volumes, chiefly works of fiction. Here, for the charge of one penny, a passenger had free access to the use of the library while waiting for trains, and for slightly more could take a volume with him on his journey, turning it in at his destination. To meet this new demand Routledge launched his *Railway Library* — novels by Cooper, James, Hawthorne, James Grant, Dumas, and others. Murray advertised his 'Literature for the Rail — works of sound information and innocent amusement'.[35]

In 1852 Louis Hachette emulated the English model in France: in a communication to the French railroad companies he proposed a 'large-scale operation of bookselling that apart from its advantages for the companies would also be both useful and pleasing to the public'. The monotony and boredom of travel by rail, mentioned in so many contemporary descriptions, reappears here as a commercial argument for the establishment of railroad bookstalls:

> The traveler finds himself condemned to idleness as soon as he enters the carriage. The monotony of the trip soon takes effect: boredom arrives, and, what is worse, impatience engulfs the unfor-

34. Michael Alexander Lips, *Die Unanwendbarkeit der englischen Eisenbahnen auf Deutschland und deren Ersatz durch Dampffuhrwerk auf verbesserten Chausseen* . . . (Marburg, 1833), p. 4.
35. John W. Dodds, *The Age of Paradox* (New York and Toronto, 1952), p. 374.

tunate traveler, pulled along by the machine like a piece of baggage.... L. Hachette and Company have come up with an idea for turning the enforced leisure and the boredom of a long trip to the enjoyment and instruction of all. They have thought of establishing a railway library that will provide only interesting volumes in a handy format and at a moderate price.[36]

Only two years after the opening of the first railway bookstall in France, of whose income the rail companies received 30 per cent, Hachette operated sixty branches in the whole of France. In 1864, the income exceeded for the first time one million francs, and the sale of books was still greater than that of newspapers. A little later that ratio is reversed: in 1866 the income from the sale of newspapers was 969,000 francs, that from the sale of books, 527,000 francs.[37]

A glance at the offerings of the English and French railway bookstalls shows that the reading public was almost exclusively bourgeois. An English survey of 1851 showed that, in contrast to the supply of trashy mass literature in the regular bookstores, the railway bookstalls and lending libraries in London carried highly respectable non-fiction, fiction, travel guides, etc.[38] Hachette's catalogue had the following categories: travel guides, books about travel, French literature, classics, agriculture and industry, children's books.[39]

Reading while traveling was an exclusively bourgeois occupation. The lower classes who used the railroad did not read, not only because they could not afford to but also because they had no desire to do so. Their traveling situation was quite different from that of the more privileged strata. The carriages of the third and fourth class were not divided into compartments: they had no formal resemblance to the traditional means of travel, while the compartments of the first and second class did. The lower classes, who really joined the ranks of travelers only after the advent of the railroad, were unencumbered by memories of previous forms of travel: thus the new forms were not as strange to them as they were to those classes who had to abandon their private coaches for the train. The primitive,

36. Jean Mistler, *La Librairie Hachette de 1826 à nos jours* (Paris, 1964), p. 123.
37. Op. cit., p. 299.
38. Dodds, pp. 374–5.
39. Mistler, p. 124.

spacious third- and fourth-class carriages into which the proletarian traveling public was crowded characteristically promoted continuous communication: in the compartments of the bourgeois first- and second-class carriages, such communication had died out, at least by the end of the nineteenth century. 'How often . . . I have . . ., while traveling alone or with people with whom it was impossible to start a conversation, envied the travelers of the third and fourth class, from whose heavily populated carriages merry conversation and laughter rang all the way into the boredom of my isolation cell', says P. D. Fischer.[40]

The emergence of the habit of reading while traveling was not only a result of the dissolution and panoramization of the outside landscape due to velocity, but also a result of the situation inside the train compartment. The railroad disrupted the travelers' relationships to each other as it disrupted their relationship to the traversed landscape. Constantin Pecqueur explains the phenomenon of dissolution, dispersal, and trivialization of perception and communication, by the greater number of objects and persons with which the travelers' power of attention (which have remained constant) were forced to deal:

> In these great halls, and in the cheerful caravans of the trains and steamships, one's affections tend to go out to a greater number of objects and individuals, and consequently become less intense or durable in each case. This encourages inconstancy and creates excitement over variety; life and affections are seen to lose in depth what they gain in range; the social and general sentiments, on the other hand, find this to be a most pleasing state; while the private sentiments, the familial ones, would seem to suffer from it.[41]

Travelers of the eighteenth century, prior to the railroads, formed small groups that, for the duration of the journey, were characterized by intensive conversation and interaction: the travel novels of the period testify to this quite eloquently. The travelers in the train compartment did not know what to do with each other, and reading became a surrogate for the communication that no longer took place. This connection between

40. P. D. Fischer, *Betrachtungen eines in Deutschland reisenden Deutschen* (Berlin, 1895), p. 31.
41. Constantine Pecqueur, *Economie Sociale*, vol. 1, p. 349.

reading and the alienation of railroad travelers from one another was made by all authors dealing with the subject of travel reading. It appears in the following contribution to the medical congress of 1866, in which travel reading is cited as the general and sole activity of travelers:

> Nowadays one travels so fast and sees, if the journey is of any duration, such a succession of new faces, that one frequently arrives at the destination without having said a single word. Conversation no longer takes place except among people who know each other, at least not beyond the exchange of mere generalities; any attempt to go beyond these often lapses due to the indifference of some travelers. Thus one might say that the railroads have in this respect, too, completely changed our habits. Whenever, in the past, one knew that one was going to pass several hours, sometimes several days, in the company of others, one tried to establish a rapport with one's companions that often lasted beyond the duration of the journey. Today we no longer think about anything but the impatiently awaited and soon reached destination. The traveler one takes one's leave from may get off at the next station where he will be replaced by another. Thus reading becomes a necessity.[42]

The effects of reading while traveling were discussed generally in medical circles in the 1860s. The debate as to whether it was harmful or beneficial related the practice to the special stresses put on the optical sense by rail travel, and to visual perception in general. According to one side of the argument, reading while traveling was harmful to the eye because 'when the traveler sets himself to read, he imposes yet further labour on the eye in tracing the shifting characters of his book or newspaper, and also on the brain'.[43] The traveler who *concentrated* on his reading behaved in just as old-fashioned a manner as the traveler who, accustomed to the pace of the stagecoach,

42. Op. cit., p. 830.
43. *The Influence of Railway Travelling on Public Health*, p. 44. A French author even posited a connection between mental affliction and travel reading, claiming that the latter caused a 'congestion of the retina': 'An eminent Parisian alienist, with whom I recently discussed this pernicious influence of reading while traveling on trains, told me that he not only admitted it to be true, but that an English physician, the head of a great private hospital, had told him that he had treated several patients suffering from general paralysis whose initial phenomenon, or determining cause, had been cerebral congestion brought about by those conditions that I have described.' (Legrand, de Saulle, in *Bulletin de la Societé de Médecine pratique*, (1863), p. 9.)

attempted to fix his stare on the objects flitting past the compartment window. In both cases, the result was exhaustion of the senses and of the mind. To adapt to the conditions of rail travel, a process of deconcentration, or dispersal of attention, took place in reading as well as in the traveler's perception of the landscape outside: Hachette's rising sales of newspapers and falling sales of books attest to that. The afore-mentioned contribution to the medical congress of 1866 stated that travel reading may have had deleterious effects on eyesight, but adds that it would be impossible to curtail it: 'Nevertheless, no matter what one says or does, reading will remain the most natural occupation of railway travelers, in this new form of locomotion that has so profoundly altered the traveler's relations to each other'.[44]

44. Op. cit., p. 830.