

1. The role of capital cities and major towns in Europe: promotion of a modern lighting system.

1.1 The use of gas as a source of light fascinated 19th populations as soon as they witnessed the first illuminations. In London, the Strand, Westminster Bridge and the streets of one parish were illuminated as early as 1813, while in Paris foreign visitors marvelled at the lights around the Palais Royal. It even occurred that gaslights enthusiasts were found in the upper levels of government. In France, Louis XVIII subsidized the construction of the first gas company in 1818, while the king of Spain, Ferdinand VII, showed great interest in the 1827 demonstration shows happening in Barcelona. All over Europe city councils more or less rapidly decided in favour of adopting the technological breakthrough. Savvy speculators and innovating entrepreneurs rushed to offer **a service of lighting** as early as 1820. The formers, such as Winsor, eulogised their bids without always being entirely able to master the technology needed to build a budding network. The latter, such as Danré in Italy and others in France and Sweden, were able to raise capital, find equipment manufacturers and hire the necessary technical engineers. Some companies whose objectives were ambitious, such as British company Imperial and Continental, multiplied submissions all over Europe. In the 1840s, Engineers specialised in the building of gasworks, English for the most part, helped the gas industry to reach the largest urban centres.

The first electric lights were not always located in cities: often, the pioneers in the field were factories, as was the case with the Finlaysson factory in Tampere in Finland or in Resita in Rumania at the same date in a **metallurgical factory**. As a rule, the new lighting system was first tried out in the smaller factories, before bids were extended to large cities. One of the first initiatives of the kind occurred in Hungary. Thus the modernisation of corn mills incited Ganz and Mechwarth to approach a young engineer, Karl Zipernowsky in 1878 so that he should lay the foundations of an electro technological industry in central Europe. After the first successful attempts, Ganz then approached the mayor of Budapest and tried to convince him to switch from gas to electric lights. But as occurred in many cities, the Budapest municipality was reluctant to allocate public money to a technological innovation that remained rather mysterious: the entrepreneur would have to risk his own capital. Hungarian engineers nevertheless managed to take the market of public lighting and they prevailed over Edison's company (all the more so, as they had made the technological choice of alternating current which guaranteed a more efficient transport). It is worth noticing that Hungarian company Ganz failed to serve German territories, but thanks to its system, it managed to serve Vienna, Innsbruck, Milan, Turin, Cologne, Lucerne, Sofia, Belgrade, and Stockholm. In 1906, the Hungarian situation differed from the German one insofar as 44% of the electric power produced was used for lighting. But Budapest on its own used up 60% of the electric power produced nationwide in those days. In Bohemia, Prague had the largest thermoelectric power plant in the country (coal was very cheap. Setting aside these two countries, use of electric power to provide lighting was not as prevalent in central European nations. However, one must consider that a plant providing a city with power used essentially for lighting is in fact underused (it runs at only 10 to 20% of its full capacity); to make electric power profitable,

either only some areas with a high purchasing power should be served, or new markets (such as industry or public transports) need to be found.

1.2 The specifications that went with the **contracts** granting concessions reveal what municipal officers expected to derive from a network of gas-powered street lamps. Nighttime security is constantly regarded as the main contribution of a light that burns brighter than oil **street lamps**. But nightlife was possible only in a few privileged districts – the same as could boast of a more lavish lighting, of colourful shop-windows and of a public space no longer plunged in semi-darkness. Private lighting contributed to increasing the impression of illumination when the candelabra lining public streets were reinforced by the blazing light around theatres, the flood of light streaming from dance halls and the appealing, because brightly-lit, terraces of coffee houses. The extension of networks stemmed from several factors. Contracts sometimes stipulated the obligation to schedule network extension and connexion programmes. It was the **concession holders'** responsibility to extend the network of pipes in each and every district of the city, while taking into account the state of the market and the needs in terms of public lighting. Of their own initiative, the gas companies naturally inclined to develop networks in the most profitable areas, linked the expansion of their networks with the connexion of public buildings and a higher proportion of lamp posts. Some districts became appealing due to high quality property development programmes. Thus, in Paris, the dynamic of urban rehabilitation set in motion by Haussmann during the Second Empire, fostered the extension of gas distribution networks in the western part of the capital.

Clearly, electric power was more costly than gas, but, in 1882, its Russian advocates claimed that it burns regularly, gives off less heat, does not pollute the air et does not emit a whizzing sound. All these arguments are used in the various cities of Europe and they are especially used against gas-powered lights (sometimes they are aimed at **kerosene** or oil, two other fuels used to provide light in urban areas). In public places such as theatres which were flooded with light, the heat and the smell from lights were as a rule considered as a nuisance. The inevitable impression of urban glamour that went with the spread of electric power can be detected in many cities and particularly in capital cities. When **World Exhibitions** were held, demonstrating that the capital was a modern city – which meant that it had gone electric – was a must. When Rumania had become an independent country, after the 1877/78 war, Bucharest did her best to show that it had achieved the status of European capital. In this particular case, authorities proved strongly supportive of the first attempts to provide the city with electric lighting. As of 1882, the city consequently accepted the proposal made by the Austrian subsidiary of an English company. In 1878, Paris did likewise to demonstrate that the 1870 defeat had not condemned it to play a secondary role. However, the most prestigious installation in Europe undeniably was the illumination of Berlin, and in particular that of *Unter den Linden*, together with that of the major thoroughfares of the city. The management of the BEW electric company (a subsidiary of the powerful industrial firm AEG) noticed the public's preference for electric lights, in particular to foster a more lively nightlife. These exceptional circumstances gave opportunity to a lavish show of electrical effects. For Queen Victoria's Jubilee, electric candelabra reproducing the colours of the rainbow or electric crowns placed on the tops of buildings lined London's streets.

1.3 The installation of gaslights along the streets starting in the 1820s brought about a debate on the deserts of the new technology compared with the more traditional oil lamps. Several arguments were used against gas. The noxious effects of gas fumes were accused of causing trees to waste away. The "ghastly" colour of the gas flame, which gave the loveliest women a livid complexion, revealed an eye untrained to the quality of the new light. The permanent

commotion caused in the streets because of the necessary works was regarded as a nuisance imposed on city-dwellers. A few resounding speeches were delivered, in defence of a waning industry – the age-old market of oil slipping away from colza and **oeillette** farmers. All this criticism reveals how difficult it is for a new technology to conquer a market, as if modernity was first and foremost perceived as the destruction of a former state of affairs. Nevertheless, gaslights gained a firm footing in the streets, supported by modern-minded city councillors and enterprising business people. The gains in terms of light and security, the domination of nature in order to defeat darkness and night, converted into assets for rapidly expanding cities. When, in its turn, gas became the target of electrical engineers two generations later, the gas people adopted various strategies: they improved burner performance, they extended networks to reach under-equipped localities, they advertised the heating potential of gas-powered engines. The competition generated by urban demand brought about a concentration of gas and electric companies.

Major cities were choice places where it was possible to make life-size comparisons between the various lighting systems (either opposing gas and electric power or contrasting electric systems with one another). The city turned out to be the place where electric arc lamps and incandescent lamps could be compared. The first device made it possible to illuminate large spaces such as public gardens, parks and squares but its main drawback was that it was very unpleasant to the eye and could not be divided into smaller units. Conversely, incandescent lamps, after Edison and Swan's invention, made the new light much easier to use. At first, when cities put up arc lamps, as was done in Vienna in 1882, the nearby streets that were still lit by gas lamps seemed quite dark. Arc lights were so powerful, that some projects involved lighting a whole city with one single source of light (Think of the 1885 *Colonne Soleil* – Sun Mast- project which might have illuminated all of Paris...) Regarding gas, many city councils, hard put to make a decision, tested the two systems in nearby streets. This was done in Paris, in the 1880s, in Avenue de l'Opéra and Rue du Quatre-Septembre. If some cities chose one competitor over the other system, other cities allowed the two systems to harmoniously exist side by side. On the eve of the First World War, the Melbourne experts who were visiting Berlin noted that arc lamps and gas lamps coexisted harmoniously in the German capital. In Petersburg, in 1914, 47% of street lamps burned gas, 37 burned **kerosene**, and 16 worked on electric power. In this country, electric power faced competition from **kerosene lamps** rather than from gas (the country produces cheap oil in large quantities). In Russia, before the Revolution, most electrically-powered installations were located in Moscow and Petersburg, which is not surprising, and also in Baku, which is more surprising, except if one considers the rapid expansion of this oil-producing city at the close of the 19th century. Finally, it is impossible to ignore the fact that all the European capitals boomed with the noise of the “war of systems” opposing the proponents of continuous electric current (Edison, to name one), who argued that it was safe and those of alternating electric current (Westinghouse or Ganz), which might have resulted in city-dwellers running major risks (comparable to those of lightning). The controversy died out when electric power no longer was produced inside towns but further and further afield: in which case, alternating current became a necessity, and more particularly **three-phase current**.

1.4 Faced with the necessity to establish a new form of public service, the town councillors of large capitals had two essential questions to sort out: they had to choose a distributor and to determine the way the gas network would be managed. More often than not, the decision was made after missions of inspection were carried out in cities that were already equipped. Geneva made its decision after sending two inspectors on visits to Lyon, Grenoble and Chambéry. **The contract form used to grant concession** in Paris in 1855 is inspired from

questionnaires sent to the English distributors. The first decades were dominated by technological transfers involving the British, Belgian and French industries. The most promising cities attracted experienced technicians. A very active search for concessions led them to visit one city upon another. *In the second half* of the 19th century, the gas industry had gained a footing that was firm enough for local initiatives to take place. Technological transfer *resulted in* the training of a competent workforce and channelled *local* capital to these initiatives. Engineers and business people extended the innovation to middle ranking localities. *For a municipality, exploiting the network made it possible to assume its traditional managerial responsibilities* (policing, embellishment) and to fill the local coffers thanks to the growing profits generated by the sale of gas. However, this mode of management remained rather rare. Except in Manchester in 1817, local exploitation prevailed only in countries with a strong tradition of local administration: in Denmark, after 1856, 72% of plants were placed under the local councils' authority. There were 45 % of municipal plants in Prussia in 1877. In England, the ideological thrust encouraging municipal socialism resulted in 4 in 10 plants falling under local control in 1896. In several *continental cities*, where the rent-orientated management of gas companies gave rise to vocal criticism, campaigns in favour of public intervention brought about the elimination of private concessions, as was the case in Darmstadt in 1880 or in Geneva in 1896. In 1902, Germany numbered 58% of exploitations *managed at municipal level*, Switzerland had 36% and Austria and Hungary, 24%.

The electrification of cities was achieved very differently from one country to the next, or even from one city to the next inside the same country. In some cases, the system of the concessions prevailed and few cities dared to own production facilities (As *occurred* in France, for example, with very few exceptions, where municipal power and technical and economic resources are limited). Sometimes, cities wished to remain in control of their initiatives as regards *the sector of energy*. A country like Switzerland (but this is also what happens in Germany), falls into that category – *Zurich, Bern, Neufchâtel are evidence of this* . But Geneva or Lausanne chose to grant short-term exploitation rights. Helsinki placed the production of electric power under municipal authority very early on. Very often, the way cities found to *retain* control of the situation was to grant short-term exploitation rights: 12 years for example in Petersburg or 18 years in Paris. At the end of that period, the city theoretically came into possession of the facilities. In fact, this rarely happened (In 1914, Paris granted a new 26 year lease *of exploitation*). Beside the system of municipal concessions, the legislations of some countries hampered the development of electric power, irrespective of the use it was put to. The strong position gained by the gas industry posed daunting legal questions, when electric power reached maturity and became a serious competitor. This is quite clear in Great Britain, where the Electricity Lighting Act passed in the early 1880s allowed each parish to have its own power plant, which further complicated technical choices. London became a maze for electrical engineers: in 1913, Greater London numbered 65 distributors, 49 different systems, 10 frequencies, and 70 quotations.... This proved all the more a nuisance as London was the largest city in the western world and thus, often served as a model. That's why, despite the brisk start taken by the industry, in terms of the large number of lamps used for public (and private) lighting, as early as the 1890s, London lagged behind because it clung to continuous current. France's legislation did little to foster the industry and some municipalities like Paris worsened the initial choices. On the contrary, Berlin was administered jointly by competent municipal staff and people outside the city council. The city formed a single unit with its industrial suburbs, which was not the case of London (many parishes) or Paris (the city is classically split into distinct *intra-muros* and *extra-muros* areas. In many respects, Berlin was the electric city of the 1900.

2 Modern lights and socio-geographic forms of differentiation.

2.1 The fast development of gas lighting went along with **population density**. But this was not the only parameter. Metropoles, harbours which made importing cheap coal possible or industrial cities were the first to develop networks. Significant chronological **discrepancies** might point *in the direction of* a hierarchical ranking of European cities *in terms of their modernity*, varying in function of the instauration of a public gas lighting service. Brussels, for example, took the decision as early as 1818, eight years before Berlin. Geneva's first public network came into being at Christmas, in 1844. Barcelona starts its own network five years ahead of Madrid, and Lisbon has one in 1848. In France, Paris has its gas-powered street lamps as early as 1818 but adjacent streets are not served until 1829. During the Second Empire, all the *préfectures* and *sous-préfectures* are equipped. Out of a sample of 254 German and Swiss cities, only the major urban centres were equipped before 1850: 66% of cities with populations over 100,000, 54 % of cities with populations between 50,000 and 100,000. A Forerunner, England already numbered 53 gas companies in 1823 and over 1,000 in 1868. In the 1880s only cities that had been by-passed by economic development still needed connecting. Lacking local investors, *they would still attract* entrepreneurs who wished to multiply concessions in order to *bolster* their position on local markets or to increase the rent. Thus, light came to Piraeus in 1889, 30 years after it came to Athens.

The chronological character of the instauration and above all of the development of electric lighting in European cities yields a few surprises. In some cities – such as London – *initial* growth was rapid, but not much came of it. Other cities took a late start but *subsequent* development took place at a sustained pace (Berlin). Others still, *both started early and effectively developed their networks* (Milan). Within a given country, differences are as marked as, *for example*, between the north and the south of Italy. It is to be noted that Milan undoubtedly was a pioneer in the field of electric power, since as early as 1880 it considered switching to *electric power* to provide light in the whole city. In fact it is only in 1882 that, at the same time as the Scala, the square in front of the cathedral (Piazza del Duomo) got to be partly illuminated. Conversely, it took fifteen years for Bologna to take the decision to introduce electric power to light the city centre, especially since the city was reluctant to see its power to decide on local things shrink. In 1898, over 10% of municipalities in Tuscany had electric lighting, in contrast with 1% in Sicily (and a national average of 4,6%). The chart below, which represents the situation in France, shows that there were two important periods of urban electrification, one happening at the end of the 1880s, the other at the beginning of the *1900s*, no doubt *due to a picking up of the country's economy*.

Dates at which the first power plants were built in French cities
with population over 50,000 (1885/1905)

[chart]

It has to be underlined that one of the differences between western and eastern Europe resulted from varying rates of urban density. Only large cities could afford to develop an electric sector essentially based on the provision of light. But the proportion of the population

living in urban centres was only 18% in Rumania, 19% in Bulgaria, 14% in Serbia when electric power appeared. France too was different in this respect: Paris was the only city with over a million inhabitants and the country remained essentially rural in comparison with Germany and northern Italy. Berlin managed to compound the advantages of a large size with the use of electric power under all its forms (in particular the electric engine and electrically-powered transportation means). In the east, only Bucharest and its 350,000 inhabitants offered a market that was large enough. However, the city of Timisoara had a significant network of street lamps at a rather **early (late?)** date (1884), *associating arc lights and incandescent lamps. The system was refurbished* a few years later and the Brush system was partially adopted (street lamps *continued running on* continuous current). It seems reasonable to say that the variations in the chronological progression of electrification result from many local factors: presence of enterprising professionals, benevolence from the municipality, local populations' expectations, urban density, stronger or weaker resistance from gas interests....

2.2 The introduction of gas lights rapidly became *a factor of differentiation defining spaces within a city*. The search for novelty *boosted* areas already made *attractive* by the presence of official buildings, by the possibility of regular visits to their shops and the opportunity for leisure activities they offered, by the appeal of their luxury. In comparison, areas that still resorted to oil lamps gave *a poor image of their population mix*, since technological modernity was apparently not regarded as a priority, there. In Paris, for example, the proportion could be twice as high in one *arrondissement*¹ as in the next one. Inner city *arrondissements* showed the highest rate of lamppost to the acre. The age of equipments and the presence in the city centre of buildings such as the Halles, the Palace of the Tuileries, the Town Hall or the large number of theatres accounted for their high density *with regards to that of* peripheral districts. But what really defines a network being the surface it covers, the advance represented by gas lighting gradually reached the confines of the city. It is not always easy to measure its progression since statistics always tackle the question globally. Thus, Zurich, in 1868, numbered 837 lampposts distributed over some 170 streets and squares. Ten years later Geneva counted 1233 **gas-powered streetlights**. In Barcelona, 1728 lampposts are erected in 1855 and fifty years later, there are over 13,000 **gas-powered streetlights**.

In many cities, electrification, regarded as an improvement, raised the issue of the hierarchy that existed among districts: should they all be electrified, or should only certain areas be electrified? Negotiations were quite tight in Paris or London. The French capital city was divided into slices (the "sectors") so that the city centre should not be privileged in comparison with outermost areas. For Milan, a city that was going through a period of rapid industrial expansion and developing along radial lines, the decision concerning lighting could bolster this or that option in favour of urban development. Opposing on the one hand the position of the city, *which wished* to reaffirm its resolute expansion policy, and on the other hand that of private business companies favouring a regular pace of expansion that focused on the more densely populated as well as the more affluent areas, the divide was by nature strategic. All the more so, as in many countries "municipal socialism" promoted the taking over of public services by the city². However, as regards the spatial expansion of towns, the question primarily remained that of a system of transport rather than the choice of a lighting system. The districts that were illuminated first, tend therefore to have been major thoroughfares. In Russia, projects to illuminate Nevski Prospect appeared as early as the 1880s but were implemented only in 1883 with 32 lampposts making it possible, in each point

¹ Administrative division of the city of Paris comparable to London's inner borough. N. of T.

of the avenue, to “read easily”. Paris chose Avenue de l’Opéra, the Grand Boulevards and the Louvre. Berlin chose Unter den Linden, etc. *The* new appeal of cities was denounced by some as one more way of speeding up rural exodus (France).

2.3 The budget for public lighting, which was multiplied by 3 in Paris between 1860 and 1880, underscores the importance that it was gradually granted. The whole of the expenditure cannot be put down to the amount of gas that was burnt: 25 to 30% of the expense resulted from the putting in of new lampposts, emblems of **the art of urban equipment**, and from labour costs. In the up-to date city, the profusion of light *was a token of a festive life-style*. The social events that attracted throngs of people, such as happened during *world exhibitions* were also the opportunity to try out new technologies. In Paris *streetlamps with burners that recuperated the heat* were inaugurated in 1889. *Custom generating need*, public lighting came to be regarded as a service due to each and everyone. *Democratic access to light became the stake of political agendas*. The issue was even at the heart of debates that spurred opinion campaigns aimed at private companies at the close of the century in London, in Paris, in Switzerland and in Belgium. One of the arguments had to do with the price of gas. *Making gas more affordable to the more modest classes of people, meant that craftsmen were encouraged to use this source of energy, and that most people could gain access to a better, more decent living standard*. *Noticeable* discrepancies existed in London where pre-payment meters fostered the use of gas; in Paris, where the local gas company refused to lower its prices; or in Belgium, in Germany or in Denmark where quotations were lowered to promote gas use in the kitchen. But stress was *also* laid on the generalisation of lighting inside the city *in both* privileged areas and deprived districts. The socialists, in particular, made it one of their favourite themes, *who regarded* lighting as a utility.

Electric light was associated with festive days and *major* commemorative events. It thus assumed an exceptional, enchanting, and of course gorgeous, quality. It enabled municipalities to make a show of their inclination towards progress and the embellishment of the city. Very often, at the close of the century, it took on the same character as fireworks staged in order to capture the favour of the general public. But electric power did not elicit a unanimous response: this new token of Progress had to be provided to the largest number of people as soon as could possibly be done. In London and in Paris, talks assumed a markedly political character. The Parisian left-wing circles for example demanded that “this useful light” be brought to working class areas, rather than “this superb light” being reserved to privileged districts. Some avenues in less privileged districts such as the Avenue de Clichy were indeed illuminated. In fact, these attempts led nowhere and, when the first licence to distribute electric power in Paris expired, in 1907, the east of Paris, mostly inhabited by workers and craftsmen, was still left out of the comforts brought about by electric power. It is worth noticing that in some cities of great renown, it was out of the question to accept electric lines, which would have spoiled the view (an often cited counter-example is that of New York City). But requirements were less demanding in the suburbs.... Lastly, One of the goals of the municipal proponents of electric power was in fact to obtain lower prices for gas, which was often regarded as *grossly* overpriced. However, such a strategy, as was devised by the municipalities in which elected representatives had no inkling how economic realities stood, proved counter-productive. Indeed, the first electric companies were totally incapable of competing with a source of energy whose installations had long come out of the payback period. This political stake – the municipal crusade against the monopoly of gas – explains why in Britain and France electric power took such a poor start.

2.4 Urban iconography crucially shows the contrast between half-lit zones and illuminated areas as a token of *technological* progress. It is a recurring theme which puts to the fore the illumination of passages at the turn of the century, the brightly-lit shop-windows of the 1860s, the lively atmosphere of illuminated junctions at the close of the century. This register demonstrates that gas lighting did contribute *to a significant improvement*. More particularly, it encouraged people to stroll in the streets and became a commercial argument. It was enough for one shop to adopt it and catch the eyes of customers, for other shops to look all the more down-market. Mimetically, gas imposed itself in the street as an essential asset *when it came to attracting* the consumer. A few comparatively well-lit areas soon became *the* places where people liked to stroll. The painters who have rendered the lively atmosphere of imperial Paris have *concentrated* the many-coloured strokes of their brushes on the moment when theatres emptied themselves into the street, on the luminous spots of dancehalls, the halos of coffee houses. The impact of gas lighting on mentalities was all the greater as it was linked with other *technological* advances that multiplied its effect: glass shop-windows, large mirrors, and adequate urban equipment. It remained used essentially inside buildings, altering the general aspect of the street by the sudden profusion of light which reinforced the joint efforts of the street lamp, the candelabra of doorways and of the **lanterns standing on the counters of shops**. The perception of change was *radically* altered when the proponents of electric lighting used this theme in their turn.

It commonly occurred that the buildings first illuminated in cities were theatres, whether inside or outside the premises. The theatre is by definition, in the 19th century the place where one puts in an appearance, where one should be seen (of course one may also go there to listen to music...). The obligation to have electric lights in these places resulted from the many disasters caused by gas (Vienna, Paris and Exeter). The Bohemian city of Brno had its electrified theatre as early as 1882, but one could also mention the Paris Race Course, in 1878, The Opera House in Vienna and the Scala of Milan in 1883. In Bucharest in 1882, the first two buildings to be illuminated were a Palace and the National Theatre. The development of electric lighting changed quite a few other aspects of nightlife. The city should no longer be the realm of semi-darkness (**a twilight zone**), and electric lighting made it a more brilliant and also safer place to be. The consequences were sometimes unexpected: elegant women were compelled to rethink their make up to adapt it to the new light, with its brighter, more powerful and also more cruel quality (testimonies of this are found in Paris and Bucharest). To this list, one can also add the luxury hotels, the vicinity of stations, the markets (to better assess the quality of products), etc. Commercial areas or commercial streets also resorted to electric light to attract passers-by (this was the case very early in department stores which used it as a promotion tool) and this was also a factor of disparity between districts. Undeniably the luxury business could afford to use a costly lighting system, *while more modest outlets were compelled to remain poorly lit*. But even if the difference was already made, the divide separating the city into busy, safe, attractive and illuminated areas and poorly-lit, desert and therefore unsafe districts is made even more perceptible by the development of electric lighting.

3. Repulsion and fascination.

3.1 Due to the nuisance caused by the gas industry, reactions tended to be the same from one city to the next. Reports shoddily drafted by scientific committees testified to the noxious character of gas - its polluting impact as it infiltrated underground water supplies and

blackened the earth. More generally speaking, municipal authorities contributed to the relocating of production sites *away from* city centres. Originally, the limited space covered by networks made it necessary to locate production sites and their gas tanks in the vicinity of the areas they served. Later on, the trend was to build new production sites on the city's margins. And indeed, there had been forerunners –the English Gas Company had, in 1824, built a site in the immediate vicinity of the fortified wall surrounding Paris, *or the Turin company which, in 1838, located its facilities near the Porta Nova*. Economic rationality made it sensible to settle plants on large unoccupied territories, to which raw material could be easily and quickly delivered. In point of fact, the major gasworks serving European capitals were located close to the waterways, rivers or canals (Beckton, below London, had docks, and Paris had La Vilette), and were connected to the railways through many junctions. Such an evolution was bolstered by a series of accidents that served as a reminder of the very real dangers posed by the proximity of gasworks. Thus, in 1909, in Geneva, an explosion at the Coulouvrenière caused considerable damage and deprived the city of gas for 17 days.

The burying of underground electric lines involved heavy works which paralysed city centres and generated protests and petitions. More serious, still, in the pioneering days of electrification, it was necessary to locate production sites close to consumers, as long distance transport technology was not yet available. This would anger the neighbouring populations who suffered the nuisance caused by *the noise and the fumes produced* by the steam engines, just as in Petersburg, complaints were made by the orthodox church on grounds that the city's gasworks lay too close to a place of worship. There was a contradiction between the arguments put forward by the electric industry, stressing that it brought comfort and hygiene and the return of sources of pollution inside inner city areas. However electric power's crucial advantage lay in its capacity to travel at the speed of light over considerable distances. Gradually, power plants were first built in the peripheral areas of cities, and later on, further and further away from cities. In mountainous countries, easily available hydroelectric resources made it possible to do away with the black soot produced by the burning of coal. In such cases, everything concurred in favour of electric power. Alpine regions for example (Switzerland, Northern Italy, Grenoble...) were quick to demonstrate the advantages of hydroelectricity.

3.2 In spite of the prevalence of gaslights inside urban areas, this source of energy remained imperfectly mastered. All the exploitations in northern Europe were faced with similar difficulties. It is thus possible to detect similarities in the degree of failure to control gas losses along the pipes in cities otherwise very different in terms of their geographic environment and the age of their networks. Gas leaks resulting from poorly designed pipes or from poor welding techniques were a blight on the industry in its pioneering period. Gas leaks accounted for as much as a quarter of the gas delivered by the pipes! The gap [between networks] closed during the second half of the century when the recruitment of experienced technical engineers became the rule. Experts from France or England moved from one country to another. In the 1860s, the Madrid network was thus completely overhauled by a French engineer trained at Ecole Centrale. In 1903, the Parisian gasmen lost 5% of the gas sent into their network, the same amount as their opposite numbers in London; in Brussels, the rate was down to only 4%; in Berlin it rose up to 7%. In the same way, the statutory penalties, as defined in the specifications, *aiming* to compensate for lighting failures, are evidence that service was not always satisfactory. The technical faults – undue extinction, lanterns whose burners were stopped, flimsy mantles in incandescent lamps – were compounded by the irregularities committed during their rounds by staff in charge of lighting the street lamps up.

Sometimes the advantages of electric light worked against it: it was described as a glare, as either too white or too yellow, or as too steady. Beside its cost, it was blamed for impairing people's eyesight. In fact, the urban consumer wished to have the advantages of both old and new technologies. The very simplicity of electric lighting baffled users. This was mostly due to the immaterial, immediate, multiform character of the new technology, which came as a surprise, appealing and disturbing at the same time. However, this new technology went along with quite a few failures: as regards electric lighting, they were inevitably visible and for quite a long time electric power was associated with malfunctions (especially in the 1870s/1880s). There were a few troublesome accidents such as fires resulting from poor installations (due to the shortage of technical staff and to the coexistence of other underground utility networks – water, gas or the telephone – the putting in of an electric line was not easy work), or electric current leaking up to the surface of the street (which caused the horses to start *because they were fitted with iron shoes*), or it was electrocutions. The position of street lamps lining avenues also *caused* problems: too tall, they were hidden by leafy tree tops in summer; erected in the middle of the street they stood in the way of traffic; too low, they were an inconvenience for the eye... In fact, they could not entirely substitute the gas-powered street lamps especially when they featured an arc light. Thus, they did not always stand in the best place and it is obvious that various solutions were tried out.

3.3 The effectiveness of gas lighting seemed real enough as long as it competed with mere oil lamps. Gas burners set in lanterns equipped with reflectors could be considered as *the most sophisticated advance* regarding light produced by a burning flame. Therefore, technical advances *remained marginal* until the arrival of electric power triggered a new competition. Gasmen responded by designing high-efficiency *burners*, composed of several burners producing a larger luminous mass, but the consumption of gas was proportionate. Solutions tested in Paris were short-lived. Still, the rivalry between gas and electric power triggered a real dynamic of research aiming to develop incandescent gas lighting. Obtaining a higher heating power through the use of a flame-resistant metallic mantle made new solutions possible. The luminous intensity of an *incandescent burner was 15 times higher than that of a plain burning flame*, with a cost that was 10 times lower. Following experiments carried out in Dresden in 1880 by Frederic Siemens, who introduced burners with **heat-recuperating devices**, a great many locally devised inventions came into being, whose renown usually exceeded the frontiers of their country of origin, as was the case with the well-known Austrian engineer, Auer, or with the burners manufactured by the English firm Sugg. More generally, from the 1880s on, municipal authorities were much more concerned with balancing expenditure made to provide urban lighting and effective gains in terms of light. The stipulations introduced in Paris, in the early 1860s, which bore on the quality of the source of light and on the proper purging of the gas, were no longer sufficient. The quality control entrusted to municipal inspectors and the creation of control laboratories goaded the gasmen.

Electric lighting was regularly improved: thus, the first arc lights needed complex mechanical systems ("regulators"). The Jablochhoff **candle / spark plug?** provided a technical solution. Then the many sorts of incandescent lights attempted to seduce the consumer. Rapidly, progress was made in terms of intensity and life-span (and prices went down). The more uses there were, the more necessary it was to find cost-effective and adapted lamps. However, conquering urban territory was a slow process. If one considers the proportion reached by gas lighting at the close of the 19th century in some cities, one must acknowledge that it still had a large share of the market. In 1895, over 5,000 high-efficiency burners and 55 Auer burners

illuminated the streets of Berlin as opposed to 185 electric lamps. In Barcelona, gas fuelled 95% of all street lamps in 1902. Still, the development of electric lighting and of the other uses of electric power was conflated in the catchall term of *electromania* at the end of the 19th century. This means that contemporaries thought that everything could work on electric power and that the possibilities of electric power were limitless, that it represented the ultimate stage of technological progress. The most telling symbol remains the Palais de l'Électricité, in the World Exhibition held in Paris in 1900. There, one could see some of the tokens that had contributed to making electric power an asset of towns: **fountains of light**, which crowds came to see at night or, indoors exhibits of all kinds of lamps and lights, which once more proved that darkness had been defeated. It was not rare to see passers-by stand under an electric lamp just to admire the new light. And the title of journals specialising in reports about the new source of energy, would quite commonly read, worded in all sorts of languages, something like *The Electric Light*.

At the beginning of the 19th century, the concept of modernity is more often than not a derogatory term. Tradition, old ways have to prevail because they stand for a certain social order. Technological revolutions, and in particular the transformation of the city resulting from new systems of lighting, bring minimal alterations to various discourses. The notion that progress is necessary, that change is for the better, prevails. Already the concept of urban modernity poses gas lighting as a break away from the traditional mode of lighting that characterizes the beginning of the 19th century (introduction of an underground network, served from a distance, industrial production of the source of energy that yields light, possibility to serve both street lamps and private installations). Conversely, at the close of the century, gas is viewed as a technology whose limits have been reached, whereas electric power symbolises the technology of the future. The same arguments in favour of electric power had been used to promote gas half a century earlier. Still, the advantages of electric lighting lie in its easy use and its hygienic quality. Throughout the century, the urban consumer becomes more demanding, as he believes that advances must be cumulative, that the city must become nicer and nicer and the street more and more illuminated. The 19th century boosts the image of many new sorts of lamps and lights, which pass from the status of a luxury to that of a basic need. Inevitably the city *plays the constantly reasserted* part of the showcase of progress and comfort.