the victory of the people was celebrated at night with a magnificent illumination; people were firing off guns with joy all night long. The American envoy, Dornelson, took part in the illuminations with warm enthusiasm. A gang of armed burghers and workers turned up at the Russian legation, too, demanding that it be lit up. Meyendorff agreed, not exactly willingly, but the consequences of a refusal would have been serious. In the eyes of the police, these festivals of light soon became as threatening as the darkness that had preceded them. After all, these lights were neither surveillance lights nor lights of royal displays as in the festive illuminations of the ancien régime — they were a revival of the ancient bonfire. Thus the following public announcement appeared on 17 March in Vienna: "As the residents of Vienna have for several days displayed their delight at the rights conceded to them by His Majesty by means of general rejoicing and illuminations, in response to a general desire we ask that, in order to avoid any disturbances and to restore the peace at night, no illuminations take place in the city and the suburbs from today on."

A Flood of Light

The flowers are real, and the trees are of lively green. Every dress and hat stands out clear and sharp in its true colours as by daylight. The trees and flowers are plainly visible in every detail of leaf, petal and twig. The very stones of the gravel walk, the mosaics on the walls are visible.

(The Sanitarian, 1876)

The nineteenth century saw a radical change in public lighting. Until then, lanterns had generally cast a kind of private light; now their beams increasingly began to spread outward. Position

83. Quoted from Untermeyer, Die Revolution in Wien, p. 96.
86. Gazette de Lyon quoted from Ibid., p. 153.

markers and luminous symbols of sovereignty turned into something that actually lit up the street. As technology became more sophisticated, the pools of light around solitary lanterns grew ever larger and finally merged, creating one vast sea of light. This expansion had begun in the eighteenth century, with the railways. The introduction of gas lighting, which multiplied the level of light, gave it a further boost. When the Mall in London was illuminated by gaslight for the first time in 1807, the Monthly Magazine printed this description: "The effect is beyond all dispute superior to the old method of lighting our streets. One branch of the lamps illuminated with gas affords a greater intensity of light than twenty common lamps lighted with oil. The light is beautifully white and brilliant." Although gaslight seemed as bright as daylight compared with traditional lighting, it was not long before it, in turn, was overshadowed. The first experiments using electric light to illuminate the streets took place after 1850. Suddenly, gaslight looked as obsolete as oil-lamps had a few decades earlier. The Allgemeine Zeitung commented on an experiment that took place in St Petersburg in 1850: "The light of the gas lamps appeared red and sooty, while the electric light was dazzlingly white." A newspaper carried this report on the illumination of the Rue Impériale in Lyon in 1855:

As far as the gas flames are concerned, they appear pale and dim; their light is reddish and has little impact on the surroundings. The comparison is perfectly suited to showing how unsatisfactory our present lighting is and how strong and bright electric light is. We went up and down the street several times, from one end to the other, and could read at all distances. Gas lighting had no effect whatsoever on the brightness of the street; it was not turned on at all for three evenings and nobody noticed the least difference.

In the 1870s and 1880s several European capitals installed arc-lights on some of the main shopping streets, with the result that the surrounding streets, still lit by gas, seemed to be in twilight. Vienna is a good example. In 1882, electric lights were installed
The Street

The expansion of street lighting.
Two generations of street-lights are clearly visible. The arc-lights are much brighter than the weakly glowing gaslights and are almost twice as high (Place du Carrousel, Paris, 1880).
(Source: L'Éclairage, 1880.)

Experimental use of arc-lights on the Boulevard des Italiens
(Source: La Lumière électrique, 1881.)

Arc-lights on the Potsdamer Platz, Berlin, about 1880.
(Photograph archive of the Werner-von-Siemens Institute, Munich)
on the Stephansplatz and the Graben. 'Anyone who came out
of one of the gas-lit side streets and entered one of the places
named felt as though he were stepping unexpectedly out of a
half-dark passage into a room filled with daylight.'

The introduction of arc lighting for the first time made good
the metaphorical description of street lanterns as artificial suns.
The arc-light was, in fact, a small sun and the light it cast had a
spectrum similar to that of daylight. In arc-light, the eye saw as
it did during the day, that is with the retinal cones, while in
gaslight, it saw as it did at night, with retinal rods. Stepping
from an arc-light into a gas-lit street fully activated the eye's
mechanism for adapting to the dark, as a medical text written in
1880 describes:

In the middle of the night, we emerge into the brightest daylight.
Shop and street signs can be recognized clearly from across the
street. We can even see the features of people's faces well from quite
a distance, and what is especially remarkable, the eye accustoms
itself to this intense light immediately and without the slightest
strain. But this impression is misleading. As soon as we look away
from the broad thoroughfare into one of the side streets, where a
miserable, dim gaslight is flickering, the eye-strain begins. Here
darkness reigns supreme, or rather, a weak, reddish glow, that is
hardly enough to prevent collisions in the entrances of houses or on
the stairs; in a wood, the most wretched light prevails. The pupil
dilates laboriously and the retina tries to catch the smallest ray of
light. The electric lantern, by contrast, emits a powerful light which
illuminates both sides of the streets, chases away the shadows,
floods every corner with light, because it is reflected from the pave-
ment and the walls of houses, and eventually dissipates into the
clouds.

The aim of all public lighting in the 1880s was to make the
streets so bright that one could read a newspaper and see the
flies on the walls of houses, but the prohibitive cost of electric

87. Elektrische Lichtung, 14 April 1882, quoted from Ernst Retke, Ueber die Uhren, Leuchten
89. The Allgemeine Zeitung reported from St. Petersburg in 1855 that the houses were 'so
brightly illuminated that one could have seen a fly sitting on the wall, even though the
houses were 300 to 450 paces from the Admiralty where the arc-lamp was situated' (quoted
from Hausmann, Das elektrische Licht).

Scene under incandescent lights, 1885.
(Source: Le Lamber électrique, 1885.)
lighting limited the use of arc-light. In Europe only a few especially significant streets, squares and buildings enjoyed the benefits of arc lighting. Ordinary streets remained the domain of gaslight which, to be sure, was modernised extensively in response to the competition offered by arc lighting and, in the form of incandescent gas lighting, increased its output of light fivefold.

Electric arc lighting was unsuitable for general-purpose street lighting for another reason apart from its cost: this artificial sun put out more light than the street could absorb. The problem of dazzling arose — something that had never happened before. The core of the arc-light was so bright, so like the sun, that in contrast to the flame of the gaslight, it could not be looked at directly. Fixing arc-lamps in the positions that had been used for the old street lanterns was, therefore, ruled out. They had to hang outside the normal field of vision, in a place from which only their light was visible — that is, not in the street but above it. The higher an arc-light was placed, the better; this not only cut out the glare, but also meant that a larger area was lit up. (The development of public lighting followed the almost mathematical formula of the brighter the light, the higher the lamp-post.)

Taken to its logical conclusion, this meant that the optimal position for arc lighting was a high tower from where it would illuminate a large area — for example, a whole city. And in fact, long before it was technically possible to produce the required intensity of light, more or less precise ideas existed about public lighting that would no longer be street lighting, but city lighting. In 1703, an individual named Favre submitted a proposal to the Paris Académie des Sciences. It involved putting up 'lampions to illuminate the city at night' in the French capital. Four reflector lanterns, one for each point of the compass, were to be placed 'on top of a column or a tower, to be built at the city's highest point'. As the inventor himself had his doubts about whether

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93. In Paris, they included the Place de la Concorde, the Opéra and the square in front of St. Petersburg, the Winter Palace and Neva River. The number of arc-lighting units produced by Siemens shows how ready this type of lighting was used in public places: of the total of 1,450 arc-lighting systems lanterns had installed by 1880, only eleven were for streets and public places, while 250 were for 'spinning and weaving mills', 236 for 'various workshops, factories, etc.', and 139 for 'theaters, shops and hotels premises' (Okładka, Loups, LCroiss, Lachter, p. 169).

will flood Paris with light like an artificial meteor. It will not be difficult to direct the rays of light and reflect them so that no shadows will remain‘ (original emphasis). \( ^{92} \) Dondey-Dupré proposed using the following experimental model to work out the height and number of towers required to banish shadows:

Build several card houses of varying height. Place an adjustable candleshinck in the middle of them. Now lift the light to the height at which the space between the card houses is lit up without any shadows remaining. If the light is too high in proportion, add one or more lights until all the shadows are gone. If one then measures the differences in height between the highest card house and the highest light, and makes the necessary arithmetical calculations, one can establish that if the houses are of a certain height, the lighthouse has to be a certain amount higher. \( ^{96} \)

For all the shrewdness of his presentation of the incidence of light and the casting of shadow as solvable problems, Dondey-Dupré did not identify the most important element in his scheme: an adequate source of light. In a secretive, alchemistic hint, he did no more than state that ‘the fuel to be used by the lighthouses is the secret of the author, who reserves the right to announce it as soon as a public trial has taken place‘ (original emphasis). \( ^{92} \) The mysterious fuel may in fact have been nothing other than gas. Just at that time, Philippe Lebon was doing his first experiments with gas lighting, and in the same year as Dondey-Dupré announced his projet, Lebon published a small paper entitled ‘Moyens nouveaux d’employer les combustibles plus utilement et à la chaleur et à la lumière et d’en recueillir les divers produits‘ (New methods for employing heating and lighting fuels more profitably and for collecting the various constituents). \( ^{96} \)

Whatever Dondey-Dupré’s mysterious fuel, his was not the only futuristic light tower built in the nineteenth-century imagination. These other towers, which were also intended to bring a second dawn to the urban night, were to be fuelled by gas.

92. Ibid., pp. 5-6.
94. Ibid., p. 7.
95. Ibid., p. 6.
96. See Ch. 1, above.
Joseph Mérie, for example, described a scheme for lighting Paris involving 100-metre-high towers, one in each arrondissement. Théophile Gautier dreamt of ‘lighting up the night with perfumed gas... The light streams forth out of big towers and is brighter than daylight.’

In Europe such ideas remained in the realm of Utopian literature. In the United States they became reality. The work of the inventor Benjamin Henfrey in 1802-3 was a prelude to this development. Henfrey offered to build lighting towers for several towns, but none of them took up his offer. Eventually, however, he got the chance to build one of these structures. In 1802, a 13-metre-high tower (about 40 feet) was erected according to his instructions in Richmond, the capital of Virginia. A theromlamp, modelled on Lebon’s, was placed on top of it. Never more than a passing attraction, this tower cannot have been much brighter than an ordinary nautical lighthouse. Large crowds came at first to view the light, but as time went on, enthusiasm lessened. The tower was soon abandoned and Richmond reverted to the use of lamp posts lit by oil.

When the discovery of electric arc-light finally made it possible to produce the quantities and intensities of light required, many American towns, especially in the mid-West and the West, installed ‘tower lighting’. From towers or masts that varied in height from 50 to 150 metres (about 150 to 450 feet) a powerful light flooded the town. A deeply impressed French observer described the sight in 1885: ‘Electric light inundates the whole town and penetrates right into the outlying districts, which, until then, did not even have a single gaslight.’

Detroit — ‘the only large city in the world lighted wholly by...’

98. Quoted from ibid.
99. In 1802 Henfrey suggested to the City Council of Baltimore that it should erect ‘tall towers with strong lights acting as beacons which would serve to illuminate the surrounding area’ (ibid., p. 42). One year later he submitted a similar proposal to the City Council of Philadelphia. ‘Towers were to be erected in certain parts of the city so that their lights cast from a great height would serve to illuminate entire areas of streets and alleys’ (ibid., p. 45).
100. Ibid., pp. 45-6.
102. Ibid. (1880), p. 35. This refers to the city lighting of San José in California, which consisted of 40-metre-high towers.
the tower system provides a good example of an integrated tower lighting system. One hundred and twenty-two towers lit up the 54 square kilometres (21 square miles) covered by the city. Each one of these towers was about 50 metres (165 feet) high. The distance between them varied from 350 to 400 metres in the city centre to 1,000 metres in the outlying districts. Consequently, the intensity of the light varied.

Gradations in the brightness of street lighting were, of course, nothing new. Since the beginnings of public lighting, there had always been more lanterns in important thoroughfares and shopping streets than in side streets. But in traditional street lighting, the intensity of light varied from street to street. Dimly lit side streets led off brightly lit shopping streets. Tower lighting, by contrast, created districts or belts of light that bore no relation to individual streets. They simply laid themselves over the town like a uniform carpet of light. This light was as invariable as the chequered pattern of the streets it illuminated.

Two totally rationalised and geometrically divided surfaces matched and complemented each other; cities lit in this way were like living Utopias of equality. This was, in fact, one of the main arguments put forward in favour of this type of lighting. The City Council Committee of Flint (Michigan) justified its decision to introduce a tower lighting system by pointing out that this is a system by which not only the streets, but the alleys, railroad crossings, depots, bridges, and even private grounds, are equally well lighted... and it matters not how many streets are opened, or houses built within the district [of a light tower], the light covers the entire space... We claim for it that it may be justly called the poor man’s light, for, by reason of its penetrating and far-reaching rays, the suburbs of the city will be equally well lighted with the more central portions, and instead of a feeble flicker of the gasoline lamps, a clear and brilliant light will permeate the most distant parts of the city.

American tower lighting turned out to be a mere episode in the history of lighting. Thirty years after its installation, Detroit's tower lighting system was dismantled and replaced by 'regular' street lighting. 'The old system of tower lighting', wrote a chronicler of Detroit five years later, 'was more spectacular than efficient.' The same light that thirty years earlier had been admired as a triumph of technology and democracy was now seen to be inadequate and dysfunctional. 'A twilight glow was shed over a wide area,' continues the same chronicler, 'but there was no effective lighting anywhere.' It turned out that for public lighting to be effective, it had to relate to the street after all — it needed to be street lighting. But the notion of lighting up whole cities or parts of cities uniformly from above proved to be an idle fancy of the sort that are produced now and then when technology offers new opportunities. If these are pursued to their logical conclusion, the result is often something that can be called technical monumentalism, in contrast to the practical applications of a particular technology. In the creation of such structures, technical rationality overshoots the mark and ends up in the realms of technical fantasy and pipe dreams. (The boundaries to art often become indistinct in such cases, as the Eiffel Tower shows.) American lighting towers were in some respects a manifestation of this sort of technical monumentalism, but they also represented a technical solution to the problem of lighting that was appropriate to the specific conditions of America — they were practical, functional and, above all, economical. In a country where wages were considerably higher than in Europe, it was simply cheaper in terms of labour to build one high tower than to put up hundreds of lampposts. And European visitors often commented on how cheaply and functionally these towers were constructed: 'In the United States the towers have not been designed with any pretense to anything like unobtrusive plainness, for they are ugly triumonergy looking things, with the most defiant appearance of utter disregard for every other claim except utility.'

Back in Europe, tower lighting remained a Utopian fantasy, and electric arc lighting changed nothing in this respect. But in one case it inspired a project of such monumentalism that this alone justifies having a closer look at it. The scene was Paris; let us return to the monument described in the first chapter.

103. Fred H. Whipple, Municipal Lighting (Detroit, 1889), p. 137.
104. Ibid.
105. Quoted from ibid., pp. 162-3.
107. Electrical Engineer (London), February 1895, p. 129.
The Sun Tower

In the early 1880s a French electrical engineer called Sébiliot set out on a tour of the United States, an almost obligatory part of a technical education in those days. Of all the installations he visited, it was the lighting towers that captured his imagination most vividly. On returning to Paris, he began thinking about trying out something similar himself. He found a soulmate and interested partner in the architect Jules Bourdais, who had just made a name for himself by building the Trocadéro. Soon after, the committee preparing the 1889 Exposition launched a competition for a monumental landmark, and Sébiliot and Bourdais entered their project. This was, to quote the title of Bourdais' submission, a 'Colonne-Soleil, Project de Phare électrique de 360 mètres de hauteur destiné à éclairer tout Paris. Construction monumentale' 108 (a 'Sun Tower, an electric lighthouse, 360 metres high, to light up the whole of Paris. A monumental construction'). Or, in Sébiliot's words: 'Avant-Projet d'éclairage de la ville de Paris par un seul foyer lumineux' 109 ("...a project to light up Paris from a single source of light"). Bourdais was to take responsibility for the architecture, Sébiliot for the lighting engineering. The Sun Tower, along with another project involving a tower, that of the bridge construction engineer Gustave Eiffel, made the committee's short list. Its pros and cons were discussed in detail at the meetings of the Société des Ingénieurs Civils de France, and it attracted a great deal of attention in the French and European technical press. In the end, the Eiffel Tower won the competition, not because it was thought to be impossible to light Paris centrally from the Sun Tower, but because it seemed too expensive, impractical and dangerous. But the fact that Eiffel, too, considered putting an arc lighting system on top of his tower shows how attractive the idea was. 110

109. Ibid., p. 73.
110. During the Exposition, the Eiffel Tower was intended 'to carry an electric light that would illuminate the entire exhibition grounds', reported the Blackwelder's Outdoor Engineer (1886, 40, p. 395). Further, it was not ruled out that, 'as has long been planned, all the streets of Paris could be illuminated from this one, high, central source.'
In style, the projected Sun Tower was traditional, as was the planned building material: it was to be a massive granite column with a diameter of sixteen metres, resting on a cubic pedestal 66 metres (216 feet) high and also made of stone. The shaft of the column was to be decorated with an iron construction in a historical style that gave the whole thing a certain similarity with the Leaning Tower of Pisa. Sébiliot, the engineer, would have preferred a more modern structure, something like the Eiffel Tower; I had originally thought of an iron structure', he confessed, 'but Monsieur Bourdaig, to whom I told my plans, disagreed. In a city like Paris, he said, the "torch-bearer" had to be more artistic, especially as it was so novel a monument and was to fulfill such functions. Apart from that, he argued, a public monument of this nature had to have a longer life-span.\textsuperscript{112}

The Sun Tower was intended to do more than just provide light. The 66-metre-high pedestal was to house a museum of electricity; the top of the tower was to hold a viewing platform for 1,000 visitors. In between, in the shaft of the column, there were to be lifts as well as 'an absolutely empty cylinder with a diameter of 8 metres, that could be used for all manner of scientific experiments — for example, to test the free fall of objects, the compression of gas and steam, the Foucault pendulum, etc.\textsuperscript{113} In addition, there would be space for eighty rooms where patients could receive air therapy. A monumental statue, representing an allegory of the spirit of science, was to crown the structure.

The place selected for the Sun Tower was the topographical centre of Paris, the area around the Pont Neuf. From here, the arc-light to be installed at the top of the tower — at the feet of the allegory of science — was to illuminate Paris within a radius of 5.5 kilometres (3.5 miles),\textsuperscript{114} not directly, but by means of a big reflector above the actual arc-light that would spread the

\textsuperscript{111} According to Bourdaig's admission (See Société des ingénieurs, Vol. 1, p. 58).
\textsuperscript{112} See Société des ingénieurs, Vol. 1, p. 74.
\textsuperscript{113} See ibid., p. 71.
\textsuperscript{114} Le Lambeau Optique (21 February 1886, p. 360) described the system thus: The lanterns are distributed around the rim of the reflector. In a circle with a diameter of 12 metres and a circumference of 36 metres. If every lantern takes up thirty-six centimetres of space, then the reflector can hold 300 high-powered lights. According to Monsieur Sébiliot's calculations, every lamp has an output of 20,000 Candels. The total output is therefore 2 million Candels.
light over a wide area. Additional reflectors throughout Paris would cast the light of this artificial sun into the most distant corners; it would, in Sébiliot's words, 'penetrate inside houses and flats', like real sunlight.  

There is no need to go into the technical arguments with which contemporary lighting engineers pulled this plan to pieces — they are obvious. The main objection, of course, was that especially in the more distant districts, the light would dazzle rather than illuminate.  

If Paris were to have this sort of monumental city lighting at all, several counter-proposals suggested, then it would have to follow the American model and consist of several towers distributed throughout the city — for example, four towers as high as the Eiffel Tower, or 100 towers of 60 to 80 metres (about 200 to 250 feet) in height. A number of towers seemed a better idea for security reasons as well, since a technical breakdown in one tower would not necessarily affect the lighting of the whole city. And finally, memories stirred of rebels smashing lanterns. As in February 1848 when the rebels seemed to be threatening the gas-works, it was now feared that the Sun Tower could one day become the target of attacks by rebels, who might seize it instead of the Town Hall. The Tower would have to be protected against such an attack. The Sun Tower that aroused such fears was itself perhaps nothing but an attempt to prevent any further revolutions — indeed, to nip any such idea in the bud — by flooding the city with light. Fifteen years after the Commune, the biggest nineteenth-century revolutionary trauma for the French bourgeoisie, this motive was not totally irrelevant, even if it remained a subconscious one. (Similarly, one could interpret the Sun Tower's shape — a heroic, monumental column — as a reaction to the Commune's destruction of the Vendôme column.)  

Public lighting that could illuminate a city as completely as the Sun Tower should have done, was an old Utopian dream. Mercier's late-eighteenth-century vision of Paris in the year 2448...

116. "Even if the light were strong enough to penetrate right to the edges of the area, no one would appreciate it. Everybody would turn away from the light tower, dazzled, and the lighting provision would be regarded as offensive" (Blatter-Athenisch Zeitung, March 1887, p. 120).  
117. Ibid. See also Société des ingénieurs, Vol. 1, p. 656.  

In the course of the nineteenth century, the value placed on street lights so bright that 'their combined impact left no shadows at all'. The only conceivable consequence, for Mercier, was an improvement in public morals: 'On the street corners there were no more prostitutes with painted faces and one foot in the gutter, offering their coarse and vulgar pleasures in the language of soldiers, accompanied by obscene gestures.'
light as a guarantor of public morals, safety and order decreased as lights actually became brighter. One of the first people to see that a room in shadowless light offered a new kind of threat was Jules Michelet. In 1845 he wrote about gaslight in the new factories: ‘These newly built big halls, flooded by brilliant light, torture eyes accustomed to darker quarters. Here there is no darkness, into which thought can withdraw. Here there are no shadowy corners in which the imagination can indulge its dreams. No illusion is possible in this light. Incessantly and mercilessly, it brings us back to reality.’ The twentieth century was to experience this relentless light to the full. The glaring and shadowless light that illumines H.G. Wells’ negative Utopian no longer guarantees the security of the individual. It permits total surveillance by the state. The Utopian dream of nights lit up as bright as day was transformed into the nightmare of a light from which there was no escape. ‘A new sort of urban star now shines out nightly, horrible, unearthly, obnoxious to the human eye’ — this is Robert Louis Stevenson’s description of electric arc lighting. ‘A lamp for a nightmare! Such a light as this should shine only on murders and public crime, or along the corridors of lunatic asylums, a horror to heighten horror.’

121. For example, H.G. Wells, When the Sleeper Wakes. ‘Gigantic globes of cool white light showed the jute mainstreets that shone down through the girders and veins’ (quoted from Mark R. Hillegas, The Future at Night: H.G. Wells and the Anti-Utopian, New York, 1967, p. 43).
122. Robert Louis Stevenson, A File for Gas Lighting’, in The Fruits of Fungi (New York, 1907), Vol. 13, pp. 148-49. The electric arc lighting was put into use at the military camps to which arc lighting was put. During the 1880s, especially in colonial areas, arc lighting was as successful as European fever was had been in the eighteenth century. An English foot of Alexandra’s sons several arc-lamps every night, directing their light on to the city and the surrounding rural area — to the great dismay of the Egyptian soldiers, who assume that supernatural forces are at work in this, to them, totally puzzling phenomenon’ (Le Guerre électorales, vol. 6, 1882, p. 566).