

LIGHTING PUBLIC SPACES: NEW TRENDS AND FUTURE EVOLUTIONS

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ABSTRACT

The article is devoted to the history and prospects of the development of outdoor lighting in public spaces with new opportunities of rapidly developing lighting technologies and trends in architecture and architectural lighting, taking into account environmental problems.

Keywords: nocturnal scene, lighting designer, night geographer, tonality of light, lighting pole, lighting mast, trees up-lighting, landscape lighting, LED, smart phone, smart luminous column, light projection (image), lighting effect deconstruction, luminous lounge, autonomous light objects, phosphorescence, bioluminescence, light materials, mastery of darkness, luminous city

1. BIRTH AND ADVENT OF PUBLIC LIGHTING

In the first decades after the end of the Second World War, lighting the public spaces was only about lighting the roadways so that motorists could see clearly at night and detect obstacles or pedestrians, because at that time the cars headlights were very poorly performing.

Initially, in the Middle Ages, the lighting, that was not yet called public, was first concentrated near the places of power (the castle), before then extending to the bourgeois neighbourhoods. The appearance of gas lanterns, incandescent lamps at the end of the 19th century, and then discharge lamps, helped to democratize public lighting by multiplying its presence, even in the poorest urban areas.

More recently, around the 1970s, it expanded to the entire cities territory and to suburban roads.

At the very beginning of the public spaces lighting, long before the advent of the civilization of the automobile and the urban development that resulted from it, the night safety of walking, the protection of property and people were at the origin of the birth and then of the development of public lighting and these subjects persist and remain very current in all public debates on urban lighting, its creation as well as its renewal.

When after the Second World War, the number of vehicles in the city began to increase steadily, continuously and significantly, the issue of the motorists vision appeared and started to greatly influence the functionalist design of public lighting installations, which is still visible today in the vast majority of cities in the world and which is still the one that is mostly implemented by city engineers in the megalopolises under development.

These functional lighting necessities have led to the methodical installation of lighting poles located at the edge of the roadway, and regularly spaced according to their height, to reach the sacrosanct and abstract uniformity of illuminance but routinely prescribed by lighting engineers. From these principles and doctrines were born all the daytime and nighttime images of the streets and all the current pointillist night landscapes of the cities. Only the tonalities of light, linked to the successive technological evolutions of the sources, have modified at the margin these starry nocturnal scenes.

The roadways, lined or not with sidewalks, were illuminated on a regular and continuous basis by lu-



Fig. 1. Tramway line, Grenoble, France (Attica, architects, Roger Narboni, CONCEPTO, lighting design)

minaires fixed on poles of height proportionate to the width of the track and positioned at the edge of the roadway (in a single-sided or bilateral way). When the roadway was lined with trees, a pedestrian lighting system (pedestrian pole or pedestrian luminaire attached to the mast at mid-height and directed towards the sidewalk) was sometimes added. In dense cities, when the built fronts were continuous or when the sidewalks were too narrow, the luminaires intended to light the roadways were fixed directly on the facade (on one or on both sides of the street) at a height also proportionate to the width of the road (Fig. 1).

More exceptionally, a pedestrian mall, an alley in a park or a river bank, were illuminated specifically by smaller pedestrian lighting poles (usually between 3m to 5m high) arranged just as regularly. The light temperature of the public lighting depended on the technological evolution of lamps (incandescent lamps in 1879, mercury vapour lamps in 1931, fluorescent tubes in 1938, halogen lamps in 1958, high-pressure sodium lamps in 1962, metal halide lamps in 1964), and for a very long time technicians did not differentiate the lighting of pedestrian spaces or that of roads.

With the emergence of high-pressure sodium lamps, a new and very technical lighting doctrine was born from the supposed properties of night vision (different from central to peripheral vision), which promoted an orange-coloured lighting on the roadway (high-pressure sodium lamps) and a cold white side pedestrian lighting (mercury vapour lamps) to improve the perception and contrast of motorists behind its wheel. This doctrine prevailed over all Parisian public lighting until the mid-1990s.

It was towards the end of the 80s, with the introduction of the first white sodium lamps (2500 K

CCT) and later the metal halide lamps with ceramic burner (3000 K CCT), when avenues and then streets from the lighting for pedestrian up to the road lighting are getting benefit with a unique tone from facade to facade. With the arrival of the power LEDs in the early 2010s, public lighting is gradually undergoing to a real revolution.

The level of illuminance of public spaces has always increased over time until the first lighting standards appeared (the European standards were published in 2005). The first public gas lights struggled to illuminate the streets due to the optical inefficiency of the lanterns. At the time of reconstruction after the Second World War, an average light level of 5 lx on a road could surprise observers by its high intensity. A few decades later and until the application of European standards for public lighting (followed by the establishment of relatively similar standards by other continents, taking into account the coordination work carried out by the International Lighting Commission – CIE – founded in 1913), it was frequently requested for any lighting project average illuminance levels of 30 lx to 35 lx on roadways and between 10 lx to 20 lx on sidewalks.

This increase in light levels in the city was of course due to technological changes in the sources and optics of the fixtures, but also in response to the supposed expectations of the inhabitants who have always thought wrongly (encouraged by the lobby in the lighting sector) that more intense lighting contributed to the reduction of night-time insecurity and improved road safety. This demagogic response has never taken into account the specificity of our night vision (mesopic and scotopic visions), the need for contrasts in the nocturnal perception, and the time it takes for the eye to adapt to lighting changes.



Fig. 2. Cours des 50 Otages in Nantes, France, 1991 (Italo Rota & Bruno Fortier architects, Roger Narboni, CONCEPTO, lighting design, photo copyright Philippe Ruault)

The European standards negotiated between the North European countries, more appreciative of low light levels in the city than the southern European countries, have fortunately helped to reduce the light levels applicable for city lanes thanks to policies reduction in vehicle speed and better consideration of night-time uses, particularly in the second part of the night (the light levels recommended in the standards are in fact related to the speed and density of vehicles, the presence or not of different types of users, and the light environment).

On the other hand, and until very recently (with rare exceptions initiated in the late 1980s and early 1990s in France, thanks to the nascent profession of lighting designers specializing in urban lighting), the way to illuminate public space has hardly changed since the origins of public lighting. Lighting systems are invariably installed on facades or more rarely suspended between them, and since the appearance of gas lighting and then electricity attached to supports of different heights installed at the edge of the roadway, which can easily be seen when walking in all the cities of the world but also, unfortunately, in all the new neighbourhoods which are under studying as well as under construction.

2. THE FIRST ATTEMPTS TO ILLUMINATE PEDESTRIAN SPACES DIFFERENTLY

The design of the public lighting was conditioned by existing fixtures and lamps on the market. The so-called road fixtures were composed of a special-shaped optic adapted to the lamp and intended



Fig. 3. City centre of Niort, France, 1992 (Roger Narboni, CONCEPTO, lighting design)

to illuminate a roadway much longer than wide. For a long time, these same luminaires, possibly smaller in size and equipped with a lower-powered lamp (and a different light tone) were used for lighting pedestrian spaces. Gradually, optics of shapes more suited to pedestrian spaces have been appeared (revolution optics, symmetrical or asymmetrical). In France, in the early 1990s, the first pedestrian lighting poles with indirect lighting and light columns inspired by those and existing from the 1950s arrived to create new, more comfortable luminous ambiances for pedestrians, Fig.2.

A few years later, projectors originally intended for the monuments lighting were tested to illuminate large pedestrian-dominated spaces. These large projectors were also attached to the surrounding facades, Fig.3. In the mid-1990s, with the development of new optics adapted to the metal halide lamps, lighting designers had the idea of setting up several architectural projectors on large dedicated masts (from 8 m to 14 m height) installed in large squares under redevelopment (in the centre or around the space) to create a more spatial and enveloping lighting that freed itself from the sacrosanct axial regularity and uniformity of illuminance. This type of lighting allowed the number of small masts in space to limit and, thus, to release the views of many verticals at day and night. It also offered the advantage of the certain modularity (by modifying the orientation and setting of the projectors on site according to particular events), although in practice few modifications were made or attempted once the installation approved.

The appearance of the first coloured metal halide lamps or the addition of colour filters also al-



Fig. 4. Sables d'Olonne waterfront, France, 2008–2013 (Gerard Lancereau, architect, Jacqueline Osty & Associates, landscape architects, Roger Narboni & Virginie Nicolas, CONCEPTO, lighting design)

lowed the first tests of coloured lighting in the public space.

The lighting tools for public spaces then diversified with the integration of light effects into objects or benches, Fig.4, mainly at the time using outdoor devices, equipped with white or coloured fluorescent tubes. The ground lighting with fixtures equipped with coloured LEDs or compact fluorescent lamps, which appeared in the early 1990s, have multiplied the possibilities of nocturnal composition of a space, regardless of its size. They were used to draw light paths or to signal a dedicated route or an itinerary (tramway lines, cycle's path, or dedicated pedestrians alley).

The up-lighting of trees and landscaping that of fountains were also important elements of the lighting schemes at the time. Finally, we must also mention the development of architectural lighting, illuminations of facades located around a public space in order to create lighted vertical plans that were fully involved in the light composition and in the three-dimensional nocturnal perception of the illuminated space.

3. LIGHTING UP PUBLIC SPACES TODAY

The public spaces lighting design has changed radically in recent years, although these new approaches remain very marginal on a global scale. The lighting of public spaces has evolved, on the one hand, because the project management teams in charge of the development or redevelopment, under



Fig. 5. Harbor district, Pantin, France (Jacqueline Osty & Associates, landscape architects, Roger Narboni, CONCEPTO, lighting design)

the impetus of public or private contractors, are increasingly using lighting designers since the tendering or competition phase, on the other hand, because the ways of appropriation of nocturnal public spaces have also evolved with new expectations of users but also because the LEDs revolution (which today represents 100 % of the lighting projects sources) has allowed lighting designers to greater creativity and new approaches.

This new design of public lighting spaces is in line with the current designs of development projects that have gradually adapted to the transformation of cities and which are now and primarily concerned with public transport and soft mobility modes at the expense of cars (fortunately for the light designer, thus released from high levels of illuminance and uniformity recommended for roadways). The willingness and growing demand of a large number of elected officials for more nature in the city as well as for development projects more respectful of the environment and biodiversity also influences new urban lighting projects.

The project management teams were able to respond to these new demands by integrating more systematically, in addition to the usual urban architects, landscape architects and engineers, lighting designers (who are more in charge of the nocturnal aspects of the public spaces and not only their simple lighting), but also and according to the projects, ecologists, designers, artists, sociologists and even sometimes philosophers or night geographers, Fig.5.

As a result, the lighting design of public spaces has become more complex.



Fig. 6. Vallée aux Loups Park, Chatenay Malabry, France (Jacqueline Osty & Associates, landscape architects, Roger Narboni, CONCEPTO, lighting design)

It must now, of course, respond to technical, normative, energy, environmental and budgetary constraints, but at the same time it must create attractive and varied luminous ambiances, propose new uses and new night readings of public spaces. It also wants to encourage the interactivity of pedestrians.

The job of lighting designer has, therefore, also gradually evolved to meet all these new challenges and the public spaces lighting is now completely renewed.

3.1. Pedestrian Lighting Poles with LEDs

The design of pedestrian lighting poles has grown enormously over the past decade, thanks to the many possibilities offered by LEDs in terms of range of light effects and dedicated optics, the de-



Fig. 8. Epars square, Chartres, France (Reichen & Robert, architects, Jacqueline Osty & Associates, landscape architects, Roger Narboni, CONCEPTO, lighting design)



Fig. 7. Al Azaiba Park, Muscat, Oman (Jacqueline Osty & Associates, landscape architects, Roger Narboni, CONCEPTO, lighting design)

cline of the energy consumption, the miniaturization of sources as well as the multiplication of decorative lightings integrations. Unfortunately, we sometimes see drifts where the whimsical design of the pedestrian lighting pole becomes the only conceptual objective at the expense of the creation of pedestrian luminous ambiances.

These new models of lighting poles, bearing luminous decorative elements and accessories, nevertheless allow public spaces to animate differently and offer to pedestrians and city dwellers more contemporary approaches to urban lighting and more varied visions of night spaces, Figs. 6,7.

3.2. Smart Luminous Columns

The desire to minimize the number of masts in public space, as well as the desire to group different lighting possibilities or needs on the same mast (functional, decorative, architectural, signage) led to the creation of cylindrical modular luminous columns to arrange these various lighting functions at different heights.

In addition, cities have expressed the idea of installing loudspeakers, video surveillance cameras, sockets for luminous decorations and, if possible, television management, presence detection or sensor systems.

Thus, were born and developed in almost all lighting fixtures and supports manufacturers these modular luminous columns so-called smart, beginnings to the announced deployment of “smart lighting”. They also offer electric charging sockets (e.g. smartphones, self-service bicycles or scooters).



Fig. 9. Flaubert Garden, Grenoble, France (Jacqueline Osty & Associates, landscape architects, Roger Narboni, CONCEPTO, lighting design)

These luminous columns smart or not allow the night space to structure and offer several light effects and thus several potentials of light compositions.

3.3. The High Lighting Masts

In the same spirit, spatial lighting from numerous orientated architectural projectors fixed at different heights on high masts was developed. These masts are increasingly drawn, decorated with luminous faults, double skins and light graphics (permitted by the use of LEDs) which makes them visible from afar in the perspectives to architecture and sign the night image of the large pedestrian squares, Fig. 8.

Given the desire of a growing number of Western countries to minimize light pollution and preserve night-time biodiversity in the city, a majority of elected officials have banned the up-lighting of trees from ground recessed fixtures (although this practice had spread significantly in some French and foreign cities in the late 1990s).

The high lighting masts now offer again to the lighting designers the only possibility of down-lighting the trees so as not to disturb animal species with the help of dedicated projectors equipped with LEDs sources which light spectrum has been based on the needs of nocturnal biodiversity to be preserved, Fig. 9.

3.4. Coloured Lights

Coloured LEDs and tuneable white LEDs have also allowed the use and development of coloured or tinted lights in an increasing number of public



Fig. 10. Cultural centre Garden, Saint-Lo, France (Urbanica, architects, Virginie Nicolas, CONCEPTO, lighting design)

spaces' lighting, even if the range of colours offered by manufacturers has been limited in recent years. They struggle to come up with hybrid LEDs engines composed at the client request of a mix of different colours, capable of satisfying the lighting designer creativity.

The coloured light in the public static or dynamic space is increasingly accepted by city dwellers, even if some residents still resist, out of nostalgia for the ancient orange atmospheres supposedly more romantic when in reality they de-qualify the illuminated nocturnal space by their very poor colour rendering index, Fig. 10.

Coloured light can transform the space, create a special ambiance encourage city dwellers to stop to look differently at a place, a garden or a statue.

On the other hand, interactivity with passers-by, the possibility given to pedestrians to choose their own colour and their colourful atmospheres is not yet on the agenda, nor encouraged by the technical services of the cities.

3.5. Projection of Images or Videos

The use of still images or videos projected onto the surrounding ground surfaces, objects, trees or facades is increasingly integrated into the lighting project of certain public spaces. The reliability and robustness of LEDs outdoor lighting fixtures capable of projecting on the ground realistic or highly graphic slides of good light quality, allows these new approaches, although much remains to be done among manufacturers to offer small projectors that can be attached discreetly to masts or nearby facades.



Fig. 11. Harbor district, Pantin, France (Jacqueline Osty & Associates, landscape architects, Roger Narboni, CONCEPTO, lighting design)

Light projections create a world of signs, symbols and graphics, clearly legible, which pleasantly complement the use of light effects alone. The projected images have a strong evocative power because they generate visual emotions, they envelop and immerse the spectators in a poetic light setting or refer them to cultural references that light alone cannot necessarily create, Fig.11.

The projected images are also capable of structuring the ground space or the facades, thanks to their density and positioning. Finally, this projection technique offers the advantage of being able to regularly change the sets or patterns projected and thus to significantly and regularly modify the night space created, Fig.12.

3.6. Ground Textures and Deconstruction of Lighting Effects

More recently, lighting designers have expressed in their public space lighting project a desire for



Fig. 13. Saint-Charles Church square, Lille, France (Atelier Jours, Landscape architects, ON, lighting design)



Fig. 12. Interlude, Valenciennes, France (Roger Narboni & Fanny Guerard, CONCEPTO, lighting design)

non-homogeneity, contrast and a will for textures, and deconstruction of effects created by LEDs on the ground or on the surrounding walls, using specially designed filters or refractors.

The pointillist frame of LEDs in projectors or lighting fixtures, which manufacturers strive to erase to obtain a homogeneous light beam and uniform illuminance, is deliberately decomposed to recreate a mesh on the illuminated surface of more or less blurred light points or effects of textures that will sign the illuminated public space and allow for a more unusual nocturnal composition, Fig. 13. In



Fig. 14. Paris Saclay campus, France (Michel Desvigne, landscape architects, Roger Narboni & Fanny Guerard, CONCEPTO, lighting design)



Fig. 15. Queen Elizabeth Olympic Park, London, UK (James Corner Field Operations, Landscape Architects, MAKE, architects, Speirs + Major, lighting design, Michael Grubb Studio, Executive Lighting Designer, Photo James Newton)

some cases, the refractor filter can be set on site to focus or defocus the desired light effect. In the case of using a mixed LEDs in the device (white tones or different colours), defocusing allows us to create surprising mixed textures and colourful graphics, Fig.14.

3.7. Special or Custom Products

Technological innovation does not necessarily precede the creative desires of lighting designers who want to illuminate public spaces. It is therefore often they who, depending on their project, will solicit new technologies or stimulate new and innovative approaches from manufacturers that will then lead to ranges of devices or accessories that will be integrated into the catalogues. The development of special products by lighting designers and the “customization” of existing devices are also frequently convened for large-scale projects.

At the same time, the incorporation of lighting and lighting effects into outdoor furniture, structures or landscaped elements designed by architects, landscape architects or designers has become more systematic, which has enlarged in a way the panoply of lighting tools available to lighting designers and therefore the diversity of night images created for public spaces. In addition, differentiated computing management of the various LEDs sources and the development of complex dynamic scenarios are also now an integral part of the practice of lighting designers when developing original lighting public spaces, Figs.15, 16.



Fig. 16. Shakespeare's New Place, Stratford-upon-Avon, UK (Timothy O'Brien RDI and Chris Wise RDI, joint Artistic Directors and Co-Designers, Speirs + Major, lighting design, Photo James Newton)

3.8. Luminous Lounges

The idea of imagining luminous lounges, inspired by the desire to recreate a cosy and welcoming interior image in the outdoor public space deemed harder, was initially confined to positioning a pedestrian lighting pole, more or less decorative, near a bench, thus changing the nocturnal image of the small demarcated space, Fig. 17.



Fig. 17. Central station square, Poitiers, France (Antoine Grumbach & Associates, architects, Roger Narboni & Virginie Nicolas, CONCEPTO, lighting design, Photo Xavier Boymond)



Fig.18. Extimity – Lounge lighting – Copyright Roger Narboni & Technilum

Gradually, a real form of living room, more complex and structured, was thought by the designers and set up in some large public spaces to accommodate passers-by or allow them a break in their daytime and nocturnal journey. The light is used to signal this reception space at night and to transform its night image into a break with the surrounding public lighting (through the use of light effects, lighting types or different colours).

More recently, modular and three-dimensional dedicated structures have been designed to serve as both a lighting or lighting effects support, but also a day and night climate shelter, complemented by a whole range of possible functions and services: charging smart phone and laptop, speaker to play music, allowing passers-by to change the light mood, etc.

This next generation of luminous lounges also allow us to create virtual volumes of light and de-

lineate a night space and a light atmosphere localized in three-dimensions, Fig.18. They are the beginnings of luminous, more complex, connected, and interactive spaces that are set to develop in the city of tomorrow.

4. AND TOMORROW

For several years now, in most of the world dense cities, new urban policies have been put in place to reduce the car's space and the speed of vehicles in the city, and to redistribute the public space gained to promote public transport, soft modes and pedestrians. These, major urban, developments should encourage us to revolutionize the way we think about the public spaces' lighting in the city.

The expectation is, therefore, high among all lighting players regarding the development and maturity of the so-called smart lighting. Beyond the real-time adaptation of lighting in public spaces (in terms of light levels and light tones) according to the needs and presence of users, the expected television management of light fixtures and the knowledge of equipment and energy consumption, the smart lighting, the dense mesh of its supports in the public space will gradually become major players in the development of digital uses in the city.

The lighting mast will also become a support of information (traffic, environmental, climatic, tourist), from sensors, light signals and user-friendly interfaces.

Coupled with applications for users' smart phones, new digital services will be able to be offered using the mesh of public lighting: sound infor-



Fig. 19. Portable lanterns, Chengdu Jincheng Greenway, Sichuan, China (CONCEPTO & Winlux lighting, lighting design, computer rendering copyright, Floriane Deleglise, CONCEPTO)

mation, video, city map, tourist or commercial information, ambient temperature, air quality, traffic density, availability of nearby parking spaces.

The LED engines of the luminaires designed to illuminate public spaces, already able to modify on demand the tone of light emitted, will evolve in the near future to take into account in a more systematic way the necessary and imperative preservation of biodiversity at night. This will require builders to provide specific LEDs spectra adapted to the fauna and flora present or to come to the proposed site.

5. IN A MORE DISTANT FUTURE

5.1. A Nocturnal City Dedicated to City Dwellers

The planned scarcity of passenger cars or their absence in the longer term, the gradual disappearance of the lanes used to them will transform the design of the public space to propose pedestrian continuous plateaus from façade to façade, which will no longer need lined-up and regularly spaced lighting pole to illuminate a now defunct roadway. Thus, the city will become again and gradually devolved and dedicated to city dwellers as it was before the invention of the automobile.

The offer of public lighting poles, once they become obsolete, will have to transform and evolve into a range of modular lighting structures capable of creating immaterial luminous volumes and different types of night spaces with various dimensions.

Another urban lighting, different forms of lighting with diverse functions are, therefore, to be invented to respond to these future morphological evolutions of public space. The new lighting systems will allow the city to be illuminated differently, not only to see clearly and to move as it has been the case since the birth of public lighting, but to generate invitations, stopovers, cuts, enlargements that will definitely break with the regularity and rectitude of the public lighting mesh of yesteryear.

These user-friendly spaces and light volumes, capable of providing climate shelter, will also be designed to be dedicated to the well-being of city dwellers (anti-stress environments, taking into account biological rhythms, light therapy, chromo therapy and dark-therapy), to foster dialogues and encounters in the public space. They will generate nocturnal places, immaterial volumes, able to trans-



Fig. 20. Personal halos, 2053, the future of urban lighting exhibition (Roger Narboni, curator, computer rendering copyright, Noémie Riou, CONCEPTO)

form and shape the nearby light environment and to interact visually with the surrounding space by highlighting it, delimiting it, cutting it, to multiply the possible uses and associated services.

They will also offer to passers-by the opportunity and freedom to drive and choose their luminous atmospheres from the cocktails of proposed compositions (intensities, colours, light sequences, types of lighting, distribution in space, effects, volumes, etc.).

In the long run, it is a real democratization of the public spaces' lighting that can be offered to users so that they regain control over their nocturnal environment as well as the luminous ambiances they desire, and finally free themselves from the control of technicians and operators of the lighting sector who have always decided, studied and designed functionally the lighting of the world's cities without real contradiction or citizen debate.

5.2. Autonomous Light Objects

While walking around today with a smart phone has become a no-brainer for city dwellers around the world, while this object that became familiar did not exist thirty years ago and its use became democratized in the late 1990s, the nocturnal urban set will gradually change in the future with the appearance of autonomous portable lanterns that will give users the opportunity to control their near-night environment according to their needs and wishes.

Indeed, even if smart phones are already equipped with a lighting system that allows clear to see at night in the absence of lighting, this one is rudimentary and does not allow the creation of real luminous ambience, Fig.19. And the headlamps used for night trips in the dark (especially by joggers and



Fig. 21. Silhouette, 2053, the future of urban lighting exhibition (Roger Narboni, curator, computer rendering copyright, Loeïza Cabaret, CONCEPTO)

night hikers) are also very simple and unfriendly because they dazzle passers-by.

The creation of autonomous and rechargeable portable light objects, their voluntary networking, will allow passers-by to reconstruct a collective light space, or even illuminate on demand an element of architecture or landscape. These self-contained portable lanterns could be thought of as current economic models of bikes, scooters or electric cars in open access and temporary rental.

The street lighting will no longer be public but shared and could only work in the presence of users.

5.3. Accessories and Bright Clothing

Light emitting clothing and light accessories integrated into shoes, roller skates or skateboards, for example, made possible by the development and

miniaturization of LEDs, batteries and their autonomy, personalize urban dwellers that are passionate about innovation and give them the first forms of nocturnal autonomy, Fig.20.

These panoplies will develop to offer night users, luminous jewellery, adornments, dressing elements allowing them to be seen in obscure urban public spaces, parks or natural spaces of very low light level, but also the ability to diffuse a soft light capable of illuminating their intimate space, Fig.21.

The recent appearance of civilian drones, remotely piloted or programmed to follow a person, and the first experiments to use them as lighting carriers, let us portend a future where the creation of luminous ambiances, the lighting of public spaces, landscapes and architectural sites, can also be made in three dimensions from the surrounding space and not just from the ground or from low-rise masts. These new flying light objects will quickly integrate into the range of lighting designers (they already allow them to create stage and event lighting) to multiply the possibilities offered to night users.

Thus, it is easy to imagine that in the future, the initial function of public lighting, which was to allow to see and be seen, will be gradually contradicted by the freedom given to city dwellers to decide when and how their near night space must and can be illuminated.

This revolutionary transformation of urban lighting into active urban light can pave the way for a re-discovery of darkness in the city and experimentation with sharing and pooling urban darkness.

5.4. Phosphorescence and Bioluminescence

Research on phosphorescent materials capable of being integrated into ground arrangements, prospective studies on the controlled use of genetically modified bioluminescent bacteria, increased understanding of the phenomenon of bioluminescence of



Fig. 22. Bioluminescence, 2053, the future of urban lighting exhibition (Roger Narboni, curator, computer rendering copyright, Noémie Riou, CONCEPTO)

certain plants and animals, augurs a new revolution in non-energy-consuming urban lighting, which will automatically adapt in real time to new urban uses (analysis of ambient light and urban form, users' flows and density, lighting needs, temporalities) and which will be ordered at the request of city dwellers.

These futuristic light sources with qualities and potentials still unimaginable today will lead to the creation of new nocturnal landscapes, natural or urban, totally in tune and in symbiosis with the environment as with the new irreversible trend of re-naturalization of cities, Fig.22.

5.5. The Advent of Luminous Architecture

Since the birth of public lighting in the middle ages, public spaces, i.e. the voids in the city, have always been illuminated, especially at the beginning from lanterns fixed on the surrounding facades.

Historical, modern or contemporary architectures (the city's solids that line the hollows) are sometimes illuminated, decorated with lights or sometimes decorated with signs or light advertisements, but these lighting systems linked to the buildings almost never participate in the lighting of the public spaces, including in the lower strata of the city, close to the pedestrian. Public lighting, including in normative and regulatory terms, therefore, remains totally indifferent to the illuminated or uninhibited architectures it encounters.

With the evolutions in the morphology of cities that can be imagined in the future, the new relationship to be instituted between private and public developments, the role that built fronts could now play in the city, new forms of architecture that could increasingly incorporating structures deployed over the public space, the lighting pole, which today clutter the streets, will certainly disappear to make way for light emitting surfaces, light materials fixed on walls, integrated directly into facades, structures, sub-sides of infrastructure, floors to illuminate the adjoining public space or located below without unnecessarily occupying it.

The building materials of the grounds and facades will become luminous at night to ensure this new perception of the night space.

The advent of light materials for floors and walls will profoundly change the design of the architectures. The relationships Architecture / Urban Space / Light always thought according to the only natural light will be transformed. The architecture will no



Fig. 23. City of Lille's dark infrastructure (Roger Narboni, CONCEPTO, lighting design, computer rendering copyright, Loeïza Cabaret, CONCEPTO)

longer be conceived as today only according to its solar orientation (and the possible contributions of natural light) but also according to its potential nocturnal role in the lighting of adjoining public spaces, resulting in an inevitable transformation, from the illuminated city to the luminous city.

This luminous city in the making will gradually establish for city dwellers a different relationship to the public space who will be accustomed to rubbing shoulders with luminous public transport and pedestrians dressed in lighted costumes or carrying their own lights.

5.6. A Development and a Mastery of Darkness

Since the early 2010s, new lighting strategies coupled with the study and development of dark infrastructures have been initiated on the one hand to reduce the electricity consumption of cities and on the other hand to control light pollution and to best preserve biodiversity at night, Fig.23.

It is in this way that plans for the preservation of darkness were born, capable of being spread over the whole of a city or a large territory in addition to and in support of the green and blue infrastructures.

This subtractive, dark-based approach was initially studied by theorizing the respective roles that public lighting and darkness can and should play in the city, in response to the demands of locals who had clearly expressed, at the time of workshops and nocturnal exploratory marches, their observation of too much lighting in the city and their desire to preserve darkness especially in the great natural spaces.

The dark infrastructure then allowed defining and delineating areas of geographical and temporal darkness, partial or temporary, their links and their

crossings. Once adopted by the elected representatives, it is available in all development projects located on or near the great natural spaces in order to carry out an in-depth reflection on the preservation of ordinary nocturnal biodiversity in relation to the photo-pollution.

When darkness is no longer systematically synonymous of irrational fears or feelings of insecurity, new urban scenarios could be imagined in response to energy crises, the global will to fight climate change and reduce air pollution, in order to experience a rediscovery of the night in the city and the invention of new ways of illuminating that respect the darkness.

The development of environmental mesh, green belts around major metropolises, will play a leading role in changing the nightscape in and around the city. The areas of darkness will gradually expand to

contain and delineate at night the luminous islands formed by the megalopolises. These new large dark territories will allow the human eye to develop and rediscover new nocturnal visual abilities, which will encourage city dwellers to mentally and psychologically rehabilitate themselves to wandering in the dark night.

The gradual abandonment of systematic, continuous and ubiquitous public lighting will pave the way for night learning and new therapies based on the pleasure of being and moving in deep darkness.

The urban night, which has always represented 50 % of a city time, with the corollary transformation of the public spaces lighting, will become a specific territory to be explored in order to better respond to urban changes and lifestyles evolutions of city dwellers which will surely surprise us in a not-so-distant future.



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the world-renowned French lighting designer, visual artist and electronic engineer, President of CONCEPTO studio, founded in 1988, has realized more than 200 landscape, urban, heritage and architectural lightings. In 1987, he launched a new discipline called Light Urbanism. Since then, he has realised more than 140 lighting master plans in France and abroad