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UNDERSTANDING PAST SENSIBILITY TO GRASP PRESENT ARCHITECTURE: THE EXAMPLE OF SOLAR RADIATION

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The sensory turning point in architecture

In the past few decades many authors have highlighted the need to grasp the architectural and urban aesthetic in all its human sensory dimensions, sonic, tactile, thermal, aeraulic, kinaesthetic or olfactive[1]. The various sensory tonalities condition our aesthetic grasp of built environments and the emergence of the ambiances in which we are immersed. For example A. Berleant[2] writes:

> Using sensibility as a key to aesthetic apprehension can illuminate our understanding of the appreciative experience of the arts. But aesthetic sensibility has particularly rich possibilities for identifying and enhancing the aesthetic experience of environment. Perception of the built environment is through multi-sensory bodily engagement. Such aesthetic engagement transforms our environmental perception of space, mass, density, force, and directionality when apprehended not as abstractions but as direct experiences in the acute sensory experience of everyday life. Indeed, it is in relation to environment that aesthetic sensibility may have its most extended development, for environment is the broadest, most perceptually inclusive human context.

This new sensory conception of the human environment is at work in various disciplines. In France the prime movers have been historians and anthropologists such as L. Febvre[3] and R. Mandrou[4], who realised very early on the considerable potential of this new line of investigation. A. Corbin[5] then brought it to its full

[1] See: Zardini, Mirko (ed.). *Sense of the city: an alternate approach to urbanism*. Montreal: Canadian Centre for Architecture. Lars Müller Publishers. 2005. Pallasmaa, Juhani, *The Eyes of the Skin. Architecture and the Senses*. New York: John Wiley. 2005.
[2] Berleant, Arnold. "Environmental sensibility", in: Thibaud, JP., Siret, D. (eds.), *Ambiances in action: Proceedings of the 2nd International Congress on Ambiances.* Montreal: Canadian Centre for Architecture. 2012, p. 55.
[3] Febvre, Lucien. "La sensibilité et l'histoire. Comment reconstituer la vie affective d'autrefois?", *Combats pour l'histoire*. Paris: Armand Colin. 1952, pp. 221-238 (1st Edition in *Annales d'histoire sociale*, No. 3, 1941).
[4] Mandrou, Robert. *Essai de psychologie historique*. Paris: Albin Michel. 1961.
[5] Corbin, Alain. *Le miasme et la jonquille. L'odorat et l'imaginaire social, XVIII^e^-XIX^e^ siècles*. Paris: Flammarion. 1982. Corbin, Alain, "Histoire et anthropologie sensorielle". *Anthropologie et Sociétés*,

expression. In the English-speaking world D. Howes[6] and R. Sennett[7] have also sought to reveal the role of the body and senses in understanding social facts in the course of history. The 'sensual turn', as defined by D. Howes and applied to urban issues, enables us to look closer at the architecture and town planning of the past, no longer seeing them as some sort of still life, but rather as a living milieu, irrigated by multiple streams and sensations related to its activities and partly determining its qualities and identity.

Our own research, over the past few years, fits into this movement. It questions the place and role of sensitivity to direct solar radiation in architecture and urbanism past and present. The sun is a fundamental component of our world, through its vital role, the power of its various tactile forms (brushing against or stroking the skin, but also striking and burning), through the cycles it organizes in our lives, and because its rays afford a glimpse of the power of the cosmos. At the interface between the technical history of radiation in the built environment, on the one hand, and the history of sensibilities and taste for the sun, on the other, our work seeks to lay the foundations of a cultural history of architecture and planning in the sun.

Within this overall context, our main hypothesis is that the relation which societies entertain with solar radiation is a cultural fact which directly influences their symbolic, social and material production, in particular the way they design the architectural and urban environments which they inhabit. In proposing a cultural approach to architecture and urbanism in the sun over time, we aim to show how the built environment reflects and organizes at one and the same time our individual and social relation to solar radiation.

Towards a cultural history of architecture and urbanism in the sun

Many books and articles have analysed the question of solar radiation in architecture and urbanism, focusing on issues relating to energy[8] or hygiene and public health[9]. Work in the field of sociology and ethnography, for example by Martin de la Soudière, in France, throws additional light, of particular interest,

Vol. 14. No 2. 1990. Corbin, Alain, *Les Cloches de la terre. Paysage sonore et culture sensible dans les campagnes au XIX^e siècle*. Paris: Flammarion. 1994.

[6] Howes, David. "Les cinq sens". *Anthropologie et Sociétés*. Vol. 14. No. 2. 1990. Howes, David. *Empire of the Senses. The sensual Culture Reader*. Oxford: Berg. 2005.

[7] Sennett, Richard. *Flesh and Stone: The Body and the City in Western Civilization*. New York: WW Norton & Comapny. 1994.

[8] See, among others: Kryza, Frank T. *The Power of Light. The Epic Story of Man's Quest to Harness the Sun*. New York: McGraw-Hill. 2003. Butti, Ken and Perlin, John. *A Golden Thread: 2,500 Years of Solar Architecture and Technology*. New York: Van Nostrand Reinhold. 1981. Knowles, Ralph. *Sun Rhythm Form*. Cambridge: MIT Press. 1981. Audibert, Pierre. *Les énergies du soleil*. Paris: Editions du Seuil. 1978.

[9] See, among others: Boubekri, Mohamed. *Daylighting, Architecture and Health, Building Design Strategies*. Oxford: Elsevier, Architectural Press. 2008. Carter, Simon. *Rise and Shine. Sunlight, Technology and Health*. Oxford, New York: Berg. 2007. Hobday, Richard. *The Light Revolution: Health, Architecture, And the Sun*. Forres: Findhorn Press. 2006. Campbell, Margaret. "What Tuberculosis did for Modernism: The Influence of a Curative Environment on Modernist Design and Architecture", *Medical History*. Vol. 49. No. 4. 2005. Cremnitzer, Jean-Bernard. *Architecture et santé, le temps du sanatorium en France et en Europe*. Paris: Picard. 2005. Medici, Tullio C. "100 ans de la Ligue pulmonaire suisse: La tuberculose et l'idéal de l'habitat moderne". *Médecine et hygiène*. Vol. 61. No. 2448. 2003.

on our contemporary perception of the climate[10]. More general works on the anthropological dimensions of sunlight have long existed[11], but we have recently seen renewed interest in these subjects with the development of analysis of our sensitivity to sunlight and our taste for its effects in the course of history. Situating his work in the context of a history of such sensibilities, C. Granger has done the groundwork for a cultural history of the construction of the taste for sunlight in western society since the 18th century[12]. Other historians have recently explored the specific question of the relation between solar radiation and the body, focusing in particular on tanning[13]; their analysis reveals the social construction of the relation to sunlight and its importance in the history of the 20th century.

Taking the same route our research offers an understanding of how solar radiation, a fundamental component of life on Earth, acts on the various ways we organize our environment and conceive both architecture and urbanism, which by definition create shadows. Our research seeks to put into perspective the various modalities by which exposure to the sun is expressed, present in discourse on architecture and urbanism since the mid-19th century. These forms of expression reveal the various uncertainties in our grasp of light and solar radiation over time – what we refer to as different 'sensations of the sun'[14] – and the consequences which these various sensibilities have had on the production of built forms. This gives rise to a history of architecture and urbanism in the sun, which is not an incantation to some supposedly 'better' allowance for the sun in the production of buildings (a recurrent feature in the discourse of militant sun-lovers of all eras), rather an invitation to understand the various ways of reconciling human habitat with a natural element which exerts its physical and symbolic force on all of us.

From bathing in light to a solar jet

Whereas exposure to the wind and movement of the air were among the key concerns of 18th century architects, natural light as a distinct phenomenon, likely to influence the layout of towns and shape of buildings only appeared in architectural discourse in the mid-19th century. The social utopias were the first to express this new sensibility. Direct solar radiation does not feature much in these declarations, which put the accent on light from the sky as a whole, as an essential component in construction of an ideal city, in its social and symbolic goals. Celestial light must pour down and purify beings; it is consequently often grasped by analogy with air and

[10] De la Soudière, Martin, Tabeaud, Martine (eds.). "Météo. Du climat et des hommes", *Revue Ethnologie française*. Vol. 39, No. 4. 2009. De la Soudière, Martin. *Au bonheur des saisons. Voyage au pays de la météo*. Paris: Grasset. 1999.

[11] Jobé, Joseph (ed.). *Le grand livre du soleil*. Lausanne: Edita, Paris: Denoël. 1969.

[12] Granger, Christophe. "Le soleil, ou la saveur des temps insoucieux", in: Corbin, A. (ed.)*, La pluie, le soleil et le vent. Une histoire de la sensibilité au temps qu'il fait*. Paris: Aubier Flammarion. 2013. Granger, Christophe. "(Im)Pressions atmosphériques. Histoire du beau temps en vacances", *Ethnologie française*, Vol. 34. No. 1. 2004.

[13] Ory, Pascal. *L'invention du bronzage*. Paris: Edition Complexe. 2008. Andrieu, Bernard. *Bronzage. Une petite histoire du soleil et de la peau*. Paris: CNRS Editions. 2008.

[14] Siret, Daniel. "Les sensations du soleil dans les théories architecturales et urbaines: de l'hygiénisme à la ville durable", in: Beck, R., Krampl, U., Retaillaud-Bajac, E. (eds.), *Les cinq sens de la ville du Moyen Âge à nos jours*. Tours: Presses universitaires François Rabelais. 2013.

water, as a fluid spreading in space and over bodies, which 'bathes' and 'penetrates' buildings to purify, as V. Considerant wrote, when describing Fourier's Phalanstery[15].

If light is a fluid, then hydraulics must inform the technology for bringing it to all places. Accordingly the new hygienic architecture was based on ideas of channelling and diffusion. Space should be laid out in such a way as to allow light to flow, as J-B. Godin specifically notes in his Familistère[16]. As such the designed space 'helps' the luminous fluid to penetrate the dwelling. The channel of light is the luminous cone which one may draw on the cross-section views of streets and courtyards. The engineer J. Borie, who published radical proposals for urban reform entitled Aérodrome in 1865, explored this approach to light, making a direct connection between 'the amounts of light falling on a structure' and the cones opening onto the sky[17]. In his demonstration, which involves cones of light plotted on the basis of non-specific rays, there is never any question of aspect, time of day or season. The light cone acts as a funnel, channelling and dispensing celestial light which is assumed to flow down in a uniform stream. Direct solar radiation is wholly absent from this approach to conceptualizing the light of the sky.

Then, in the last two decades of the 19th century, the perception of natural light as a fluid which bathes buildings and beings gradually gave way to a stricter geometrical representation, defined by the dynamics of the ray of sunlight marking out clear-cut planes, volumes and shadows. This shift opened the way for a new era in natural light, which may be defined as a solid or angular age, the time of the sensation of a 'solar jet' induced by the dynamics of the sun.

The discovery of microbes, on the one hand, and the role of direct solar radiation in killing microbes, on the other, contributed to this shift. Statistical studies of housing conditions in industrial towns drew attention to the part played by darkness in the spread of tuberculosis. The ability of the environment to combat the spread of tuberculosis was demonstrated and this role specifically involved direct exposure to solar radiation. Up until the end of the 19th century direct exposure to the rays of the sun could be seen as a discomfort better avoided, then it gradually became a part of the hygienic ideal[18]. The architecture inspired by this new 'sensation' of the sun replaced the hydraulic analogy with an optical metaphor. Above all this was to be an architecture of opening and exposure. The bath of liquid light which prevailed in the theory of the previous century was no longer adequate. Buildings must be opened up to a powerful 'jet' of direct light. The recommendations made by tuberculosis conferences served as a scientific justification for demands for more sun, which became an absolute imperative in architectural and urban thinking.

This prompted a huge debate, in France and elsewhere in Europe, on what 'maximum' insolation might mean. Many authors asserted that the solar optimum could be defined simply in terms of length of exposure. The body was seen as

[15] Considerant, Victor. *Description du phalanstère et considérations sociales sur l'architectonique*, Paris: Librairie sociétaire, Librairie phalanstérienne. 1848.

[16] Godin, Jean-Baptiste. *Solutions Sociales*. Paris: Le Chevalier Editeur. 1871.

[17] Borie, Jules. Aérodomes, Essai sur un nouveau mode de maisons d'habitation, Paris: Morris et Compagnie. 1865.

[18] Medici, Tullio C. "100 ans de la Ligue pulmonaire suisse: La tuberculose et l'idéal de l'habitat moderne". *Médecine et hygiène*, Vol. 61. No. 2448. 2003.

a photographic plate which soaked up light: it should be exposed to the rays of the sun as long as possible, regardless of the season or time of day. Following this assumption, the optimal alignment for a road network was north-south, exposing alternately east and west-facing walls. In particular this led to the heliothermal theory of A. Augustin-Rey[19], reused by Le Corbusier in his Ville Radieuse (radiant city) project in 1935[20]. Others, on the contrary, maintained that the duration of exposure was not the only factor: variations in the angle of incidence of sunlight over time should also be considered. In the first decade of the 20th century the theoretical work of F. Marboutin, among others, demonstrated the superiority of south-facing facades in summer and winter.

The aspect controversy remained a topic for debate in hygienic architecture until the outbreak of the second world war[21]. At the same time as these ideas on the optimal solar exposure of towns and buildings developed, new building techniques using concrete, steel and glass opened the way for the material expression of Modernist aesthetic principles. Extending the use of glass roofs, as seen on 19th century markets and arcades, vast lightweight glazed facades started appearing on early-20th century housing projects. This in turn confronted architects with the problem of the greenhouse effect, prompting an emblematic invention of the Modern movement: the 'brise-soleil' capable of acting as a diaphragm in front of the sheet glass deployed by the new 'optical architecture'[22].

From a solar jet to an energizing flux

From the 1960s onwards the solar age, with its beaming, radiant architecture, went into decline. With widespread use of Penicillin after the second world war, exposure to sunlight came to play an insignificant role in prevention of tuberculosis. In the post-war years this architectural style lost its hygienic justification. Furthermore, in the context of economic growth, large-scale urban development and abundant, cheap energy which characterized this period, lighting, heating and ventilation systems encouraged most people to forget the random side of the elements.

However at the beginning of the 1970s the first oil crisis once more focused attention on the use of alternative energy sources, in particular solar. This went hand-in-hand with the quest for a new social order, breaking away from the consumer society. New solar utopias took shape, harking back yet again to the Civitas Solis and the age of Solarians, and the Cité Radieuse, whether real or merely projected.

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[19] Augustin-Rey, Adolphe, Pidoux, Justin, Barde, Charles. *La science des plans de villes, ses applications à la construction, à l'extension, à l'hygiène et à la beauté des villes, orientation solaire des habitations*. Lausanne: Payot et Cie, Paris: Dunod. 1928.

[20] Le Corbusier. *La ville radieuse: éléments d'une doctrine d'urbanisme pour l'équipement de la civilisation machiniste*. Paris: Editions de l'Architecture d'Aujourd'hui. 1935.

[21] Harzallah, Amina, Siret, Daniel, Monin, Eric, Bouyer, Julien. "Controverses autour de l'axe héliothermique: l'apport de la simulation physique à l'analyse des théories urbaines". *International Conference Changing boundaries: architectural history in transition*. Paris: INHA. 2005.

[22] The history of the invention of the 'brise-soleil', from the end of the 1920s to the beginning of the 1950s, was explored in our previous research works. Cf. Siret, Daniel. "Généalogie du brise-soleil dans l'œuvre de Le Corbusier: Carthage, Marseille, Chandigarh". *Cahiers thématiques : architecture histoire conception*. No. 4. Lille: Ecole nationale supérieure d'architecture et de paysage. 2004.

In his famous 1978 book D. Wright describes the coming of new 'solar citizens', who would take responsibility for their lives and natural environment, drawing intelligently on the resources of sunlight[23]. This new solar age, setting aside the solar jet and switching to a stream of energy capable of meeting the economic and social demands prompted by the crisis, has renewed the relation to the sun, driving new changes in the built environment. Solar capture in architecture, first studied in the early-20th century particularly in the United States[24] and experimented all through the Modernist period, is once again moving centre-stage. Passive exploitation of radiation, its conversion into heat through greenhouses and storage in the adjoining thermal mass, has opened the way for bioclimatic architecture which is now developing original solutions, in particular for individual housing. Meanwhile the principles of active capture, using thermal or photovoltaic solar panels have gradually been established. At the start of the 1970s G. Rottier's utopian Ecopolis revealed a whole town designed in terms of its relation to the sun[25]. In 1979 G. Alexandroff projected towns equipped with heliostats large enough to collect the radiation falling on a whole town, concentrate it and divert its heat into inter-seasonal storage[26]. The first projects involving roof-mounted photovoltaic arrays feeding into the grid were launched in the 1990s, entering the mainstream in the early 2000s.

The architecture of the past is both familiar and exotic

The brief architectural excursion offered by this article shows that in the past 150 years architecture, in its discourse and forms, has apprehended sunlight in different ways. We have organized them into three main moments, three main 'sensations' which condition three approaches to organizing the urban environment. The first is the sun bath with its fluid, almost liquid conception of light, which must quite literally bathe the city and its bodies; it defines an architecture of channelling and diffusion inspired by hydraulics. The second sensation hinges on the solar jet, an almost solid directional light which forms a powerful jet purportedly shining on the city and its bodies. Bodies and facades strip off and expose themselves to the sun. This architecture of exposure defines the 'radiant' city, which presents itself in black and white, the black of the shadows cast by exposed volumes, and the white of the sunlit facades. The third and last sensation, which we are now experiencing, centres on the flow of energy. Light has become an energizing resource for both beings and buildings. Captured, converted and stored it has become a commercial good, over which thinking on the sustainable city exercises ambiguous control.

[23] Wright, David. *Natural Solar Architecture: A Passive Primer*. New York: Van Nostrand Reinhold Company. 1978.
[24] Siret, Daniel. "William Atkinson, pionnier de la science de l'ensoleillement en architecture en Amérique du Nord". in Mondini, D. (ed.), *Light and Darkness in XX Century Architecture*. Mendrisio: Accademia di Architettura. 2014.
[25] Ragon, Michel. "Urbanisme et énergies solaires". *Revue Urbanisme*. No. 139. 1973.
[26] Alexandroff, Georges. "Les feux du soleil. La ville solaire", *Techniques et Architecture*. No. 325. 1979.

Our analysis seeks to contribute to an understanding of past sensations in order to perceive present architecture. It aims to overcome the various forms of anachronism in our interpretation of past architecture. The latter is both present and familiar, because it accommodates our daily activities and because we have grown used to it. It is also exotic, resulting as it does from reasoning and sensibilities different from those we know today. A period of architectural and planning history cannot be summed up exclusively in terms of its 'style'; it must also be understood through the specific sensibilities of the men and women who inhabited it, their way of being in the world. Understanding these past sensibilities may make the familiar architecture of our present unexpectedly exotic.