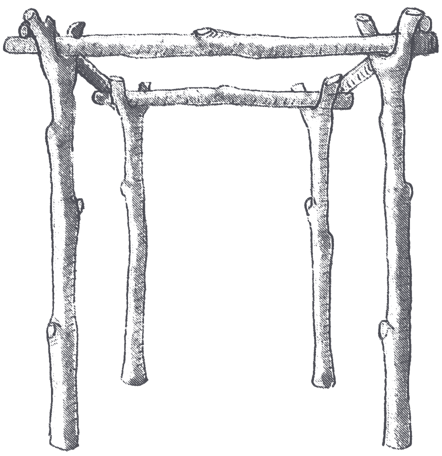
PAVILLON DE L'ARSENAL

Press kit

NATURAL HISTORY OF ARCHITECTURE

HOW CLIMATE, EPIDEMICS AND ENERGY HAVE SHAPED OUR CITIES AND BUILDINGS



Guest curator
Philippe Rahm

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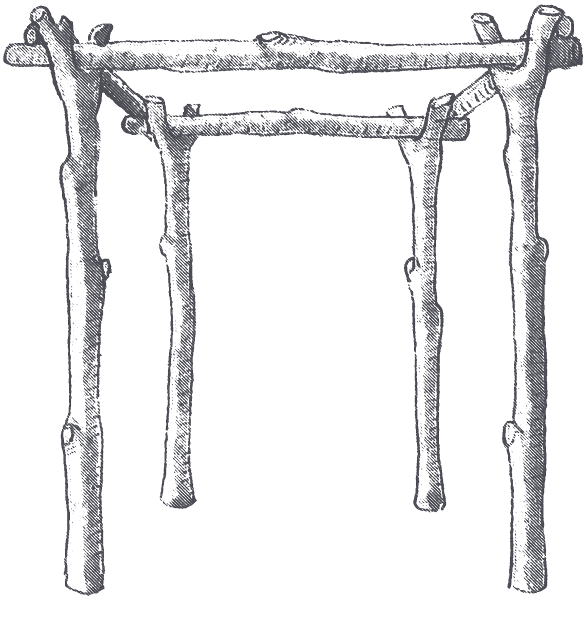
The history of architecture and the city as we've known it since the second half of the twentieth century has more often than not been re-examined through the prisms of politics, society and culture, overlooking the physical, climatic and health grounds on which it is based, from city design to building forms.

Architecture arose from the need to create a climate that can maintain our body temperature at 37 °C, raising walls and roofs to provide shelter from the cold or the heat of the sun. Originally, the city was invented as a granary to store and protect grain. The first architectures reflect available human energy. The fear of stagnant air brought about the great domes of the Renaissance to air out miasmas. The global cholera epidemic that began in 1816 initiated the major urban transformations of the nineteenth century. The use of white lime, which runs throughout modernity, is above all hygienic. More recently, oil has made it possible to develop cities in the desert... and now, carbon dioxide is driving the architectural discipline to reconstruct its very foundations.

The exhibition offers three chronological itineraries in one: the untold history of architecture and cities grounded in natural, energy, or health causes; the development of construction materials; and the development of energies and lighting systems through full-scale objects. This new approach, which could be described as an objective one, brings various historical ages closer and forges unexpected links. The secular whiteness of the roofs of Shibām in Yemen resonates with the project of modernity, the invention of the decorative arts with today's thermal curtains, domes with the ventilation of social housing…Taken together, this brings out the real foundations of the forms, materials and arrangements that are necessary for living purposes, as well as storage, cooling, protection, ventilation, care and so on.

The exhibition and its companion volume, will highlight the natural, physical, biological and climatic causes that have influenced the development of architectural history from prehistory until today, in order to understand how to face the major environmental challenges of our century and build in a better way in response to climate urgency and new health challenges.



FOREWORD

Alexandre Labasse
Executive director of Pavillon de l'Arsenal

There is no history of architecture that is not also a prospective vision of the construction of the world. Every treatise is fascinating in how it bears witness to both the evolution of humanity and the know-how (or heritage) of tomorrow.

Dedicated to Emperor Augustus, the first known manuscript takes the form of an encyclopedia of ancient techniques and, at the same time, that of a guide to good practices. Based on the triad of *firmitas, utilitas, venustas*, the ten books of Vitruvius, *De architectura*, established the foundations of classical buildings, which were followed well into the seventeenth century. During the Middle Ages, Villard de Honnecourt's *Portfolio*, which portrays medieval society through religious or secular scenes, naturalist sketches and details of mechanical devices, also served as a vademecum of good practices for builders. The following literatures, notably those of Leon Battista Alberti, Andrea Palladio, Father Marc-Antoine Laugier, Eugène Viollet-le-Duc, Gottfried Semper, Adolf Loos, Walter Gropius or Le Corbusier, which are frequently cited in this publication, offer this double reading. All can be read as accounts of the know-how of their time, but they also question these practices in order to better project the future.

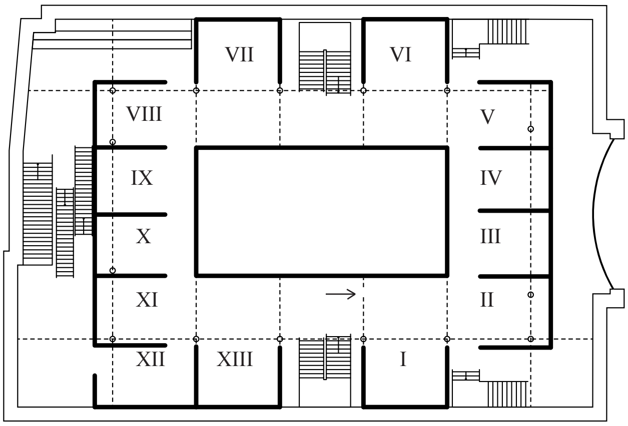
The Natural History of Architecture falls with the same perspective. It is based on the great, mostly Western, urban saga and its daily applications, but re-examines them through the prisms of the climate, health, and energy challenges of our times. To that end, Philippe Rahm engages in a dialogue that goes beyond the sole analysis of the discipline. The cross-cutting studies and works of chemists, writers, historians, engineers, paleontologists, philosophers, physicists inform his chronicle…Scientific discoveries, technological innovations and contemporary phenomenological re-examinations allow us to grasp architecture and the cities once again, not as cultural phenomena, but as the obvious consequences of human necessities.

This unconventional review focuses on fragments from history and pivotal moments, contrasted with contemporary issues. The author reminds us that our homoeothermic nature dictates the design of all buildings, that cities were born to protect the produce that allows us to survive, the history of building sizes depends on the amount of human power available, parks were invented for health reasons, the beginnings of the urbanization of the coast were the result of the fight against rickets and cretinism and that cinema owes its success to the invention of air conditioning. Our historiography summons not the icons and masters of the discipline, but also everyday architectures and oft-forgotten vernacular strategies.

This new chronology, which could be described as “objective”, brings together different time periods and establishes unexpected connections between builders of various eras. The centuries-old whitewashed roofs of Shibām, in Yemen, resonate with the project of modernity, the invention of decorative arts, today’s thermal curtains, the domes of classicism, the ventilation of low-cost housing units, and many more...
The real foundations of the forms, materials and arrangements necessary to live, store, refresh, protect, ventilate, nurse, and so on, then become apparent. Architecture and its transformations can be traced back to underlying natural, physical, biological, sanitary and climatic factors. Even though some programs have disappeared, they still resonate in the present, as is the case of the Persian windcatchers used for ventilation, attics for storage, the ice houses of the Pays d’Arles for food preservation, and lazarettos to quarantine the sick.

The Natural History of Architecture is an adaptation by Philippe Rahm, with the support of Pavillon de l’Arsenal, of his thesis prepared under the co-direction of Philippe Potié and Antoine Picon, and defended on 19 December 2019. The thesis was commended by the jury panel, consisting of Paolo Amaldi, Martine Bouchier, Anouchka Vasak and Chris Younès, under the direction of Bruno Latour. It reflects the commitment of the architect and doctor in architecture Philippe Rahm, who has been investigating the architectural field from the standpoints of physiology and climate for the past twenty years. It is published as a companion to the exhibition, with the same name, produced by Pavillon de l’Arsenal, which demonstrates our desire to share the understanding of the major challenges facing the world today as widely as possible.

EXHIBITION AGENDA



Philippe Rahm,
Architect, Doctor in Architecture

(I) Why did our need to keep our body temperature at 37°C lead to the emergence of architecture? (II) How did the plain wheat granary give rise to the city? (III) How did pulses lead to the development of cathedrals? (IV) How did churches provide freshness during the warm summers of the Mediterranean? (V) When were the decorative arts more than mere decoration? (VI) Why did the fear of foul odours cause huge cupolas to be raised over buildings? (VII) How did a sprig of mint return nature to the city? (VIII) How did a volcano eruption lead to the invention of the modern city? (IX) How did iodine cause the urbanization of the coast? (X) How did the air-dried meat of Graubünden give birth to modern architecture? (XI) How did oil cause cities to grow in the desert? (XII) How did antibiotics enable the return to the city? (XIII) How is CO2 transforming cities and buildings? (XIII)

The Natural History of Architecture highlights the natural, physical, biological and climatic causes that have influenced the course of architectural history and caused its figures to emerge, from prehistory until today. Induced within a context of massive and easy access to energy, that of coal followed by oil, and by the progress of medicine (with the invention of vaccines and antibiotics), political, social and cultural historiography in the twentieth century has largely ignored the physical, geographical, climatic and bacteriological facts which have decisively shaped architectural and urban forms throughout the centuries.

Rereading the history of architecture based on these real, objective and material data will help us face the major environmental challenges of our century and build in a better way in response to climate urgency.

I . HOW OUR HOMOEOTHERMIC NATURE GAVE BIRTH TO ARCHITECTURE

To understand the origin of architecture, we must return to our «homoeothermic» condition and our need to maintain our body temperature at 37°C. In order to do this, regardless of external conditions, the human body regulates its internal bodily functions related to thermoregulation (vasodilation, sweating, muscle contractions, catecholamine secretion) and external means, in particular food, clothing, migration and, of course, architecture. In order to take shelter from the winds that cool the skin by convection, to get protection from the rain that accelerates the cooling of the body by conduction or to hide from the sun whose rays burn by radiation, humans erect roofs and walls.

RETURNING TO THE CLIMATIC EDEN THANKS TO ARCHITECTURE

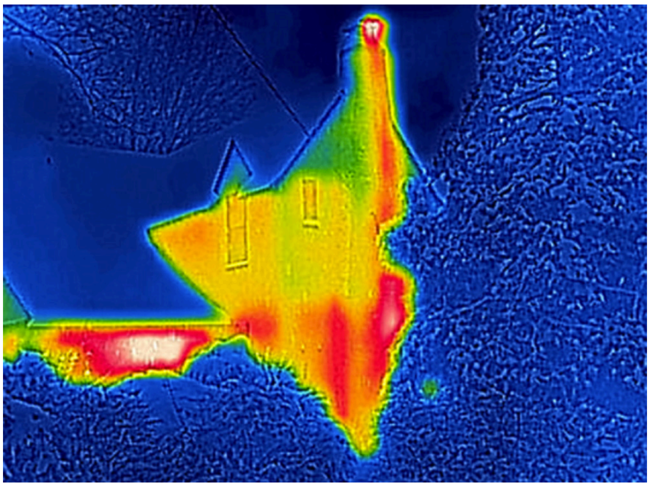
When in their condition of naked apes, human beings are most comfortable under specific and limited climatic conditions, with moderate sun and a temperature between 20 and 28°C. Maybe these conditions match the original climate of the cradle of humanity in Sub-Saharan Africa, as well as the paradise of mythology, the Garden of Eden with its perpetual temperate spring from which Adam was cast out. An amplified, exogenous and artificial form of body thermoregulatory mechanisms, architecture's primary mission is to supply this climatic well-being to humans.

STAYING ON THE MOVE AS A MEANS OF PROTECTION

During the Neolithic, before the invention of agriculture, humans lived from hunting and gathering, following the migrations of animals, moving according to the direct availability of food and immediately eating what their environment offered them. To protect themselves from the elements, they erected structures that were simple and quick to assemble, made of light locally-sourced materials. With their conical shape that resists the winds, such as American Indian tipis, these huts absorb all types of applied forces and do not require any foundation because they are self-supporting.

Adam cast out of Paradise. Drawing by Antonio di Pietro Averlino, the Filarete, *in Trattato di architettura,* circa 1465. Biblioteca Nazionale Centrale Coll., Florence.

Native American women from the Blackfoot Confederacy, raising tipis. Photography, circa 1910. Montana Historical Society Research Center Coll., Helena (Montana, USA).



CLOTHING
AS SHELTER

Clothing and architecture share the function of maintaining a more or less thick film of air around the skin, at an ideal temperature of 20–28°C. Since air is the best thermal insulator, when trapped in between the wool fibres or within the fur (and also in the snow or beneath the ice), it protects the body of the Eskimos against the cold. Inside an igloo, there is a microclimate with a temperature that is up to 20°C higher than the outside temperature.

Eskimos constructing an igloo with blocks of ice. Photography by Frank E. Kleinschmidt,1924. Library of Congress Coll. (Washington D.C., USA) © Frank E. Kleinschmidt.

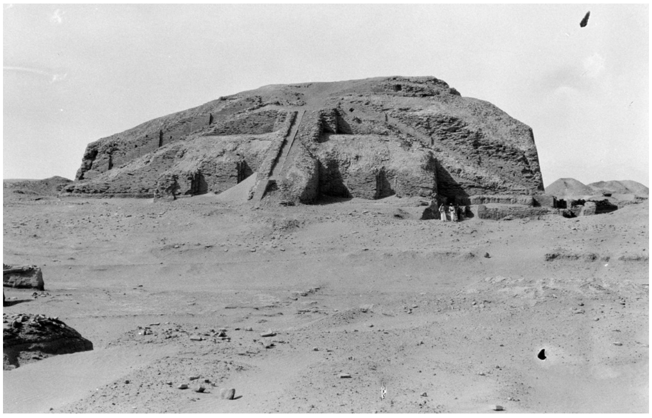
BUILDING
TO RECREATE A CLIMATE

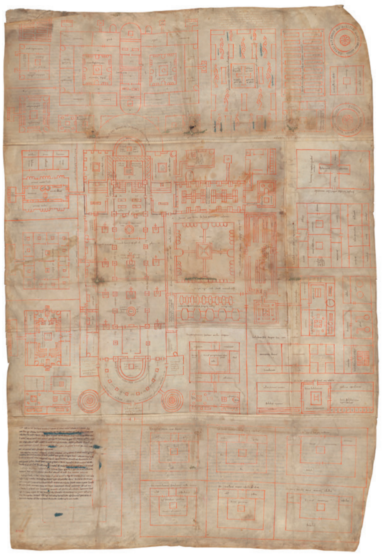
The thermal losses of a poorly insulated building are distributed as follows: around 30% through the windows, 19% through the roof, 16% through the walls, 14.7% from the discharge of combustion gases, 10.5% through the ground and 10% from ventilation. Insulating windows, walls and roofs properly could reduce greenhouse gas emissions by 32.4%. However, the Paris Agreement signed in December 2015 aims for 40% reduction in CO_2 emissions by 2030. Through additional measures on ventilation and the use of solar and geothermal energies, this objective can be achieved through the building sector alone, by improving its energy efficiency.

A forest house during the winter, Ithaca (New York, US), 2019. Thermography by Philippe Rahm. © Philippe Rahm architectes.

II . HOW WHEAT GAVE RISE TO THE CITY

The very first cities were born along with agriculture, at the turn of the Neolithic, dating back 10,000 BCE. Humans went from living in societies of nomadic hunter-gatherers migrating with the seasons, to a life of farmers and pastoralists. Underlying this change is a milder climate. Moist air from the Atlantic and the Mediterranean caused heavy rainfall in the western Middle East: in Egypt, as far north as Mesopotamia, and Sumer and Babylon to the east. The plains of this sunny and humid “fertile crescent” were covered with vegetation. The city then played the role of a fortified granary, in which the peasants deposited their harvest to ensure it was protected from looting and weather hazards.





THE CITY WAS BORN AS A FORTIFIED GRANARY

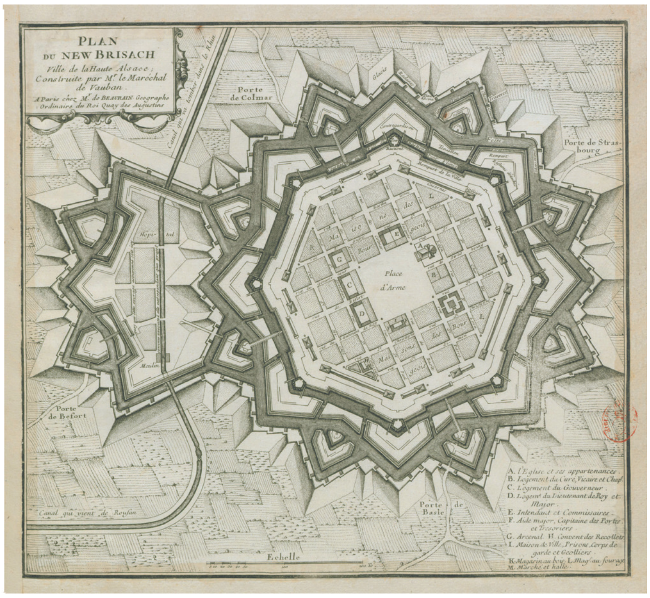
In Sumer, temples doubled as granaries, and priests as wheat stock managers — as archaeologist Tate S. Paulette explains in his description of a ziggurat dedicated to the god Nanna in the city of Ur. Sumerian temples, just as the ziggurats and temples of Ancient Egypt, primarily consist of chambers dedicated to the storage of wheat, which is used to produce bread, and barley, to be used for beer. These were the staple foods of the population at the time. So these temples were first built to serve as fortified granaries, the religious motive remaining ancillary.

ABBEYS AND MONASTERIES AS GRANARIES

After the fall of the Roman Empire in the fourth century, Barbarians, who had been Christianized, no longer attacked abbeys and monasteries where all sorts of economic, religious and social activities clustered together. The idealized plan of the Abbey of Saint Gall, which dates back to the ninth century, reflects the architecture and organization of these monasteries. The urban complex includes a mill, a bakery, stables, an infirmary, a dormitory and more in its enclosure, around the church and the cloister. These religious communities, which were conceived as “ideal cities”, proliferated, and played a key role as warehouses for grain reserves during the High Middle Ages, thus taking up the role of cities in Antiquity. Like the priests of the first Mesopotamian civilizations, monks and abbots administered grain stocks.

The great ziggurat of Ur in Mesopotamia (in present-day Iraq). Photography, 1932. Library of Congress Coll., G. Eric and Edith Matson Photograph Collection, Washington D.C. (USA).

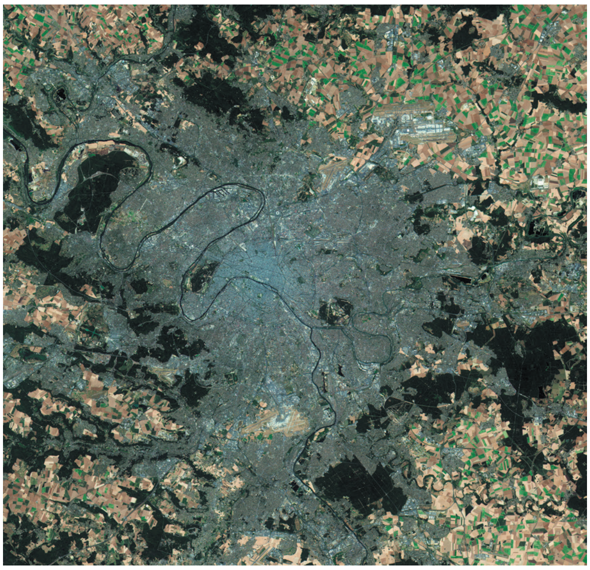
The Abbey of Saint Gall (Switzerland), a Benedictine monastic complex. Idealized plan, early 9th century. Stiftsbibliothek St. Gallen Coll. (Switzerland).



THE DESIGNED AND FORTIFIED CITY

The affluence of Renaissance society fostered the emergence of the architectural profession, in particular with Filippo Brunelleschi and Leon Battista Alberti in Italy during the fifteenth century. In their city projects, the primary task of protecting harvests from looters behind a wall is taken up as a formal basis, leading them to draw rigorous geometrical plans — convex or shaped as stars or circles — with an enclosure forming a barrier against attackers. Cities are designed and drawn before they are built. They must also resist cannon fire and firearms. The defensive geometric shapes, simple and pure, which imparts them with an ideal and geometric quality, lasted until the beginning of the nineteenth century.

Plan of the fortified town of Neuf-Brisach (in Alsace, France), built ex nihilo in 1697 by Maréchal de Vauban. Prepared in 1740. Bibliothèque nationale de France Coll. (Paris, France).



URBAN SPRAWL VS. AGRICULTURE

Before the industrial era, the population and spread of cities would depend on the quantity of grain that the surrounding farmland was able to produce. The massive use of fossil fuels from the nineteenth century onwards broke this original relationship of interdependence. Cereals, fruits, wine, meat and other produce from all over the world could now be transported on demand, including through the use of air freight or refrigerated cargo. Food stocks are no longer only kept in the city, but can be stored anywhere. In Île-de-France, 90% of the food products consumed are imported, though 49% of the surface area is devoted to agriculture. Based on this figure, the food autonomy of Paris can be estimated as being limited to approximately three days.

Paris in focus. Satellite photography captured by Sentinel-2A on 15 July 2015. © Contains modified Copernicus Sentinel data (2015), processed by ESA.

III . WHAT PUBLIC SPACE OWES TO THE SEARCH FOR COOLNESS

In Ancient Rome, the civil Roman basilica, which was a vast covered space with various functions, including trade, justice and leisure (as a place to go for a stroll), served as a public place as much as the open space of the Forum. Its ability to offer a haven of coolness during the summer heat naturally gives it a unifying status. The public desire to provide each district with a cool place seems to have increased starting in the Renaissance: in Rome in particular, there are more than nine hundred churches dating from the Baroque period..

THE BASILICA, A REFRESHING PUBLIC SPACE

In his treatise, *Discourses on Architecture* (1863), Eugène Emmanuel Viollet-le-Duc analyses the public spaces of the Roman era, namely thermal baths, basilicas and temples: “These great Roman monuments...maintain an even, mild temperature within that would be very precious in a climate such as ours...This is due not only to the plan layout drawn in accordance with the Roman plan, but also to the nature of the construction. The thick retaining walls and brick cladding transfer neither the heat nor the cold dampness from outside; they form a neutral obstacle to outside temperatures.” Immense buildings that were devoid of any religious function were thus put at the disposal of citizens by the Roman *res publica.* Similarly to Rome’s Pantheon, they accommodated tribunals, government offices, banking activities and stores, and served as a covered public space.

The Pantheon in Rome, commonly referred to as the “Rotonda”, 126 CE. Engraving by Francesco Piranesi, circa 1790. University of Melbourne Library Coll. (Australia), Baillieu Print Collection.

GATHERING AT THE CAFÉ DURING THE WINTER

The basilica and lime trees offer cool spaces in summer, but the tavern of the Middle Ages, followed by the café of the Age of Enlightenment, brought warmth and conviviality during the winter, as firewood remained expensive and scarce. These were real public spaces, as recognized in the old English name “pub”, which stands short for “public house”. The first café opened in Paris in 1672, followed by Le Procope in 1684. They developed very quickly: in 1710, there were three hundred cafés in the French capital (and three thousand pubs in London). France had 200,000 cafes in 1960 but has less than 36,000 today. The decrease in the frequency of café visits correlates with the generalization of heating installations in homes.

Les Nouvellistes. Etching by Gabriel de Saint-Aubin, 1752.
© The Elisha Whittelsey Collection, The Elisha Whittelsey Fund, 1939.

PUBLIC SPACES WERE BORN UNDER THE SHADE OF TREES

Historically, the climatic quality of a tree precedes public function: there was a lime tree before there was a court of justice, and the shadow of a tree was what transformed a place into an attractive public space. Originally from Persia, the planted space model spread to Greece and Rome during Antiquity. The shade of plane trees, and previously of elms in France and lime trees in Switzerland, causes a drop in temperature that is conducive to the development of public social life. Sheltered by these «urban forests», the community congregate and confer together there. The activities are similar in many ways to those held in the Roman basilica or in the early cathedrals.

Trees and public fountains on Petersplatz, Basel (Switzerland). Engraving by Matthäus Merian, in *Topographia Helvetiae, Rhaetiae, et Valesiae,* Frankfurt am Main, 1654 (2nd ed.). ETH-Bibliothek Coll., Zürich (Switzerland).

CAN GLOBAL WARMING INCREASE THE STANDING OF PUBLIC SPACES?

The climatic qualities at the origin of the emergence of public space are yet again pivotal contemporary concerns. Many cities are seeking to renew public spaces, less for their visual and aesthetic value than to fight against rising temperatures and the growing number of heatwaves. In 2009, in the business district of Ōtemachi in Tōkyō, the landscaper Michel Desvigne was commissioned to design a small 3,600 m2 forest: “We are on a slab, on the roof of a station and a group of buried buildings. The plot was intended to give way to a forest with more than two hundred trees. The trees were pre-cultivated for five years in the mountains around Tokyo and planted identically, so that they would grow together. Five years after the transplant, I can see that it is working very well. In this city that is much warmer than in Paris, the constellation of pocket gardens and small forests in this very dense district provide high freshness value. It goes beyond the decor.”

Urban forest. Ōtemachi, Tōkyō (Japan). Michel Desvigne, landscape designer, 2009–2013. © MDP Michel Desvigne Paysagiste © 45g Photography

IV . HOW PULSES CAUSED THE RISE OF GOTHIC ARCHITECTURE

At the fall of the Roman Empire at the end of the fifth century, the inhabitants of Western Europe were scattered in some of the most remote lands. They sought refuge from the constant looting, and experienced great physical weakness as a result of food shortages and famines. The perpetual state of hunger and these weak muscular capacities brought about a pithy, low-rise architecture, carried out without unnecessary expenditure of energy. The Revolution of the year 1000, which featured the invention of the plough and the development of three-field crop rotation, introduced legumes into the diet. Their high protein content provided the muscle strength that helped elevate the cathedrals that have been preserved to this day. These buildings reflect the direct and fundamental link between built form and the tools and energy required.

THE EVOLUTION OF ARCHITECTURE IS ASSOCIATED WITH A CHANGE IN AGRICULTURAL TECHNOLOGY

After the year 1000, Europe experienced a sudden and rapid change in agricultural practices (with the introduction of three-field crop rotation and the plough), draught animal technology (including horse shoeing, horse collars and improved breeding), as well as the harnessing of motive power sources with watermills and windmills. These simultaneous transformations improved labour efficiency and increased agricultural yields. The consequences were manifold: the population of Europe tripled between the ninth and fourteenth centuries, a bourgeois class appeared, and the spreading of "food affluence", which allowed a substantial part of the population to free itself from work in the fields and devote itself to philosophical, technical, artistic or scientific questions as well as to trade or craft. This is the time when the works of art and architecture that survived into our times were created. The Gothic cathedrals were first born in France, where alluvial lands were ploughed and produced a great deal of wheat.

A FOOD REVOLUTION DRIVES THE GROWTH OF ARCHITECTURE

Between the tenth and the fourteenth century, the North Atlantic region experienced what is referred to as the Medieval Warm Period (or the Medieval Climate Optimum), which was associated with agricultural and technical developments leading to a generalized increase in energy availability. Plant protein provided humans and work animals with the physical strength to extract, transport and raise stones to build cathedrals, hospices, guild houses, castles and fortresses differently. Urban and architectural forms changed; buildings became larger and taller and more massive. "In the span of three centuries, from 1050 to 1350, France extracted several millions of tons of stone to build 80 cathedrals, 500 large churches and tens of thousands of parish churches." (Jean Gimpel in The Cathedral Builders, 1958).

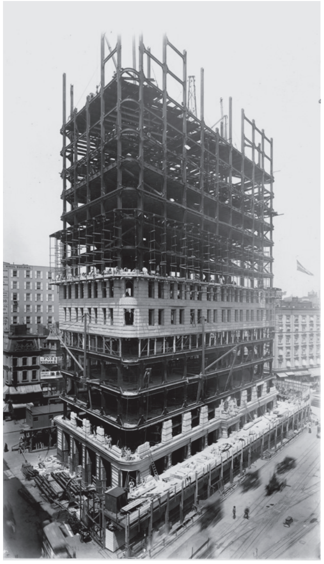
Mars (The month of March). Miniature by the Limbourg brothers for *Les Très Riches Heures du duc de Berry,* early 15th century, folio 3.

Rebuilding of Troy by Priam. Miniature by Jean Colombe, circa 1490. Kupferstichkabinett Coll. (SMPK), Berlin.

AN ARCHITECTURE LINKED TO THE AMOUNT OF ENERGY AVAILABLE

The invention of the steam engine, which transforms heat generated from the burning of coal into mechanical energy, multiplies the potential energy of each worker by a hundredfold. With the invention of steel and the advent of rail transport, the industrial revolution of the nineteenth century made it possible to erect huge structures quickly and easily, such as London's Crystal Palace, for which architect Joseph Paxton worked with engineer Charles Fox and his firm, Fox, Henderson & Co., which conducted the studies on materials and structural resistance. Architectural forms changed accordingly, achieving unprecedented dimensions.

Rebuilding of Crystal Palace in Sydenham after the World's Fair of 1851, London (UK). Joseph Paxton, architect, Charles Fox, engineer, 1850–1851. Photography by Philip Henry Delamotte, 1854. © Victoria and Albert Museum, London.



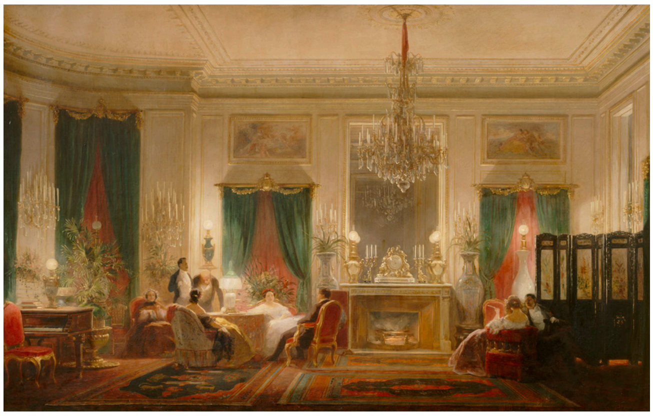
AT THE ORIGIN OF SKYSCRAPERS, COAL

At the origin of modern architecture, the architectural style of the Chicago School, which emerged in 1875, during the reconstruction of the city after the great fire of 1871, is a pure consequence of the cheap power afforded by the use of coal. Among the architects of the first American skyscrapers, Daniel Hudson Burnham built many high-rise buildings in the 1880s in Chicago, as well as the famous Flatiron Building in New York in 1900–1902. Culminating at 81 meters upon completion, it was one of the tallest skyscrapers in Manhattan.

Flatiron Building during construction, New York (US). Daniel Hudson Burnham, architect, 1900–1902. Photography by George P. Hall & Son, 1902. © New York Historical Society.

V . WHEN DECORATIVE ARTS WEREN'T JUST DECORATIVE

Up to the advent of modern thermal regulation technologies, interior decoration played a key role in providing coatings for the internal surfaces of buildings, including the tapestries of the Middle Ages, the *boiseries* of the Renaissance, and the fabric-lined walls of the nineteenth century. During the twentieth century, the improved efficiency in heating, lighting and ultimately, cooling appliances, allowed for just about any creative whim in even the most hostile climates, and thus also the so-called "decorative art", "decorative style" or "interior decoration". That is to say, anything that comes under the finishings and fittings of the building, or even under finishes and artworks, as they are not load-bearing nor structural.



AT THE ORIGINS OF DECORATION

In the castles of the late Middle Ages, heating techniques were very inefficient and tapestries and panelling formed a barrier against the cold coming from the stone or brick walls, which have high thermal conductivity. Just as woollen rugs and wooden floors with their low emissivity, insulate floors, tapestries lower wall emissivity and improve indoor comfort. Tapestries were transported from one castle to another and changed with the seasons: thicker during the winter and thinner during the summer, including leather hangings. Located everywhere in castles, they remained in common use in the townhouses of the affluent classes until the end of the nineteenth century.

FABRIC, A BARRIER AGAINST THE COLD

Prior to the massive dissemination of central heating during the twentieth century, new technologies had improved the efficiency of fireplaces, including the use of emissive cast iron plates to radiate infrared heat and the capture of heated air by ducts that removed the fumes away from users, and stoves were invented. All the same, decorative elements became even more widespread, preventing heat loss and making interiors more comfortable. Tapestries, rugs and drapings blocked the diffusion of the outside cold; screens and curtains protected against drafts. Quilted armchairs insulate the back from the cold. The mirrors and crystal pendants of the chandeliers amplify the dim light of candles and later petroleum flames. And, in a way, the pictures on the walls also contribute to thermal insulation.

«À mon seul désir». Sixth tapestry in The Lady with the Unicorn tapestry series, around 1484–1500. © RMN-Grand Palais (musée de Cluny-musée national du Moyen Âge)/Michel Urtado.

Princess Mathilde's Living Room in the Mansion on Rue de Courcelles. Oil on canvas by Sébastien Charles Giraud, 1859. © RMN-Grand Palais (domaine de Compiègne) / Gérard Blot / Christian Jean.

WHY DECORATION DISAPPEARS WITH MODERNITY

In the twentieth century, the use of fossil fuels and the spread of heating appliances made it possible to create artificial climates almost independently of external constraints. Farnsworth House, which was built in Illinois in the US by architect Ludwig Mies van der Rohe, embodies this new capacity. Widely open to nature, no thermal comfort equipment is apparent. Underfloor heating, in the form of water coils fed by a boiler located in the basement, retains heat without the need for rugs, drapings or tapestries. The low thermal efficiency of the glass panes is compensated by the heavy use of fossil fuels.

Farnsworth House, Ludwig Mies van der Rohe, architect, 1946–1951. Photography by Hedrich-Blessing, 1951. © Chicago Historical Society.

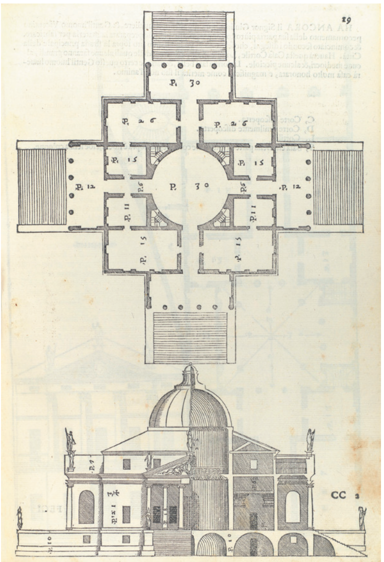
THERMAL INSULATION THROUGH FABRIC

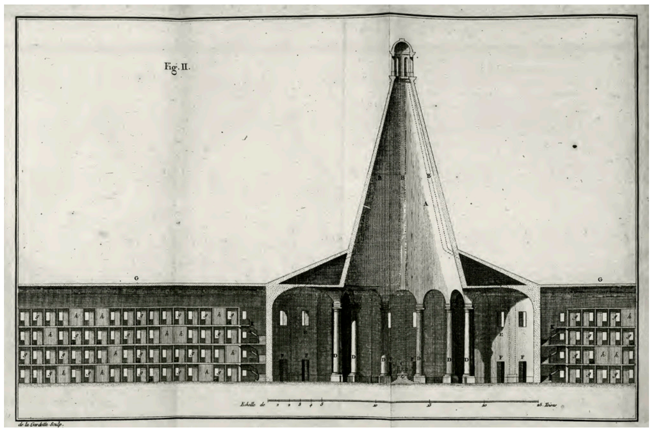
In France, we now use six times less energy than in 1970. The announced objective of the RT2020 standards is to reach 12 kWh per m² per year, that is to say, twenty-five times less energy use than in 1970. To meet the increasingly demanding thermal recommendations, certain architects, such as Arno Brandlhuber in Germany and the Lacaton & Vassal studio in France, are re-examining the thermal potential of sets of solutions including mobile elements. Thus, the combined use of thermal curtains and shading in the winter gardens of the Ourcq-Jaurès housing complex contribute to the building’s energy savings. Placed inside the winter garden, just behind the exterior facade, a shade curtain serves to block solar radiation in order to avoid summer overheating. It is made of strips of aluminium, which reflect solar radiation outwards, placed on an openwork fabric that allows air to circulate.

Combination of thermal curtains and shading in the winter garden of a residential unit. Social housing, Ourcq-Jaurès neighbourhood, 19th arrondissement of Paris, Anne Lacaton & Jean-Philippe Vassal, architects, SIEMP, developer, 2014. © Philippe Ruault.

VI . WHAT LIGHT DOMES OWE TO THE FEAR OF STAGNANT AIR

The conception that good health is linked to the air we breathe is believed to come from Hippocrates, a Greek physician born in the fifth century. It was rediscovered in Italy during the Renaissance, when his texts were first translated in Latin, especially On Airs, Waters, and Places. A real treatise on town planning, it explains where and how to build cities, depending on the prevailing winds and the quality of the water. Priority is then given to the symmetry of buildings and the alignment of windows in order to promote ventilation. Concurrently, with the neoclassical rewriting of architectural forms in the eighteenth century, «building mechanization» techniques concerned with air renewal appeared. Domes served to draw up miasmas in hospitals, before being generalized to all large public buildings. The theory of "bad air", which was solely responsible for contagion, remained widespread until the early twentieth century, and has influenced the way collective housing is configured.





THE NATURAL VENTILATION OF PALLADIAN VILLAS

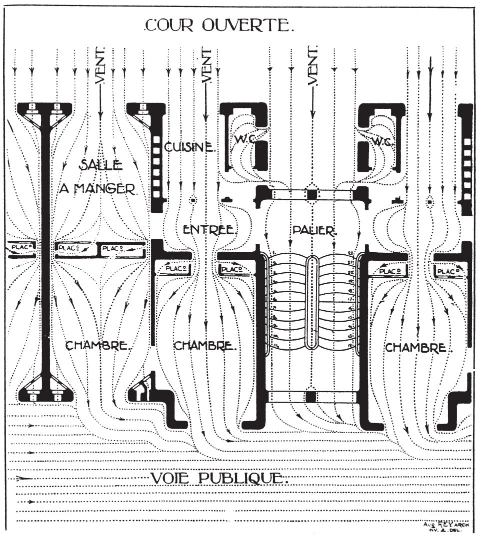
A far cry from the strictly cultural and formal interpretation that dominated in the second half of the twentieth century, the so-called "Palladian" architecture, which is that of the villas built in Veneto in Italy in the sixteenth century, takes into account the climatic foundations of the discipline. Built in 1571 near Vicenza, the Villa Rotonda is an exemplary application. The villa is laid out around a cool, high central space called the sala, which is laterally shielded from the sun by lower peripheral rooms, each of which is oriented based on its seasonal use. The symmetry and the correspondence of its openings ensure that the air circulates deep inside the building. Below the sala, a cellar cools the air coming from the ground, which escapes through the open centre of the dome.

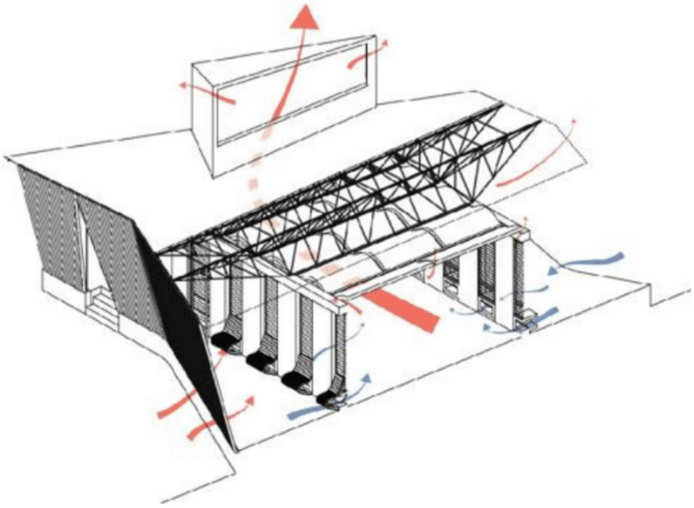
DOMES AND CUPOLAS TO RENEW THE AIR

In the eighteenth century, reiterating the principles of the Renaissance, architects such as Jacques-Germain Soufflot, Claude-Nicolas Ledoux, Étienne-Louis Boullée and Antoine Petit designed hospitals and buildings for large audiences around air circulation. In the course of the discussions over the principles that were to guide the construction of the new Hôtel-Dieu hospital in Paris, the professor of medicine, Antoine Petit, proposed a panoptic plan, with rooms arranged radially ending in a circular air vent creating a continuous flow of air. This enormous pneumatic machine was designed to accommodate 1,800 to 2,400 patients, the capacity of the Hôtel-Dieu de Paris, which it was supposed to replace. The project did not see the light of day however.

Plan and cross-section views of Villa Almerico (Villa Rotonda), Andrea Palladio, architect, 1566–1571. In *I quattro libri dell'architettura*, book II, 1570.

Hospital project, cross-section, Antoine Petit, physician and surgeon. In *Mémoire sur la meilleure manière de construire un hôpital de malades*, Paris, Louis Cellot, 1774.





NATURAL VENTILATION FOR A RESIDENTIAL COMPLEX

As early as the nineteenth century, the Prefect Haussmann prescribed a system of courtyards of various sizes for Paris, sometimes so narrow that they are comparable to modern ventilation ducts. In the twentieth century, the principles of ventilation continued influencing architects, still based on the principle of dissipation, but this time of microbes. Architect Adolphe Augustin Rey thus developed a project promoting natural ventilation of double-sided apartments for a workers' housing estate. The winner of the Rothschild Foundation competition in 1905, this building is laid out in parallel to the prevailing wind, so that the air can enter and circulate unsuppressed, in all the rooms.

"Diagram of a whole-house ventilation system", Augustin Rey, architect. In "*La tuberculose dans la chambre habitée. Comment l'empêcher de s'y établir*" [Tuberculosis in inhabited rooms. How to prevent it from taking hold", Congrès international de la tuberculose [International Congress on Tuberculosis]. Paris, 1905.

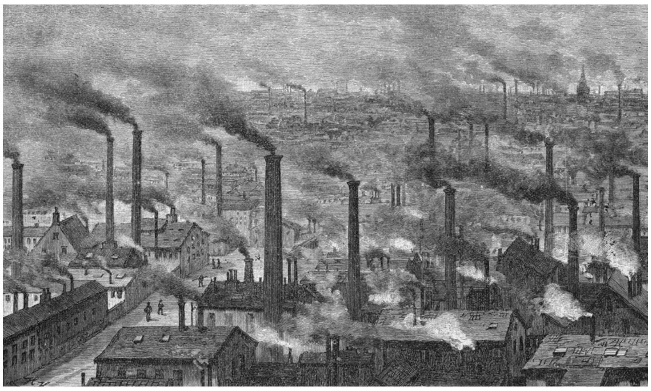
VENTILATION SYSTEMS TO SAVE ENERGY

The "Peon's House", a model individual housing unit designed for the planned city of Chandigarh in India, is part of a programme of affordable housing adapted to local climatic conditions. This application of the *Grille climatique* (or "Climate Chart") by the Atelier Le Corbusier, reflects the desire for a reasoned and rational scientific architectural response. Its creators, the workshop of Le Corbusier, the composer, architect and engineer Iannis Xenakis, and the engineer and industrialist André Missenard, intend to create a "material means of visualization that enables enumeration, coordination and analysis of climate data for a place defined (by its latitude) in order to orient architectural research towards solutions suited to human biology. The aim is to regularize and rectify in a useful way the asperities of extreme climates and to obtain, [through] architectural devices, [the conditions capable of ensuring well-being] and comfort."

Peon's House, Le Corbusier, architect. Principles of ventilation for a housing unit, drawing from the *Grille climatique*, circa 1950. © FLC/Adagp, Paris, 2020.

VII . HOW A SPRIG OF MINT INVENTED THE URBAN PARKS OF THE 19TH CENTURY

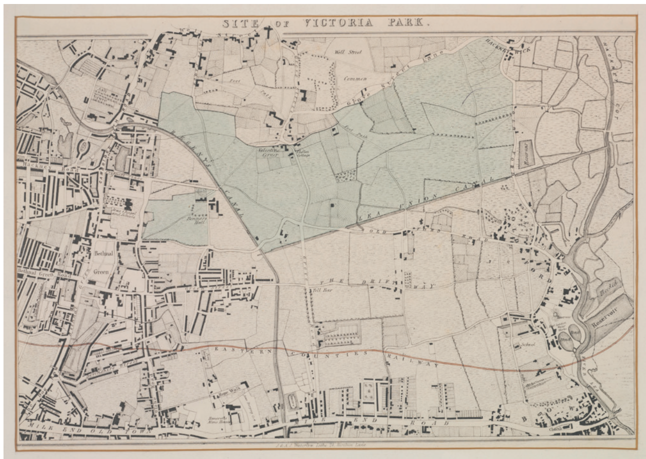
In the eighteenth century, Scottish physician and chemist Joseph Black, established that air consisted of two gases that would be later referred to as oxygen and carbon dioxide. Calling CO2 “fixed air”, in 1756, he found that it extinguished candles and killed animals. English chemist and physicist Joseph Priestley observed that mice can live longer under a closed bell containing plants than under a bell without any. He also observed that all plants (he first used a sprig of mint) have the power to “clean” the air of that part which was then believed to be toxic, that is to say, to transform *the fixed or mephitic air* (carbon dioxide) into *dephlogisticated air*, later identified and named oxygen by Antoine Lavoisier. This major discovery formed the basis for the understanding of photosynthesis and influenced scientists at the time, who immediately drew a number of lessons in terms of land planning. The creation of city parks is due primarily to this health concern: trees are “devices” for “improving the air”.



WHEN CITY AIR WAS COAL-BLACK

Starting in the eighteenth century, London was nicknamed the “Big Smoke”. Its atmosphere was indeed blackened by domestic smoke (from chimneys or coal stoves) and its buildings were covered in soot and particulate matter. England had an abundance of coal in the ground, compensating for the lack of firewood due to deforestation. This is why London developed based on prevailing winds: the upper classes settled upwind, while the poorest had to settle downwind. In East End London, where the wind carried soot-laden smoke from the city centre, life expectancy was the shortest around 1830.

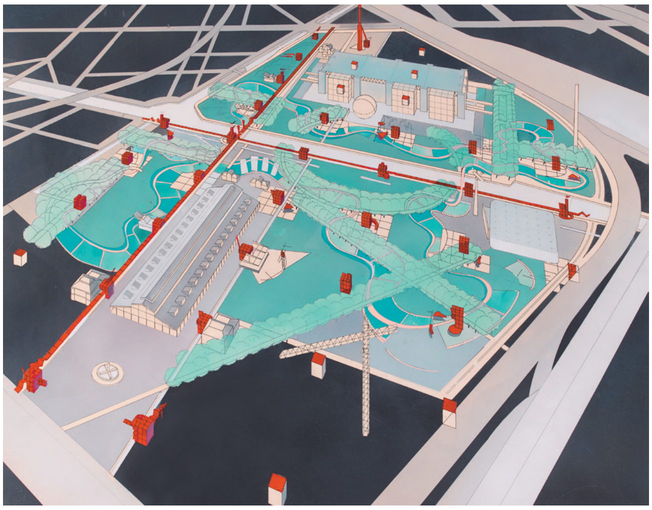
Factory smokestacks in an industrial city in England. Wood engraving by Roth, circa 1880. © INTERFOTO / Alamy Stock Photo.



PARKS TO LIVE LONG LIVES

In 1839, the English reformer Edwin Chadwick, advocated ventilating the cities through the widening of streets, thereby allowing the wind in, and, following the work of Joseph Priestley on photosynthesis, planting more trees to alleviate excess mortality. He is listened to by inhabitants of East London: 30,000 Londoners sign a petition asking Queen Victoria to create what will become Victoria Park. Opened in 1845 in the borough of Hackney, in the eastern part of the city, it is the world’s very first modern urban public park and became the benchmark for others that would be designed during the nineteenth century, from the Haussmannian parks of Paris, to Central Park in New York.

Victoria Park, London (UK), Sir James Pennethorne, architect, 1842–1845. Plan showing the proposed layout for Victoria Park, circa 1840. © Victoria and Albert Museum, London.



THE PARK AS A CULTURAL CONSTRUCTION

In the twentieth century, when it is understood that the carbon dioxide we breathe is in fact not harmful, trees and urban parks lose their sanitary purpose. Parks were viewed as social or cultural constructions from then on, and no longer as a fragment of nature imported into the city. The winner of the competition launched in 1982 for Parc de La Villette in Paris, Bernard Tschumi explains: “The park could be conceived as one of the largest buildings ever constructed». Highlighting function and events for the social structuring of this urban space, he opts for aluminium canopies rather than plants and favours large empty spaces that can accommodate concerts, parties, picnics, circus shows and so on.

Parc de La Villette, 19th arrondissement of Paris, Bernard Tschumi, architect, 1982–1987. *In Cinégramme folie. Le parc de La Villette*, Seyssel, Champ Vallon, 1987. © Bernard Tschumi.

“THIRD-LANDSCAPES” AND BIODIVERSITY

Planting trees in cities is a rather limited solution for absorbing carbon dioxide: indeed, a single tree captures only 25 kg of CO2 per year, while an individual in France releases around 6,900 kg each year. The challenge of nature in the city is therefore to bring freshness thanks to the foliage of trees, and to maintain biodiversity. Since the 1990s, landscape designer Gilles Clément in particular has defended this idea of an urban sanctuary. In the very heart of Parc Matisse in Lille, he reserved an inaccessible space of 2,500 m² placed on a concrete base more than 7 meters high, a replica of a small island in the southern hemisphere imagined as a laboratory of forest evolution over several decades, kept free from any direct human intervention.

Derborence Island, the biodiversity reserve of Matisse Park, Lille (France), Gilles Clément, gardener, Claude Courtecuisse, associate artist, Cabinet Empreinte, Éric Berlin, associate landscape gardener, 1996–2003. © Gilles Clément.

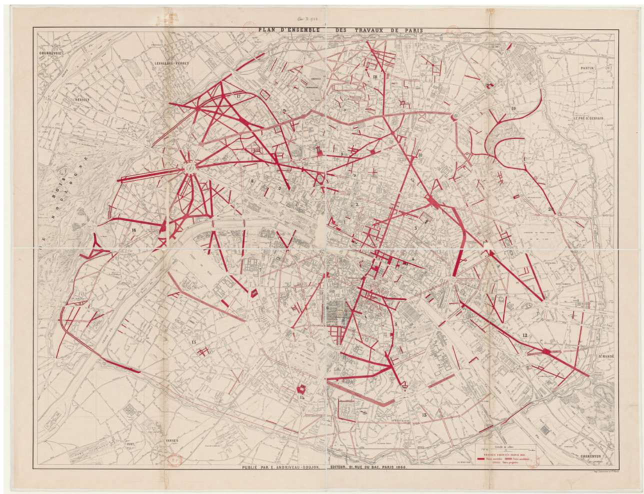
VIII . WHEN A VOLCANO ERUPTION CREATED THE MODERN CITY

In 1815, the cataclysmic eruption of Mount Tambora in Indonesia projected a mantle of dust into the stratosphere that decreased solar radiation for several years and destabilized the global climate ecosystem. In the Bay of Bengal, the disruption of the monsoon season resulted in a formidable mutation of the cholera germ, and the epidemic soon reached Moscow. The disease spread throughout Europe, starting in 1832. To overcome the disease, which was thought to be ensconced in the stagnant air of narrow alleys, and in order to dispel their stench, metropolises such as London and Paris initiated major urban transformations that shaped the second half of the nineteenth century, in particular the planning of wide «windswept boulevards». Though it only caused a drop in temperatures of 2 °C, as revealed by Gillen d'Arcy Wood in Tambora: The Eruption That Changed the World (2014), the eruption of Mount Tambora changed the course of history and the makeup of cities at the eve of the twentieth century.

VOLCANO ERUPTION: A YEAR WITHOUT A SUMMER

In April 1815, the eruption of the volcano of Tambora on the island of Sumbawa in Indonesia formed a thick sulphate fog and caused numerous climatic disturbances, notably in Bengal, where the British army was stationed. In August 1817, an unusually large cholera epidemic decimated the Indian population, eventually reaching the English military camp in November: 5,000 people died there over the course of five days. Men who ingested contaminated water introduced the cholera morbus epidemic to Europe in 1831 as they moved across the globe.

"The march of cholera-morbus from India to Europe, 1831". Bibliothèque nationale de France Coll. (Paris, France).



BEHIND HAUSSMANN'S RENOVATION OF PARIS, CHOLERA

When, in the middle of the nineteenth century, Baron Haussmann decided to redesign the Old Paris and 'air it out', imagining an urban development model structured around wide avenues and boulevards. The Prefect based its principle on the extensive medical literature that attributed the origin of diseases to stagnant air since the end of the eighteenth century. The population of Paris had grown from 759,000 inhabitants in 1831 to 1,053,000 in 1846, and was crammed into medieval districts requiring, in Haussmann's eyes, a large restructuring of the existing urban fabric and the extension the city. Wind circulation would be put to good use to fight against major epidemics.

Thoroughfares commissioned and projected during Haussmann's renovation of Paris from 1851 to 1868. Eugène Andriveau-Goujon, 1868. Bibliothèque nationale de France Coll. (Paris, France).

THE PARADOX OF THE THEORY OF POLICE CONTROL

In his memoirs, Haussmann himself explains that his renovation works weren’t intended as counter-insurgency measures: “Surely when he traced the Boulevard de Strasbourg and its extension up to the Seine and beyond, the Emperor didn’t have the strategic relevance of this extension any more in mind than for so many other major thoroughfares ... the straight alignment of which did not lend itself to the usual tactics of local insurrections.” He states that neither Napoleon III nor himself had followed a strategic objective aimed at supporting law enforcement. The reasons expressed are health-related: “it was absolutely necessary for the capital that vast arteries be open to public circulation to unclog the inextricable maze of narrow squalid streets entangled in the centre of the Old Paris as an inescapable consequence of its ever increasing population, which continued gaining thirty thousand souls a year since the development of the railway network, as well as of the increasingly pressing demands of sanitary science regarding urban sanitation.”

HAUSSMANN: WITHSTANDING THE TEST OF COVID

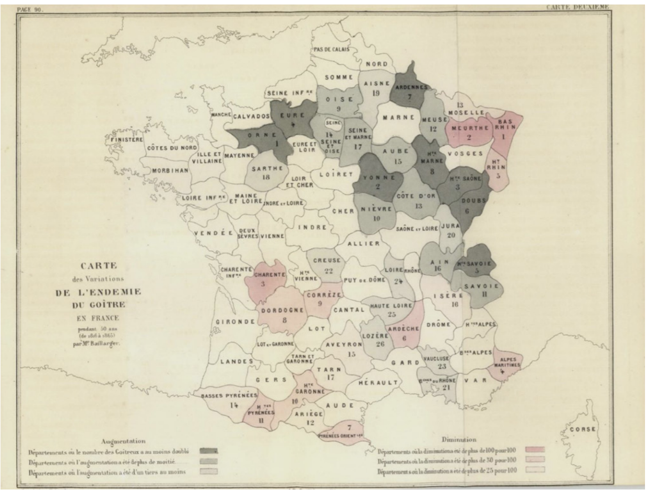
In the twenty-first century, global warming, air pollution and the coronavirus pandemic are a reminder of the physical and chemical nature of the urban atmosphere, as well as the health issues that stem from it. There have been studies investigated whether Covid-19 could be spread through PM2.5 and PM10 particulate matter. The current health crisis certainly gives us a better understanding of the aims of nineteenth century politicians, city planners and architects when they were building the modern city.

Boulevard Haussmann, close to No.4, 8th arrondissement of Paris. Photography by Charles Marville, circa 1877. © Charles Marville/BHVP.

Cycling lanes on Rue de Rivoli, 4th arrondissement of Paris. Photography by Aurélien Morissard. © Aurélien Morissard/Xinhua/Maxppp.

IX . HOW IODINE CAUSED THE URBANIZATION OF MORE TERRITORIES

In the nineteenth century, the discovery of the healing properties of iodine transformed territories that had been relatively sparsely populated until then: seashores and mountainous regions. To allow patients to reach these naturally iodized sites, rail networks were developed. The real estate developers of the seaside resorts worked in agreement with the then still private railway companies and were sometimes even one and the same party—up until nationalization of rail in 1937. For instance, the Pereire brothers, Parisian bankers and the promoters of many Haussmannian works, founded the Compagnie des chemins de fer du Midi in 1852, connecting Bordeaux to Arcachon among other places, and funded the construction of the Arcachon seaside resort in 1860. As early as 1936, the French coast, which represents 4% of the national territory, is almost three times more populated (193 inhabitants per km2) than the rest of France (77 inhabitants per km2 on average). Between 1968 and 1999, it experienced twice the national average population growth rate.



THE APPEAL OF IODINE

Until the nineteenth century, people living far away from the territories that were naturally rich in iodine suffered from thyroid problems and cretinism. As early as the middle of the eighteenth century, the English doctor Richard Russell started recommending seaside stays to his patients. And in 1820, the Geneva doctor Jean-François Coindet scientifically established that these diseases resulted from a lack of iodine in the diet of populations living far from the sea or from a source of naturally iodized thermal water. By administering iodine to affected patients, he managed to cure them in a matter of weeks. These results sparked tremendous enthusiasm for the seaside and spas with iodine-rich mineral waters across Europe.

Map depicting the variations in endemic goitre in France over 50 years (from 1816 to 1865), in *Recueil des travaux du Comité consultatif d'hygiène publique de France et des actes officiels de l'administration sanitaire,* t. II : *Enquête sur le goître et le crétinisme* [Investigation on goitre and cretinism]. Report by Dr. Jules Baillarger, Paris, Librairie J. B. Baillière et Fils, 1873.

URBAN DEVELOPMENT AND THE QUEST FOR OCEAN SPRAY

It was in Dieppe that the first French sea bathing establishment was inaugurated in 1822, followed by the construction of hotels and residences, as well as a racecourse in 1852 and a casino in 1886. Thanks to the railway serving the city from 1848, Parisians and Londoners flocked there to dive into its iodine-rich waters. Other towns followed suit: Arcachon opened a bathing establishment in 1823, followed by Biarritz, Trouville and Cabourg in 1853, Houlgate in 1854, Villers-sur-Mer in 1857, then Monaco, which created the Société des Bains de Mer in 1863, and Deauville in 1864. Because these developments took place on the flat lands of the coast, urban forms had little in common with the uneven ones of the villages and towns of the past. The layout of the seaside towns follows a regular orthogonal grid of streets and avenues that are perpendicular or parallel to the shore, with large blocks where buildings offer long facades facing the sea.

Dieppe's beach and casino, Alexandre Durville, architect. Autotype, 1884.

THE BENEFITS
OF VITAMIN D

In the eighteenth and nineteenth centuries, rickets, which is a childhood disease caused by a lack of calcium that deforms the limbs, was very present in central and northern Europe. In 1822, it was understood that the lack of the exposure of the skin to UV light causes the disease. Ultraviolet rays, which are naturally present on the sun-drenched Mediterranean coast, are lacking in the skies of northern cities, especially when further obscured by smoke from the coal mines. The rays of the sun allow the skin to synthesize the vitamin D necessary for bone calcification. From then on, the quest for ultraviolet light gave rise to a new appreciation for the sun and tanned bodies.

Children exposed to ultraviolet light, London (UK). Photography, 1934.
© akg-images/Imagno.

THE URBANIZATION
OF MEDITERRANEAN REGIONS

The search for ultraviolet light became the driver of considerable urbanization of the Mediterranean coast in Spain, Italy and France. In 1963, in order to stem the flow of French holidaymakers to Spain, the French President Charles de Gaulle commissioned Pierre Racine, the Chief of Staff to the Prime Minister, with a tourism development plan for the Mediterranean coast. The “Mission Racine” included the ex nihilo construction of seven seaside resorts in Languedoc-Roussillon, such as La Grande-Motte or Le Cap-d’Agde, with imposing buildings open to the sea and exposed to the sun on previously undeveloped marshland.

Residential building “Le Grand pavois”, La Grande-Motte, Jean Balladur, architect, with Jean-Bernard Tostivint, architect, 1967–1968. Postcard, photography by Pierre Riby, undated. © Yvon. All rights reserved.
© Adagp, Paris 2020.

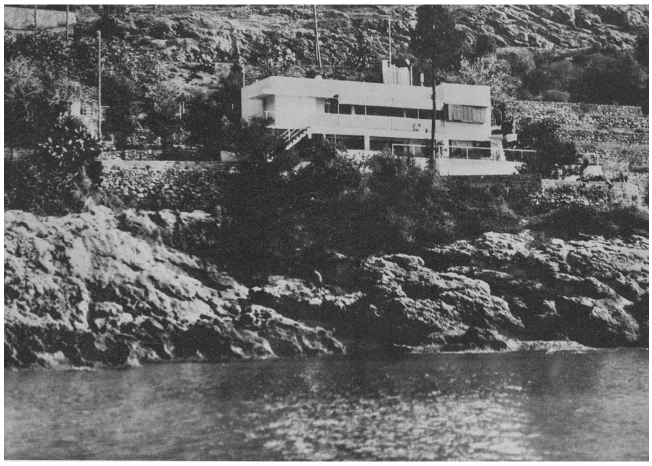
X . WHY MODERN ARCHITECTURE IS WHITE IN COLOUR

Following an unexpected analogy with the air-dried meat of Graubünden, which is preserved from rotting through exposure to direct sunlight and the outside air, modern architects seek to replicate the virtues of the sanatoriums of the early twentieth century in their constructions. Their buildings are painted white, for two reasons that are also related to hygiene. Firstly, because it has been known since the beginning of the nineteenth century that whitewash, which is naturally white, is a powerful antiseptic and its use is recommended to destroy any miasma that could become embedded in the walls. Secondly, white amplifies the rays of the sun, which are believed to be bactericidal, especially against the tuberculosis germ. Today, the interest in natural light is returning because it is loaded with energy that can be freely captured to heat homes in winter, reducing heating needs and therefore also the emissions of greenhouse gases.

SANATORIUM

According to Louis Pasteur, "Light delays or prevents the development of bacteria and microscopic fungi". Since the beginning of the twentieth century, mountains have become conducive to healthcare practice. With the construction of the Schatzalp sanatorium in Davos in 1900, a new architecture appeared, with large windows, all facing south, balconies and terraces allowing patients to be exposed to the sun and the air, and, above all, the white colour that coats the various building materials in order to increase the intensity of solar illumination. The purpose of having the sun penetrate into the depths of the rooms is to eliminate bacteria and disinfect patients. All sanatoriums were henceforth built following this principle of full-sun exposure and white paint. The Davos Sanatorium is the largest of the Swiss sanatoriums and is connected to the city with its own cable car, which at the time was truly a technical feat.

Schatzalp sanatorium, Davos (Switzerland), Otto Pfleghard and Max Haefeli, architects, 1898–1900. Photography by Werner Friedli, 1949. © ETH-Bibliothek Zürich, Bildarchiv/Stiftung Luftbild Schweiz © Werner Friedli.



WHITE MODERNITY VS. CONSTRUCTIVE TRUTH

Following the discovery of the health benefits of ultraviolet rays, the appeal of the Mediterranean coast operated a seasonal reversal from the winter to summer from the 1920s onwards. Architecture was transformed accordingly. Facades were opened to the southern sun through large bay windows and terraces started offering solariums to expose the naked body to the sun. Eileen Gray was inspired by these precepts for her Villa E-1027 in Roquebrune-Cap-Martin. Dominating the shore, it takes the form of a small white villa of 190 m² on two levels. For her first architectural creation, Eileen Gray primarily refers to the ideas and aesthetics of the white architecture of the modern movement: roof terrace, stilts, horizontal bays… A modernity that can also be found in the choice of materials such as reinforced concrete and a metal framework, as well as the invention of pipe railings drawn from nautical handrails.

Villa E-1027, Roquebrune-Cap-Martin, Eileen Gray and Jean Badovici, architects, 1926–1929. In *L'Architecture vivante*, winter 1929. Bibliothèque d'architecture contemporaine Coll., Cité de l'architecture et du patrimoine, Paris. All rights reserved.

THE LAW OF WHITENESS

Le Corbusier's 1930 masterpiece, Villa Savoye, near Paris, best reflects all the ambition of white modernity. The entire building is traversed by light, air and sunlight. The building calls on the therapeutic vocabulary of sanatoriums. Isolated in the centre of a large park and built on an elevation to benefit from unrestricted access to the winds and the sun, it features a roof solarium so that its residents can expose themselves to the moving air and the rays of the sun. The four facades are open from one angle to the other by a long continuous strip of glazing that lets in the light all day long and give the house its name: "Les heures claires" [The bright hours].

WHITE IS BACK TO TACKLE A WARMING ENVIRONMENT

The summer heat waves, linked to global warming and amplified in urban environments, are now redefining the colorimetric strategy applied to architecture and urban planning. Conversely, light-coloured materials reflect sun rays and remain cool. The albedo principle, aiming to reflect the heat of the sun, is well known in warm regions such as the Greek Cyclades, where the low-rise houses and streets are completely white. Their bright roofs reduce the heat build-up, and the interiors and streets are kept comfortably cool. According to the most recent studies, such a strategy is more effective for reducing the temperature in cities than green roofs and is now recommended.

Villa Savoye, Poissy (France), Le Corbusier, architect, 1928–1931. Photography by Marius Gravot, circa 1930. © FLC / Adagp, Paris, 2020 All rights reserved.

Roofs being painted in white by volunteers engaged in the NYC CoolRoofs initiative, Bronx, New York (US). © Ken Cavanagh / Alamy Stock Photos.

XI . WHEN OIL CAUSED CITIES TO GROW IN THE DESERT

Though humans have known how to heat the air artificially since prehistoric times, there were no technical means of cooling air until the beginning of the twentieth century, except putting it in contact with ice that had been stored during the winter in underground coolers or transported by boat from regions with cold climates. In 1902, Willis Carrier, an engineer employed by an American ventilation company, invented air conditioning. He managed to control air humidity levels and unexpectedly found that he could also lower its temperature. Air-conditioning units provide cooling via convection — by blowing air like a fan — but especially via conduction — lowering the temperature of the air. As early as 1955, one in twenty-two Americans had air conditioning and in the South, one out of ten. A full 9% of buildings in the southern United States were equipped with air conditioning by the mid-1970s. Globally, the number of air conditioners has tripled over the past thirty years and now represent 10% of global power use, along with fans, as at 2016.

URBANIZATION THROUGH THE DISCOVERY OF OIL

Los Angeles was only sparsely inhabited, just as the other cities that were built in the American desert such as Las Vegas, Denver, Dallas and Lubbock and the whole of the southern United States. There were a few houses by the sea in an area with long hot summers and no potable water: a location where Vitruvius would not have recommended building a city. Its exponential urban and demographic development, especially during the second half of the twentieth century, only became possible following the discovery of oil in California in 1892 and the massive and unlimited use of fossil fuels.

Oil derrick in Signal Hill (California, US). Photography, circa 1925. City of Signal Hill, California. All rights reserved.

AIR CONDITIONING AND THE AMERICAN SOUTH

Between 1910 and 1950, the southern United States saw its population drop, losing more than 10 million residents. This trend was subsequently reversed however. The urban development of the Sun Belt, which concerns all the states located south of the 36th parallel, is the corollary of the mass production of air conditioning units. Cities such as Las Vegas, Los Angeles, Miami, Palm Springs and New Orleans attract populations looking for sunny climes, but the heat of which is now artificially tempered down. This is reflected in the demographic boom of Los Angeles, which now has 19 million inhabitants, up from 1.5 million in 1940.

Santa Monica Boulevard, between Beverly Hills and Westwood, Los Angeles (California, US) Photography from 1927. Library of Congress Coll., Prints and Photographs Division, Washington, D.C. (USA). All rights reserved.

Aerial view of the city of Abu Dhabi (United Arab Emirates). Photography circa 1960. Jorge Abud Chami Collection. Courtesy of the Arab Image Foundation.

AIR CONDITIONING ERASES THE IDIOSYNCRATIC FEATURES OF REGIONAL ARCHITECTURE

Globally, the number of air conditioners has tripled over the past thirty years and now represent 10% of global power use, along with fans, as at 2016. The recent development of Qatar, Dubai and Abu Dhabi is also correlated with the acceleration in the use of air conditioning. In short, after World War II, living comfortably in the desert or in jungles, in extremely warm climates, was made possible by the liberal use of air conditioning.

Facebook’s first data centre in Europe, located close to the Polar circle in Luleå (Sweden).

TOWARDS THE URBANIZATION OF COLD REGIONS TO USE LESS ENERGY

Given that temperatures decrease with altitude, by 0.65°C for every 100 meters gained, there could be cooler towns in mountain regions. Likewise, sites farthest from the equator could become pleasant to live in. The shift of data centres and large server farms from California (where the natural warmth leads to a huge use of air conditioning for cooling purposes) to Alaska or northern Europe in order to benefit from a constant supply of cool air and lower energy expenditures, may be evidence of a new trend. For instance, in 2013, Facebook built a 27,000 m2 hangar in Luleå in Sweden to host some of its servers.

XII . HOW ANTIBIOTICS HAVE PAVED THE WAY FOR A RETURN TO THE CITY

The French reconstruction after the Second World War was carried out based on a modernist health programme that was already obsolete when it was initiated, given that antibiotics and vaccines, which had become widespread starting in the 1950s, had largely freed human beings from the health issues that had forged the urban principles since the nineteenth century, increasing life expectancy from an average of 40 years in 1900 to upwards of 80 in 2000. This last modernity will be supplanted by postmodernism, which is marked with a return to the city starting in the 1970s, as we can now all return to live in the winding, dark alleys of the old historic centres as they have shed all their negativity thanks to antibiotics. Architecture was then able to focus on values of symbolic or cultural images and social uses rather than on health and climatic values.

THE FAILURE OF MODERN SANITARY THINKING

Starting in the 1970s, everything came together to sign the death of modern architecture, as postmodern American architect Charles Jencks points out: “Modern Architecture died in St. Louis, Missouri, on July 15, 1972, at 3.32 p.m. (or thereabouts), when the infamous Pruitt Igoe scheme, or rather several of its slab blocks, were given the final coup de grace by dynamite.” That day, a building complex created in 1954 by architect Minoru Yamasaki was demolished. The year 1972 does indeed correspond to the end of modernity and the beginning of postmodernity, that is to say, of an era free from the health problems that had hampered architecture and the city since its inception. Thanks to antibiotics, architecture and urban planning no longer have to worry about the medical, the biological and the chemical and can now turn to the human sciences: the political, the social and the aesthetic.

Pruitt Igoe’s residential complex, Saint Louis (Missouri, US), Minoru Yamasaki, architect, 1951–1954. Demolition of a building, 22 April 1972. U.S. Department of Housing and Urban Development.

THE RETURN TO THE CITY

The first French example was the Hautes-Formes neighbourhood in Paris, designed by Christian de Portzamparc in 1979. On a site slated to be razed to the ground and replaced with modern high-rises, the architect designed a street, alleys, a square and buildings aligned with these urban spaces, together creating a block inspired by those of pre-modern cities but open to vistas, to the sun and the wind thanks to the division of the programme into small volumes, testifying to the conservation of certain achievements of modernity.

Les Hautes-Formes, group of residential buildings, 13th arrondissement of Paris, Christian de Portzamparc, architect, with Georgia Benamo, RIVP, project developer, 1975-1979.

FROM PHYSICAL CONSTRUCTION TO SOCIAL CONSTRUCTION, AN ARCHITECTURE THAT SPEAKS FOR ITSELF

The 1980s spawned a theoretical synthesis of the opposition between the modern and the postmodern in the figure of Jean Nouvel, whose postmodern linguistic structure skilfully brought into play narrative signs that came no longer from the past, but from the present or the future. To construct his postmodern narratives, Jean Nouvel also works based on images, hints and symbols, no longer borrowing them from the past as Aldo Rossi or Bernard Huet did, but from the contemporary world, from science fiction.

Théâtre Le Granit, Belfort (France), Jean Nouvel, Gilbert Lézénès and Dominique Lyon, architects, artistic intervention by Gary Glaser, François Seigneur and Pierre-Martin Jacquot, scenography by Jacques Le Marquet, 1980–1984.

FROM A FRENCH-STYLE POSTMODERNISM TO THE OVERCOMING OF POSTMODERNISM

The return to the city that started in 1980 was accompanied by the onset of numerous signs evoking the culture of the premodern city, whether Haussmannian, Renaissance, medieval, or even from Greek or Roman antiquity. For example, the nineteenth century corner rotundas, the bricks of which, in addition to their role as construction material, mark a historical period, as do the steel lintels with their green color reminiscent of the paint used on metals at the end of the nineteenth century (for example by Hector Guimard)... The internationally-renowned postmodern architect and theorist, Aldo Rossi, signs his only Parisian creation at La Villette. The full-block structure includes 91 social housing units and a post office, highlighted in blue on one corner of the complex. The construction is intended as an interpretation of everyday Parisian vocabulary.

Residential building, Paris (France), Aldo Rossi and Claude Zuber, architects, SAGI and French Ministry of Posts and Telecommunications, developers, 1991 © photography by Vincent Fillon.

XIII . AND WHAT IF CO2 WAS TO CREATE AN ARCHITECTURAL WAKE-UP CALL

The sector relating to sheltering of human activities, which can be encompassed under the term of architecture, globally emits 39% of global greenhouse gas emissions, mainly for heating or cooling. By contrast, the aviation industry amounts to only 2%. Architecture is therefore at the forefront in the fight against global warming, which is reflected in the implementation of thermal regulations, new standards and recommendations that as a first step seek to limit energy consumption, which is still 85% dependent on fossil fuels. A new architectural style is now appearing, where the meteorological parameters of space, air, light, heat, humidity, their behaviours and physical characteristics, such as convection, conduction, pressure, emissivity, effusivity and diffusivity, become the new tools of architectural and urban composition.

THE OIL CRISIS SPURS A QUEST FOR ALTERNATIVES

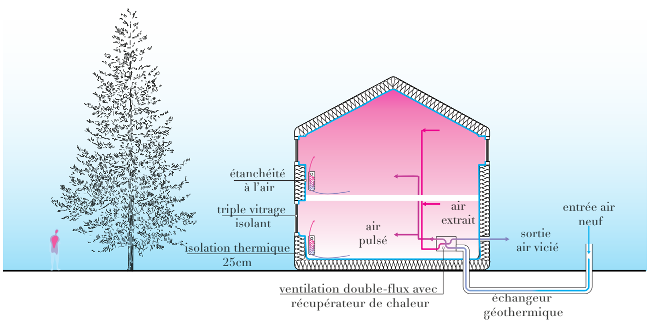
In the wake of the oil shock of 1973, the first experimental energy-autonomous houses, harnessing solar energy, geothermal energy, the principles of thermal inertia, forms that adapt to the course of the sun, to the wind, to geographical features and so on, see the light of the day. A few architects, some of them close to the hippie counterculture in their overall rejection of economic and technical development, tried to find architectural solutions that were not dependent on oil or industrial manufacturing. Such was the case of Paolo Soleri, an architect of Italian origin and creator of Arcosanti, an ecological experimental town in Arizona. Around the same time, Mike Reynolds created the Thumb House, a house made of scrap tires and used cans that was energetically self-sufficient thanks to solair gain and thermal inertia.

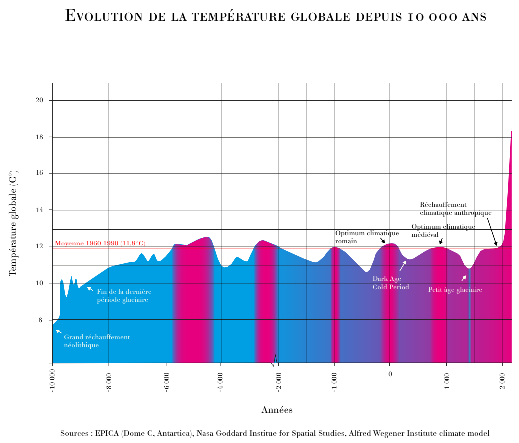
Experimental house, Taos (New Mexico, US), Michael Reynolds, architect. Photography by David Hiser, June 1974. National Archives at College Park.

WHEN FOSSIL ENERGY CAUSED BUILDING FAÇADES TO DISAPPEAR

The 1970s also marked the beginning of ecological and energy thought, aiming to offer buildings that had broken free from the dependence on fossil fuels and opening up to renewable energies. In 1974, Douglas Kelbaugh began building his residence in Princeton, New Jersey. Inspired by the Trombe wall implemented and tested by Professor Félix Trombe and architect Jacques Michel in the 1950s to 1970s, this heating device leverages the greenhouse effect to harness the free energy of the sun to heat the house. Analyses show a fairly high stability of the indoor temperature around an average of 17°C when outdoor temperatures vary between -13 and 14°C. The quest for an architecture that is independent from oil and industrial manufacturing remained marginal during the 1970s and largely disappear in the 1980s when the price of oil began to drop again.

Kelbaugh House, Princeton (New Jersey, US), Douglas Kelbaugh, architect, 1975. Photography, circa 1976. Canadian Centre for Architecture Collection, Montréal.





THE IMPORTANCE OF THERMALLY INSULATING BUILDINGS

Effective energy consumption reduction programmes such as Passivhaus in Germany (which was created in 1996) or Minergie in Switzerland (created in 1998),have been applied to the construction or renovation of public buildings. These pragmatic labels aim to drastically reduce the energy consumption of buildings (by a factor of eight) through a few simple measures: insulating the exterior walls, the roof and the floor by lining the supporting structure with no less than a 150 mm thickness of mineral wool (currently at least 200 mm), placed outside, to avoid thermal bridges; making the interior airtight by preventing air leakage from the outside through cracks or leaking gaskets; using double glazing (triple glazing is now also used), reducing the thermal conduction of glazing and controlling the renewal of indoor air, in particular by recovering heat from the outgoing exhaust air to preheat the incoming fresh air through double-flow ventilation systems.

Low-energy house. Sources: Minergie-Suisse / Passivhaus-Allemagne © Philippe Rahm architectes, 2020.

THE LINK BETWEEN ARCHITECTURE AND CLIMATE REACTIVATED DUE GLOBAL WARMING

In December 1895, Professor Svante Arrhenius, hypothesized that the Earth's surface temperature had varied in ancient times based on changes in the level of CO2 in the air. This was the first scientific study to report that increasing this rate causes temperatures to rise. It formed the basis of the correlation model between the release of greenhouse gases and global warming as established today by the Intergovernmental Panel on Climate Change (IPCC) 4. By analysing variations in the average temperature of the earth's surface since 1850, which has increased globally by about 1°C, as well as in the concentration of CO2 in the air over the same period, which has risen from 280 ppm (parts per million) to over 400 ppm, there is a correlation that could be explained by the opacity of CO2 to infrared light.

Global temperature change over the past 2,000 years. Sources: EPICA, Dome C, Antarctica / NASA Goddard Institute for Space Studies / Alfred Wegener Institute climate model © Philippe Rahm architectes, 2020.

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Le quartier sacré de la cité d'Ur, en Mésopotamie, révélé par des fouilles britanniques entre 1922 et 1934. Photographie aérienne, Royal Air Force, 1927. DR

blé[4] – l'égyptologue Barry Kemp les décrit d'ailleurs comme « les banques centrales de réserve de leur époque[5] ».

Si l'une des fonctions des temples égyptiens est ainsi de conserver et protéger les récoltes, l'historien des sciences Pascal Acot explique plus généralement que le stockage des richesses alimentaires est « vraisemblablement la raison majeure du phénomène urbain, vers 5 000 av. J.-C.[6] ». Il mentionne ensuite des compositions urbaines dans lesquelles le grenier ou la grange est la pièce majeure, notamment la ville de Mohenjo-Daro, dans l'actuel Pakistan, dont la citadelle comprenait des bains luxueux, un grand silo à grains, deux salles d'assemblée et un ensemble résidentiel. Cela concerne aussi, durant l'Antiquité, des villes comme Uruk ou Rome et, plus tardivement, les abbayes et les châteaux du Moyen Âge.

Il s'agit donc ici d'interroger, au fil d'un vaste panorama historique, la notion de « ville » comme grenier fortifié, c'est-à-dire les liens étroits entre alimentation, climat, énergie et développement urbain.

Au néolithique, la ville naît comme grange fortifiée

Durant cette période de la préhistoire qui commence en 12 000 av. J.-C., les êtres humains – et en premier lieu les Natoufiens – passent d'une société de chasseurs-cueilleurs nomades, migrant selon les saisons, à une vie sédentaire d'agriculteurs et d'éleveurs.

Cette évolution commence par un adoucissement du climat faisant suite à la brusque période de froid du Dryas récent, survenue vers 12 900 av. J.-C. et qui aura duré environ un millénaire, au cours duquel les températures ont chuté de 7 °C. Le phénomène de réchauffement, ultérieurement nommé The Great Warming[7], voit un air humide provenant de l'Atlantique et de la Méditerranée provoquer de fortes chutes de

4 Voir Carolyn Steel, *Ville affamée. Comment l'alimentation façonne nos vies* (2008), Paris, Rue de l'Échiquier, 2017.
5 Barry J. Kemp, *Ancient Egypt. Anatomy of a Civilization*, New York, Routledge, 2006.
6 Pascal Acot, *Histoire du climat*, Paris, Perrin, 2004.
7 Voir à ce sujet Brian Fagan, *The Long Summer. How Climate Changed Civilization*, New York, Basic Books, 2004.

VIe siècle « étaient formés de très grands troncs d'arbres sciés par le milieu, enfoncés en terre de manière que le côté brut restât en dehors ; les intervalles étaient remplis de terre et de mortier, le toit était en chaume [...][16] ». Jusqu'au XIe siècle, les châteaux forts sont généralement en bois, comme les églises et les abbayes. De manière générale, aucun plan ni dessin n'existent au préalable des constructions – à l'exception du plan de l'abbaye de Saint-Gall en 820. Il n'y a pas d'architecte non plus. Beaucoup plus tard, durant le bas Moyen Âge, c'est le charpentier ou le maçon, c'est-à-dire celui qui construit, qui conçoit aussi l'architecture. Pour les bâtiments d'exception tels que les cathédrales, c'est le « tailleur de pierre », le plus haut rang dans les métiers de la construction, qui remplit le rôle d'architecte. Durant le haut Moyen Âge, il n'existe pas de tailleur de pierre et encore moins d'architecte, car l'excédent alimentaire n'est plus suffisant pour nourrir cette profession de service. Ce n'est qu'à la fin du XVe siècle que le mot « architecte » apparaît en France.

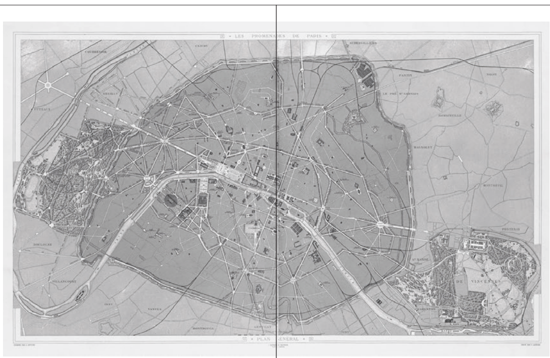
L'évolution de l'architecture liée à un changement de technique agricole

Lorsque la faim s'apaise peu à peu, à partir du Xe siècle, que l'énergie mise à disposition de chacun augmente, de même que la masse musculaire des êtres humains et des animaux de trait, les formes d'urbanisation et d'architecture se modifient : les constructions deviennent plus grandes, plus hautes, plus massives.

C'est le début de l'art roman, avec ses épais murs en pierre et ses voûtes en berceau empruntées aux Romains. Né après l'an mil, il perdure jusqu'en 1200. Il est suivi de l'art dit « gothique », aux grandes cathédrales, plus hautes, plus légères plus lumineuses, dont le caractère innovant s'affaiblit vers 1400, peu après l'arrivée du Petit Âge glaciaire et l'irruption de la peste noire. L'art roman et l'art gothique, qui symbolisent le Moyen Âge central et le bas Moyen Âge, ont traversé le temps grâce au poids de leurs murs.

16 A.-R. Emy, *Traité de l'art de la charpenterie*, *op. cit.*

« Mois de mars ». Enluminure des frères Limbourg pour *Les Très Riches Heures du duc de Berry*, début du XVe siècle, folio 3. © RMN-Grand Palais (domaine de Chantilly)/René-Gabriel Ojéda



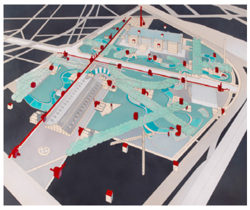
Plan général de la ville de Paris, Adolphe Alphand, ingénieur. Dessin d'Émile Hochereau, in *Les Promenades de Paris*, Paris, J. Rothschild, 1867-1873. Coll. Bibliothèque nationale de France.

Face à la perte de pouvoir du végétal dans la seconde moitié du XXe siècle, certains se mettent à encenser Yves Brunier, paysagiste star des années 1980 très tôt disparu, privilégie le bitume à l'herbe, l'aluminium à la verdure : « un paysagiste contre la nature[25] », comme le qualifiera Rem Koolhaas, sans arrière-pensée. « La nature à la campagne, le béton à la ville » est ainsi un slogan sérieux et commun dans les années 1980, qu'adoptent des architectes fascinés par la densité minérale, les villes contemporaines faites d'acier, de béton, de verre et de néons clignotants, et par les images du film *Blade Runner* de Ridley Scott, sorti en 1982.

Le parc est dès lors envisagé comme une construction sociale ou culturelle, et non plus comme un fragment de nature en ville. « Le Parc pouvait être ainsi considéré comme un des plus grands bâtiments jamais construit », explique Bernard Tschumi à propos du parc de La Villette, à Paris. « Le concept d'"espace vert" s'épuise devant la réalité du parc culturel[26]. » En cette période postmoderne, la réalité physique, biologique et chimique, mise à l'écart par les antibiotiques et le pétrole, s'efface devant la réalité culturelle, sociale et politique. Les parcs ont désormais vocation à être des lieux de loisirs et de détente pour les habitants des villes, des espaces publics et gratuits, qui inspirent plus ou moins les concepts prévalant à leur dessin. Mettant en avant la fonction et l'événement comme structuration sociale du parc de La Villette, lors du concours en 1982, Bernard Tschumi privilégie des canopées en aluminium plutôt que végétales et opte pour de larges espaces vides pouvant accueillir des concerts, fêtes, pique-niques, spectacles de cirque…

L'historienne Danièle Voldman, dans un article publié en 1985, explique que le programme du concours pour le parc de La Villette va à l'encontre des parcs haussmanniens et de leur vocation sanitaire : « En 1987, le parc de La Villette devrait offrir ses ombrages aux Parisiens. Ceux qui l'ont conçu ont cependant refusé d'emblée d'en faire un îlot de verdure au milieu de la ville. Si, depuis le développement continu de la capitale à partir du XIXe siècle, squares et jardins ont toujours été jugés indispensables, la notion de réserve d'oxygène et de chlorophylle pour citadins anémiés a été résolument écartée. Pour la construction de ce nouveau parc, les enjeux

25 Voir Isabelle Auricoste, *Yves Brunier. Landscape Architect Paysagiste*, Bâle, Birkhäuser Verlag AG, 1996.
26 Bernard Tschumi, « Le parc du XXIe siècle », in Bernard Tschumi, *Cinégramme folie. Le parc de La Villette*, Seyssel, Champ Vallon, 1987.



Le parc de La Villette, Paris 19e, Bernard Tschumi, architecte, 1982-1987. In *Cinégramme folie. Le parc de La Villette*, Seyssel, Champ Vallon, 1987. © Bernard Tschumi

ne sont plus dans la nécessité d'aérer Paris et d'accroître le nombre d'arbres dans la cité, mais dans la capacité de la doter d'un symbole du XXIe siècle, jardin-programme et déclaration de modernité[27]. » Elle précise ensuite la teneur du rapport d'objectif du concours : « Cette conception pulmonaire et moralisante semble dorénavant inadéquate, car le tels jardins sont "déconnectés de la vie et de la ville", attirant seulement les enfants, leurs accompagnateurs et des vieillards, ce qui semble trop étroit aux yeux des rédacteurs du programme. Le corps social ne comprend-il pas également les adolescents, les ouvriers et les immigrés ? De plus, les jardins haussmanniens sont fermés la nuit, excluant la fréquentation des "couches les plus nocturnes de la population[28]". »

27 Danièle Voldman, « Le parc de La Villette entre Thélème et Disneyland », in *Vingtième Siècle, revue d'histoire*, nº 8, octobre-décembre 1985.
28 *Ibid.*

Puits de pétrole à Signal Hill (Californie, États-Unis). Photographie, vers 1925. City of Signal Hill, California. DR

une imprimerie de Brooklyn, à New York, qui modifie le format du papier lors des différents passages de couleurs, créant des décalages d'impression des images. En appliquant avec une machine les principes de la thermodynamique à l'air, Willis Carrier parvient à contrôler son taux d'humidité et découvre par hasard qu'il peut aussi contrôler sa température. Ainsi, si l'air conditionné rafraîchit par convection – en soufflant l'air comme un vent –, il rafraîchit surtout par conduction, en faisant baisser sa température.

L'air conditionné est d'abord développé pour un usage industriel, dans les usines de textile et de tabac du sud des États-Unis. Pour la première fois, on réussit à refroidir efficacement l'air chaud en été. Heureuse conséquence, ces entreprises, sans l'avoir voulu, gratifient leurs ouvriers d'agréables conditions de travail. On raconte ainsi que, dès la mise en place du premier système d'air conditionné dans cette imprimerie de Brooklyn, tous les employés veulent prendre leur pause déjeuner, en été,

près de la salle d'impression, à l'air rafraîchi[1]. Cela donne à Willis Carrier l'idée que l'air conditionné pourrait servir à autre chose qu'à garder constante l'humidité du papier.

En Europe occidentale, où le climat est relativement tempéré, l'air conditionné demeure presque inexistant jusqu'aux très récentes années caniculaires, depuis 2003. Au contraire, l'Amérique du Nord, non tempérée par le Gulf Stream, connaît des étés très chauds et des hivers très froids. L'air conditionné y est d'abord installé dans des établissements publics et commerciaux accueillant beaucoup de monde, comme les théâtres, les grands magasins, les hôtels ou les banques, car le système est à l'origine coûteux, compliqué à mettre en œuvre et encombrant.

En 1925, Willis Carrier, sentant le potentiel de son invention, équipe pour la première fois un air conditionné un cinéma qui ouvre à Times Square, à Manhattan : le Rivoli Theatre. C'est un immense succès populaire. Le propriétaire de ce cinéma, Adolph Zukor, est aussi le président de la compagnie Paramount Pictures, qui produit des films et construit les salles où ils sont projetés. La salle de cinéma américaine a trouvé sa stratégie commerciale, en offrant à ses clients des lieux de fraîcheur durant l'été. Dès lors, tous les nouveaux cinémas sont équipés d'air conditionné. Celui-ci restant coûteux jusque dans les années 1950, la salle de cinéma s'avère être l'un des seuls lieux publics et facile d'accès où le grand public peut échapper à la chaleur estivale.

L'air conditionné urbanise le sud des États-Unis

À mesure que la technique se simplifie, la taille des appareils d'air conditionné diminue, de même que leur coût, et ils deviennent un produit de masse dès les années 1950, équipant habitations, bureaux et automobiles d'une majorité d'Américains. En 1951, la compagnie Carrier, toujours active aujourd'hui, met ainsi sur le marché des unités individuelles économiques destinées au grand public, faciles à accrocher en façade.

1 Voir Steven Johnson, *How We Got to Now. Six Innovations that Made the Modern World*, New York, Riverhead Books, 2014.

Démolition des fortifications des villes, fortification des nations

Après la peste noire, la Renaissance se développe à l'intérieur des espaces créés par le Moyen Âge, mais la baisse de la population européenne due à la maladie et aux famines entraîne une modification majeure du système politique. D'abord, on abandonne à la forêt les terres les moins aisées à cultiver, ce qui améliore le rendement et facilite les travaux agricoles. Les salaires des paysans s'élèvent, ceux-ci étant plus fortement sollicités car en nombre réduit. Certains historiens situent durant cette période le début du capitalisme, qui prend le dessus sur la féodalité.

L'aisance de la société à la Renaissance favorise l'apparition de la profession d'architecte, en particulier avec Filippo Brunelleschi et Leon Battista Alberti en Italie au XVe siècle. Dans leurs projets de ville, la tâche première de l'architecte est de mettre à l'abri des pilleurs les récoltes de céréales derrière une muraille, est reprise comme fondement formel les conduisant à des plans à la géométrie rigoureuse : convexe, en étoile ou en cercle, avec une enceinte faisant le dos rond contre les attaquants. À la différence du bourg médiéval, bâti sans plan sur un promontoire géographique naturel et dont les remparts suivent les formes accidentées, les villes de la Renaissance sont conçues et dessinées avant d'être construites, en plan, au té et à l'équerre, sur une feuille de papier. À la différence des villes du Moyen Âge, celles de la Renaissance doivent désormais résister aux tirs des canons à poudre et des armes à feu. Ces formes géométriques défensives, simples et pures, leur donnent une qualité idéale, abstraite. La ville de Palmanova, en Italie du Nord, conçue par l'architecte vénitien Vincenzo Scamozzi au XVIe siècle, a ainsi une forme d'étoile à neuf branches. Au XVIIe siècle, Neuf-Brisach en Alsace est construite par Sébastien Le Prestre, dit Vauban, selon un hexagone, tandis qu'au XVIIIe siècle, la cité idéale de Chaux, en Franche-Comté, dessinée par Claude-Nicolas Ledoux suit un cercle.

Ce n'est qu'au XIXe siècle que les villes commencent à démolir leur enceinte fortifiée, témoignage d'une réalité politique morcelée du territoire, celle de la féodalité, composée de seigneuries qui, à la moindre mauvaise récolte, pouvaient s'attaquer mutuellement pour piller les

réserves de céréales voisines. Pendant de très courtes périodes durant l'Antiquité, ces murailles étaient devenues si étendues qu'elles entouraient un pays ou un empire, dont elles fortifiaient les frontières. C'est le cas à Rome, sous la Pax Romana (« paix romaine », Ier-IIe siècles), avec des fortifications à l'échelle de l'empire, en Angleterre pour le mur d'Hadrien ; ou encore entre le Rhin et le Danube pour le limes germanique. À l'époque moderne, l'extension de la puissance des royaumes sur les seigneuries entraîne la perte des remparts pour certains châteaux, tels ceux de la Loire au XVIe siècle. Le phénomène s'amplifie avec l'apparition des empires et des États-nations, entre autres le Second Empire de

Paris in focus. Photographie satellite capturée par Sentinel-2A, 15 juillet 2015. © Copernicus Sentinel data (2015)/ESA

Immeuble d'habitation Le Grand pavois, La Grande-Motte, Jean Balladur, architecte, avec Jean-Bernard Tostivint, architecte, 1967-1968. Carte postale, photographie de Pierre Riby, s.d. © Yvon. DR © Adagp, Paris 2020

grand plan d'aménagement touristique du littoral méditerranéen. La « mission Racine » comprend la construction *ex nihilo* de sept stations balnéaires dans le Languedoc-Roussillon, comme La Grande-Motte ou Le Cap-d'Agde, aux imposants immeubles en béton ouverts sur la mer et exposés au soleil. Dès 1936, le littoral français, qui représente 4 % du territoire national, est presque trois fois plus peuplé (193 habitants/km²) que les autres régions de France (en moyenne 77 habitants/km²). Entre 1968 et 1999, la croissance démographique y est deux fois plus importante que la moyenne nationale[33], tandis que le nombre de résidences secondaires explose. Ce succès quasi continu jusqu'à nos jours entraîne d'importantes modifications culturelles et des modes de vie, que résume le *Sea, Sex and Sun* chanté par Serge Gainsbourg à l'été 1978.

33 Voir Jean-Marc Zaninetti, « L'urbanisation du littoral en France », *Population & Avenir*, 2006/2, nº 677.

Le cancer de la peau diminue-t-il l'attrait des séjours au soleil?

Toutefois, depuis quelques années, la tendance à urbaniser les bords de mer commence à s'inverser. En France, la loi littorale de 1986 interdit toute construction nouvelle à moins de 100 mètres de la mer, diminuant sensiblement l'urbanisation des côtes pour la première fois depuis les années 1950. Mais, surtout, en 1992, le Centre international de recherche sur le cancer de l'Organisation mondiale de la santé (OMS) classe les ultraviolets parmi les « cancérogènes certains[34] ». Au cours du XXe siècle, le nombre de cancers de la peau augmente, et il est prouvé qu'ils sont plus nombreux chez les personnes à la peau claire et au plus près de l'équateur[35]. L'OMS écrit ainsi : « Il y a chaque année dans le monde quelque 132 000 cas de mélanomes malins (cancer cutané le plus mortel) et plus de deux millions de cas d'autres cancers cutanés. Un cancer sur trois diagnostiqué dans le monde est un cancer cutané. La plupart de ces cancers cutanés sont imputables à une surexposition au rayonnement UV naturel[36]. » En France, le ministère des Affaires sociales et de la Santé émet en 2008 une série de recommandations visant à limiter l'exposition au soleil.

La crainte des ultraviolets fait émerger une nouvelle modification des habitudes culturelles. La vente de maillots de bain plus couvrants et anti-UV se développe ; la baignade le matin ou en fin d'après-midi est privilégiée, quand le soleil est moins fort. Le bronzage comme critère de beauté régresse, une peau trop bronzée étant de plus en plus assimilée à un potentiel cancer. Les cabines de bronzage aux ultraviolets sont interdites en Australie depuis 2015 et au Brésil depuis 2009. Quant aux traitements contre le rachitisme, face au risque de cancer, les études médicales les plus récentes font pencher la balance vers l'huile de foie de morue plutôt que vers une exposition aux ultraviolets. Les conséquences urbaines, territoriales et culturelles sont certainement à venir.

34 International Agency for Research on Cancer Expert Group (IARC), *Monographs on the Evaluation of Carcinogenic Risks to Humans*, vol. 55 : *Solar and Ultraviolet Radiation*, Lyon, IARC Press, 1992.
35 Voir « Mieux prévenir et détecter tôt les cancers de la peau », dossier de presse en ligne, 23 mai 2012 (https://www.anses.fr/fr/system/files/PRES2012CPA09.pdf).
36 Voir OMS, « Rayonnement ultraviolet (UV) et cancer de la peau », 16 octobre 2017 (https://www.who.int/fr/news-room/q-a-detail/ultraviolet-(uv)-radiation-and-skin-cancer).

accusant les Modernes de naïveté. Peter Blake, dans son livre *Form Follows Fiasco* (1977), déplace le débat médical vers un débat esthétique, définissant le projet moderne par son abstraction : le blanc désinfectant et réfléchissant du lait de chaux et du Ripolin n'est à ses yeux qu'un symbole de pureté ; l'absence d'ornement, un principe moral. Si l'ensemble des principes sanitaires qui ont participé au style de l'architecture moderne sont devenus caducs, si l'architecture a perdu sa mission médicale, il ne lui reste plus alors qu'une mission culturelle. Le glissement entre modernité et postmodernité s'opère ainsi du physiologique vers la sémantique, du climatique vers le symbolique, du médical vers le métaphorique. Tout devient langage, construction sociale, effaçant la réalité physique, biologique et chimique.

Plus radical encore que Robert Venturi, qui proposait une équivalence hiérarchique des trois termes de la trilogie vitruvienne, « solidité, commodité, beauté[9] », Charles Jencks ne garde que le troisième, celui de la beauté, c'est-à-dire le plus littéraire et *fantaisiste*, comme le qualifiait Claude Perrault dans sa traduction du *De architectura* de Vitruve[10]. La solidité et la commodité sont écartées. Tout bâtiment n'est dès lors interprété et jugé que comme un ensemble de signes qui raconte une histoire, dont on décode les symboles et les métaphores. Ainsi, une grille en béton précontraint typique de l'architecture moderne de la fin des années 1950 devient une « râpe à fromage[11] ». De façon plus générale, les bâtiments de l'architecture moderne sont lus comme des « boîtes à chaussures ». Tout relève d'un point de vue subjectif, de l'interprétation culturelle. Ce dont témoigne Jencks dans *Le Langage de l'architecture postmoderne*, en relatant un amusant conflit qui l'oppose à Kisho Kurokawa à propos d'un bâtiment de l'architecte japonais. Si ce dernier y voit un empilement de cages à oiseaux, l'architecte américain y lit un empilement de machines à laver. Lorsqu'il parle des toits, Jencks « oublie » qu'ils permettent de protéger de la pluie quand ils sont en pente ou de faire une cure d'héliothérapie quand ils sont plats, et ne les définit qu'à travers leur symbolisme psychologique, celui d'être une métaphore du foyer protecteur. Chez Charles

9 Voir le diagramme de Robert Venturi sur la méthode fonctionnaliste de Vitruve dans Robert Venturi, Denise Scott Brown, Steven Izenour, *Learning from Las Vegas*, Cambridge, The MIT Press, 1972 ; éd. franç. : *L'Enseignement de Las Vegas*, Liège, Pierre Mardaga, 1978.
10 Claude Perrault, *Les Dix livres d'architecture de Vitruve, corrigez et traduits nouvellement en François*, Paris, Jean-Baptiste Coignard, 1673.
11 C. Jencks, *The Language of Post-Modern Architecture*, *op. cit.*

Studio per blocco dello Schützenstrasse/Berlino, étude pour le Schützenstrasse Block, Berlin, Aldo Rossi, architecte, 1994-1997. Dessin d'Aldo Rossi, 1993. Courtesy of Fondazione Aldo Rossi. © Eredi Aldo Rossi

Jencks, l'architecture, vidée de nécessités physiques et constructives réelles, n'est plus que symbolique et parlante.

Le moment antimoderne rompt ainsi avec la modernité et, plus fondamentalement, avec l'esprit des Lumières en affirmant « l'échec du projet de la modernité, à travers la dérive de ce qu'il incarnait, qu'il s'agisse de l'universalisme, du progressisme, du rationalisme ou même de l'humanisme[12] ». Le postmodernisme s'inscrit dans une critique de la raison qui commence par les Romantiques, puis se poursuit chez Georg Wilhelm Friedrich Hegel et Friedrich Nietzsche à la fin du XIXe siècle, Walter Benjamin, Max Horkheimer et Theodor W. Adorno après la Seconde Guerre mondiale, et s'épanouit dans les années 1970 et 1980 en France avec les poststructuralistes Michel Foucault et Jacques Derrida. Critique de la raison, critique de la science, critique du progrès, critique de l'universalisme, critique de la vérité en sont les maîtres-mots.

12 Christian Bouchindhomme, Rainer Rochlitz, « Avant-propos des traducteurs », in Jürgen Habermas, *Le Discours philosophique de la modernité*, Paris, Gallimard, 1985.

GUEST CURATOR

Philippe Rahm,
Architect, Doctor in Architecture

Philippe Rahm is a Swiss architect born in 1967. He graduated from École Polytechnique Fédérale de Lausanne in 1993, became a doctor in architecture from the University of Paris-Saclay in 2019, and his studio, Philippe Rahm architectes, is established in Paris since 2008. His work which extends the field of architecture between the physiological and the meteorological, has acquired an international audience in the context of sustainable development. In 2011, he was the winner of the international competition for Taichung Central Park, along with Catherine Mosbach and Ricky Liu, for a 70 ha urban park in Taiwan and its buildings that was inaugurated in December 2020. In 2017, with Nicolas Dorval-Bory, he won the competition for the development of the Agora of the Maison de la Radio (Radio-France) in Paris, for which the studies are ongoing. In 2019, with OMA, he won the project for the urban renewal of the 62 ha Farini neighbourhood in Milan, Italy, which is also currently in the studies phase. He has been teaching at Princeton, Harvard and Columbia universities since 2010, and Cornell today, among other places. He is a lecturer at the École Nationale Supérieure d'Architecture de Versailles. He has been invited to many architecture biennales, including Venice in 2002, where he represented Switzerland, and in 2008 and 2017, to the biennales of Seoul and Chicago, and Sharjah in 2019. His most recent publications are *Form Follows Climate* in 2017, *Le jardin météorologique* [The Meteorological Garden] published by Éditions B2 in 2019, *Arquitectura meteorológica* [Meteorological Architecture] published by Arquine in Mexico in 2020.

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